A CLOCKWORK CLIMATE?
AN ATMOSPHERIC HISTORY OF NORTHERN AUSTRALIA

By Chris O'Brien

A thesis submitted for the degree of Doctor of Philosophy of the Australian National University
This thesis, and the research upon which it is based are my own original work.

Chris O'Brien
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ABSTRACT

Weather and climate are truly arresting in Australia's far north. They set the 'Top End' – the northernmost parts of the Northern Territory – apart; not only from 'temperate' Australia, but also from other tropical locales. Weather and climate are integral to the experience of the place. Authoritative histories of the Northern Territory, with justification, routinely discuss its weather and climate. They indicate the ineluctable physical parameters that bound human activity in this region and which also set the stage for the dramas of human history played out there.

In this study weather and climate are the drama. They are the characters, and they are the plot. Elements of the great aerial ocean in which the 'Top End' is immersed – rain, wind and heat - are studied on a variety of time scales. Events are examined: their intensity, duration, chronology and patterns in time. Just as nature and culture are inextricably entwined, so these elements cannot intelligibly be amputated from human experience. To paraphrase US environmental historian William Cronon, this is a study of stories about stories about weather and climate. The third dimension of this history is its interrogation of the cultural biases and philosophical assumptions both underlying and revealed by these stories about weather and climate.

However, this work focuses on one constellation of encounters and responses: those of the colonial invaders. The ideas and (mis)understandings of this group have determined how weather and climate have been seen since colonial times. Now, in the Anthropocene, as the effects of anthropogenic climate change unfold, this understanding is pivotal in dealing with this looming problem. This study is a history of a plausible, coherent misunderstanding.

It is also a history of the northernmost region of the Northern Territory, a history refracted through a different prism to those of its worthy predecessors. Here the subject is the colonial encounter with tropical skies, science in colonial and northern Australia and experience-based efforts to grasp something so foreign to people from temperate environs. It reveals how western ideas of time have distorted understandings of weather and climate. It demonstrates the poor fit of received ideas of seasonality and climate to historical experience. Reflecting on important contingencies of this place between 1800 and 1942, this history situates human experience in the Northern Territory firmly in the global currents of both environmental history and intellectual history.
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INTRODUCTION

Weather is intrinsically historical. Weather is an unavoidable environmental contingency; it also emerges from and is engulfed by manifold contingencies. Weather happens in time and is always in flux. It recurs yet is ineluctably variable. Climate - weather patterns over decadal timescales, and longer - is not as stable as is often thought. With anthropogenic climatic change accentuating and accelerating atmospheric dynamics across various slices of time, understanding weather, climate, and their relationship has become more urgent and more complicated. How people come to understand something so complex is a fascinating problem. The constitution of valid knowledge, the role of experience and the conceptual repertoire brought to the task of grappling with such dynamic intricacies as those of the atmosphere all reveal vital aspects of human understandings of non-human nature. We cannot thoroughly grasp weather and climate by merely studying physical processes. Weather and climate are not historical merely because they happen in time. They are also historical because grasping them is bound up in culture, philosophy, experience, perception and story telling. Accordingly, this study has three dominant strands. The first relates to ideas about weather and climate, the second a physical history of weather, and the last examines what we can glean from stories told about weather and climate.

Climate has commonly been defined as average weather.\(^1\) Conventionally it derived from thirty years of climate statistics, but as climatologist H H Lamb noted: 'the statistics required to specify a climate comprise not only averages but the extremes and frequencies' of various weather elements.\(^2\) This thesis strenuously argues in support of Lamb's concept of climate. Accordingly, in a similar vein to Lamb, it defines climate as patterns of weather over decadal timescales and longer. Embedded in the longer term climate is fused to memory. As Tim Sherratt observes in his adroit essay, this link to memory - an often unreliable human element - is integral to human misunderstanding of climate.\(^3\) Data and statistics are needed, but they too are shaped by human elements. If climate is distant, even somewhat cognitive, weather is immediate, perceptual, sensual and experiential. Weather is the state of the atmosphere at any given point in time and any given place. We see it, we hear it and we feel it. Occasionally we can smell it and, rarer still, taste it. Weather is comprised of distinct elements - rain, wind, heat, humidity -

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\(^2\) H H Lamb, ibid.
\(^3\) Tim Sherratt, op.cit., p2.
as well as extreme events such as cyclones, floods and droughts. We define weather by its most salient elements at any point in time, or during short stretches of time such as the day. These elements are quantified over short periods and this observing, measuring and recording creates much of the historical record of weather. Like climate weather is understood through numbers. However, experiences of weather lend themselves well to storytelling.

Conceptually and ontologically weather and climate are also tied to time and therefore concepts of time. So, this thesis begins with an effort to understand the relationship in western thinking between time, weather and climate. Weather and climate are dynamic processes pulsating in time but they have largely been studied through snapshots. The dynamism of the skies is suited to historical narrative. The narratives created in Part Two of this thesis use thousands of snapshots and aim to restore complexity and movement. The verbal and visual narratives of Part Three show how others have understood weather and climate through stories and maps.

What follows is not a demonstration of the jejune but important truism that knowledge is shaped by culture. This thesis elaborates the specifics of encounters between European colonial invaders and an especially challenging, strange and imposing tropical environment. To elucidate this encounter it historicises and aims to render strange what Europeans and neo-Europeans have long taken for granted. Two insightful Australian collections of essays - *Windows on Meteorology*\(^4\) and *A Change in the Weather*\(^5\) - illustrate two problems that have motivated this study. The first is how people of different cultures can experience a common weather and common environment yet conceptualise vastly different parallel ideas of season and climate. In the far north of Australia’s Northern Territory – The ‘Top End’ – Aboriginal groups identify six annual seasons where European newcomers have generally identified two. The second is the vast gulf between the western notion of weather cycles across Australia generally repeating year after year and the many floral and faunal adaptations indicating long-term climatic variability on an annual time scale. A deeper look into what seems an obvious by-product of colonisation is, as we will see, most revealing.

Weather and climate are truly arresting in northern Australia. This is particularly the case in the Top End. Weather and climate are integral to the experience of the place. Indeed, they are vital in setting the scene in the most important histories of the region. Just seven pages into the first chapter of his

\(^5\) Tim Sherratt, Tom Griffiths and Libby Robin eds. op. cit.
authoritative opus *Far Country*, Alan Powell begins a three-page discussion on weather and climate in his ‘Short History of the Northern Territory’. In this discussion, the governmental entity of the Northern Territory – born largely of a series of arbitrary straight lines drawn across maps of Australia – is divided into four geographical regions defined by ‘natural features and economic use’ by the geographer J MacDonald Holmes. Powell’s 500 or so words on the Top End climate speak of average temperatures, mean rainfalls, and the Wet/Dry dyad of the annual two seasons. This is a sophisticated, considered account, explaining these dynamics in terms of the movement of the Intertropical Convergence Zone (ITCZ), south-east trade winds and high pressure systems over southern Australia. This is a region with ‘high, reliable and strictly seasonal rainfall’. Citing an earlier edition of Powell’s history, David Carment opens Chapter 1 of his influential *Looking at Darwin’s Past* with a similar summation of the region’s climate. I pick no quarrel with historians for drawing on this concept: this is how the region’s climate is generally understood. Indeed this is the very idea of the region’s climate outlined by no less authoritative source than geographer F H Bauer’s historical geography of the area between Katherine and Darwin, undertaken for CSIRO. Even Ernestine Hill’s legendary *The Territory* devotes space to an explicit outline of weather and climate in the two extremes of the Top End and Red Centre. Like the other accounts, Hills speaks of alternating periods of wet and dry in terms of prevailing monsoons or trade winds blowing at particular times of year.

Such discussions of atmospheric fluxes do not appear in histories of more temperate Australian locales. However, historians and storyteller are justified in attending to the weather and climate of the far north. In this region both set important limits on human activity. This is true for communities, governments, enterprises and for individuals. Weather and climate here can be forbidding and lethal. Both are at the very least impossibly memorable. They cannot but infuse experience of the region. Historians have generally and understandably used this received understanding of weather and climate to render the setting for human dramas. But the concept itself and its relation to physical history are yet to be examined. This study will interrogate this very idea of Top End climate – the Wet/Dry dichotomy - and its history. It will also study the weather itself.

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7 Ibid., p7.
8 David Carment, *Looking at Darwin’s Past*, (Darwin: North Australia Research Unit, 1996), p1
In this history weather and climate are the drama. They are the characters and they are the plot. This is an ‘atmospheric’ history because weather, as well as climate, are its very grist. It is animated by Annalist imperatives to incorporate geography and environment into the study of the past and to examine human thoughts and events on a variety of timescales. Founded in France in 1929 by Lucien Febvre and Marc Bloch, the Annales School sought to link history more closely with other social sciences and urged historians to use the methods of other disciplines. Annales history examines structures: social, cultural, economic, environmental. Instead of looking at events it encourages historical study in terms of conjuncture – short or medium term – or la longue duree: the longer term, in the order of centuries. It also recognises the worth of analysing and historicising collective mentalities. I concur with Marc Bloch that ‘the variety of historical evidence is nearly infinite’ and includes ‘everything that man says or writes, everything that he makes, everything he touches.’ This history does not quite draw on the range of sources of the magisterial Annalist opus *Times of Feast, Times of Famine.* The Top End simply does not have the harvest, parish and tree-ring records of Le Roy Ladurie’s Europe. Its scope is merely from the 1820s – with some tendrils of thought reaching back much further – to 1942, not the 1000 years of *Times of Feast.* Nevertheless, the evidentiary material here ranges from numbers in their thousands, to scientific studies, explorers’ journals, almanacs, sailors’ manuals, maps and some very atmospheric and poetic literature and newspaper articles. Unlike *Times of Feast,* unlike H H Lamb’s remarkable *Climate, History and the Modern World* and even Wolfgang Behringer’s recent work *A Cultural History of Climate,* this study examines weather and not just climate. This matters not because it records more events on a different timescale, though this is worthwhile. A decadal-scale study of weather indicates the inadequacy of commonly held notions of climate being average or normal weather. But the relationship between weather and climate is not, after all, as simple as the commonly repeated adage ‘weather is what you get, climate is what you expect’.

Weather histories are still few in number. Many that have been written also have a different focus to this thesis. The most prominent of the US studies have been about knowing weather. The concentration here has been on meteorology,

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13 H H Lamb, op. cit.
official knowledge and communication of knowledge. James Rodger Fleming's *Meteorology in America* offers an indispensable insight into the attentive engagement, diligent observation and imaginative enterprise nineteenth-century natural philosophers and scientists brought to the endeavour of establishing meteorology in the United States. Mark Monmonier's adroit *Air Apparent* is a history of how meteorologists, principally in the US, came to see weather, how they have represented weather visually and how they have communicated these representations and the predictions they made from maps and satellite images. In *British Weather and the Climate of Enlightenment*, Jan Golinski examines the influence of emerging enlightenment aspirations, meanings of knowledge and understandings of making knowledge on how British people grappled with weather. His study includes meanings people made of major events such as the hurricane that tore through southern England in November 1703. It also examines perceived relationships between weather, health and environment and the development of theories of British weather and climate in a period when the study of the atmosphere became more scientific. Katherine Anderson's history is of the Victorian era but its geographical scope extends beyond metropolitan Britain to Europe and India. *Predicting the Weather* is a study of meteorology but breaks new ground in analysing relationships with Victorian visual culture as well as roles played by the state, colonialism and the evolving technologies of transport and communications. These works provide a vital international context, particularly during the eighteenth and nineteenth centuries, for my study.

Meteorology, as such, is peripheral in Vladimir Jankovic's *Reading the Skies*. His opus is a history of sky study before the emergence of official, national meteorology in Britain. What people observed, how they responded, meanings people attributed to atmospheric spectacles, how they thought about what they saw in the skies are all within the purview of Jankovic's study. His book is not just about weather, but *meteors*, in the Aristotelian sense — comets, shooting stars, vapours. Jankovic reveals and reflects on folkish as well as more scientific approaches and how constellations of human responses shaped broader debates about politics, religion, society, agriculture and natural history. While Robert Marc Friedman's *Appropriating the Weather* is a history of meteorology, it is also a history of how scientists came to explain one of the most significant global

atmospheric phenomena. Friedman charts how meteorologists elucidated the structure and general behaviour of extra-tropical (or temperate) low-pressure systems. This is a study not so much of an event but of an irregular pattern that is never identical to the ones before it or the ones that follow. Friedman also shows how modern meteorological theory and knowledge have been made and transmitted. Such histories of weather phenomena and elements are rare. The other memorable elemental history of the last half-century is W E Knowles Middleton's rich and conceptual History of the Theories of Rain, but it has all but fallen into oblivion.

Numerous weather and weather-related histories concentrating on Australia have appeared in the last decade or so. The most recent, Don Garden's Droughts, Floods and Cyclones, published in 2009, examines the local effects of the vicissitudes of the global El Niño Southern Oscillation (ENSO). Accordingly it straddles the penumbra between weather and climate. It also meticulously details a plethora of weather events and their chronology, duration and intensity in a number of regions in South Australia, Victoria, New South Wales, southern Queensland and New Zealand. In this interplay between local and global, the short and longer term we come to understand the serious social, economic and environmental consequences for communities scattered in time and space. Here weather is not a chronicle of seemingly random events but is demonstrated to have underlying precipitants and a rationale – albeit an indeterminate one of order within chaos and chaos within order. As well as recovering many forgotten weather events, Garden captures the probabilistic nature of atmospheric dynamics. The Weather Watchers, David Day's, encyclopaedic study of Australian meteorology centres on institutions, networks, people, government, science and technology. This history of Australia’s Bureau of Meteorology is Australian in the governmental sense – it charts and analyses how the nation state of Australia, through a Commonwealth Government institution, made sense of the skies. Day's opus details the institutional setting in which the material for the latter half of the period of this study is produced. But weather events are at best tangential in this important history. Where treatment of colonial meteorology is, by design, thin in Weather Watchers, the historian Kirsty Douglas and geographer Joseph Gentilli step into the breach with detailed histories of the practices, networks and cultures.

of colonial meteorology in Australia.24 Both works demonstrate how assiduous meteorologists in colonial Australia were, including those in the Northern Territory. The two collections of essays mentioned earlier – *Windows on Meteorology* and *A Change in the Weather* - cover a remarkable range of material and perspectives on weather and climate history. Collectively they investigate historical beliefs about climate and health, responses to heatwaves, drought and floods, climate in deep time, elements such as wind and faunal evolutionary adaptations to Australia's variable climate, in addition to epistemologies about season and climate. Their geographical scope is continental and the content ideal for sparking in-depth, ongoing scholarly conversation and debate. Both works are launching points for this atmospheric history.

Cyclone Tracy blew modern Darwin's third incarnation away. Unsurprisingly this momentous event in both Top End and Australian history has generated cultural responses. Bill Bunbury's *Cyclone Tracy: Picking Up the Pieces*, based on detailed oral histories and interviews offers a humane social history of the trauma atmospheric furies inflict on people.25 Damage is more than physical, the biota cannot simply be fixed and wounds sting decades later. But as Kevin Murphy's book *Big Blow Up North* impresses upon us, Tracy is the cyclone most remembered, but it was one of many swirling vortices of clammy air to threaten the Top End.26 And it is not just the destructive events that have compelled the attention of newcomers to Australia – whether tropical or temperate. The swift changes in weather along the NSW coast brought by the southerly buster drove Watkin Tench to put pen to paper in the late eighteenth century and William Stanley Jevons in the mid-nineteenth century. Indeed future Bureau of Meteorology chief, H A Hunt won a prize in 1896 for an essay devoted exclusively to the southerly buster. Australia does not have a self-conscious tradition of nature writing in the manner of the US, let alone a recognised tradition of writing about the skies. But weather and climate on this continent have attracted scholarly as well as scientific attention. The words, numbers, tables and maps left by those who have turned their minds skyward to weather and climate are copious and warrant meticulous and dedicated study.

This atmospheric history advances and deepens this endeavour. The weather element of this history does look at the extreme and the spectacular – these have

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always mattered. But it also looks at the ordinary and the 'normal' as it emerges in time and is swept away by much more forceful flows of air. The weather that collectively, over decades, constitutes climate is a composite of the ordinary, the almost unnoticed and the extreme. Dominant ideas of climate smooth out the extremes; recollections and awareness of weather forgets the ordinary. This atmospheric history restores range to climate and the unremarkable to weather. The history of weather offered in this thesis will show how the ordinary, drawn out from the shadow of the salient, can be easily misunderstood.

As well as being a history of weather and climate this is also an environmental history of the Top End. As Anita Angel noted in 2006 the Top End is not a region with a consistent spatial or cultural meaning. In this study the Top End is the northernmost third or so of Australia's Northern Territory. It extends about 500 kilometres south, as the crow flies, from the north coast to Daly Waters. The Daly Waters region is much drier than Darwin and the coast and arguably has a different climate but one that is a variation on the same theme. Drawing the line at Katherine would have provided too limited a scope to examine spatial climatic variability and provided insufficient quality controlled instrumental records. South of Daly Waters, the climatic and ecological differences with points north are too vast to intelligibly be part of a study with this focus on the wet tropics. The 'line' is not necessarily at Daly Waters, it is not a straight line and shifts back and forth from year to year; but it is almost always north of the next location for long term reliable data: Tennant Creek. During the period of this study the name of the principal settlement changed from Port Darwin to Palmerston and finally to Darwin in 1911. For simplicity this history refers to Darwin, regardless of the period.

Environmental history has burgeoned in Australia over the last few decades. Unsurprisingly, most work has been undertaken where the bulk of Australia's population lives and where most economic and agricultural activity has taken place: the virtual islands of the south east and far south west of the continent. Important works such as Hunters and Collectors, The Colonial Earth, Country: Visions of Land and People in Western Australia, Heartland, Discovering Monaro and A Million Wild Acres are just a few that exemplify this. Or the focus has been

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continent wide – Geoffrey Bolton’s *Spoils and Spoilers*, for example - or on the nature of cities, such as in *Harvest in the Suburbs*, which most effectively blends environmental history with urban history. The felicity with which these works draw out and explain nature’s complexities inspires my narrative history of weather and climate. In a similar vein to Alan Powell, Geoffrey Blainey (especially in *Tyranny of Distance*) has also situated the human dramas of Australian history in their climatic and meteorological context, particularly in relation to winds.

Recently attention has turned to the environment of the Northern Territory. Mickey Dewar’s *In Search of the ‘Never-Never’* highlights that the northern environment – the atmosphere as well as the landscape – has been integral to Northern Territory literature. From the colonial need to conquer environmental forces to the ‘Territorian’ manner of marking time by wet seasons Dewar shows how nature is bound to the social and cultural in Top End writing and, indeed, life. In *Slower than the Eye Can See* Darrell Lewis shows through historical inquiry that environmental change is underway in the Victoria River District, particularly a thickening of tree covers around rivers and creeks. Libby Robin’s *How a Continent Created a Nation* analyses how agricultural interests saw the Top End environment, how they tried to exploit it and how they have forgotten their failures. This thesis is an effort to redress the lack of vital environmental knowledge that Robin highlights. Rich and engaging, the recent collection of essays *Desert Channels* is the most recent of few Australian environmental histories incorporating any region north of the Tropic of Capricorn. This thesis therefore joins only a handful of such scope concentrating on a region north of 23 degrees south. It is also the first wholly tropical Australian environmental history concentrating on weather and climate. Its focus might be the atmosphere but it is grounded in the Top End. Weather and climate being so distinctive there, they are the prism through which this study examines how newcomers grappled with a strange environment. Termites are arguably the other equally significant environmental force in Top End history. But this is also, in part, a history of the Territory’s north refracted through scientific thought and practice.

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Human habitation of the Top End registers in deep time. Aboriginal people have lived, adapted to and modified this region for at least 50,000 years. Until the early twentieth century the Arafura and Timor Seas, and the Gulf of Carpentaria, which collectively embrace the Northern Territory coast, were a conduit to the outside world. These waters facilitated contact, they did not isolate. Debate still ensues about exactly when Macassans from the Celebes first came to these coasts seeking trepang or sea-cucumber. Nevertheless, they began their annual periodic sojourns at least decades before Phillip established the colony on the shores of Port Jackson.35 They did not settle permanently but they spent considerable time on Top End shores and interacted, sometimes closely, with Aboriginal groups such as the Yolngu. Asia has had a longer presence in far northern Australia than Europe has had in the south. Following the establishment of a permanent British colony on the north coast Chinese labourers were imported to develop Darwin and its hinterland. More came with a gold rush at Pine Creek and many Japanese came with the advent of the Pearling Industry. Both Regina Ganter's *Mixed Relations* and Peta Stephenson's *The Outsiders Within* detail the rich polyglot tapestry that was Darwin and to an extent Pine Creek and Katherine during the late nineteenth and early twentieth centuries.36 As Henry Reynolds' *North of Capricorn* shows, every northern town from Mackay around to Roebourne (WA) was similarly multi-racial before the advent of white Australia.37 Indeed both Darwin and Katherine have been multi-racial since the 1870s and withstood the onslaught designed to legislate non-white Australia out of existence by, in the words of Henry Reynolds, a 'new nation obsessed with ideas of blood, biology and racial purity'.38 Nevertheless, with legislation to forbid Macassan trepangers visiting north Australia contact ceased in 1906; the seas became a barrier as governments in the south imposed isolation on Australia's north.

Unfortunately this thesis cannot examine how the various cultural groups tried to understand weather and climate in the polyglot Top End. This would require a number of book-length volumes to complete with adequate breadth and depth. Only in the last 30 or so years have anthropologists become aware of the place-based, ecologically interconnective notions of weather, climate and season that the Top End's Aboriginal peoples have developed during their epochal scale tenure

38ibid., p xi.
there. The work of Deborah Rose, Rhys Jones and Stephen Davis, among many others, has proven invaluable in informing us how Aboriginal people mark seasons and conceptualise climate. This offers revealing perspective on western practices of defining season by the calendar. With considerable work having been untaken in ethno-meteorology and Aboriginal meteorology, there is a need to examine non-Aboriginal approaches to weather and climate. Given the demographic history of the Top End, two groups of newcomers stand out: Europeans and the ‘tropical’ Chinese. As histories by Diana Giese and Timothy Jones show, in addition to those by Regina Ganter, Peta Stephenson and others, Chinese men and women have been significant in both number and influence in the Top End since the 1870s. Many came from tropical south China or had been in what we now know as Malaysia before being recruited in Singapore. Their understanding of the Top End environment shone through in their successful market gardens and the work some did in Darwin’s Botanical Gardens. Understanding how the Chinese grappled with Top End weather and climate would be a fascinating, fruitful and valuable inquiry. This thesis, however, focuses on the response of European newcomers because European ideas have dominated the discourse of northern settlement for well over a century. This fact alone warrants a history. European ideas have also informed so much decision-making and are an influential part of how people grapple with the local consequences of global warming now. These inherited, transplanted ideas are startlingly inadequate in this place. It is vital to learn how they have been constituted historically and how they made sense for so long. History alone can elucidate this. These are the environmental ideas that have had the most impact and, until now, have been scarcely scrutinised. Amid the variety of understandings embedded in this diversity, this study singles out one strain because the time has passed when it can simply be taken for granted.

The period of this study – 1824-1942 - was chosen because it conforms to the conditions implicit in the questions compelling my thesis. The period accords with an interest in how newcomers, accustomed to temperate climates, came to understand so vastly different a climate as the Top End’s monsoonal tropical climate. The starting point marks the first of several attempts to colonise Australia’s far north. A specific question that motivates this study is how did the


prevailing idea of the region's climate – the wet/dry dichotomy - come about and then endure? But the second dimension deals with time and technology: how did people grapple with the weather before computing and the use of satellite and radar technology for weather? An enquiry addressing such an issue would always be limited to a period ending during the mid-twentieth century. But the air raids on Darwin beginning February 19, 1942 gave this study its temporal full stop. With the destruction of the second incarnation of Darwin almost 73 years of daily records ended. In fact, not only are there no surviving records from 1942 to 1945, but records since 1945 are from a different observatory, more than eight kilometres away, with vastly different topographical surrounds. Given the sheer bulk of records to 1942 it would not have been prudent or even necessary to use material from a different location, with the inherent complications this would present.

This thesis is divided into three parts. The first —‘Thinking’ — comprises Chapters 1 and 2 and is a history of ideas relating to the study of weather and climate in both European thought and in northern Australia. Part 2 is ‘The Elements’. Comprising chapters 3-6, this is a physical history of Top End weather through three elements: rain, wind and heat. How weather and climate have been represented in stories, reports and studies is the subject of Chapters 7 and 8, and constitute Part 3: ‘Telling’.

Hesiod may seem a strange place to start an atmospheric history of north Australia. Chapter 1 starts with an ancient Greek poet because vital elements of western atmospheric history had their origins in classical times. This is not a recapitulation of the relationship between classical and enlightenment science. Chapter 1 is a history of time, as well as of ideas of season and climate. It demonstrates how time, season, weather and climate are conceptually enmeshed, how this tangling is not recognised and how it continues to distort our concepts of weather and climate. Chapter 1 demonstrates how time was naturalised and the role this plays in misunderstanding weather and climate. In Chapter 2 this is applied to tropical climes generally and the Top End particularly. Chapter 2 is a history of how Europeans constructed knowledge of tropical weather and climate, particularly around the Indian Ocean, and how these concepts came to apply to the Top End. It is built around the centrepiece of the European conceptual repertoire for the tropical atmosphere: the monsoons.

‘The Elements’ begins with an elaboration of how the elements were observed, measured, reported and understood. Chapter 3 outlines the history of official weather observation and reporting in the Top End. This history shows that
this network was extensive and, even before becoming part of the Bureau of Meteorology's national network in 1908, had close links with observatories in other colonies/states and also enjoyed links with networks overseas, particularly that overseen by Henry Blandford in India. Chapter 3 establishes the authenticity and validity of the evidence offered in Chapters 4-6. Chapter 4 is an elemental and largely numerical history of rain in the Top End. This history has two dimensions: measured quantities and timing. It aims to establish for the first time what happened and when it happened, in terms of rainfall. But it is also a comprehensive rebuttal of the propositions advanced in Chapter 2. Although it does examine figures from across the Top End, Chapter 4 in parts focuses on Darwin because it offers the most extensive records and this one voluminous set is all that is needed to demonstrate the inherent variability of rainfall in the region. Chapter 5 looks at two facets of wind – the ordinary and the cyclonic. It examines how often and when certain winds have blown in Darwin and Katherine since these observations have been taken. Wind was not measured with the same numerical precision during the period of this history, however wind history clearly undermines received understandings of Top End weather and climate. But most of the chapter is a history of cyclones across the Top End from 1839 to 1942. Threaded through this is a brief history of Darwin's built environment to give context to the 1897 and 1937 cyclones, in particular. Chapter 6 is a history of heat. Like Chapter 4, this is an argument with Chapter 2 and dominant understandings of the region's climate. As with Chapter 4 heat is examined, historically, in terms of intensity and timing. Heat history is also analysed in light of the period's geo-political controversies relating to race, climate, health, security, development and white Australia. These debates in relation to the Top End were predicated on significant forgetting of historical realities and imprecision in the study of environment and climate.

'The Elements' has a particular and deliberate approach. Although it examines statistics and statistical techniques it does not use complex statistical tools in its analysis, for several reasons. First, this is not necessary to advance my argument. Second, my aim is to get a sense not just of atmospheric flux but also of what people experienced and so abstractions such as standard deviations, variance, inter-quartile ranges, etc, get too far from this. This is also why elements such as rain, wind are heat are included and less experiential ones such as evaporation and solar radiation are given less attention. While I do use abstractions such as means this is done in a manner that relates to events and experiences people are likely to have perceived. The idea is to show how people may have been aware of variability, weather and climate. Numbers are vital but they are a proxy. Third, this use of data underlines how merely reorganising
material, something requiring no mathematical or statistical proficiency, can reveal important patterns that statistical analysis is often blind to. Fourth, this thesis is part an experiment in turning numbers into prose and enumeration into history. The text itself is something of a practical meditation on the poetics of the atmosphere and the endeavour of applying language to the fluid and dynamic.

‘Telling’ is inspired by William Cronon’s dictum that to understand the relationship between human and non-human nature we need to tell stories about stories about nature. Chapter 7 studies narratives of weather and climate. Drawn from Darwin newspaper articles and important Top End literary works this demonstrates how important weather and climate are to embodied experience of this region. The rich trove of stories here show how weather and climate insinuate their way into a sense of place and how the seasons have powerful analogues in the landscape. Chapter 7 uncovers a distinct Top End literary tradition in press reporting of weather. It also puts the Top End weather experience par excellence of thunderstorms front and centre. Chapter 8 – Seeing Weather – is a history in two parts. The first is how people, globally and then in northern Australia, described the most visual element of weather: clouds. The second part concentrates on the stories told by science in the language of maps. This latter section contributes enormously to understanding how an erroneous idea can prevail.

Much as this history quarrels with the dominant understanding of Top End weather and climate it also seeks to show how these concepts were manifest and made sense. There are reasons why they endured and it is important to understand them. This comes not from sympathy for the colonial project but from a concern to comprehend the difficulties of knowing and explaining complicated phenomena and intricate processes such as weather and climate. Understanding the experience and misconceptions of the past weather can illuminate misunderstandings in the present.
THE TOP END

(Adapted from 'Wettest Months of the Year 1912')
'THINKING'
CHAPTER 1

SEASONS, WEATHER AND TIME

Few things seem as self-evident as seasons. Western thinking has long held that each year comprises four distinct seasons of equal length throughout the mid-latitudes and two six-month seasons in the tropics. Regardless of the climatic zone, seasons are thought to come and go with remarkable regularity. Originating in antiquity, this most pervasive and enduring concept arose millennia before systematic study and measurement of weather phenomena.

Yet the concept of season is synonymous with quintessential weather. It identifies prevailing weather patterns and commonly recurring atmospheric conditions for particular locations at particular times of year. Western notions of season denote coherence in atmospheric fluxes. They powerfully imply a unifying tendency in the dynamics of weather and an underlying order amid apparent disorder. In this framework spring in the temperate world is understood as a three-month period of inexorable warming, new life and growth; summer a time of consistent heat, light and abundance; autumn brings ineluctable chilling, darkening and death; with winter comes cold, dark and hibernation. In the tropics, six months of wet switches to six of dry and back again, with mechanistic regularity.

Seasons are the meta-narrative of meteorology. However, this template of analysing and understanding weather distances us from the complex phenomena we are trying to grapple with. It shapes the countless events, now measured and observed, that constitute what we call weather and climate into patterns that are far more orderly than what actually happens. A history of this concept shows that it arose from non-meteorological phenomena and became fused with important technologies and innovations of social and economic life. While the meaning of season has long been intrinsically meteorological, its origins and development were not.

Seasons are profoundly cultural phenomena. This is not to say that they do not exist in the physical world; rather, that how their manifestations are understood and conceptualised is shaped by culture. As Ben Orlove and Sarah Strauss note, people talk about and interpret weather and climatic phenomena according to how their cultural frameworks divide time into current, recent and distant periods, as well as how physical characteristics of events are received,
recalled and anticipated.\(^1\) Where Westerners have identified just two annual seasons across far northern Australia – The Wet and The Dry – the Yolngu of northeastern Arnhem Land recognise six. Irregular in duration these indigenous seasons are identified not just by weather but also by distinct floral and faunal changes: *Mayaltha* is the ‘flowering season’; *Midawarr* the ‘fruiting season’ and *Dharratharramirri* is marked by *Burrugumirri* – the birth of sharks and stingray.\(^2\) Deborah Rose identified a similar schema among the Aboriginal people in the Victoria River district of the Northern Territory.\(^3\) Across the Arafura Sea and within the same western climatic zone the Kaluli of Highland Papua New Guinea recognise three: annual seasons *dona* after the fruit trees that flowers then; *imou*, the time when trees shed leaves, and *tau*, when the pandanus tree ripens.\(^4\) Indigenous people in the Amazon basin discern four annual seasons in their tropical climate. Related to the wet/dry conceptualisation they identify a two or so month period of rising waters – *subida* – as a season, along with *enchente*, the flood, *baixa da agu*, time of falling waters and *vazant*, ‘empty water’, the latter three each lasting three to four months depending on rainfall and waterflows.\(^5\)

Seasons are cultural. Accordingly they have particular histories. The western paradigm of regularly timed seasons of even duration throughout the year is imbued with ideas, beliefs and projections about the workings of non-human nature. This brief history of western seasons aims to elucidate them and outline their impact on how modern westerners have told stories about weather and understood the flows of the great aerial ocean. In particular it shows that western notions of ‘absolute’ time have been applied to weather and climate in a manner that distorts understanding of atmospheric dynamics. After showing that time is cultural, as well as natural, this chapter argues that western metaphysical convictions about a regular, ordered physical world and natural time are both pervasive and blind to important atmospheric characteristics such as variability. Structurally the concepts organising western weather watching impose and exaggerate order where there is sometimes little.

\(^5\) Ibid.
Seasons in Antiquity

People have recognised celestial regularities for millennia. Manifestations on earth, such as rhythmic lengthening and shortening of shadows, cyclical increases of both night and day, recurrent periods of budding, flourishing, shedding and absence of leaves coinciding with perceived repetitions of distinct weather regimes were also identified long ago. Indeed, from Hesiod's *Works and Days* it is clear that the people of Boeotia during the eighth century BCE held a remarkably sophisticated understanding of the annual procession of the seasons. In fact, despite its poetic form and lyrical style, *Works and Days* is the oldest farmers' almanac in existence. Essentially a primer on how to lead a good, virtuous life, Hesiod's opus offers detailed instruction on good husbandry and stewardship of pastoral lands and in doing so gives us an insight into how the interaction between land, sea and sky was understood in early antiquity. Sometimes the directions are straightforward – 'When the Pleiads, Atlas' daughters, start to rise begin you harvest; plough when they go down'.\(^6\) Similarly, lines 598 and 599 declare: 'When great Orion rises, set your slaves to winnowing Demeter's holy grain'; the stanza concluding with an exhortation that 'When the Pleiades and Hyades and Great Orion sink, the time has come to plough; and fittingly, the old year dies.'\(^7\) Weather and seasonal changes seemed so reliable as to enable harvesting and ploughing to be read from the regular stars above. Hesiod is even more explicit about the regularity of weather in what we now know as Greece. Lines 617-621 communicate this sense of reliability:

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But if your heart is captured by desire
For stormy seamanship, this time is worst;
Gales of all winds rage when the Pleiades,
Pursued by violent Orion, plunge
Into the clouded sea.\(^8\)
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Other examples speak of a sailing season 50 days after the autumn solstice, a time of gentle breezes followed by ‘”Notos” awful blasts’ and raging seas.\(^9\) All comprise the first surviving transmission in western culture of weather as a regular, predictable phenomenon synchronised with important constellations. While Hesiod identified regular seasons, he did not divide the year into four seasons. As

\(^7\) Ibid., p78.
\(^8\) Ibid.
\(^9\) Ibid., p80.
Michael Kämmen recalled, the notion of the four seasons did not gain general acceptance until the early Hellenistic Period, circa 300 -150 BCE. In pre-classical Greece three mythological figures represented the three seasons. No figure denoted winter - indicating that this period of dormancy was not considered a season and, therefore, in these pastoral societies, that seasons were associated with vegetation, cultivation and agricultural husbandry. Like the Minoans of Crete and the Egyptians, pre Hellenic Greeks recognised a cycle of three seasons a year in concert with the heavens.

Hesiod’s weather, however, was not written exclusively in the stars. His instructions included a variety of signs in terrestrial nature. The cries of the returning crane indicate ‘the time of chilly rains’. Blooming thistles and loud cicadas herald summer. While these signs are inherently variable in their times of arrival and cessation from one year to another, they were positioned in a poem that implies that they are as regular and predictable as the stars. Ecology and meteorology were invested with the certainties of astronomy. Anticipating Ecclesiastes by five centuries Hesiod exhorts his readers to keep in mind ‘that all works have their proper seasons’. The cosmos is orderly and land, sea and sky have cyclical rhythms that humans can exploit to their purposes.

Even the very oldest surviving work of History shows that this sense of regularity in nature long ago spread beyond Hesiod. Reporting a conversation between Croesus and Solon about happiness and the human life span Herodotus quotes Solon:

Take seventy years as the span of a man’s life: those seventy years contain 25,200 days, without counting intercalary months. Add a month every other year, to make the seasons come round with proper regularity.

That the rationale for making this calculation, in this manner, is understood both within this conversation and among Herodotus’ audience suggests that it reflects something of the Greek mentalité of the time – the mid fifth century BCE. Seasonal regularity here has two important aspects. One, a societal recognition of and need...

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11 Hesiod, op.cit.,p73.
12 Ibid.,p77.
13 Ibid.,p79.
for regularity, unsurprising given what we learn about Greek society from *Works and Days*, the order it discerned in nature and the importance it placed on exploiting natural patterns to enrich society. Solon's explicit mention of intercalary months and their function - to ensure regular seasons - also reflects the system for marking time and indicates that this regularity was so important that the system of marking time contrived this very regularity. However, this calendrical regularity is predicated on a sense that the physical seasons were regular in their development, duration and passing. It is probable that expectations of predictable seasonal cycles were widespread in Greece by the fifth century BCE and framed how people understood both weather and, perhaps, nature more generally.

Indeed, this intellectual scene had already been set in the two centuries before Herodotus. With the emergence of the Ionian school of philosophy came, to use Arthur Koestler's words, a 'Promethean quest for natural explanations and rational causes' in understanding physical nature.15 Spearheaded by Pythagoras, Ionian natural philosophy was the first systematic attempt to understand physical processes without invoking the supernatural. Continuing the belief in an underlying order in nature, Pythagoras and his followers maintained that this order could be elucidated with numbers and relationships between them. Encapsulated in Pythagoras' dictum 'All is number', this mathematical approach to physical nature reinforced the notion of a predictable natural world. Natural regularity had spread from the mythico-poetic world into the realms of science, such as it was. Pythagoras' discovery of numerical ratios underlying musical harmonies (*armonia*) reinforced this. If numerical ratios underpinned the harmonies of music, so there must be ratios inherent in the movement of the stars, according to Ionian natural philosophy and its convictions about an orderly universe.16

Since then the idea of an orderly nature has been a strong current in western thinking. While Greek thinkers disagreed about the shape of the earth, the fundamental basis of physical matter and the relationship of man to nature, the notion of a regular, ordered and hence predictable universe was largely uncontroversial. In his exhaustive study of nature in western thought, Clarence Glacken observes that the phases of the moon, revolution of the sun and periodicity of seasonal change were widely seen as evidence of an essential harmony in the cosmos.17 Seasons were a broader sign of the very regularity they were considered to possess. After identifying that the word cosmos came to mean universal order

from the fifth century BCE onwards, Glacken highlights that this sense of order applied to structure, form and functioning of the human body, as well as the universe more broadly. According to Clarence Glacken, this idea of unity and harmony in nature is perhaps the most important from the Greeks in its effect on geographical thought. The same can be said for its effect on the study and telling of stories about nature. R G Collingwood’s examination of Greek cosmology in his earlier work, *Idea of Nature* concurs with Glacken’s analysis. More explicit about the basis of this belief about unity and order in nature, Collingwood gives an even stronger sense of its power and pervasiveness. Greek natural science was based on the principle that nature is permeated by mind; mind in nature underpinned regularity and orderliness in the natural world and enabled the scientific study of nature. This mind, Peter Coates indicates in his more recent study of western attitudes to nature, is the mind of a creator-artisan who ‘wrought order out of chaos’ and gave all creatures a particular purpose. This idea, of nature infused with the mind of its creator, shaped not only Greek thought, but also Roman thinking about nature as well.

Nature had an underlying rationale. Moreover, this rationale was plausible. Phenomena such as seasons, which both concurred with this worldview and reinforced it, seemed not to require systematic analysis. Astronomical seasons were real and easily observed. Determined by the apparent movements of the sun due to earth’s tilting on its axis four astronomical seasons were discerned for each year – each of earth’s revolutions around the sun. Marked by observable solstices and equinoxes, the coming and going of these seasons is regular, predictable and gives a sense of natural order in dividing each year into four almost equal segments. While it is not clear precisely when the notion of four annual seasons supplanted that of three in Greek thought, we know from Eratosthenes’ successful attempt to measure the circumference of the earth that people were aware that the sun shines directly above the equator on the equinoxes by the third century BCE. Along the Mediterranean littoral there was then considerable awareness that this coincided with days of equal daylight and equal night. This pattern was understood in the same century that the concept of the four seasons emerged. The weight of such awareness of these astronomical dynamics in moulding the new concept is beyond the scope of this study. An important matter, however, is the significance of the number 4, in the Greek natural order. When the framework of the 4 seasons emerged, 4 fundamental elements were recognised, 4 humours

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18 Ibid., p17.
19 Ibid.
accounted for health and illness, there were 4 cardinal directions in navigation, rooms generally had 4 walls and, in Aristotle's pervasive doctrine, phenomena had 4 causes. This template probably contributed the emergence and development of the four seasons concept in Hellenistic Greek society and suggests potent cultural influences infusing the concept.

The four seasons feature prominently and explicitly in Europe's second oldest surviving farmer's almanac. A graceful and arresting poem, modelled on *Works and Days*, Virgil's *Georgics*, similarly offers a wealth of advice on cultivating the land and husbanding animals. Similarly it also provides a detailed portrait of weather in the vicinity of Rome around the mid first century BCE. Virgil advises that:

Wet midsummers and fair winters are what the farmer
Should ask for; in winter's powdery dust the spelt will flourish²²

With winter by then recognised as a distinct season it is in Virgil's time an unremarkable part of discourse about nature that was lacking in Hesiod's time. Later in the poem Virgil indicates that by then seasons were understood as regular, declaring that it is:

Well for us that we watch the rise and fall of the sky-signs
And the four seasons that divide the year equally.²³

This urging might be the oldest surviving expression of the conceptualisation of four annual seasons of equal length. Recurring at the same time each year they generated expectations about weather patterns and their timing. In this statement Virgil is not explicit in his definition of season. Taken by itself and with the reference to sky-signs seasons here might be read as astronomical. However, repeated associating of particular kinds of weather with the appearance or departure of certain stars or constellations throughout *Georgics*, suggests that the meaning of season here is also meteorological. Virgil represents the warm weather of summer when speaking of the time when 'the Atlantic Pleiads come to their morning setting and the blazing star of the Cretan Crown sink in the sky'.²⁴ He tells of the 'storms and stars of autumn';²⁵ in addition to the passing of the last showers and general drying expected in spring, 'when the milk-white Bull begins the year and the Dog

²³ Ibid., p59.
²⁴ Ibid., p58.
²⁵ Ibid., p61.
Star drops way. According to Virgil meteorological seasons were regular, predictable and a solid foundation for expectations relating to agricultural work. Worthy of note is that the phases of the moon are another sky-sign Virgil uses to foretell weather, suggesting an acknowledgment of the inherent variability of weather, even within seasons. Nevertheless, his linking of various signs to kinds of weather indicates his belief in an underlying and discernable order to weather that can be identified given sufficiently astute observation. Despite apparent changeability and seeming unpredictability, weather is ultimately regular, regular enough and with distinct patterns across time to be genuinely seasonal. At least in the Greco-Roman worldview articulated by Virgil.

Virgil’s *Georgics* is as lyrical as modern farmers’ almanacs are prosaic. Like almanacs and navigators’ guides from the seventeenth to the nineteenth centuries, however, *Georgics* also tried to enable readers to forecast weather by observing colours of the sky and cloud formations. One vivid example of many maintains that when the sun’s beams:

> Filter between thick cloud, rayed out like spokes...
> Such a storm of harsh hail is coming to rattle and bounce on the roofs. ⁷⁷

Speaking of celestial colours Virgil asserts that ‘dark-green stands for rain, flame colour foretells an east wind’. ⁸ While such notions have been dismissed, especially in modern times, as mere folk knowledge we must be cognizant of what they say. They are yet another indication of a belief in an orderly nature amenable to reading, interpretation and prediction. Along with demonstrating this belief, Virgil’s opus, and probably others that have not survived, also transmitted this conviction to a wider audience and generations that followed.

**Ordering Space**

If seasons order time, climatic zones order space. Just as seasons were identified by the position of the sun in the sky and the direction and extent of noonday shadows objects cast in consequence, so too was climate defined by shadows. As early as the fifth century BCE Parmenides developed the five zones theory of global

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²⁶ Ibid., p58. Before 153BCE the Roman Year began on March 1: Virgil was thinking with an outdated calendar here.
²⁷ Ibid, p66.
²⁸ Ibid.
climate: two frigid zones, two temperate zones and one middle torrid zone. Sketching this idea's history Lucian Boia notes that this became the dominant theory of climate during antiquity and that it exaggerated differences between each zone.\textsuperscript{29} Aristotle also theorised five global climatic zones, determined by latitude in \textit{Meteorology} the following century. This idea, however, did not go unchallenged. Thinkers such as Posidinius (second century BCE) and Claudius Ptolemy (second century CE) argued that seven distinct climatic zones engirded earth. However, as Strabo's \textit{Geography} (early first century BCE) demonstrated Posidinius later adopted the five-zone theory, albeit with different boundaries to both Parmenides and Aristotle.\textsuperscript{30}

Strabo's \textit{Geography} is a remarkable window on classical thinking about the natural world. Ostensibly a critique of earlier Astronomers and Geographers -- two disciplines then so entwined -- such as Eratosthenes and Hipparchus, it provides an informative history of Greek and Roman thinking about climate, place, physical geography. We learn that as early as the fourth century BCE Eratosthenes correctly identified the summer solstice as a time of turning, when the tilting of the earth on its axis reaches a maximum and reverses, bringing an apparent reversal of the sun's motion in the sky. We learn that by then he and probably others, had come to know that this happened at the same latitude repeatedly when the same constellations were visible in the same region of the night sky. We also learn that classical thinkers associated latitude with climate in a meteorological sense. Discussing the Eratosthenes method for identifying the location of southern India, Strabo repeats Eratosthenes' belief that proof that the southern extremities of India are at the same latitude as Meroe, comes 'both from astronomical observations and the temperature of the climate.'\textsuperscript{31} While Strabo's detailed discussion of \textit{klimata} focuses on shadows, day length, the height of the sun and turning points -- tropos, from which tropical derives -- it is also clear that this concept includes weather phenomena such as heat, cold, wet and dry.\textsuperscript{32} While the zones derived from astronomical phenomena and their observed consequences on the ground, they carried meteorological meaning.

Polybius sliced sky and space into six slivers. As Strabo relates, 'two situated between the poles and the Arctic circles; two between the Arctic Circles and the

\textsuperscript{31} Ibid, p106.
\textsuperscript{32} Ibid, pp198 - 204.
Tropics; and two between the Tropics which are divided by the Equator. Since the two tropical zones of this scheme are similar and contiguous, Strabo averred that dividing the tropics is unnecessary and misleading. He concludes that:

division into five zones accords best with the order of external nature and geography...celestial phenomena and the temperature of the atmosphere.

So, the five zone theory of climate dominated Western thinking from antiquity, through to the Renaissance, to the late nineteenth century. When Claudius Ptolemy shaped the concepts of latitude and longitude into the form we recognise today, and urged terrestrial locations to be identified within this grid system, the zonal theory of climate acquired a meta-framework in which it fitted seemlessly.

Classical thinkers differed from one another on how climate changed from south to north. Nevertheless, classical natural philosophy used the same template: that of klimata or inclination of the sun relative to the earth. Reasonably this maintains that the inclination at which the sun's rays hit the earth influences both the degree of heat at a location and the distribution of heat globally. Also determined by thinkers such as Posidinius by the length of the longest day, this notion conveys the idea that spatial variability, at least of climate, but perhaps also of weather, is regular, orderly and gradual going from north to south and vice versa. In this way the powerful and enduring idea of distinct zones regulating weather and climate across terrestrial space developed and gained widespread assent. While this framework and its underlying logic yielded different schema, at their core they spoke of an ordered, intelligible cosmos. Just as seasons regulated weather across time, climate zones gave both earth and atmosphere seeming regularity and predictability across space. The conformity of the climatic zone paradigm to the dominant western spatial concept for navigation and locating places – the coordinate system of latitude and longitude – helps explain its longevity. But so does its seeming congruence with experience.

Marking Time

Calendars and seasons have long been inextricably linked. The almost ontological solidity of calendars, however, is a relatively recent phenomenon. With the last adjustments having been decreed by Pope Gregory XIII in 1582, the calendar, at

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33 Ibid, p146.
34 Ibid.
least in the West, is a very stable intellectual technology. A cultural production, it now has an almost natural aura. So natural that physical phenomena such as weather have been expected to conform to calendrical timing by many people, if not most, influenced by European thinking. Historically, the relationship was more reciprocal.

We do not know when the first calendars were produced. Sunrise and sunset were probably humanity's first time signals. The periodicity of the moon has been recognised for millennia. Lawrence Wright avers that understanding the less obvious cycle of the seasons came with tilling and sowing – at least at the level of understanding the patterns of weather that followed others and preceded different kinds of weather again.36 Once this cycle had been discerned the year could be recognised naturally. Of course, cycles in the fall of shadows cast by the sun and the movement of the stars also offered cues for the year. With increasing complexity of society all manner of activities need to be timed accurately: commercial, legal and judicial, religious, festive. Time had to be marked. Calendars became essential because nature provided too few practicable cues.37

Time is deeply cultural. Like weather and climate it is a phenomenon in which nature and culture are intricately entwined. Before the hegemony of the Gregorian Calendar various societies devised countless calendars. A quick sketch of the antecedents of the current system gives a sense of their diversity. The Jewish calendar was based on phases of the moon. Babylonians incorporated the dynamics of both sun and moon as early as the second millennium BCE. Babylonian calendars generally started the year at the spring equinox. Some 2500 years ago both the Greeks and Persians elucidated the complex relationship between solar and lunar motion: after 19 years or 6940 days a new moon recurs on the same solar day.38 Clearly a system based on one, or the other, was better suited to human purposes. During the late third century BCE the Egyptians devised the oldest known calendar comprising a 365 day year. According to historian of science and mathematician Otto Neugebauer it derived from repeated, long term observations and averaging of the successive arrivals and phases of Nile River flooding at Heliopolis.39 While other scholars have disputed this as too variable a phenomenon, mathematician W M O'Neill has shown that in the periods 1382 – 1522 and 1693 -1862 most intervals between the arrival of successive floods clustered

38 Ibid., p13.
Variations were too small to influence time reckoning on scales of less than a century. Comprising 12 months of 30 days each with 5 extra days to fit the observed flood cycle, the Egyptian Civil calendar explicitly included three seasons each year. Each season - inundation, sowing time and harvest time - was exactly four months long, conveying a sense of the regularity in the arrival and departure of each season. When the Egyptians became aware that the astronomical year is not exactly 365 days long they constructed another calendar. Seasons were coming at the wrong time and regularity had to be restored. Any variability in the seasons was insufficient to undermine the sense that they were a solid basis for an ordered conceptualisation of time. Having noticed that the rising of the Nile coincided with the appearance on the horizon, just before dawn, of the dog star Sothis (Sirius), this came to be used as the basis for a newer Egyptian calendar. The Sothic calendar was the only known ancient calendar to accommodate the inconvenient fact that earth takes 365 days 5 hours, 48 minutes and 45 point something seconds to do a full loop around the sun.

Other calendars were tweaked when natural signs indicated that they were out of order. The most common solution was the use of extra days and, especially months. Egyptian, Babylonian, Jewish, Greek, Hindu and Chinese peoples all employed these intercalary months to recalibrate their calendars. By far the most famous reorganisation was that of Julius Caesar in 46 BCE. From this came the Julian Calendar, the basis for the Gregorian Calendar and spine of time marking in the modern world. Originally beginning on March 1, the Roman civil calendar lives in the names of the latter months of the contemporary calendar: September, October, November, December in the Anglo phonic world. In 153 BCE the New Year was moved to January 1 to coincide with the then new practice of consuls taking office from January 1. Where the New Year had for so long, in so many societies, been tied to astronomical events such as the vernal equinox, summer solstice and even new moons, it had become a legal and governmental construct. Underscoring the social and cultural nature of calendars we should be mindful that with the emergence of Christianity in the fourth century CE the Church began its year on March 25 – the feast of the Assumption and that Venice maintained March 1 as the beginning of the year until 1797.

46 BCE was 445 days long. Known as the ‘year of confusion’ it was the solution to ongoing confusion caused by the seasons and calendar being so out of synch.

41 Ibid., pp40-43.
42 G J Whitrow, op. cit, p67.
43 Ibid.
Over two thousand years ago calendar dates had become strongly associated with certain signs in nature: constellations, shadows, seasons (by any definition) and weather. Conceptually the links between calendar and season were so strong and necessary that one year was given an extra 80 days to restore order and synchronicity. By 46 BC the disjuncture between calendar and nature was stark - winter, in every sense, was happening in spring. After consulting the Greek astronomer Sosigenes Julius Caesar extended the year 46BCE and instituted a civil year of 365 days beginning, 1/1,45 BCE, with a leap year of 366 days every fourth year. A much better fit to the natural world, it did not require adjustment until 1582. By then the over estimation of the year by just over 11 minutes had accumulated to the calendar falling 10 days behind the skies. While it is doubtful that this was significant meteorologically it caused serious ecclesiastical problems. Easter had by then long been defined in relation to the first full moon following the vernal equinox. As Stephen Jay Gould observes, this ten day discrepancy was creating practical problems for priests and astronomers alike. The Jesuit mathematician Christopher Clavius calculated that the elimination of the leap year every turn of the century, except for those divisible by 400 would solve the problem. Pope Gregory XIII decreed that this system be implemented and that the days from October 6 to 14 of 1582 be eliminated to resynchronise the calendar with the stars. Although it was calibrated by nature, this system was at its core social, cultural and governmental.

Other aspects of temporality had long been resolved. With the development of Christianity and its core belief in the resurrection, time acquired directionality. Mircea Eliad’s examination of numerous pre-Christian societies details the universality, across many cultures, of cyclical conceptualisations of time based on recurrent successions of periods of renewal, growth and destruction based on observable natural cycles such as phases of the moon and the seasons. The crucifixion and resurrection however, have always been seen as unique and thus unrepeatable events. As a corollary, linear time is built into Christian belief and, accordingly, as Christianity spread conceptualisations of linear time supplanted those of circular time. Time became continuous and future events could not be ascertained as periodic repetitions of events in the past.

44 Ibid, p66.
Future days of feast and worship therefore had to be reckoned by laborious calculation. In the sixth century CE the pope instructed Dionysius Exiguus to calculate future dates of Easter and devise a system of time reckoning from the birth of Christ to supplant the then current system that marked time from the founding of Rome. With this the still current BC/AD system of dating emerged. In the 720s BCE the Benedictine Monk Bede computed tables of the date of Easter for each year from 532 to 1063. This not only transmitted the sense of an ultimate orderliness to the world, albeit not a regular one but a calculable one, but also gave rise to the *computus*, a Middle-Ages genre that determined dates of religious movable feasts, which itself repeatedly reinforced this sense of harmonious arrangement in nature. Significantly, through operations such as the *computus*, the calendar came to be used as a baseline or referent for other phenomena. Fitting into a broader system to mark, and measure time, the calendar seemed almost natural.

Around 800 CE the marking of time became a sonorous endeavour. Tolling bells told the time. In Benedictine monasteries time had come to be ordered not just on a seasonal, monthly, or even daily basis. Each day was shaped by a sequence of prayers and labours with bells identifying when one activity was to cease and another to begin. Circa 540 BCE, Abbot Benedict of Nursia formulated the *Table of Hours*.47 ‘Hours’ had been marked in Ancient Greece and Egypt by shadows during the day and constellations at night. But no activities then took on the complete, regimented time discipline that emerged in medieval monasteries and, in a predetermined manner, shaped every day of each year in the life of those who lived there. Each day was not an isolated fragment of time, but was linked to weeks and seasons from one year. Devotional practices for each day were set out in the Breviary, which, as Lawrence Wright notes, had a volume for each of the four seasons.48 Where farmers and sailors enacted time discipline on a general seasonal basis, clerics came to live, perform and repeat it on the time scale of the hour. They did not merely master the calendar and the time of day, they enacted and, in a literal sense embodied it, day, after day after day.

Time was not just ordered; it was conquered. Within the walls of the community life was regular and structurally predictable. Beyond monastery walls towns in Europe rang bells to inform their community of important times. Long before the coming of the clock many lived clock-work lives. Living with ordered, predictable sequences of events and tasks likely strengthened the long held sense

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47 Arno Borst, op. cit., p26
48 Lawrence Wright, op. cit, p39.
in religion and natural philosophy of an orderly world. The unpredicted was aberrant, unnatural, supernatural, deviant. It is not unreasonable to suppose that this order transformed in some cases and reinforced in others a mentalité that saw nature in the same way. In any case the use of the calendar to mark time was already well entrenched in scholarly European society and spreading more broadly.

We do not know when the mechanical clock was invented. Consensus has formed around 1270 BCE. By the preceding century trade and commerce were being transacted on the scale of hours. As commercial/bureaucratic rationality spread from the market centres of northern Italy so did the need for standardised calendars across Europe, or at least its market places and seats of governments. Contracts had to be fulfilled and dates agreed upon between all parties of a transaction. As trade networks expanded, so did the use of the standard Julian calendar, beginning each year on January 1. However, many people lived in two times: they used the civic and economic calendar for business and the local calendar for social and cultural life. Either way, calendars both marked time and ordered people’s lives. Of course, many transactions took place on the scale of hours and the clock enabled greater precision for these. Where only clerics had once lived day-to-day life to timetables, merchants, service providers, administrators and officials now performed to schedules. Those who dealt with them also had to conform to these schedules as time came to be divided into smaller units and measured with increasing precision. Long before modernity, time discipline was entrenched in European society and this order and regularity was imposed on the natural world. Time was marked and measured on a variety of scales, events and activities calibrated against this aspect of existence, which was becoming divided into smaller and smaller segments. In 1377 the clock became a powerful metaphor for the cosmos. Nicole Oresme expounded a mechanised concept of time, describing the universe as an eternally working clock observed through the movements of the planets.

With revolutions in astronomy and physics what seemed natural became profoundly so. The painstaking work of Copernicus, Galileo and Tycho Brahe during the sixteenth century demonstrated just how pervasive order in the heavens is. It showed just how widespread regularities are and the predictability of observable celestial movements. When Galileo demonstrated that any pendulum of a given length swings at a constant frequency, regardless of amplitude, the same sense of

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50 Arno Borst, op. cit., p87.
51 Alfred Crosby, op. cit., p83.
physical and temporal harmony appeared to operate in our world. Time seemed regular, constant and, it was measurable. But it was the work of Johannes Kepler that would have the most profound effect during this century. Kepler’s laws of planetary motion are known for their demolition of long standing dogma maintaining that celestial motion is uniform and perfectly circular. However, in successfully explaining observed planetary motion they also demonstrated inherent temporal regularity in the physical universe. Predictable, regularly timed observations could be fully accounted for by properties of the cosmos giving a sense that nature really is ordered, as had long been believed. Kepler’s correct explanation of the tides buttressed this further.

Within a century time took on a life of its own. With the publication of *Principia* in 1687 the mechanics of observable and observed motion were completely explained. The laws Isaac Newton outlined accounted for gravity, planetary motion, terrestrial motion, acceleration. They were testable. When tested and retested they proved reliable. By the 18th century Newton’s laws allowed physical motion to be explained and predicted. Accounting for so much experienced phenomena they spoke forcefully of the harmonious nature of the cosmos. Significantly they not only built on the work of earlier astronomers and natural philosophers but also complemented work in fields such as insurance. John Graunt’s study of births and deaths in London from 1604 to 1661—*Natural and Political Observations made upon the Bills of Mortality (1662)*—indicated stability in human biology. The ratio of boys born to girls was constant, there were clusters around particular ages of death, stable proportions of the population who lived beyond particular ages and there seemed to be a definite maximum human life span. *Order and harmony went way beyond the inanimate. Even more important for this study however, was the fact that Newton explicitly predicated his explanation on a particular view of time. Time is ‘absolute, true and mathematical time, (which) of itself, and from its own nature, flows equally without relation to anything external.’* 


54 R G Collingwood, op. cit., p108.
many seamlessly interwoven concepts that could be demonstrated experimentally and accorded with experience that it was considered final for nearly two centuries.\textsuperscript{55} Even more powerfully, this idea of universal, absolute and independent time accorded with everyday experience. Physicist Paul Davies observes that Newton's time became the time of physics and science until the 20\textsuperscript{th} century and relativity, and remains the time of everyday experience to this very moment. Infusing the repeatedly proven laws of mechanics it 'encapsulated the rule of cause and effect', 'epitomised the very rationality of the cosmos' and came 'to play a fundamental role in our description of the physical world'.\textsuperscript{56} Following Newton, time was an absolute, unvarying, linear and independent dimension of reality that could be used as a bedrock upon which to study other phenomena: projectile motion, acceleration, chemical change, mortality, weather...Timing could be and was, used to determine the regularities and orderliness of phenomena. It can be and has been used to generate expectations and make predictions. Although deeply cultural and conceptual in nature, time became profoundly ontological and 'natural' in Europe after Newton. This is not to say that these ideas were universally accepted or even widely known. But they do structure how nature has been studied and written about. Understood as a continuous and linear flow, independent of the rest of nature, and unchanging, time has been an absolute divided into and marked by various units. Seasons, calendars and clocks both mark and measure this constant flux, attaining the same sense of immutability and naturalness.

From 1582 the predominant western calendar was part of a stable system of temporality. Time had long been accepted by Europeans as moving forward and this sense of time was natural, unquestionable even. The method for marking time's progress had long been accepted. Marking time by these means was coherent and also seemed natural. Moreover this system has been stable, hardly questioned in the modern west since 1752, when Protestant Britain belatedly adopted it. By then it had gained rock-solid metaphysical foundations. Far from natural, this history shows how deeply cultural time and means of marking its passage really are. Yet, with their utility, intelligibility, perceived match to the world and enduring potency, they've been deployed as a fundamental fact of nature and as a constant external referent for events and nature, which in fact follow other logics. These particular, contingent concepts of time and calendar became deeply embedded in everyday life. Over time, increasing numbers of people came to embody these ideas of time through their actions and activities; they structured thinking and commerce and government. This concept of time made sense. It

seemed to be explained and to explain so much else. The calendar and clock increased order and increasingly regulated life and experience. So culture became nature.

Momentous, yet forgotten, this has had profound consequences for modern understanding of seasons, weather and climate.

Almanacs before the 19th Century

For such important cultural products, almanacs have received scant attention. I’ll draw on the only two comprehensive English language studies of almanacs in Britain and its colonies: Maureen Perkins' *Vision of the Future* (1996) and Bernard Capp’s *Astrology and the Popular Press* (1979) to show how almanacs transmitted the calendar and ideas of western calendrical time throughout British society. Informed by Robert Darnton’s notion that it is possible to access the cosmology of non-scholars by looking at the things people used to think with, Maureen Perkins states that nineteenth century people ‘thought with their almanac.’ With 605,000 authorised Almanacs printed in 1801, 649,000 in 1839 and countless ‘unauthorised’ volumes printed and circulating, this is a justified claim. Even before this, almanacs had come to be very influential. Before printing European almanacs appeared in manuscript. Before manuscript they were carved on wood or bone. Long predating Hesiod, the unifying factor from the oldest to the most recent almanacs was the use of time reckoning by calendar. Technically almanacs were tables of astronomical and astrological events of the coming year. In making accurate predictions, year after year they certainly transmitted a sense that the cosmos, or at least aspects of it are ordered. From the Middle Ages almanacs combined information about ecclesiastical feasts and observances with details of eclipses and the movements of planets and constellations. Almanacs ordered life and inculcated time reckoning by the calendar long before modernity. In 1448 an almanac was the first item to come off the Gutenberg press. In 1639 an almanac was the second publication of the Cambridge Press of Massachusetts Bay. An almanac was the second book printed in colonial Australia. In the mid seventeenth century sales in England ran at 400,000 per year, or, one in three

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60 Ibid., p2.
families purchased a copy each year. By the mid eighteenth Century England was, to quote Robert Poole, a ‘society of the almanac’.

Following the advent of the printing press both the readership and the remit of Almanacs expanded. Bernard Capp’s analysis indicates just how pervasive prognostication was in almanacs by the seventeenth century. Astronomical forecasts became almost completely reliable as the mechanics of celestial motion became increasingly and rapidly understood in the sixteenth and seventeenth centuries. In a conceptually small leap this quickly extended to weather and times for planting certain crops and plants. In a larger stride this soon incorporated forecast optimum times for procedures such as bloodletting. In a perilous long jump this also incorporated societal and political forecasts, which had consequences, especially in an era of regicide and civil war in England. Almanacs were not homogenous. Calendars, tables of church and civil festivities as well as of stellar and planetary appearances were the sine qua non of English almanacs. While they generally followed a standard format from the Elizabethan era onwards, there was enormous diversity among almanacs: they were published for specific towns and regions, and for different religious groups and by the late seventeenth century both Whig and Tory volumes abounded. Crucially their reception was just as heterogeneous. Many predictions failed to materialise and this was duly noted. By far the most amusing sceptical response to overblown forecasts by almanac compilers was Jonathan Swift’s prank almanac of 1708. As compiler Isaac Bickerstaff Swift published Predictions for the Year 1708. This was not the first satirical almanac but, according to Bernard Capp, it was the most faithful to the genre and Swift maintained the pretence that it was a work of genuine prophecy. Swift lampooned by making outrageously ambiguous predictions, except for his very specific prophecy that England’s pre-eminent compiler of the time, John Partridge, would die of fever at 11pm on 29 March 1708. He did not, of course.

Nevertheless, almanacs were profoundly influential. Before newspapers they were where communities grappled with weather. Before weather forecasting fell decisively out of favour in the early nineteenth century, almanacs commonly provided forecasts of major weather events or for particular days, usually significant days such as religious feast days. Almanacs also transmitted local weather lore. Jan Golinski’s analysis of seventeenth and eighteenth century almanacs reveals that these consisted of signs in either the sky or in the animal

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63 Ibid, p17.
65 For more detail see Bernard Capp, op. cit., pp243 -245.
kingdom or rules maintaining that certain kinds of weather on particular feast days indicated what would come weatherwise in the ensuing days, weeks or even months. While giving a sense of the variability of weather this also conveys a sense of order and predictability: a limited variability that can be anticipated and adapted to. Acknowledging the fickle nature of English weather and its variations from one locale to the next some almanacs issued rules for forecasting rather than actual forecasts for particular days as early as the late 17th century. In other ways, however, almanacs transmitted and reinforced the calendrical template of time, the sense of the regularity of weather and linking weather to calendrical time. From around 1600 the standard form for almanacs included discussing weather prognostications according to the four seasons of the year, which themselves were defined by exact dates in the civic calendar. Furthermore, Jan Golinski shows that the very weather lore that captures something of weather’s variability uses is nonetheless structured by the calendar. Weather was popularly thought of and spoken about as belonging to calendar months in England, Scotland, as well as Ireland well into the eighteenth century. Accordingly, when ‘March days’ occurred in April, and any untimely weather, judged by the calendar, happened they were considered ‘borrowed days’ and occasioned a variety of superstitions. Official calendrical time even structured weather lore as it resisted the universal generalities of the more systematic efforts of natural philosophers.

It conceived of and deployed time in the same manner as natural philosophers. Published in Thomas Sprat’s History of the Royal Society in 1667, Robert Hooke set out the format for serious, empirical observation of weather with his ‘Method for Making a History of the Weather’. This gave detailed instructions for compiling daily observations and measurements, where possible, of wind, atmospheric pressure, humidity, temperature, clouds, thunder and lightning, the tides and incidents of illness. All were to be tabled in a standardised format to allow comparisons from time to time and from place to place. Most significantly, for the study of weather, each table was to be arranged so that a whole month’s observations would be on one sheet. This soon became the standard practice of scientific weather observation in ships’ logs, journals and parish records long before the establishment of official nation bureaux of meteorology, from the latter half of the 19th century onwards, and remains the very format of official weather

67 Bernard Capp, op. cit., p62.
68 Ibid., p30.
69 Jan Golinski, op. cit., p93.
records, even electronic records, to this day. Thus the month became the fundamental structural unit of European weather reports and analyses.

This is unsurprising. But it has borne serious consequences. In folk and popular imagination the month was already a basic weather unit – March weather, April weather, etc. This was entrenched and continued circulating no doubt orally, as well as in almanacs. For all of the cleavages between folk and elite knowledges of weather, this 'natural', linear idea of time, divided into the same categories was common to both. With it a deep sense of expected weather for particular calendrical times was communicated and reinforced. More generally almanacs inculcated calendrical time, giving solidity to these kinds of expectations. As a method this also makes sense. Humans had already recognised seasons as recurring phenomena for millennia. Weather as the vital constituent of these cyclical repetitions must also, at least logically, recur. How else to measure/confirm this but with a calendar? Indeed, given the manageable quantities of data, the calendar month seems the ideal category to investigate this. In addition, guided by a belief in the inherent harmony of the cosmos, natural philosophy was an enterprise geared at seeking, outlining and explaining regularities. Using the calendar in this way facilitated this. Both method and instrument skewed in the direction of order, recurrence and periodicity, giving misleading understandings about weather, which later chapters will examine. Weather does not stop at the temporal boundaries marked by humans. Weather happens in time, but is determined by physical, not temporal processes. Rain, dry, warmth, cold, calm and tempest pay no heed to the time of day or year. The only alternative, given the technologies and knowledges available would have been to record weather as particular events in time. But recording the intensity of weather events, when they happened and how long they lasted would not have enabled standard categorisation or the relatively easy use of categorised measurements for statistical computation. This was evidently not the path to order, but it may have yielded deeper understanding.

Weather diaries were almost fashionable among eighteenth century educated men in England. Apart from providing valuable information about significant weather events and their effects in particular locations they reveal the conventions and formats of writing about weather. Like more general diaries, weather diaries were organised by calendar dates and, sometimes, clock time. Specifically entries were organised by day and the information later arranged and assessed by the month. Weather was matched to particular times. Examining many of these diaries Jan Golinski concludes that the aim of compiling such a body of
records was to uncover the dynamics to enable weather forecasting as reliable as the predictions of various celestial bodies had become.\(^7\) Along with almanacs and weather records diaries reinforced the links between weather and time. They also abstracted expectations of what to expect in particular places during particular calendar months. Even before the Industrial Revolution European people, both scholarly and not, saw much of nature as a mechanism. Nature's dynamics played out in strictly linear cause and effect along an absolute and independent timeline against which the regularities of the cosmos could be quantified and determined. When deep geological time was revealed by rocks and fossils during the nineteenth century, only an extension of this timeline from its Biblical parameters was needed. Its structure and logic remained unchanged. It still made sense and it still helped make sense of the physical world.

**Almanacs and ‘Antipodean’ Time**

Both Bernard Capp and Maureen Perkins concur that almanacs changed remarkably during the early nineteenth century. With a general decline in the popularity and credibility of astrology and a litany of failed attempts to predict weather in public awareness, a number of more sober, even scientific almanacs emerged in Britain. Almanacs of a more statistical flavour were published from the 1760s onwards,\(^7\), but, following the formation of the Society for the Diffusion of Useful Knowledge (London), in 1826, they became more influential. Motivated by a reformist drive to educate the poor and combat superstition, their almanac – The *British Almanac* - did not venture to forecast the weather, but merely record it. Columns of observations, arranged by calendar month, were supplemented by tables of averages, also organised by month.\(^7\) Indeed the introduction included an explanation about the weather tables: that they were based on means because they represent the equilibrium state of the atmosphere or the state to which a disturbed atmosphere returns.\(^7\) Katherine Anderson reminds us that less rigorous, folkish almanacs coexisted with and generally attracted more readers than the likes of the *British Almanac*. Also, other almanacs, such as the Illustrated London Almanac trod a middle path, featuring both folkish verse on traditional rules for weather prediction and tables of information, including weather observations, organised by the calendar month. By the mid 1840s even the middlebrow almanacs became more scientific, downplaying or eliminating weather predictions in any form and emphasising the clock-work movements of

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\(^7\) Jan Golinski, op. cit., pp78-79.
\(^7\) Maureen Perkins, op. cit., p46.
\(^7\) *British Almanac* 1830, (London: Charles Knight, 1830), pp 10-32.
\(^7\) Ibid., p3. *British Almanac* 1831, p5.
constellations and planets. Scientific respectability had become a major concern, in the decades before official meteorological organisations and daily newspapers supplanted the role of almanacs in communicating weather. Nevertheless, the ubiquitous practice of relating weather to calendar months continued, without abatement and, in conjunction with European time, came to the continent of Australia with the colonial invasion.

Australian almanacs were not mere facsimiles of their British counterparts. Certainly they transferred English culture and imposed it on foreign and strange environments. As in England, tables of enumerated weather phenomena became more common. Rules for predicting weather featured during the 1830s but almost all weather folklore disappeared from Australian almanacs during the following decade. However, Maureen Perkins quotes the Whig British press as stating that numerous Australian almanacs exemplified statistical almanacs ‘unalloyed by superstition and ignorance’, in contrast to so many in England. Studying early colonial almanacs in New South Wales she also reveals that weather became a regular feature in Howe’s *Australasian Almanac* from 1822 when a column headed ‘Usual State of the Weather’ first appeared. Looking at the usual, rather than the actual, it gave the sense of weather as a regular phenomenon happening at particular times. Under a different compiler, the editorial preface to the almanac declared that both weather and climate in New South Wales was ‘vague’ and ‘conjectural’ and so not amenable to prediction or ordering.

Nevertheless, almanacs confidently announced and defined the temperate Australian seasons and, accordingly ordered the weather and generated expectations about what to expect. Unlike northern hemisphere seasons, which are determined by the almost perfectly regular and totally predictable ‘movement of the sun’, colonial Australian seasons were defined solely by calendrical date. The *NSW Pocket Almanac and Colonial Remembrancer* applied the paradigm of the four European seasons, each of equal length, each recurring at the same times from year to year to the environment they were trying to understand and tame. As early as 1806, in what Maureen Perkins rightly calls a colonial innovation, this publication modified the four seasons framework to apply to exact, astronomically

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77 ibid., p187.
78 ibid., p76.
79 ibid., p184.
unimportant calendar dates. In the 'antipodes' Spring began on September 1; Summer on December 1; Autumn March 1 and Winter on June 1. Weather had long been seen as regular, the calendar had long ordered time in Europe; calendar and clock became more pervasive with increasing industrialisation and technologies such as almanacs spread this conceptual repertoire to ever increasing reaches of the world. Remarkably though the Remembrancer's seasonal paradigm disconnected weather from the astronomical cycles it had been linked to for millennia and hitched it to the calendar. Accordingly, the calendar explicitly became the determinant of weather and people's expectations about it. This was not an uncontested idea but it has been the conceptualisation of seasons that has dominated in temperate Australia since the latter half of the nineteenth century. As the astronomical bases for marking particular calendar dates was forgotten and, more generally, as time in the West and industrialised societies has become disconnected from nature the calendar has become an absolute, independent, benchmark for the ordering of nature, just like the time it marks and divides.

Calendars determined weather in South Australia. Like the rest of nature, weather was a clock, before, during and after South Australia experimented with imperialism and took over the Northern Territory. South Australian almanacs show in great detail just how ordered they believed nature to be and how crucial calendars were in identifying this and defining the unusual. Indeed they ordered weather by the month, even when they did not explicitly discuss weather. Produced scarcely two years after the founding of the colony, the Royal South Australian Almanack for 1839 was largely a daily calendar listing both fixed and movable feasts, phases of the moon, selected anniversaries of historical events and a guide to the fledgling colonial government. It begins with a table of feasts, including long forgotten almost exotic sounding days such as Septuagesima Sunday and Rogation Sunday. Then, a page is given to each calendar month. At the top appear precise times for the four phases of the moon, to the minute. Against each day of the month exact times of sunrise and sunset are noted, as is the significance of any particular calendar day deemed important. Underneath is the 'Gardener and Farmer's (sic) Calendar'. January's begins:

Sow cauliflowers and broccoli early in the month as possible.
Swedish turnips and cabbage for an early crop may also begin. Sow celery and seakdale seeds
Ending with the imperative:

Break up ground for wheat or barley. 83

February's Gardener and Farmer's (sic) Calendar commands:

Finish planting of potatos; prepare the ground for turnips; sow
cauliflower, broccoli, cabbage, peas, broad beans, celery,
artichokes and seakale... 84

For March it instructs:

Prepare ground for onions and leeks; plant out strawberries, sweet
herbs, cauliflower, broccoli and cabbage; sow peas, beans, leeks,
onions, spinach, carrots, cress, radish, parsley, lettuce, endive,
sorrel, for early crops... 85

Each month a set of instructions is issued, similar in style, all predicated on a
clockwork nature that shows a distinctly different face each calendar month.
Interesting in itself, but utterly fascinating when we recall just how little
experience Europeans had of this environment. Spatial ideas about climate
combined with the temporal to harmonise this strange new world. The 1840 edition
of this almanac featured a copy of a lecture on the 'science of gardening' delivered
by George Stephenson at the Adelaide Mechanics Institute in which he speaks of
the need to experiment in order to forge progress and understanding of plants and
soils. 86 Nevertheless, the hegemony of the calendar still dominated, albeit with
more crowded tables of feasts and anniversaries.

Andrew Murray's almanac had an almost identical format and underlying
logic. For each month the floral instructions are divided into kitchen garden and
flower garden. From the South Australian Almanack and General Colonial Directory
for 1850 we see that, unsurprisingly, the instructions for each month for the kitchen
garden correspond to those of the Gardener and Farmer's Calendar of the 'Royal'.
The April 1850 'flower garden' directives exemplify their nature:

83 Royal South Australian Almanack for 1839, (Adelaide: Robert Thomas and Co., 1838), p7
84 Ibid., p8
85 Ibid., p9.
Commence planting different kinds of bulbs and hardy annuals; commence laying the orange and lemon, citron, loquat and olive.\(^{87}\)

This volume is distinguished by including a Meteorological Register for Adelaide. Comprising three tables it features annual means for each year 1838 – 1847; running means for the cumulative data and hygrometrical results. Barometric Pressures, temperatures, winds and numbers of days on which particular kinds of weather occurred are all enumerated. *Prima facie* it appears that the year is the fundamental unit here. In a piece introducing this data called the ‘Climate of South Australia’, written, in a Hippocratic spirit, by William Wyatt, Coroner of the Province, we learn that these are composites of official figures. Outlining how these tables were compiled Wyatt tells us that annual tables were all calculated from twelve tables of monthly means for each calendar year.\(^{88}\) While the focus here might be the year, official records were organised around the month, in accordance with then nearly two centuries of practice. These tables of annual means showed order and stability in the atmosphere, indeed means smooth variability in quantity and the time scale of the year obscures variability in timing.

In 1855 an almanac appeared for ‘all’ of Australia. Of course few Europeans were living north of the Tropic of Capricorn so Australia then meant southern Australia to the colonials. Despite the vast differences in climate and soil between Tasmania and Gladstone, then the northernmost substantial settlement; and between, say, the Monaro and the area around the Swan River, *Waugh and Cox’s Australian Almanac* also published general instructions for each month. Waugh and Cox’s ‘Gardener’s Calendar’ divided flora into four groups: kitchen garden, the nursery, flower garden and field. Directions were similar in form and content to those of other almanacs.\(^{89}\) Most significantly, the month, not geography, was the primary organisational category – nature was working to a timetable here.

Weather now featured more explicitly in South Australia’s almanacs. Often measurements of phenomena such as temperature and rainfall featured in addition to what can be read from the gardener’s calendars and the like. By 1862 Andrew Murray’s almanac explicitly combined weather and gardening directions in a piece appearing below each month’s calendar headed ‘The Weather and the Garden’. Succinct abstractions of each month’s weather came before brisk

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\(^{88}\) William Wyatt, ‘Climate of South Australia’, in Andrew Murray op. cit., p.25.

\(^{89}\) *Waugh and Cox’s Australian Almanac, 1855*, (Sydney: Waugh and Cox, 1855), pp33-37.
instructions on what to do in the garden. February’s entry gives a feel for content and tone:

The weather is still very hot, in fact this may be considered the hottest month in the year; frequent lightning and occasional thunder after sunset.
Plant cress, radish, lettuce, turnips, broad beans and peas, transplant cauliflower, and cabbage plants, sow annuals, plant bulbs and make layers and, gather ripe fruit, prepare ground for Cape Barley, cross-plough for wheat, dig and store potatoes.90

By its nature this summary conveys order in the skies and soils. Other entries give an even more misleading sense of harmony in the weather. In March ‘the atmosphere is still dry and hot during the early part of this month, but a change generally sets in about the 15th’.91 Not only is the month thought to be a coherent meteorological unit, but the weather also is understood as precisely timed and linear, at least in the sense that late March is cooler than early March and warmer than April when ‘the summer has now entirely left us’.92 Of course, there is a distinct cooling trend during Autumn but, as weather records for Adelaide during the late 19th century reveal, this does not mean that the cooling is linear, that each week is cooler than the one it follows. Periods in May can be warmer than periods in March.93

The Northern Territory did not have its own almanac until 1885. Between then and the establishment of Darwin in 1869, South Australian almanacs included information about the territory and circulated there. Commonly information about the Northern Territory was restricted to information about the Government and particular office holders.94 Josiah Boothby’s almanacs still featured the traditional monthly calendar with gardening instructions. Utterly irrelevant to people in the territory these still transmitted and reinforced the ideas of a timetable nature and the notion of the month as a meaningful analytical unit in the study of physical and biological processes. Boothby’s 1880 edition also included tables of annual rainfall at Adelaide for each year from 1839 onwards, averages for each decade and rain totals for each calendar month in the previous two years.95

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90 Andrew Murray, *Almanack for 1862*, (Adelaide: Andrew Murray, 1861), p10
91 Ibid., p11.
92 Ibid., p12
93 See Bureau of Meteorology, *Climate Data Online*, Daily Maximum Temperature, Adelaide West Terrace, Station Number 023000, for any ‘autumn’ 1887-1900.
94 Josiah Boothby’s *Adelaide Almanac and Directory for South Australia 1872 and 1880* editions illustrate this.
V B Solomon’s *Northern Territory Times Almanac and Directory* was comprehensive and authoritative. Like Boothby's almanac, editions included detailed rainfall figures at Port Darwin Telegraph Station for each year from 1872 and monthly totals for the previous year or two. Weather was also discussed in an historical and geographical sketch of the territory, which was almost identical in all fourteen editions. In this narrative clockwork nature was applied locally. J A G Little, Senior Inspecting Officer at the Post and Telegraphs Department Darwin, and Darwin’s most then foremost authority on weather, describes the weather of the far north as flipping from wet to dry, twice each year. ‘The wet season extends from October to April and the dry one from May to September’, stated Little, regularly, without variation. Memorably, Little also stated that the ‘changes of these seasons are so uniform and regular that they may be predicted almost to a day’. The following chapters examine this idea, its history and its fit with the environment. Here we need note that Little’s portrayal matters because it shows that weather in Australia’s north was thought of, spoken about and understood as ordered, regular, running to time and defined by the calendar month. The paradigm of the calendar had been imposed on the tropical troposphere.

Nature and the seasons once marked time. For many centuries now the opposite has been true. In western thinking the logic of the calendar and the millennia-old conviction of a harmonious and orderly cosmos long ago fused into a worldview that sees time as absolute as well as independent of the rest of nature and so an ultimate, unimpeachable benchmark against which to examine natural processes in time. The calendar and the clock have not only been learned but for many centuries have been embodied in how people and communities structure their lives. Time, particularly calendar time, and particularly seasons and the calendar month are the most important and compelling elements structuring how Westerners have studied, thought about and understood weather. As calendars became widely adopted the logic of the season as a coherent meteorological category became applied to the month – a development warranting further study. This certainly enhanced understanding of the atmosphere but has excluded vital, more variable phenomena. However, with people not just thinking in terms of the calendar, but also, living, very effectively, by it; with the multitude of calendars and their histories

97 Ibid.
effectively consigned to oblivion, calendars have long been felt to be natural and unquestionable. Long before meteorology emerged as a formal science, calendars and the time that they marked had overwhelming ontological significance and by the 19th century few in the west looked to nature for time signals. Time had an independent reality. In Chapter 2 we see how this has shaped, even distorted understanding of tropical weather and climate.
CHAPTER 2
A BRIEF HISTORY OF THE MONSOON - TO 1869

When the Moonta dropped anchor in Darwin Harbour in 1869 its crew knew what to expect of the weather. It was February and so 'the Wet'. As George Goyder and his surveyors mounted the plateau on which Darwin would be built they expected their immediate labours would take place under grey skies, in a soupy atmosphere relieved by regular downpours as the Wet continued until April. Weather measurements and records were not to begin until March 6, 1869, but the colonisers felt they knew about local weather and climate long before instruments were calibrated, put in place and used to enumerate the dynamics of this part of the great aerial ocean.

Just a year before Goyder arrived Francis Cadell assumed an intricate understanding of the region's climate. Indeed, thousands of weather observations and measurements had already been taken in the region since 1824. Commanding a South Australian government expedition to identify an optimal location for a permanent northern colony Cadell hardly spent a year along the north coast. Weather was an evident concern. Keeping with standard practice, Cadell's expedition, undertaken in the wake of the recent abandonment of the settlement at Escape Cliffs, maintained a detailed daily meteorological register. These records show the care this party took to record and measure the weather.\(^1\) Reporting to the Chief Secretary of South Australia Cadell outlined both spatial and temporal dimensions of atmospheric fluxes. Identifying the 'north-west monsoon' as the major source of the region's rain and fresh water supplies, Cadell was explicit about 'latitudinal monsoon limits of, say, 14 degrees south'.\(^2\) Continuing, Cadell then expressed disappointment that 'about the middle of November last, nearly a month and a half after the monsoon should have set in...the country looked so barren, withered and inhospitable to us'.\(^3\) Despite his limited experience of the region, Cadell held that the rain-bearing monsoon should arrive at a particular time of year. He understood it as a regular phenomenon that worked over a well-defined spatial range. Moreover, Cadell's narrative of this expedition evinced an understanding of the climate as an alternation of two periods of wet and dry each year, regularly switching with the arrival and retreat of the moisture-laden north-west monsoon.

\(^1\) Register of Meteorological Observations kept by Mr Napier, *Parliamentary Papers, South Australia*, No. 24, 1868, pp3-7
\(^2\) F Cadell to Chief Secretary of South Australia, 18/2/1868, Ibid., p.2.
\(^3\) Ibid.
No descriptions or theories about trade winds were elaborated, but the region was portrayed as dry, even 'withered' in the absence of the north-west monsoon. The dry was characterised by lack and absence. In a report on the earlier periods of this expedition Cadell used the term monsoon to indicate a prevailing wind regime numerous times. 4 Matching these references to entries in the meteorological register it is clear Cadell used 'monsoon' to indicate what later came to be known as the south-east trades.

Others had made earlier observations. Throughout the mid 1860s weather and climate along the Top End coast was part of vociferous debate about the best location for what was hoped to become a permanent colony and capital. Influenced by Hippocratic notions relating health to fresh winds and illness to damp, hot and stagnant airs BT Finniss chose to establish the fourth attempt to colonise Australia's north coast at Escape Cliffs, where the Adelaide River flows into Adam Bay. As Chapter 6 details, these putative associations between climate and health were so integral to then contemporary medical and scientific thinking about development in the tropics. Its significance showed in the South Australian Government's imperative to Finniss, commanding him to give the highest priority to 'salubrity of climate' in selecting a site for the capital. 5 Defending against criticism that the location is poor, Finniss extolled its virtues of climate and health. Escape Cliffs enjoyed 'superior salubrity' because:

It is open to the N. W. monsoon, and to the sea breeze which sets in daily throughout the year almost without intermission...no marshes are to be found in sufficient proximity to prove injurious to health by their malarious exhalations, nor known malarious localities so situated that the prevailing winds (S.E and N.W) can waft any noxious miasma in the direction of the city. 6

Merely three weeks later Finniss buttressed his argument to Henry Ayers, Chief Secretary of South Australia, claiming, erroneously, that the site of present day Darwin receives no refreshing breezes yet is vulnerable to winds blowing from a malaria prone locale. 7 Convinced of the link between meteorology and malady, Finniss also circulated tables of temperature, barometric and rainfall measurements, which also included a column of the ratio of sick to overall

4 Report of Explorations of the Northern Territory by F Cadell, Parliamentary Papers, South Australia, No. 178, 1867, pp 2-5
5 Settlement of Northern Territory, Parliamentary Papers, South Australia, No. 36, 1865, p 2
6 BT Finniss to H Ayers, 15/4/1865, Parliamentary Papers, South Australia, No. 15, 1865, p 5.
7 BT Finniss to H Ayers, 2/5/1865, Ibid., p 14.
population for each month. Idiosyncratically, he postulated an association between illness and high air pressure.\(^8\) His reports, like Cadell's, used the language of monsoons, rainy seasons and dry seasons. While B T Finniss did not offer an elaborate account of weather and climate in the Top End his frequent references to both indicated the same conceptual template of the regular, dyadic flipping between wet and dry assumed by Captain Cadell.

Disquiet about the location of the settlement occasioned more surveys of the far north. F Howard's survey was purely of the coast; J McKinlay also traversed the hinterlands. Both carefully observed the weather. Howard understood the weather to be determined by a climate in which the seasons alternated between the dry south-east monsoon and the wet westerly monsoon.\(^9\) Spanning over four months, McKinlay's journal account described the intricate interactions between rain, winds, heat, plant growth and the landscape. His framework for grasping weather and climate was the same as that of his aforementioned contemporaries. Unlike the others he referred to south-east trades rather than the south east monsoon. John McKinlay was also more explicit than the others in his expectations of regularly timed weather. On March 30 he noted 'Very dull, but suppose it won't rain as the dry weather now appears to have set in and nearly time'.\(^10\) Confounded by what he was experiencing McKinlay recorded on May 15 that it 'Looks very much like setting in for rain; it is unaccountable weather for this time of year'.\(^11\) Experience and observation cannot explain this understanding, or the assumed temporal order upon which it is based.

Earlier sojourners held similar understandings. Reporting to the New South Wales government about his North Australian expedition A C Gregory identified a distinct wet season throughout the 'intertropical' north, 'occurring from November to March'.\(^12\) Northern seasons were identified by the presence or absence of rain and the alternation is seen as regular. Gregory's experience was likely informed by reports and the meteorological register kept between 1838 and 1849 at Port Essington. However, the issue as to whether a mere decade is long enough to discern the intricacies of a region's climate then arises. It might be long enough to identify broad turnings in the patterns of weather. But, as Thomas Thistlewood in Jamaica had observed during the eighteenth century, there are many kinds of rain in

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\(^8\) Ibid., p5 & p9.
\(^9\) F Howard to Governor in Chief, 9/9/1865, Parliamentary Papers, South Australia, No. 84, 1865, p5.
\(^10\) J McKinlay's Northern Territory Explorations, 1866, Parliamentary Papers, South Australia, No. 82, 1866, p8.
\(^11\) Ibid., p16.
\(^12\) A C Gregory, North Australian Expedition, Parliamentary Papers, South Australia, No. 170, 1861, p8.
the tropics and an array of patterns of how it falls in time. In Northern Australia rain commonly falls in cataclysmic thunderstorms, days-long periods of constant rainfall, periods of intermittent showers, some torrential, some much lighter, all of varying duration, with irregular breaks in between. The men who tried to settle littoral north Australia had not been there long enough to even notice these complexities. Longer periods when rain was frequent and other periods when it was rare or completely absent were strikingly obvious. Indeed these extremes of drenching and dry are the most salient feature of weather and climate. Fine details, however, take much more time to observe let alone formulate into a coherent concept of climate.

Two Port Essington observers, however, did not see the local climate as especially orderly. While correspondence from Port Essington abounds with terms such as monsoon, east monsoon, dry monsoon, west monsoon, wet season, dry season and so forth, surgeon and naturalist John MacGillivray gave a more nuanced account of the climate of Port Essington in a long letter to the Sydney Morning Herald in 1845. According to MacGillivray:

The year at Port Essington is divided into two seasons, the dry and the rainy. The former generally lasts from the middle of March to the beginning of October; but as its limits depend upon the changes of the monsoons in the neighbouring seas, which are by no means regular, of course, its duration varies...rain seldom falls at this time and generally in the shape of passing showers. During the rainy season, the temperature falls only a few degrees. It is usually ushered in by violent squalls of wind and rain, which are continued at intervals throughout the season. The quantity of rain which then falls is very great.

Despite his relatively short stay – well under a year – John MacGillivray did notice and record important intricacies of local weather and climate. Still seeing the region's climate as being of two annual seasons he discerned that both the timing and duration of seasons varied from year to year.

Reporting to the Colonial Secretary in Sydney, the Commandant of the settlement was descriptive in outlining the coming of the wet in 1845. Captain John McArthur opened his report stating:

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14 Sydney Morning Herald, 15/10/1845.
We have experienced another West Monsoon of a character differing from all former seasons. The rains commenced early in November, and with frequent intervals continued until about a week since. November and December were fine showery months, the rain occasionally falling in true tropical storms.\textsuperscript{15}

The meaning of the opening sentence hinges on the possibility of a missing comma. If an intended comma between ‘Monsoon’ and ‘of’ is missing, McArthur was noting one variation to the usual pattern. He was conveying a sense of expectation and the reality of the weather not meeting this expectation. If a comma was not intended to punctuate John McArthur’s sentence, then he meant to say that this is at least the second monsoon that has differed in character from those experienced consistently in the years before and the expectations generated by these experiences. Either way, this gives a sense that the succession of seasons and the climate are not as orderly as reports from the explorers and administrators who were to follow would portray. Like those who would follow, Captain McArthur was preoccupied with the salubrity of the locale’s climate.\textsuperscript{16}

One time resident and champion of the settlement at Port Essington, George Windsor Earl, wrote of a generally ordered climate with mild variability from year to year. Written to encourage the development of seaborne trade between southern Asia and northern Australia and the growth of Victoria township at Port Essington, Earl’s Enterprise in Tropical Australia tells of a relatively benign climate. In a chapter devoted to the seasons and climate of the Cobourg Peninsula, George Windsor Earl compared this region’s general climate and salubrity favourably with those of other tropical places.\textsuperscript{17} Sketching the seasons as being determined by either the westerly monsoon or south-east trade winds, Earl, linked the arrival and departure of each with the procession of the sun and the two annual equinoxes.\textsuperscript{18} Earl’s account also noted complexities ignored, both before and after, of periods of dry in the wet and periods between the two dominant seasons when neither wind regime dominates, when it can be both wet and dry.\textsuperscript{19} Erroneously, but common for the time, George Windsor Earl saw a change of moon and the coming of rain and squalls during the wet as causally related.\textsuperscript{20} While indicating that he believed that the timing of wet and dry varied from year to year, this relationship with regular

\textsuperscript{16} Captain John McArthur to Governor Sir George Gipps, 11/2/1840, in ibid., p60.
\textsuperscript{17} George Winsor Earl, Enterprise in Tropical Australia, (London: Madden and Malcolm, 1846) p90.
\textsuperscript{18} ibid., pp86-89.
\textsuperscript{19} ibid.
\textsuperscript{20} ibid.,p87.
phenomena such as phases of the moon gives a sense that any irregularities in the
climate were still inherently predictable and still orderly. Variability occurred but
within strict temporal limits. Moreover, it was amenable to forecasting. There was,
Earl averred, an underlying order to apparent disorder.

Little survives from the aborted settlement at Raffles Bay. Considered a more
suitable location for a trading port and eventual capital than Fort Dundas, the first
effort at colonising the north coast on Melville Island, Raffles Bay was established in
1827 then abandoned in 1829.21 Initial plans to move the Melville Island garrison to
Raffles Bay and abandon Melville Island altogether were not fulfilled. Writing to
Governor Darling about the proposed move in December 1826, Governor Stirling
supported the idea, but urged its implementation be delayed because the
‘periodical winds, called the N W Monsoon’, causing the ‘rainy Season’, ‘will
continue from the present time to the beginning of April’.22 At the time of this
missive non–Aboriginal inhabitation in the Top End was barely into its third year.
Founded in 1824, the British Garrison at Fort Dundas was a location of acute nature
observation. Commander of the fledgling settlement from 1826 to 1828, Major John
Campbell left a rich and enduring snapshot of the natural world on and near Melville
Island in his Geographical Memoir, published by the Royal Geographical Society of
London in 1834. Soils, native plant life, introduced plant life, rocks, reefs, shoals,
birds, reptiles, creatures of the sea and the ebbs and flows of the great aerial ocean
all commanded Campbell’s attention. Equipped with thermometers the colonists
measured the intensity of the heat no fewer than six times a day between 6am and
midnight, subsequently organising these metrics into averages for each of six times
of day for each calendar month. Health concerns motivated these efforts. Campbell
began his vivid exposition on Melville Island’s climate remarking that ‘the climate of
Melville Island is certainly unhealthy from the end of October until the beginning of
April’.23 Outlining the seasonal dynamics Campbell continued:

The heat is excessive, and the atmosphere, then overcharged with
moisture, is extremely oppressive and debilitating. This is the period of
the north-west monsoon, or rainy season.24

21 Dora Howard, ‘English Activities on the North Coast of Australia in the First Half of the Nineteenth
Century’, Proceedings of Royal Geographical Society of Australasia, South Australian Branch, XXXIII,
1931-1932, pp77-79. Howard notes that P P King was first to recommend Raffles Bay over Melville
Island following his voyages along the north coast between 1818-1822.
22 Captain Stirling to Governor Darling, 8/12/1826, Historical Records of Australia, Series I, Volume XII,
23 Major John Campbell, ‘Geographical Memoir of Melville Island and Port Essington, on the Cobourg
Peninsula, Northern Australia; with some Observations on the Settlements which have been
Established on the North Coast of New Holland’, Journal of the Royal Geographical Society of London,
4, 1834, p147.
24 Ibid.
Over the next two pages Major Campbell outlined a climatic regime of two annual seasons – wet and dry – alternating with orderly and predictable timing as north west monsoons over come south east monsoons and the former then vanquished by the latter. Despite detailing significant variations in the timing of the north-west monsoon during the period from 1824 to 1827 Campbell subsequently concluded that the seasons are regular.\textsuperscript{25} His arrangement of the meteorological table of temperature measurements, included with his narrative, further demonstrates his belief in this temporal regularity. Each calendar month April to September is categorised as ‘south-east monsoon, or Dry Season’; the other six months the North-west monsoon, or Wet Season’.\textsuperscript{26}

When there are only twelve calendar months per year, the notion that a two-month gap in the arrival time of monsoonal rain does not constitute irregularity is unintelligible. It seems that Major Campbell brought a template of the region’s weather and climate with him and read these variations as anomalies rather than an inherent aspect of the climate. However, he had not spent enough time to draw his conclusions from systematic observation. While those who were to follow would sometimes identify slightly different features of the climate of littoral North Australia, the content was organised by the same intellectual framework structuring Campbell’s thinking: the concept of a wet/dry dyad, flipping regularly in time with an orderly switching of wind regimes twice each year. Thousands of observations were made between 1824 and 1869. But these did not inform understanding of Top End weather and climate. While it would dominate long after the British first dragged their boats onto the sands of Melville Island and hoisted a flag to claim possession, this paradigm had already long taken root in the minds of European sailors, explorers and colonisers.

Certainly this framework structured the thinking and stories about atmospheric action of the two British maritime surveys preceding efforts to settle Australia’s far north. Between 1818 and 1822 Phillip Parker King and crew surveyed the Australian coastline with forensic diligence. In the resulting narrative King included daily observations of land, sea and sky for the entire Australian coastline. Reporting the weather on the waters of the coast of what we now know as the Northern Territory, King stated that ‘winds are periodical and are called the east and west monsoons’.\textsuperscript{27} Portraying a clockwork weather system King elaborated, ‘the easterly monsoon commences about the first week of April...it ceases about the latter end of November or the early part of December; the westerly monsoon may

\textsuperscript{25} Ibid., pp148-149.
\textsuperscript{26} Ibid., 152.
\textsuperscript{27} P P King, Narrative of a Survey of the Intertropical and Western Coasts of Australia Performed between the Years 1818 and 1822, Vol II, (London: John Murray, 1827), pp 307-308.
then be expected to blow strong'. Phillip King's account includes astute observations of patterns of wind and weather across the day during various stages of each season, displaying a sophisticated understanding of local influences on far reaching weather systems. But King, also, did not experience the weather long enough to identify its patterns and theorise a climate from what he saw and felt.

Monsoons, 'the wet' and 'the dry' also organised Matthew Flinders' thinking about Top End weather. As a sailor he Understandably evinced a concern with prevailing winds and concerns about getting to, say, Torres Strait before being buffeted by an expected opposing westerly monsoon. Flinders had expectations about weather, even before experiencing particular places. On 16 February 1803, at what has been known as Cape Wilberforce since Flinders' voyaging there, he encountered what for over 200 years was the human face of the monsoons along Australia's north coast – Macassar navigators. Coming with the westerly monsoons from Sulawesi they returned with the south-easterly trades. Pobassoo, commander of the largest of six divisions of prow, told Flinders about their voyages and efforts to obtain trepang along the far northern shores of Australia. Pobassoo also informed Flinders that the north-west monsoon 'would not blow a month longer'. Although Macassan sailors had collectively spent far more time in the region than Europeans, it was not from them that Flinders learned about the local climate. Both he and King brought their understanding with them to a region that experienced a common weather but multiple climates and parallel seasons.

**Indigenous Seasons**

Aborigines had lived there since long before the end of the last ice age. Their habitation registers on the scales of deep time. By more than 30,000 years ago ancestors of Aborigines had successfully occupied every major ecological zone of the islands of New Guinea, mainland Australia and Tasmania. By the early nineteenth century they had already experienced 13,000 years of weather since the global climate stabilised. Studying various Top End Aboriginal communities and linguistic groups during the latter part of the twentieth century Anthropologists have detailed elaborate conceptualisations of weather, season and climate. Based on many generations of experience and assiduous empirical observation in the region, these Indigenous notions of climate and seasons have developed over an

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28 Ibid., p308.
30 Ibid., 207.
indeterminate period. It is unclear just how long ago various Indigenous communities first developed theories of weather and climate. Given the copious and intricate details inherent in these understandings it seems likely that they took many years to elaborate and, with their intense experiential focus, are unlikely to have ever been static in their content. Despite the absence of written evidence that Top End Aboriginal people held these understandings throughout the nineteenth century it is unreasonable to assume that they did not: this absence of evidence can be accounted for by an apparent lack of exchanges of such information between Indigenes and invaders. Moreover, given the length of Aboriginal tenure in this region and the close link of these theories to individual and community survival, this praxis was almost certainly operating when Flinders was voyaging along the north coast, and long before. Elucidating Indigenous knowledge about climate and seasons of the people of Yarralin in the Victoria River district of the western Top End, Deborah Rose explains that this and other important knowledge is passed from generation to generation in songs, stories, myths and life practices. Not only does a development of these climatic ideas long ago seem probable, their transmission through time can be explained. In any case, these concepts are products of historical experience and memories of embodied experiences. They have emerged from an acute ecological awareness developed through hunting in and living off an often forbidding environment.

Indigenous concepts of season and climate are not merely about the dynamics of the atmosphere. They are inherently interconnective, noting complex interactions of natural phenomena: changes in patterns of weather, flowering and growth of plants, colouring of seed pods, and a wide variety of animal behaviours such as the coming of particular insects and laying of crocodile eggs. Incorporating these observed connections in the vicissitudes of land sea and sky these ideas of weather and climate stand most in contrast to western conceptualisations of the same in their temporal flexibility. As in nature, change of season and the pulses of a climate are not defined by the calendar. Top End indigenous communities identify changes of season by observing connected events in flora and fauna, as well as the skies. Unlike western frameworks of regularly oscillating monsoons this does accommodate the fact that the timing of Top End seasons changes from year to year and that the wet, as understood in western thought, does not always arrive.

32 Ibid., p15.
34 Jones and Meehan, op. cit., Rose, op. cit., p39 and Jane Simpson in Eric Webb ed., op., cit., pp23-24., all relate this in detail to the communities they have studied.
35 Deborah Rose, op. cit., p37.
Indigenous knowledge makes far more distinctions among weather phenomena than the colonists and explorers did. Winds are not classified merely according to where they come from. They are also defined by their strength, temperature and associated phenomena such as dust, haze and rain. Among others the people of Yarralin identify different kinds of rain: wuruwuru, ‘the very first rain in the hot time’; yipu, ‘the regular settled rain of the rainy time’; there is ‘light’ and ‘dark’ rain and ‘heavy’ rain. Distinctions between kinds of wind, types of rain, between dry heat and humid heat and their interactions with the local biota are all part of local Indigenous concepts of season and climate throughout Australia’s far north. Consequently, where newcomers have recognised two seasons, the Yolngu of North Eastern Arnhem Land recognise six, as do the Gundjeihmi of coastal western Arnhem land and at least two other indigenous groups of the far north coast.

In Indigenous thinking, seasons are not structured by time. They are not about particular kinds of weather befalling a region at the same time each year, happening for as long as all other seasons. In Indigenous thinking seasons are irregular; smaller stories in a larger meta-narrative telling of a remarkably variable climate. Signified by visible and palpable processes and events in the physical world, seasons are not constellations of events determined by calendrical time. Seasons are patterns of natural events that occur in time, in particular sequences. Even where a season might not eventuate a general sequence is followed as the earth flies through space on its journey around the sun. This sequence is cyclical but not regular. The contrasts with the dominant western notion of a regular wet/dry dyad affected by changes in monsoon are striking. While Indigenous concepts of season and climate often incorporate the different monsoons, or prevailing, wind regimes, they are not structured by them. Unlike western conceptualisations they are based on long-term observations through lengthy adaptation to the environments of Australia’s far north. Despite their intricate detail, sound empirical basis and good fit to the actual environment these understandings never came to influence western thinking about the weather and climate of the Top End.

That Europeans felt they already understood the weather and climate, even before they ventured there, might largely explain this. Also, virulent and enduring racial prejudice predisposed newcomers against learning about weather and climate from Aboriginal people. Flinders, King and all who followed merely imposed

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37 Deborah Rose, op. cit., p39.
38 Janet Simpson, op. cit., p24
40 Ibid, p130.
a received understanding of the region’s weather and climate. Although their
diligent observations made sense within this framework, the resulting data also
indicated a need to modify it. But this did not happen. This was an enduring
conceptualisation, albeit it with much shallower roots in time than parallel
indigenous understandings. Ingenious and eminently useful, the paradigm of the
monsoons was not, however, developed through disinterested studies of the
natural world.

The Classical Monsoon

Understanding of these seasonally reversing winds came through trade. Seaborne
trade and commerce around the Arabian Sea and the shores of the North Indian
Ocean was well established more than 4000 years ago.41 No doubt people in various
locations around the Indian Ocean littoral had long been aware of the seasonal
reversal of winds in their locale, but it was through voyaging that the scale of this
massive flux of air came to be comprehended. Investigating ancient records of sea
trade and weather archaeologist Bruce Warren found that the oldest surviving
records, from circa 2000BCE, do not explicitly mention winds but suggest a pattern
in Babylonian nautical activity shaped by an understanding of the seasonal changes
of wind above the Arabian Sea.42 Surviving Sumerian texts evince a similar
understanding.43 In these documents merchants were, understandably, timing their
voyages to coincide with the most favourable conditions, enabling not just the
safest, but also the fastest and most efficient voyaging to their markets and back
again.

Westerners finally encountered the monsoons with Alexander’s conquests.
Although Nearchus’ account of Alexander’s nautical expedition from Mesopotamia
to India has been lost, a version of it survives in Arrian’s *Indica*, produced in the early
second century of the common era. Reproducing several passages, Bruce Warren
makes clear that Arrian and Alexander were aware of the seasonal nature of
prevailing winds over India and adjacent waters. They also knew which times were
favourable and which were potentially calamitous for sailing. They did not, however,
understand the ocean-wide scale of these potent flows of air.44 This crucial
understanding came with the growth in Roman trade along the Indian Ocean shores.

Two contemporaneous volumes, both surviving to the present, transmitted this

41 Bruce Warren, ‘Ancient and Medieval Records of the Monsoon Winds and Currents of the Indian
pp137-139.
42 Ibid., p139.
43 Ibid.
44 Ibid., pp140-142.
knowledge. The better known, Pliny the Elder's *Natural History*, published shortly before his death in 79CE, contains a lengthy passage detailing the sea-route from Egypt, including optimum times for voyaging:

Travelling by sea begins at midsummer before the dogstar rises or immediately after its rising and it takes about thirty days to reach the Arabian port of Cella...the most advantageous way of sailing to India is to set out from Cella; from that port it is a 40 day's voyage if the Hippalus (south-west wind) is blowing.\(^{45}\)

It is worth noting that Pliny does not seem to see the westerly monsoon as a completely orderly and timely phenomenon. Yet, coinciding with a regular astronomical event, it is clearly regular enough to organise nautical timetables around. Outlining the return voyage Pliny declares that:

Travellers set sail from India on the return voyage at the beginning of the Egyptian month Tybis, which is our December...They set sail from India with a south east wind and after entering the Red Sea, continue the voyage with a south-west or south wind.\(^{46}\)

Thus, the understanding of the monsoons as a regular, oceanic scale phenomenon entered western thinking. Possibly the oldest surviving western navigation manual, The *Periplus of the Erythrean Sea*, and its unknown author, not only outlined the same seasonal changes of prevailing winds, but also identified the navigator credited with having first discovered how to exploit these aerial dynamics to voyage directly across the open ocean. Hippalus, the nautical pilot after whom the Romans named the winds of the south-west monsoon, is credited with this momentous discovery around 50CE and, accordingly, revolutionised Roman navigation in the Indian Ocean.\(^{47}\) Until this entered Roman awareness Roman sailors ventured along the coastlines, where they understood the various local workings of the monsoons. Conceptually trapped in Aristotelian cosmology and its explanations of winds in terms of exhalations of the earth, a thorough understanding of the physical causes of this seasonal reversal of winds eluded the Romans. In fact, westerners would forget and then rediscover this knowledge before gaining a deeper awareness.


\(^{46}\) Ibid, p419.

Following the fall of the Roman Empire this knowledge was lost to Europe. Trade networks contracted and disappeared. Europeans ceased to venture to this part of the world. During this millennial scale absence Arab knowledge persisted. Their monsoon, however, was very different to that of later Arabs and Europeans. Examining the ninth century texts of Arab Geographer Ibn Khurraadhbih and surviving work of the tenth century scholar Abu Zayd, Bruce Warren found that while both were enthralled by the annual seasonal rains of littoral Arabia, neither related the seasonality of the rains to the seasonality of the winds. By this time though, Arab sailors commonly used the word ‘mawsim’ meaning season, and the word from which monsoon derives, to denote times of year for sailing between different ports, not prevailing wind regimes or periods of wet and dry. With longer distance maritime activity inextricably linked to the winds this sense of season is nonetheless strongly associated with prevailing winds and their timely reversal. By the late fifteenth century, when Europeans again journeyed to the Indian Ocean, Arab and Indian sailors certainly understood the vast spatial scales over which these twice-yearly atmospheric reversals operated.

**Monsoons in the ‘Age of Discovery’**

It was not Vasco Da Gama but his pilot who identified the direct path from littoral Africa to the western shores of India. Da Gama’s records of his voyage (1497-1499) are long lost. But chunks of an unknown contemporary’s journal survive. From it we learn that an Indian pilot from Gujarat directed Da Gama’s fleet from Malindi, on the coast of present day Kenya, to Calecut, in southwestern India. Prevailing winds and seasons are not explicitly referred to in this work but it is clear from the speedy journey and its timing that the voyagers took advantage of a consistent west or southwest monsoon extending most, if not the whole way from Africa to India. The timing of the return journey, to coincide with the opposite monsoon, suggests that Da Gama and his crew learned of crucial temporal and spatial facts about the Indian Ocean monsoons. At the time of Da Gama’s explorations the word monsoon and its equivalents in other European languages was not yet part of the western lexicon of nature. It was, however, on the cusp of entering European usage through Portuguese, a likely product of Da Gama’s voyage and the encounters he and his men had with people and nature on and around the Indian Ocean.

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49 Ibid., p147.  
Moncao is Portuguese for Monsoon. According to the Oxford English Dictionary, moncao emerged in Portuguese in the sixteenth century and was a literal equivalent to mawsim, which by then had acquired the meaning of season in a more meteorological sense. An early use of 'monsoon' to denote seasonally reversal of winds was that of Florentine merchant Girolamo Sernigi in a letter to an unidentified man in Florence. First published in 1507, this letter details Da Gama's return voyage and salient characteristics of the Indian coast and Arabian sea. Republished in 1550 with some substantial stylistic amendments and the condensing of many passages, the surviving published version is nonetheless, according to Ravenstein, 'a faithful reproduction of the original'. Reproduction of the 1550 version of letter, with annotated comparisons to the 1507 version, includes a section titled 'The Monsoons'. Under this heading the periodic reversal of winds is simply delineated:

There are only two dominant winds in those parts, namely westerly and easterly winds, and it is winter during the former and summer during the latter.

Without consulting the original document it is impossible to tell whether the term moncao was used in the 1507 publication. Notwithstanding Ravenstein's claim about the fidelity of the 1550 reproduction this seems unlikely. One of the great changes made in the latter version was the use of headings to separate sections and identify particular topics. It is likely that this description of the winds was not headed by the term moncao in the original. Indeed the piece is meaningful without the use of the term. Given that moncao was in use in sixteenth century Portuguese it is possible that Ravenstein's English translation is a straightforward translation of moncao to monsoon, reflecting that the term had likely come to denote seasonal reversal of prevailing winds by the mid sixteenth century in Portuguese.

Monsoon had six forms when it entered English. First used in Hakluyt's Voyages, published in 1599, it soon became a commonly used term in nautical correspondence. By this time English merchants had formed the English East India Company (EIC) following the slightly earlier establishment by their Dutch counterparts of the Dutch East India Company (VOC). With new reliable sea paths known from Europe to south and south east Asia both sought to establish and

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52 E G Ravenstein, in E G Ravenstein op. cit., p120.
53 Ibid
54 Ibid., p136.
55 Ibid., p120.
develop lucrative trade networks exploiting the bounties of these lands. Among the first modern corporations to leave detailed and orderly records, the EIC and its meticulous practices have bequeathed rich information on how its sailors understood the weather and climate of the tropics in the early seventeenth century. Even before the six EIC voyages to establish trading posts throughout southern Asia had concluded, EIC men of the sea understood the weather and climate there in terms of a seasonal reversal of winds. Correspondence between the company and its emissaries in the east shows that such an understanding was transmitted within the company no later than 1608. Writing to the ‘Governor and Company of East India Merchants, on 22/6/1608, Anthony Marlowe tells of being informed by sailors from Surat and Gujurat that westerly winds were imminent and would blow for four months. After further alluding to these dependable winds, Marlow advises that subsequent voyages should leave England no later than December in order to be off the shores of east Africa in time to take advantage of the periodic winds.57 Evaluating the merits of separating his fleet in a letter written in 1610 to the Company Hugh Frayne explicitly refers to both ‘the monsoon’ and distinguishes it from the ‘winter monsoon’.58 Moreover, in the same correspondence he makes two explicit references to the regular timing of the monsoons, one identifying a particular date: 15/10. Even if these authors were themselves unsure of this information, they were communicating it within a rapidly expanding network and contributing to the development of this knowledge. Correspondence from November 1610 confirms that EIC sailors were beginning to get a sense of the regularity of the monsoons, were developing expectations as to the timing of the two monsoons and determining their ocean voyaging according to their understanding of these atmospheric oscillations. Writing to Henry Middleton, Lawrence Femell and Hugh Frayne affirmed ‘there is no going hence to India till the great western monsoon comes, which will be in May’.59 The monsoons were also integral to concerns about where fleets should tarry while awaiting changes in the winds.60

References to the monsoons abound in the first two volumes of EIC letters from Asia. The index to volume 1 contains no fewer than 29 references to ‘winds and monsoons’.61 Volume II contains 52.62 On further examination these indicate that the term was used and commonly understood by a large number of EIC seamen by the 1610s. They understood that monsoons were seasonal winds; they understood that...
monsoons reversed direction and they understood that this reversal was timely. This sense of precision timing is even sharper in the later correspondence of this set with more numerous statements linking specific calendar dates to the advent of particular monsoons and putative sailing schedules featuring from 1611 onwards. By 1614 ‘monsoon’ had acquired an additional meaning. Along with its established meaning it came to be used as a distinct time period, in the manner of the four temperate European seasons. George Cokayne and Richard Welden explicitly spoke of ‘this monsoon’, the ‘same monsoon’, ‘last monsoon’ and ‘next monsoon’.63 Although this usage would ensue the term would also maintain its principal meaning for more than 300 years to come. The physical phenomenon came to European awareness by way of Indian and Arabian knowledge. With rapidly increasing experience Westerners built on this foundation. European explorers and natural scientists acquired from both earlier Indian Ocean seafarers, and their sense of their own experiences of weather and climate in the region, certitude about the clock-work nature of the monsoons between Africa and India.

Yet Abel Tasman already had firm expectations about weather in the tropics in the 1640s. 9 degrees and 48 minutes south of the equator, he wrote the following journal entry for 26/3/1643:

I cannot understand how it is that such a steady westerly wind is blowing so far into the South Sea – unless it should be that the western monsoon is continually blowing over NOVA GUINEA.64

This remark demonstrates an expectation that the monsoon operates within particular spatial limits, at certain times. Tasman already understood the monsoons as phenomena that stirred the atmosphere far beyond the Indian Ocean and its shores. Trade networks of the Dutch throughout the Indonesian Archipelago likely contributed to this awareness, along with Tasman’s two visits to India during the 1630s. From Tasman’s journal it is clear that he encountered reversing prevailing winds while voyaging in the tropical southwest Pacific and understood them in terms of the same concept of monsoons used by EIC seamen and their predecessors on the Indian Ocean.65

63 ibid., pp35-36.
65 Two examples: Abel Janssooan Tasman’s Journal, p 35 & p58, the latter just a few hundred kilometres north of the Northern Territory Coast.
The Modern Monsoon

As Europeans grappled with new climates the climate of 'science' was changing. During the seventeenth century reliable barometers, mercury thermometers, hygrometers and anemometers were developed and installed on ocean-going ships. The long established practice of describing the weather, particularly wind direction at regular moments in time, in journals and log books could now be supplemented with measurements of heat, atmospheric moisture and air pressure. Before long companies such as the EIC amassed vast stores of weather data. Companies and their captains guarded this increasingly numerical information, restricting it within their organisations in an effort to establish and maintain an advantage over their rivals. The new instruments were not merely material.

In 1620 Francis Bacon inaugurated a new way of thinking. His *Novum Organum* (New Instrument), outlined and promoted a then novel way of investigating the natural world. Bacon shared the dominant belief of literate, educated westerners, from Ancient Greece through the Middle Ages, of an essentially harmonious and orderly universe. Francis Bacon's innovation was to detail a method of investigation based on experience, systematic observation and experimentation. Empirical observation and experimentation as ways of knowing were unremarkable in antiquity. Bacon's method was distinguished by its rigorous systematisation and its standardisation of methods, measurement, recording and transmission of results. In a quirk of history, Roger Bacon, an unrelated namesake argued for observation based investigation of nature during the thirteenth century and outlined numerous principles and methods of empirical science. Encased in the overwhelmingly rigid strictures of the medieval Christian world, these ideas remained peripheral before being forgotten. In 1377 Polish monk Nicole Oresme became the first European thinker to use the clock as a metaphor of the universe and its seeming precise periodicity and regularity. In the wake of the then recent invention of the clock the classical concept of harmony acquired a distinctly modern visage, long before modernity. With the confluence of this conviction of an orderly, clock-work universe, the more advanced breaking down of Aristotelian cosmology and nascent awareness of the importance of numbers and measure to 'scientific' investigation,

seventeenth century England offered a fertile thoughtscape for Francis Bacon's empirical approach to nature. While Part One of *Novum Organum* in its entirety sets out both this method and the rationale underlying it in a battery of axioms, Francis Bacon's thinking is encapsulated in one axiom:

There are and can exist but two ways of investigating and discovering truth. The one hurries on rapidly from the senses and particulars to the most general axioms and from them, as principles and their supposed indisputable truth, derives and discovers the intermediate axioms. This is the way now in use. The other constructs its axioms from the senses and particulars, by ascending continually and gradually, till it finally arrives at the most general axioms, which is the true but unattempted way.70

Nature had long been studied through practical demonstration, proof and deduction from general principles. Certainty marked authoritative knowledge.71 Francis Bacon, however, paved the way for probabilistic knowledge. He maintained that the proper investigation of the universe came from assiduous observation and theories derived from this. With this, data as we know it was born and deductive reasoning was (eventually) supplanted by an inductive process as the broad approach to studying nature. In this approach things could not be proven with absolute certainty. But from systematic study of particulars, general principles, causes and associations could be shown to a high level of probability. Studying Baconian empiricism Mary Poovey noted that these 'particulars' of Francis Bacon's investigations were regarded as fundamental units of knowledge. Produced through disinterested enquiry, these 'nuggets of experience detached from theory', were the building blocks of understanding.72 Convinced of an abiding order in nature, Francis Bacon nonetheless viewed any deviations in observed or measured facts as errors in either observation or nature.73 Accordingly, they were to be disregarded in any further analysis.

In 1637 French philosopher Rene Descartes promulgated a refined method of deductive reasoning and knowing through demonstration and analogy, which he elaborated, in subsequent works, into a system of knowledge.74 Systematic and mathematical, Descartes' epistemology aimed to re-establish the primacy of certainty. Although Bacon's inductive, empiricist approach would soon dominate

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73 Ibid., p99.
74 For more see Rene Descartes, *Discourse on the Method and Meditations.*
Descartes made an indelible impression on the study of nature. Descartes’ mechanistic system required the division of phenomena into the binary of the physical and the mental, or perceptual. Only the physical could be truly known. Cartesian Dualism gave to modernity and science an authoritative conceptual template of binary opposites. Phenomena had long been categorised into sets of opposites, but through Descartes it received modern, philosophical and scientific gravitas.

With the establishment of the Royal Society in 1662 empirical reasoning was effectively institutionalised. Founded ‘for the improvement of natural knowledge’ to quote its own formal title, The Royal Society organised experimental studies and communicated their results. Committed to disinterested knowledge, the society increasingly drew on the observations of EIC sailors and other voyaging traders. Indeed, Mary Poovey argues the society quickly came to view merchants as ideal knowledge gatherers: they had no intrinsic interest in what they watched and recorded and, not grasping the deeper significance of their actions, constituted no threat to natural philosophers. To facilitate, even standardise this process the society published its 'Directions for Sea-Men, Bound for Far Voyages', in the first volume of its Philosophical Transactions. Explicitly declaring to:

Study nature rather than books, and from the Observations, made of the phenomena and effects the presents (sic), to compose such a History of Her, as may hereafter serve to build a solid and useful philosophy upon.

This manual instructed sailors to observe compass readings, note ‘ebbings and flowings’ of seas, rivers and ocean currents, to plot ports and coastlines and take depth soundings of all coasts and ports. To investigate weather, sailors were ordered:

To keep a Register of all changes in Wind and Weather at all houres(sic), by night and by day, shewing(sic), the point the wind blows from, whether strong or weak; the rains, hail, snow and the like, the precise times of their beginning and continuance, especially Hurricanes (sic) and Spouts; but above all take care to observe the Trade-Wines (sic), about

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75 Peter Dear, op. cit., p87
76 Mary Poovey, op. cit., p93.
78 Ibid., pp141-142.
what degrees of Latitude and Longitude they first begin, where and when they cease, or change, or grow stronger or weaker, and how much; as near and exact as may be.

The copious data generated by these instructions leave no doubt over compliance. Before long there was sufficient data to describe the monsoons over all oceans and venture an evidence-based explanation for their existence.

Twenty years after the Royal Society published Directions, Edmund Halley published the first systematic account of monsoons and trade winds. Using the work of what Halley called ‘a multitude of observers’, he wrote his history of winds, based on observations of winds at particular points in both time and space.\(^{79}\) Essentially an outline of how winds blow throughout the tropics at particular times of the year this is a history in the sense of drawing on historical data and extrapolating from it. Rather than discussing specific events or contingencies it expounded general principles based on detailed historical records of winds in the past. Having outlined the perennial nature of easterly trade winds over the western tropical Atlantic and the periodic reversal of the trades to a regularly westerly monsoon near the coast of Guinea, Halley examined dynamics over the Indian Ocean. Confirming what navigators had long understood, Halley described its winds as ‘partly general, as in the Aethiopick(sic) Ocean, partly periodical, that is half the year they blow one way, and the other half upon the opposite points’.\(^{80}\) Sketching the flow of air above particular parts of the sea Edmund Halley twice referred to the region now known as the northern coast of the Northern Territory and its adjacent seas. Explicitly speaking of the east Indian Ocean near ‘Hollandia Nova’ and ‘between 2 and 12 south latitude’, Halley described a regime with SE winds for half of the year and NW winds for the other half.\(^ {81}\) Discussing the region between ‘Java to the west’ and ‘New Guinea to the East’ he outlined the same periodic reversal of winds.\(^ {82}\) Halley frequently used terms such as monsoons, change of monsoons and trade winds in sketching these flows of air. Just as evident is his certainty that these patterns are not subject to any variability from one year to the next. Halley’s understanding of the monsoons as caused by the march of the sun rigorously reinforces this. Realising that sunlight falls with varying intensity over different latitudes Edmund Halley also saw that different latitudes and the airs in which they are immersed receive different intensities of heating. Winds and monsoons therefore were determined by

\[^{79}\text{Edmund Halley,} \text{ An Historical Account of the Trade Winds, and Monsoons, Observable in the Seas between and Near the Tropicks, with an Attempt to Assign the Physical cause of the Said Winds, Philosophical Transactions, Vol 16, 1686-1692, p162.}\]

\[^{80}\text{Ibid., p158.}\]

\[^{81}\text{Ibid., pp158-159.}\]

\[^{82}\text{Ibid., p160.}\]
a tendency of the atmosphere to establish an ‘Aequilibrium’.\(^{83}\) Grasping that land heats to a greater extent than the oceans Halley also explained the monsoons as part of a process of establish equilibrium between the air masses above heated landmasses and cooler seas.\(^{84}\) Trade winds blow to bring about equilibrium and are overwhelmed by monsoons where the demands for thermal equilibrium dictate. With these dynamics caused by the strikingly apparent and precise movement of the sun between the Tropic of Cancer and the Tropic of Capricorn, the monsoons in each hemisphere were not only understood to be regular through observation but also by the very mechanism at their core.

Monsoons were atmospheric clocks. They were periodic, predictable and could be expected with particular movements of the sun. Coming from a respected natural philosopher, with the imprimatur of the Royal Society and an empirical base this was an influential work. That it was limited and undermined by an inability to conceptualise atmospheric movement in three dimensions did not matter. It seemed to explain (indeed did partly explain) what so many observed and experienced. Accordingly, it began to mould the notion of tropical climates as periodic alternations of trade winds and monsoons. From the late seventeenth century westerners had a framework within which they could fathom their observations of weather and climate in the equinoctial world.

Another authoritative account soon reinforced this template. Following extensive voyaging throughout the Indonesian Archipelago, the Philippines and parts of the west coast of Australia, William Dampier published his most famous work *A New Voyage around the World* in 1697. With seven editions published by 1727 this was a widely read work. From 1699 it included a second volume including Dampier’s now scarcely known *Discourse on Winds*.\(^{85}\) Based more on personal experiences and observations than Halley’s exhaustive data set it nonetheless reinforced what Halley expounded about monsoons and trade winds in the tropics. In general they are regular, result in two annual seasons throughout the tropics and where changes of monsoon occur, these changes are periodic and related to the movement of the sun as outlined by Halley. Most significantly, Dampier explicitly linked monsoons to rainfall. Describing the climate of the ‘Torrid Zone’, Dampier declares ‘as to the Seasons of the Year, I can distinguish them there, in no other

\(^{83}\) Ibid., p165
\(^{84}\) Ibid., pp166-167
\(^{85}\) William Dampier, John Masefield ed. *Dampier’s Voyages: consisting of A New Voyage Round the world, a Supplement to the Voyage Round the World, Two Voyages to Campeachy, a Discourse of Winds, a Voyage to New Holland, and a Vindication, in answer to the Chimerical Relation of William Furnell,* (London: E Grant Richards, 1906).
way than by Wet and Dry.\textsuperscript{86} Outlining the winds of the Indian Ocean tropics he gives a strong sense of a mechanical regularity in their working when he notes that:

all shift in the shifting seasons, which are April and September, at one and the same time and to their opposite points... these shifting winds in the East Indies are called monsoons; one is called the East-Monsoon, the other the West-Monsoon.\textsuperscript{87}

Addressing differences between the winds north and south of the equator Dampier discerned some variability from year to year, albeit very limited and somewhat predictable variability when he tells us 'though these winds do not shift exactly at one Time in all Years; yet September and April are always accounted the turning months and do commonly participate of both sorts of winds'.\textsuperscript{88} But this slight sense of variability was not further developed in Dampier's conceptualisation of tropical seasons and climate. Seasons happen because of a twice yearly flipping between two poles of a wet/dry dichotomy. This sense of the two tropical seasons is curious, given his awareness that two months of the year comprise weather of both seasons. If one period is wet and another dry, it hardly makes sense that a defined period in which both occur does not constitute another season. This lack would only make sense if, say, all wet days, with wind blowing from one direction occur consecutively, in one block, and all dry days with winds blowing from the opposite direction follow in another block of consecutive days. Such a scenario is highly improbable in one year, let alone over decades of Aprils and Septembers. The framework for seasons Dampier advanced does not account for his own observations of two annual periods where both wet and dry prevail. However, far from subverting this dualistic template of tropical climate Dampier's admittedly impressive work strengthened it. Read by some seamen and verbally transmitted to many others, this idea about tropical weather and climate had already become powerful by the early eighteenth century. Not only was it promulgated by authoritative investigators, it had been worked out through empirical inquiry and seemed to account for the most striking weather phenomena of the tropics, at least for voyaging Europeans.

Without discussing monsoons George Hadley buttressed their explanatory undergirding. Hadley gave trade winds and by implication monsoons a convincing theoretical underpinning that accounted for the flows of air in the three dimensions of the atmosphere. He also linked tropical air circulation with fluxes and pulses over.

\textsuperscript{86} Ibid., 230.
\textsuperscript{87} Ibid, pp246 - 247
\textsuperscript{88} Ibid., p247.
the rest of the great aerial ocean. In his work of 1735, Concerning the Cause of the General Trade Winds, George Hadley sketched the influence of sun on air. The sun generates winds by:

Causing a greater rarefaction of the air in those parts upon which its Rays falling perpendicularly, or nearly so, produce a greater degree of heat there than in other places; by which means the Air there becoming specifically lighter than the rest round about, the cooler air will by its greater air by its greater density and Gravity, remove it out of its place to succeed into it its self, and make it rise upwards.89

Where Halley tried to explain atmospheric dynamics in two dimensions, Hadley's account was cognisant of the behaviour of heated air and the vertical dimension of the atmosphere. Hadley averred that this heated air rose and at high altitude flowed away from the equator. When sufficiently cooled and dense it descended to the surface in the temperate zones.90 In providing the basis for present day models of atmospheric circulation Hadley also explained the trade winds and their particular directionality in each hemisphere. The replacement of rising heated air with cooler air accounts for a general motion from north to south in the northern hemisphere and from south to north in southern latitudes. The easterly component of both flows comes from surface of the earth moving fastest at the equator with Earth's rotation resulting in any air moving towards the equator being effectively deflected to the west: hence NE trades in northern tropics and SE trades in the tropical south.91 With monsoons as a different aspect of these solar driven kinetics of thermal equilibrium they, along with trade winds, were better explained as a regular, periodic seasonal phenomenon. By 1735 the understanding of tropical weather and climate in terms of alternating seasons of wet and dry brought by opposing monsoons over the Indian Ocean and tropical Western Pacific, and as periodically varying trade winds over the western Atlantic, had attained sound and convincing theoretical foundations.

Burgeoning trade and a profusion of data brought a plethora of navigation manuals during the ensuing century. Similar in many ways to classical sailors' guides such as Periplus, the directories of the eighteenth and nineteenth centuries were almost encyclopaedic in their scope. Ostensibly outlining directions for sailing

90 Ibid., p61.
91 Ibid., pp59-60.
from European ports through to India, China and Indonesia they also offered
detailed descriptions of ports *en route*, local cultures and the natural world. Coming
at a time when trade, transport and communication were largely determined by
both the flow of currents in the aqueous ocean as well as the fluxes in the aerial
ocean, tides, ocean currents, weather and climate featured prominently in nautical
directories. Self-consciously modelled on the 10 volume *La Neptune Oriental*,
published between 1745 and 1775, *A New Directory for the East Indies*, includes a
very detailed rendering of trade winds and monsoons throughout the tropics over
some 40 pages.92 Part of a composite of pieces that constitute the whole work, this
examination of trade winds and monsoons was first composed by an author or
authors known as Philo-Nauticus in 1774 for the second edition of *A New Directory*.93
This was an arresting work that outlined monsoon and trade wind dynamics in
different parts of the Indian Ocean and ‘China Seas’. It extensively quoted from
Halley’s *An Historical Account* to both describe and explain trade winds and
monsoons.94 Through the numerous editions of *A New Directory* Halley’s template
for tropical climate was disseminated widely among seamen a century or so after it
first appeared. In addition to transmitting Halley’s understanding, this opus made
important distinctions between monsoons and sea breezes and sketched important
local manifestations of monsoons in various locations on the littoral of the Arabian
Sea, west India and Malacca Straits. It is also one of the earlier works in English to
correctly link the simultaneous workings of the dry SE monsoon or trade winds south
of the equator and the wet SW monsoon in northern tropical latitudes.95 Despite its
adherence to the thinking of Halley this piece indicated inherent variability in the
timing and duration of seasons: ‘the changing of the monsoons is commonly
gradual, and some years happens nearer a month sooner than others’.96
 Nonetheless, this is not incorporated into the conceptualisation of tropical weather
and climate expounded by this work. The two seasons, wet and dry, are understood
to be regular and opposite, in accordance with earlier notions. This timeliness of
weather is reinforced in the piece’s discussion of various sailing passages at each
month of the year.97 Undoubtedly useful to merchants and sailors, the calendar
month is not a meteorological unit. Weather coincides with calendrical time and the
syntheses of actual events to create a picture of typical weather for a month

92 The full title of the 6th edition is *A New Directory for the East Indies: The Whole Being A work
Originally begun upon the Plan of the Oriental Neptune, Augmented and Improved by Will Herbert, Will
Nichelson and others and now Methodised, Corrected and further Enlarged by Samuel Dunn*. The two
‘others’ were Philo-Nauticus and Captain Thomas Neale. This edition was published in London, by
Gilbert and Wright in 1791. The ‘monsoon’ discussion appears pp27-67.
93 Ibid., pii.
94 Just two examples: Ibid., pp27-29 and pp35-36.
95 Ibid., p38.
96 Ibid.
97 For example pp 54-56.
structurally exaggerates a sense of regularity distorting any understanding of the natural world.

With later nautical guides the received understanding of tropical climate became more entrenched. Compiled by Captain Joseph Huddart and first published in 1794 *The Oriental Navigator*, was based on journals and observations from numerous seamen, particularly from the EIC, on earlier voyages. Opening with an adumbration of how ‘solar’ movement causes thermal inequalities across the globe, which in turn animate trade winds and monsoons, this work reiterated the received notions of tropical climate and tropical seasons in the first five pages.\(^9\) Tropical weather and climates were portrayed as regular and binary. Monsoons, described as periodical winds, ‘which blow one half of the year from one quarter and the other half of the year from its opposite side’,\(^9\) were discussed with reference to calendar months throughout this guide. Again, while describing consistently distinct periods weatherwise around the changes of monsoon this work ignored this evident meteorological phenomenon in its understanding of seasons and climate.\(^10\) Weather was routinely categorised according to the month in which it occurred and discussed according to what is to be expected during each month. Recurrent precise phraseology throughout these directions strengthened this sense of regularity. Examples included: ‘the N. E. monsoon begins to be felt in the first days of November’;\(^10\) ‘The S. W. monsoon begins to blow on the coast of Africa to the North of The Equator in the first days of March’\(^10\) and ‘From Cochin to the south as far as Cape Comorin, this monsoon commences fifteen days sooner than at Bombay.’\(^10\) This directory gives a distinct impression of a clock-work climate unwinding in time. And it explicitly extends this dependable periodicity to the atmosphere embracing the Australian shores of the Arafura and Timor Seas.\(^10\) The earliest English language study of monsoons as a weather phenomenon, James Capper’s *Observations on the Winds and Monsoons*, appeared in 1801, barely two years before Flinders sailed along northern Australia.\(^10\) Capper reinforced the received understandings of tropical weather and climate. Despite its empirical and numerical basis this study was just as dismissive of indications that confounded the by then established understanding as other works. In a discussion about the monsoons in and around India Capper made the following claim:

\(^9\) Joseph Huddart, *The Oriental Navigator, or New Directions for sailing to and From the East Indies*, 2\(^{nd}\) ed., (London: Robert Laurie and James Whittle, 1797), pp1-5.
\(^10\) ibid., p3.
\(^10\) ibid., p5.
\(^10\) ibid., p93.
\(^10\) ibid., p125.
\(^10\) ibid.
\(^10\) ibid., p5.
The winds in the Gulf of Bengal are generally said to blow six months from the N.E. and the other six from the S.W. This is far from being precisely true respecting any part of India; it is, however sufficiently accurate for our present purpose.

With such undefended assertions the nuances of the Indian monsoons were alluded to but ignored. By default monsoons were represented as regular, a sense reinforced by the frequent use of calendar months to indicate particular stages in this putative monsoon/trade wind cycle.

Nothing changed with the last major English nautical guide before the ill-fated attempt to colonise northern Australia at Fort Dundas. In James Horsburgh’s *India Directory*, monsoons were the opposite of trade winds, they reversed every six months and this oscillation constituted the climate of tropical regions that do not enjoy perennial trade winds. With more information to exploit this opus provided a more sophisticated understanding of monsoons in the southern tropical Indian Ocean. It expounded that:

Although the monsoon in the open sea, seldom extends beyond latitude 8 or 10 degrees S, yet in the vicinity of the East Coast of Madagascar and the N.W. coast of New Holland, that monsoon extends several degrees farther to the southward, by the land being greatly heated when the sun is near the southern tropic.\(^\text{106}\)

Horsburgh imposed these workings on the Top End, along with the periodic mechanism underlying them, just like Halley and many during the two centuries between them.

**Climatic Imperialism**

Ideas about local weather and climate washed up on the shores of Australia’s north coast with the colonisers. Indeed the newcomers reinforced what had long been imposed on the area by people who lived half a world away. The notion of a climate comprising dyadic and regular cycles of wet and dry had long been a part of European knowledge of the general region. Studies such as P P King’s voyage, supplied more information about specific locations in northern Australia. As King was applying the received template about coastal tropical weather and climate this was really a case of putting flesh on a skeleton. Like many observers both before and after

\(^{106}\) James Horsburgh, *India Directory or Directions for sailing to and from the East Indies, China, New Holland, Cape of Good Hope, Brazil and the interjacent ports*, 3\(^{rd}\) ed., (London: Parbury, Allen and Co., 1826) p iii.
after, he seemed to be placing his observations within an established framework rather than evaluating these observations and developing a better concept. This framework was imbued with the forgotten naturalisations of time and season outlined in Chapter 1. Wittingly or not, the colonial invaders perpetuated it in their new environment.

Monsoons are real. This conceptual continuity is not just groupthink sprawling over several centuries. The wind shifts that accompany monsoons are real. Annual periods of wet and dry are also real. The transmission of this idea of monsoon and tropical climate accorded with the most obvious observations and experiences. Experience seemingly confirmed the theory for so many seamen, usually elsewhere in the tropics, over centuries. Moreover, Cartesian Dualism has been an influential epistemology in modern western thinking. It is scarcely surprising that this idea of monsoons and tropical seasons has had such longevity. But many elements make weather and climate — many more than comprise this understanding of tropical climate. Wet can encompass humidity: in the Australian tropics humidity occurs during the ‘dry’ as well. Rain can fall in many ways: thunderstorms, showers, long periods of rain etc. Is there not some justification for multiple annual wet seasons where certain kinds of rain predominate and fall in distinct patterns during clearly defined periods of time? But the simple notion of Wet and Dry, even conceptually, misses much of what happens in the tropical troposphere. As meteorological and climatological concepts, along with that of the monsoon, Wet and Dry are inadequate, failing to capture the many dimensions of what they aim to elucidate.

Monsoons are not quite what we think they are. Although long understood as terms relating to weather and climate, ideas of monsoon and ‘wet’ and ‘dry’ seasons did not come from thorough and disinterested study of the atmosphere. Knowledge of monsoons and the seasons accompanying them came with efforts to identify the fastest and safest routes for seaborne trade. With maritime transport powered by sails, winds were the major preoccupation; rains and storms became more important when seamen ventured to wetter climates. Important but more complex and nuanced weather phenomena were disregarded as irrelevant. Tied to trade and commerce, events such as change of monsoons and tropical seasons were explicitly and repeatedly related to calendrical time rather than constellations of events in nature. This makes sense: merchants needed to know when goods and staff would be arriving and leaving. Calendars had long been developed by the time Arabian sea trade was established. People lived to time. With the advent of nautical directories and indeed almanacs, this relating of weather to defined periods of calendrical time, particularly months, became more widely disseminated, giving an
exaggerated sense of climatic regularity to increasing numbers of sailors and traders. This was true during the time of the ‘classical’ monsoon and became true of the ‘modern’ monsoon that was constructed through copious observations with European expansion. In modernity these observations were chiefly of winds and were still taken with the same concerns of trade and timing in mind. With industrial land use a vital part of trade in the latter period, rain was tailored for this template.

While it seems unremarkable that Halley’s seminal work should have linked atmospheric events to calendrical time, we can see that this came from a particular conjoining of contingencies. First the pervasive sense in western thinking of time as a basic, fundamental and ahistorical unit, in evidence through the multitude of navigational guides examined. Second, the creation of scientific knowledge to further economic ends. Bound by such a thought horizon it is unsurprising that weather came to be so consistently and frequently associated with an utterly non-meteorological unit such as the calendar month. Of course, calendars are vital to mark the occurrence and duration of events, including weather. However, this particular association of intrinsically unrelated concepts and phenomena distances us from what we try to understand, used as uncritically as it has been. Halley’s work is remarkable for offering the first comprehensive outline theory of climate, throughout the global tropics, distinguishing tropical climates determined by trade winds, such as that of the Caribbean, from those shaped by monsoons – India and Northern Australia. In providing a convincing explanation of the changes of monsoons, and, indeed, trade winds, linked to the apparent and periodic movement of the sun, Halley also offered powerful proof that these changes are regular and hence tropical climates largely clock-like in their precision and predictability. With this theory never being challenged and observation often seeming to affirm this sense of regularity it is unsurprising that this understanding of monsoons, seasons and tropical climate has prevailed. This apparent match of observation and mechanism might also account for the striking tendency of so many observers, such as Huddart in his directory and Captain Campbell at Fort Dundas, to so casually ignore variation and not see it as even possibly indicating an extra dimension of weather and climate: variability.

When the Moonta dropped anchor in Darwin Harbour its crew expected a predictable monsoonal climate. Variation occurred; variability was inconceivable. While no Europeans had lived there long enough to discern the climate from systematic observation many authorities had long reiterated and transmitted the
by then long established understanding of the region's weather and climate. This conceptualisation was seemingly irrefutable orthodoxy about tropical nature. Determining the match between European understandings of all tropical climates and particularly the sense of regularity inherent in them is beyond the ken of this study. Curiosity and perhaps habit saw the colonists at Darwin establish a weather station there within a month or so of landing. Accordingly, the resulting rich and reliable data set of rainfall measurements stretching from March 1869 onwards enables us to examine the fit between the imported and imposed notion of the weather and climate on the one hand and the region's actual rainfall history. Chapter Four compares the concept and its periodicity with two aspects of rainfall variability: variability in quantity and variability in timing/duration of rainfall events. The results are intriguing. Chapter Three before it establishes the reliability of the records that undergird this fascinating story.
‘The Elements’
CHAPTER THREE

NUMBERS AND STORIES

Weather happens in time but disregards calendars. Yet western ideas of weather, season and climate are deeply temporal. In Chapter 1 we saw that conceptualisations of season are linked to regular astronomical events: the solstices and equinoxes, and hence calendrical time. The forgotten cultural dimensions of seasons and calendars were also elucidated. The transformations in how nature was seen and understood between the classical era, the Renaissance and modernity did not extend to the relationship between season, and by implication weather, on the one hand and time on the other. In modern western thought seasons happen at particular and predictable times. They happen with dependable regularity. They and their accompanying weather patterns are part of a clockwork climate working to a celestial schedule – according to modern, western thinking.

Developed in temperate climates this tick-tock temporality was also imposed on the tropics. Chapter 2 traced the history of tropical seasons and the idea of the monsoon, showing that while tropical seasons differed from temperate ones and were understood to do so, they have been seen in western thought as occurring with the same precise timing as seasons in the temperate zone. Like temperate seasons tropical seasons emerge, ensue and dissipate in a reliable annual cycle. By the late nineteenth century western scientists and mariners had identified a variety of tropical climates: the three Indian seasons of cold, hot and wet and, before the emergence of the idea of the build up during the mid-twentieth century, the two annual seasons of the wet and dry of Australia’s Top End, among others. In these understandings tropical climates also are rhythmic. Such similarity between the tropical and the temperate is a remarkable departure from predominant nineteenth century western thought about the tropics and tropicality. In contrast to healthy temperate Europe and North America the tropics and their climates were seen as teeming, miasmatic and dangerous: temperate Europe’s foil, its ‘Other’. Yet for all of its otherness, its weather and climate were still ordered by the same regular temporality. Indeed, in Darwin, J A G Little, Postmaster and Superintendent of Telegraphs, who for over 30 years diligently recorded Darwin’s weather and organised the collection and collation of weather data across the Northern

Territory through most of the period before the establishment of the Commonwealth Bureau of Meteorology in 1907, made a virtue of Darwin's clockwork climate. His account first published in 1880, then in numerous Northern Territory almanacs, and, most significantly, included in Griffith Taylor's seminal opus *The Australian Environment*, tells of weather even more rhythmic and reliable than that in temperate climes:

The different changes of these seasons are so uniform and regular that they may be predicted almost to a day. Signs of the approach of the wet season appear immediately after the sun has crossed the equator during the spring equinox...thunder-clouds gather over the land, increasing in size and density day by day until they burst into terrific thunderstorms accompanied by hurricane squalls of wind and rain, these squalls, at first, take place every four or five days, gradually increasing in numbers until the end of November when they occur almost daily...During December the N.W. monsoon gradually gains the ascendency and blows steadily, with an occasional break of calm weather...the N.W. monsoon is accompanied by rain almost daily and increases in force until the latter end of January or the beginning of February, when it is blowing in full heart, and penetrates with its copious and fertilising showers into the very centre of Australia...on the approach of the autumn equinox the N. W. monsoon gradually dies away, and is succeeded by the calms, variable winds, thunderstorms and oppressive weather until about the end of April, when cooler weather is felt; the S.E. monsoon sets in and the dry season may be said to have fairly commenced.

Plaudits are due for the vivid imagery Little evokes and his acute observations. The full 500-plus words of the narrative includes arresting references of low 'banks of nimbus' scudding rapidly across the sky, and other word pictures excluded here for the sake of brevity. This is a piece stemming from deeply engaged attentiveness. Moreover, it does portray the interplay of elements in the great aerial ocean enveloping Australia's Top End with some fidelity. In this region clouds frequently billow over the hinterland before storms develop, engulf and either dissipate or move out to sea. Most of the time thunderstorms do precede the sheets of rain that almost always come with the wet. Almost always, there is an interlude of thunderstorm activity between periods of unrelenting rain.

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3 J. A. G. Little, 1902, quoted in Griffith Taylor, *The Australian Environment (Especially as Controlled by Rainfall)*, (Melbourne: Government Printer, 1918), p 70.
and 'the dry'. There is an order among elements and weather events, at times even something of a progression.

However, J A G Little imposed an artificial linearity and regularity on atmospheric events. 'Uniform' seasons predictable to a day; storms increasing in size and intensity 'day by day'; late in the calendar year, rain squalls increasing in frequency over a period of three months in direct relationship to the progression of days – all notions that ring with an extraordinary sense of order, an order that certainly made sense at the time. Griffith Taylor did not dispute it; rather he used Little's narrative to portray the region's weather and climate. Despite the fact that he had already shown that in terms of rainfall volume, the Top End was more variable than temperate Tasmania, southern Victoria and the south west of Western Australia – in conflict with much then contemporary thinking about rainfall being more reliable in the tropics than in drought-prone temperate locales, Griffith Taylor did not quarrel with the idea of temporal regularity. This sense of cyclical, rhythmic weather events pervades stories told about weather and climate in the Top End, as Chapter 7 demonstrates. They reinforce the portmanteau conceptual repertoire – to extend Alfred Crosby's metaphor – the ideas of local weather and climate imported by European newcomers to the north; ideas that are reflected in official weather statistics but might not reflect reality.

The remainder of this chapter is a history of official weather reporting in Australia's Top End. Its concern is how data was gathered, authenticated, organised and disseminated. It is about official and scientific attempts to understand weather and climate.

Formatting

Stories of weather routinely featured in ships' logs and explorers' journals from the early seventeenth century. Predominantly, these were organised by the calendar month. With the bourgeoning of seaborne trade between Europe, Asia and the Americas came marked interest in understanding the workings of the atmosphere, especially over oceans. Understanding weather afforded economic advantages. Understanding weather demanded detailed observation and recording of atmospheric phenomena and such observation called for agreed methods of observation and ways of codifying the results. With the 1666

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5 Crosby introduces the idea of the portmanteau biota: the concept of Europeans carrying European organisms to North America and Australasia as they travelled, in his *Ecological Imperialism*, (Cambridge: Cambridge University Press, 2nd ed, 2004), p90.
publication of *Directions for Sea-men, Bound for Far Voyages*, the Royal Society set a template for observing and recording the skies.\(^6\) Nautical almanacs advising on maritime meteorology had already been published, such as Tim Gadbury's *Mariners' Almanack for the Year of our Lord God 1661*. They canvassed issues such as instrumentation, catalogued instruments and provided directions for their use. But it was *Directions* and Hooke's *Method* that set standards for observations and recording data.

Quoted in detail in Chapter 2, the Royal Society's directions evince a desire to measure the world and its phenomena. Exact positions must be taken — by measurements of latitude and longitude; weather events must be timed, winds identified by compass point. This instruction manual marks the inauguration of reporting weather in numbers. With consensus on standards for measuring temperature still half a century into the future and dispute about measuring rain volumes to ensue for much longer, metrics concentrated on times, durations and geographical locations. Nevertheless, the ambition to create order through measurement shines out.

Following the publication of *Directions*, ships' logs commonly featured tables with all of these phenomena measured. When agreement on how to measure other phenomena (such as temperature) emerged, or the meaning of other measurements such as barometric pressure came to be understood, these numbers became routine inclusions. After Luke Howard published his Linnean cloud classification system in 1803,\(^7\) logs and journals supplemented numbers with brief narratives of visual observations of the sky using the concepts, language and codes of Howard's system. Just as anatomists dissected bodies and classified species so mariners and early modern meteorologists sliced the skies into fragmented phenomena: measuring some; watching and classifying others.

Even before the litany of abortive attempts to colonise Australia's north coast, the format of telling stories about weather had been established. Certain things were measured, recorded and reported; others were ignored. Winds, temperature, rainfall and the movements of the sky mattered; colours in the sky and changes in its appearance outside the cloud classification system did not. All was reported in table form, with rows and columns. Colonial officials on land, motivated by Hippocratic understandings of health showed similar interest in

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weather and replicated this formatting. Indeed the first reports on weather from a static point on land on the north coast come from the first attempted settlement. Understanding the region’s weather and climate was not a stated reason for its colonisation; but stories of weather are a notable feature of this enterprise.

In the aftermath of the Napoleonic wars Britain was compelled to relinquish Dutch possessions it had earlier seized. Consequently British mariners and merchants had to negotiate access to Dutch East Indies ports. Desirous of expanding trade in this region, British traders would lose profits to Dutch taxes unless they could establish their own ports. Coming at a time of rumour-fed British anxiety over its tenure of the Australian continent a push by traders gave British authorities a further spur to establish a port on Australia’s north coast. British merchants and officials such as George Windsor Earl imagined a multiracial trading emporium along these shores entwined with the seaborne trade networks of southern and eastern Asia, even after a number of settlements had failed. Galvanised by his experience as commissioner for lands at Port Essington and certain of the potential of the far north Earl wrote his 1846 work Enterprise in Tropical Australia, to persuade others of its viability. North Australia was repeatedly colonised with a sense of its natural connectedness to Asia firmly in mind. The sea was a conduit, not a barrier; links with places north as prized as connections with the south of the Australian continent. An Australia integrated with Asia is an old idea in the north, even in post invasion history.

Means to Understanding

Weather was taken seriously at Fort Dundas. It bears repeating that the oldest land measurements and reports of weather along Australia’s north coast come from here and the efforts of Major Campbell, commandant of the fledgling colony from 1826 to 1828. During his tenure Campbell undertook detailed surveys of the physical environment of both Bathurst and Melville Islands, making keen and detailed observations of plant and animal life, geology, soils, seas and the weather. His efforts bequeath the first table of weather observations and measurements taken in tropical Australia, published in his Geographical Memoir.8 In Campbell’s narrative this table concludes a lengthy discussion of weather he had observed, incidence of disease, and the challenges of the climate to maintaining health in the settlement. Melville Island, Campbell declares, is ‘more of the

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character of an unhealthy than a healthy climate'. 9 Campbell’s delineation of the locale’s succession of seasons is nuanced and precise and we learn from it that in late 1827 and early 1828 there was no ‘regular monsoon’ or wet season on Melville Island or in the Timor Sea. 10 This narrative also includes the same information enumerated in this table (see Figure 1.) of mean temperatures.

**Memoir of Melville Island and Port Essington.**

<table>
<thead>
<tr>
<th>Month</th>
<th>Thermometer</th>
<th>Average State of the Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>75 63 57 68 82 79</td>
<td>Cloudy, with squalls and rain, fine in the afternoon, clear and dry from the 10th to 15th.</td>
</tr>
<tr>
<td>May</td>
<td>75 60 67 77 80 79</td>
<td>Glassy weather, with light easterly and southerly winds.</td>
</tr>
<tr>
<td>June</td>
<td>65 78 84 74 78 78</td>
<td>Clear weather, with easterly winds and strong inversion in the afternoon.</td>
</tr>
<tr>
<td>July</td>
<td>65 70 82 89 87 87</td>
<td>Pleasant cloudy weather, with variable winds.</td>
</tr>
<tr>
<td>August</td>
<td>66 70 85 74 78 78</td>
<td>Pleasant cloudy weather, with variable winds.</td>
</tr>
<tr>
<td>September</td>
<td>70 77 80 76 77 77</td>
<td>Pleasant cloudy weather, with variable winds.</td>
</tr>
<tr>
<td>October</td>
<td>75 80 80 90 92 79</td>
<td>Cloudy and rainy weather, with variable winds and thunder.</td>
</tr>
<tr>
<td>November</td>
<td>75 82 82 84 82 83</td>
<td>Cloudy weather, with squalls and rain from S.E. to W.W.</td>
</tr>
<tr>
<td>December</td>
<td>83 84 89 83 83 83</td>
<td>Cloudy, with squalls and showers from S.E. to W.W.</td>
</tr>
<tr>
<td>January</td>
<td>80 87 82 83 83 84</td>
<td>Cloudy, with heavy rain, thunder, and squalls.</td>
</tr>
<tr>
<td>February</td>
<td>79 82 88 83 83 84</td>
<td>Squaly, with heavy rain, thunder, and squalls.</td>
</tr>
<tr>
<td>March</td>
<td>78 82 80 80 80 80</td>
<td>Cloudy, calm, scurry, with rain in the afternoon and wind from the N.W. and S.W.</td>
</tr>
</tbody>
</table>

Table 1 ‘Meteorological Table’ from Major Campbell’s *Memoir*

A number of things about the table warrant attention. The implicit volume of daily observations, even if more reflective of aspiration rather than practice, shows a determination to understand weather through measuring it. The numbers appear not to be approximations, suggesting precision. The short descriptions of the weather, while too general and idealised, nonetheless capture something of weather experienced that is not reflected by numbers. Division of the year into 'dry' and 'wet' seasons reinforces prevailing understandings of the local climate. However, in starting the year at a putative turn of season, rather than the start of the calendar year, somewhat uncouples the weather and climate from calendrical time. On the other hand, arranging data according to calendar months solidifies this link.

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9 Ibid., 151.
10 Ibid., 152.
Most significant, but perhaps less striking, is the use of mean or average temperatures. These are the figures Campbell has calculated and tabulated as indicative of local conditions. Earlier in the nineteenth century Adolphe Quetelet, Belgian astronomer royal, had identified a law of errors for observational astronomy and other sciences of measurement. He had discovered that the distribution of measurement errors in a large set of astronomical observations formed what had not long before been identified as the Gaussian distribution, a consistent pattern produced in the graphical plotting of the values of large number of raw measurements – what we now know as a normal curve. Abraham de Moivre had already conceptualised the symmetrical structure of the normal or bell curve in 1730. He also discovered the concept of standard deviation. In a conceptual leap Quetelet argued that in a distribution of measurements of multiple observations there is a regression toward the mean: where individual readings contain error; the mean, provided sufficient measurements, reflects reality. With enough observations the error inherent in any individual measurements is cancelled out. From this an epistemology of physical phenomena emerged in which deviations from a mean were seen as indicative of causal deviations from a ‘normal’ circumstance – identified by the mean. Throughout Taming of Chance Ian Hacking shows that this concept became a template for understanding all measurable phenomena for much of the nineteenth and most of the twentieth centuries: means, also conceived as norms, were considered to indicate reality in both natural and social sciences. With a large batch of measured phenomena true values are reflected in the mean. Historian of science Lorraine Daston concurs. Her history of probability demonstrates that aggregates and averages for almost anything that could be quantified were calculated as part of a mathematical rationality that saw knowledge of natural and social phenomena as a matter of identifying regularities and norms. Applied to weather, this analytical method contends that averages – of temperature, rainfall volumes etc, indicate true climate and generate expectations.

Promulgated by other thinkers such as Condorcet and Laplace, the idea that the physical world was orderly, machine-like and predictable built on pervasive Newtonian thinking among natural philosophers in the early nineteenth century. To paraphrase Daston, this was a pervasive metaphysical conviction. Unlike in quantum physics, where statistical thinking flags the indeterminate; statistics

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13 Ian Hacking, op. cit., pp 105-106.
15 Ibid., p51.
were linked to notions of deterministic causes. The regularities statistics identified were understood as signs of a designed universe.\textsuperscript{16} Where fluctuations were identified patterns in these deviations were sought and identified. Such 'oscillations' around the normal 'equilibrium state' were conceived as regular, periodic and cyclical.\textsuperscript{17} Weather cycles were a means of explaining seemingly regular variations. In 1880s and 1890s Europe geographer Eduard Bruckner argued that damp-cold and warm-dry periods alternated over a 35-year cycle. Clement Wragge in Queensland supported this. Charles Egeson in Sydney argued for a slight variation on the theme: a 33-year cycle.\textsuperscript{18} H C Russell, of Sydney Observatory, disputed 33 and 35-year cycles based on decades of weather records throughout NSW. Russell later advanced a regime based on 19-year cycles. While many farmers supported this notion it has not survived scientific scrutiny.\textsuperscript{19} Like all of these cycles it made intuitive sense and seemed to accord with proven celestial periodicities. However, each of these theories lacked a demonstrable cause. In any case regularities mattered not distribution and deviation.

A century later Australian Commonwealth Statistician G H Knibbs evinced this understanding. He was also certain that statistics reflected reality in his address to the AAAS meeting, in 1909.\textsuperscript{20} Western thinkers widely understood weather and climate as operating with mechanistic regularity and that statistics showed this. Accordingly, it is plausible that the skies were seen as yet another instrument that can malfunction. After all, that an abstraction such as an average was understood to unmask reality illumines crucial aspects of the relationship of western man to non-human nature at this time. Regardless of whether Major Campbell was among the many who read Quetelet's 1828 textbook on statistics and probability, mean measurements were the crucial analytical tool of Top End weather reports. As Chapters 4, 6 and 8 amply demonstrate, this was the case from Campbell's table through to the mid-twentieth century.

Mean temperature measurements certainly occupied the time and attention of officials at Port Essington. Acting Commandant John McArthur included a 'Table shewing (sic) the Mean Temperature of each Month of 1839, and the first Six Months of 1840' in a report to officials in Sydney, later tabled in the NSW Legislative Council, published as a NSW Parliamentary Paper and included in George Windsor

\begin{itemize}
  \item \textsuperscript{16} Ibid., p187.
  \item \textsuperscript{17} Ibid., p382.
  \item \textsuperscript{18} For more detail see David Day, \textit{The Weather Watchers}, (Melbourne: Melbourne University Publishing, 2007), pp17-19.
  \item \textsuperscript{19} Ibid.
\end{itemize}
Earl’s *Enterprise in Tropical Australia*. Unlike Campbell’s ‘Meteorological Table’, McArthur’s is not arranged according to understandings of local seasons. It is organised by the calendar, beginning January 1839. But the mean 6am and 2pm temperatures for each month are displayed, along with the average maximum and minimum temperatures and the mean daily temperature range for each month. McArthur took care to describe the location and circumstances of his instrument for anyone interested in scrutinising his methods, stating ‘the thermometer is situated in the house, about 40 feet above the level of the sea, midway between the harbour frontage and the bay which runs behind Minto Head’. McArthur’s efforts yield a glimpse of how temperatures and hence weather at Port Essington varied from month to month during this period. Deploying means, they seem likely to aspire to illuminate the reality of local climate. Throughout his tenure at Port Essington McArthur included mean temperature values in his reports back to Sydney. Sketching the weather of early 1845 to Colonial Secretary Edward Deas Thomson McArthur noted of January:

This month was wet and occasionally gloomy with fresh gales...on the 8th there were some appearances of an approaching hurricane from the south for two or three hours. Barometer fell 7100ths rather rapidly...however the wind suddenly subsided...much electricity throughout the month; temperature mean of max 91.78; temperature mean of min 80.94.

Of February:
In February much rain, gloomy and humid atmosphere; prevailing wind N.W. until 19th and then much to N.E.; temperature mean max 88.14; temperature mean minimum 79.06.

And of March:
Prevailing winds N.E., occasionally S.W. and N.W. , frequent and heavy showers ; temperature mean max 88.14; temperature of mean min 79.06.

Such narratives offer much about Port Essington’s weather. We learn about other elements – winds, rain, thunderstorms and showers and something about the nature of precipitation there. In February it appears more prolonged, in March more repeated, short-lived and discrete. However, while these pieces mention

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22 Ibid.
24 Ibid.
25 Ibid.
rain, they do not quantify it. Only temperature and barometric pressure were measured at Port Essington. Yet by this time rainfall quantities were routinely measured elsewhere in Australia. Sir George Kingston began daily rainfall records in Adelaide in 1839.26 Not colonised by South Australia until 1863, the Top End was still governed by NSW, which in 1840 operated 3 weather stations that officially registered rainfall volumes each day.27 Earlier NSW observatories of William Dawes, P P King and Sir Thomas MacDougall Brisbane were more focussed on astronomy; nevertheless they routinely measured temperatures but not rainfall.28 Quantities, however, are not always the story.

On November 25, 1839, wind and rain combined to destroy Victoria, the infant settlement at Port Essington. Writing to Governor Gipps, Captain McArthur described the hurricane as a ‘calamity that it hath pleased Almighty God to visit us with’.29 The summary of damages includes: the pier, ‘totally demolished’; boathouses and their boats, ‘swept away, nothing remaining’; an unroofed smithy; the church, ‘levelled with the exception of the tower basement’; seven cottages ‘blown down’, 14 unroofed; and ‘the wreck which the forest trees still present...bear silent and voluminous testimony to the desolation and terror accompanying this destructive visitation’.30

Both the Port Essington Cyclone and reports of it are examined in Chapter 5. Noteworthy here is that reporting featured details of wind sequences, relationship between these and barometric pressure and the timing of changes in wind direction.

In fact, this practice mirrors that of contemporaneous investigators of storms elsewhere. Just a decade earlier, in 1828, Heinrich Wilhelm Dove concluded that low-pressure systems operate according to a law of turning.31 Having observed the succession of winds and sequences of barometric pressure measurements Dove concluded that low pressure systems turn around a line of low pressure, produced by alternating currents of warm and cool air. His curiosity piqued after a severe storm hit New England in 1821, when he noticed alignments of toppled trees suggesting a circular storm, William Redfield used the same technique and came to

26 Sir Charles Todd, 'Meteorological Work in Australia: A Review', in Report of the Fifth Meeting of the Australasian Association for the Advancement of Science (AAAS) (Sydney: AAAS, 1893), p248.
27 Ibid., 246.
29 Captain McArthur to Governor Sir George Gipps, Sydney, 11/2/1840, in Letters from Port Essington, op. cit., p60.
30 Ibid., pp60-62.
a different conclusion. According to Monmonier, Redfield published additional papers on temperate low-pressure systems, as well as tornados and tropical hurricanes, and understood the sequences of wind direction and barometric pressure to indicate that these phenomena are rotary systems generated by a convergence of air from all directions on a low-pressure core. By the late 1830s the idea that hurricanes and low-pressure systems operated around a cell had gained reasonable acceptance among weather investigators. Yet, as this conceptualisation garnered greater acceptance, the dynamics of these systems came into greater dispute, not to be resolved until the emergence of Norway’s Bergen School in the 1910s and the publication of their studies in the 1920s. Nevertheless, it is noteworthy that mariners in Australia’s Top End practised the same techniques as serious weather investigators elsewhere. Thought to be isolated they were in fact part of networks of information and ideas about the natural world and particularly the atmosphere that circulated at the time. Published in sailors’ manuals this material was as likely transmitted through verbal instruction on the deck of a brig or sloop as at a desk.

The 1848 publication of Henry Piddington’s *Sailor’s Handbook for the Law of Storms* inaugurated the incorporation of such mapping of wind sequences into a broader raft of practices geared at understanding and predicting the weather. It also began the use of the term tropical cyclone for hurricanes in the southern Indian and Pacific oceans. In this manual sequences of winds are considered in conjunction with increases and decreases of atmospheric pressure and also wave patterns, the visage of the sky, local cloud formations and even the appearance of the stars. Piddington identifies scores of scenarios, across diverse oceanic locations and with especially drawn transparent cards provides methods enabling seafarers to identify the path of storms and patterns of winds based on particular signs. Based on Piddington’s experience, as well as that of other sailors and information from logbooks, this manual was regularly updated and nearly twenty versions were published. However, at about the same time as *Sailors Handbook* was rolling off the presses decisions to disband the settlement at Port Essington were finalised. The region had not been assailed by another cyclone, nor had it been beset by a tropical malady; the anticipated maritime activity, trade and commerce had simply not materialised.

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32 Ibid., p31.
33 Ibid., pp31-32.
34 Ibid., p34.
Top End weather during the 1850s has been consigned to oblivion. Apart from logs and reports from ships sailing across the Arafura and Timor seas and A C Gregory's expedition to the Victoria River, no records would have been taken or reports made. In the late 1850s John MacDouall Stuart's first expeditions took him much further south in the NT. Only on the sixth expedition did John MacDouall Stuart's party finally reach the north coast, at Chambers Bay on July 24, 1862. However, once the settlement at Port Essington was curtailed, the NSW government undertook no new initiatives in the far north. Despite a competing claim by Queensland, South Australia annexed the Northern Territory in 1863. From then interest in the far north bourgeoned and, after a few years, so did stories about the weather.

Networking

With South Australia's expansion, the Northern Territory came under the purview of Charles Todd and Adelaide Observatory. Having worked at the Royal Observatory in Greenwich and as assistant Astronomer at the Cambridge Observatory, Todd was appointed South Australia's Government Astronomer and Superintendent of Telegraphs in 1855. Elsewhere, the British Meteorological Office had only just been established as a governmental scientific institution the previous year. Nearly 20 years passed before the establishment of the India Meteorology Department under Henry Blandford, in 1875. By 1860 the observatory had been fully equipped with a complete suite of instruments and by then fourteen other weather stations had been established throughout southern South Australia. By 1863, when South Australia then included all of the Northern Territory, observations from these stations were published annually in South Australia's Parliamentary Papers. Rainfall observations were routinely posted on a public notice board at Adelaide Post and Telegraphs Office. South Australian officials were engaged with weather and measuring its phenomena. As perusal of the 1863 Parliamentary Paper *Meteorological Observations* indicates, records were assiduously taken and meticulously kept. Introducing the data Todd provides details about the instruments used: ‘barometers are all of Negretti and Zambra’s construction, having brass scales graduated to 0.03 inch.’ Indicating concern for precision Todd notes that each barometer was calibrated to the standards of the Royal Observatory Greenwich and furnishes a table of index errors for each instrument in

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37 Charles Todd, *South Australia, Meteorological Observations, Parliamentary Papers, South Australia*, No. 15, 1863, p3.
each location.\textsuperscript{38} Todd gives similar assurances of reliability and standardisation for other instruments.\textsuperscript{39}

From these instruments we learn about barometric pressure, temperature and rainfall. The stories are told in terms of means. Mean barometric pressure at 9am and 6pm for each calendar month for the year 1863 is reported. On the same table mean measurements for the previous seven years allow comparison and contextualising of results for 1863.\textsuperscript{40} But Todd also attempts to reconstruct atmospheric disturbances in real time by providing tables of simultaneous barometric readings with brief descriptions of local weather in Cape Otway, Melbourne, Sydney, Brisbane and Albany.\textsuperscript{41} Although hampered by a limited number of readings and large spatial gaps between measurements Todd is still able to identify the eastward passage of a low pressure cell from south of the Western Australian coast to the Tasman Sea from the 14/10 to 18/10 1863. With these readings an approximation of the location of the disturbance each day can also be made. Specific real time observations were used to chart the histories and passages of particular weather systems. From these early observers were able to learn of the general west to east trajectory of weather systems.

Yet measurable weather phenomena such as temperature and rainfall were reported in means, usually in blocks of calendar months, not specific readings at particular points in time. Todd himself best describes it: ‘The mean of the daily maximum and minimum readings have been adopted as the approximate mean temperature of the month and of the year.’\textsuperscript{42} Mean 9am and 6pm temperatures for Adelaide, Guichen Bay, Mount Gambier, Strathalbyn, Kapunda and Mt Barker also structure the story, along with a table of longer term monthly mean temperatures for Adelaide. Giving a sense of variation the highest and lowest ten temperature readings and the month in which each occurred is also provided. Wedged between more visible tables of means variation seems intended to be read as anomaly rather than pointing to any inherent variability in the climate. Rainfall readings are presented in tables of monthly totals, as well as longer term means – based on 26 years of measurements in the cases of Adelaide.\textsuperscript{43} Offering opportunities to read variation, the presentation of means, without discussion of their abstract nature, gives a sense of a stable climate against which aberrations occur at particular periods. If Ian Hacking’s contention that means were understood to reflect stable
physical reality\textsuperscript{44} is correct, stories about nature told within the framework of mean measurements are stories that do not admit the possibility of inherent variability in a natural system like weather. They are narratives with structures that exclude variability. Within this paradigm difference can only be read as deviation. Nevertheless, the idea that the mean of a set of measurements is the most reliable reflection of reality may plausibly explain such pervasive use of mean figures in weather reports from the Top End.

Weather and climate were compelling preoccupations of Top End colonists of the 1860s. Active South Australian involvement with the Top End produced various weather reports from the region during this decade, many weaved through published accounts of explorers' expeditions. With a site for the principal settlement yet to be determined, efforts to fulfil this demanded labours to understand the environment of the far north and these encompassed study of and attention to weather and climate. As has been shown in Chapter 2, the climate of particular locales was a major determinant in deciding one place for settlement over all others. To assess the climate and weather of potential settlement sites B T Finniss' party was given six thermometers and eight barometers to 'land' on the north coast.\textsuperscript{45} Finniss himself considered science crucial to his endeavours. Writing to Chief Secretary Arthur Blyth in September 1866, B T Finniss claimed that the northern colonial venture:

Can only be undertaken, with any assurance of success, by someone, who, like myself, has the necessary scientific qualifications, together with a knowledge of the nature of the country, and of the obstacles to be encountered in the shape of attacks by the aborigines (sic), climate, seasons.\textsuperscript{46}

The thermometers and barometers were certainly used. In a report to Henry Ayers, Chief Secretary of South Australia, enumerates monthly average temperatures at Escape Cliffs, near the mouth of the Adelaide River, for each month from September 1864 till February 1865.\textsuperscript{47} Being monthly means they obscure specific weather events. But, from the marked decrease in average temperatures for January and February compared with November, it is a reasonable inference that sun shone for far fewer hours during these months. The subsequent paragraph

\textsuperscript{44} Ian Hacking, op. cit.
\textsuperscript{45} Ibid., p.6.
\textsuperscript{46} B T Finniss to A Blyth, 'Northern Territory Correspondence, 29/9/1866, Parliamentary Papers, South Australia, No. 79, 1868, p.7.
\textsuperscript{47} B T Finniss to H Ayers, Northern Territory Correspondence, 15/4/1865, Parliamentary Papers, South Australia, No. 15, 1865, p.5.
reports average monthly barometric readings and the paragraph following makes the first mention of a rain-gauge and rainfall measurements. Taken in January and February 1865 and erroneously labelled ‘averages’ by Finniss, the figures provided are monthly rainfall totals and at 19.673 and 13 inches respectively for these months,\textsuperscript{48} they certainly indicate heavy rainfall coinciding with a period of lower temperatures. Appended to this report a table of the monthly means supplied in the body of Finniss’ report also details monthly mean temperatures at 9am and 3pm, the total number of days each month on which rain fell, the number of days each month when winds blew from the west at 9am and 3pm and finally, a column listing ‘the ratio of sickness, or number of cases on the sick list, to the greatest number that could have occurred.’\textsuperscript{49} The colonists were examining links between illness and particular weather elements – pressure, temperature, wind direction and rainfall. The focus on westerly winds may have been an attempt to identify the timing of the onset of the ‘western monsoon.’\textsuperscript{50} However, along this part of Australia’s north coast westerly winds are a product not only of a monsoon but also of convection driven sea-breezes. On particularly warm days without strong prevailing land winds it is not impossible for sea-breezes to have developed by 9am – reading the arrival of the monsoons through coastal wind data is very problematic.

Weather data was integral to a dispute about the site of settlement. It peppers Finniss’ report amid claims and counter claims from individuals such as Jefferson Stow, John Stuckey and Jacob Bauer as to the relative merits of Escape Cliffs and other north coast locations for the site of the colony.\textsuperscript{51} This debate spread beyond the pages of parliamentary papers. In 1865 Charles Todd read a paper to the Adelaide Philosophical Society based on meteorological observations taken by Jacob Bauer at Escape Cliffs, along the shores of Adam Bay, which, unfortunately, was never published.\textsuperscript{52} Between September 1865 and June 1866 John McKinlay undertook an expedition to find a better location for the settlement. McKinlay’s journal abounds with references to the weather. They generally occur on a daily basis. Sometimes these reports are pithy descriptions: ‘Monday January 15 – A very boisterous night, the rain pouring in torrents’\textsuperscript{53} and from February 15’s entry ‘Thunder and lightening(sic) and heavy rain from noon till evening and occasionally
during the night.\textsuperscript{54} On other occasions temperature measurements were included in these descriptions – ‘Nice cool morning, temperature 66 degrees.’\textsuperscript{55} On May 10 McKinlay observed ‘strong south east winds during the greater part of the night; beautifully cool, quite calm this morning; temperature 70 degrees.’\textsuperscript{56} These temperature readings were not means but were measurements at particular times – generally sunrise, but the timing was not standardised. Sometimes noon temperatures were given but McKinlay never calculates the averages of these readings. Although no rainfall measurements were taken, as discussed in Chapter 2, we also know from McKinlay’s journal that rain fell during the first half of May, against the party’s expectations. John McKinlay’s reports are corroborated by Acting Government Resident, J T Manton’s observations in his Journal, written at Escape Cliffs, some distance from McKinlay’s party, at the same time, suggesting the rainfall was fairly widespread across the north.\textsuperscript{57} Weatherwise May 1866 seems significant for bringing rain during the ‘dry’.

It was not the weather that ended the colony at Escape Cliffs. Deemed to be too difficult to access from the hinterland it was disbanded in 1867. Nevertheless salubrity of climate was still a consideration when George Goyder determined the site of the fifth and finally successful settlement in the north. When George Goyder chose the present site of Darwin for the settlement – an airy peninsular above a vast body of water on three sides – climate infused concerns about health, and elevation, which accompanied other considerations such as a safe harbour, water supply and access to the interior.\textsuperscript{58} When the Moonta dropped anchor at Port Darwin on February 5, 1869, the fifth, and what would become the successful attempt to found a centre of government and commerce on the north coast was poised to begin.\textsuperscript{59}

On March 6, 1869 rainfall totals were recorded at Darwin Post Office for the first time. They continued on a daily basis until the bombing of Darwin on 18/2/1942. Some gaps in this record occur: no records survive from July, August and September of 1870 and from the period between the end of July 1871 and January 1, 1872. Curiously, although there were thermometers in Darwin as early as 1869,\textsuperscript{60} no official temperature records from Darwin taken before 1885 are known to exist now.

\textsuperscript{54} Ibid., p5.
\textsuperscript{55} Ibid., p14.
\textsuperscript{56} Ibid., p15.
\textsuperscript{59} Ibid., p10.
\textsuperscript{60} Ibid., p19.
It is likely that they were taken but have been lost. In any case, despite abiding and growing preoccupations as to whether white men can labour in tropical heat and humidity, rainfall measurements were the major meteorological interest of newcomers to the north in the late nineteenth and early twentieth century. Stories about Top End weather in local newspapers, Almanacs and Official and Scientific reports were mainly reports about rain. No discussion about the shift of focus from temperature to rain occurs in official and scientific literature. It appears to have been understood. Perhaps the conceptualisation of local seasons in terms of rainfall: a dichotomy of regular periods of ‘wet’ and ‘dry’ can partly account for this understanding. Measuring rainfall is consistent with the logic of this framework. But, recording rain also ran with the conceptual grain of the period between 1826 and 1869, when temperatures were measured. Instead, the focus on rain volumes might reflect a belief that understanding rain was more important in determining the productive capacity of the land, which in turn was integral to conclusions about the viability of the colonial venture in the north. On the oceans wind is the element that really counts; on land to be transformed for agriculture, it is rain that matters.

Before the telegraph, news travelled with the weather. This, of course, included information about the weather. The establishment of Port Darwin preceded the arrival of he undersea cable from Timor, and ultimately London, by little under 3 years. It predated the coming of the overland telegraph from Adelaide by just over 3 and a half years. As the net of telegraphic wire was cast more widely across the far north, more weather stations were established and more reports from more locations were made. The first stations in the far north outside Darwin were established along the Overland telegraph line at Katherine and Daly Waters in 1873.61 Pine Creek followed in 1874 and then Victoria River Downs, more than 200 kilometres off the Overland Telegraph Line in 1885.62 Observations taken at these stations focused on rainfall. With the colonisation of the Top End taking in a larger area and the expansion of the telegraph network, meteorological stations were opened in Borroloola (1889), Roper River (1894), Brock’s Creek (1897) Bradshaw’s Run (1898) and more than a dozen other far north locations by 1920.63 Notably, stations were not established in east Arnhem Land until the 1930s and 1940s, leaving an enormous part of the north coast without any systematic study of weather and measurement of its elements for a large portion of Top End post invasion history. For a society dependant on the sea for many connections with the outside world and much of its commerce, there was surprisingly little interest in

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62 Ibid.
63 Ibid.
studying weather along the coast. Of the thirteen lighthouses established along
the NT coast by 1912, none then routinely supplied the weather bureau with
weather records. Only with the instituting of weather stations on Bathurst Island in
1913 and at Cape Don Lighthouse in 1917 did quality-controlled weather reporting
come from coastal locations besides Darwin.65

In an address to the Australasian Association for the Advancement of Science
(AAAS) in 1893 Charles Todd describes the nature and operations of the stations
supervised by Adelaide Observatory. Todd states ‘at the telegraph offices at Port
Darwin and Alice Springs, the observations are taken every three hours day and
night, at other stations at 9am, 3pm and 9pm’.66 Temperature and pressure, as
well as rainfall were measured. It is difficult to identify when this regime began.
Charles Todd told the 1881 Intercolonial Conference on Meteorology that Port
Darwin was among the stations in the colony of South Australia that took
observations every three hours.67 Surviving records from Port Darwin before 1882
show only daily rainfall totals. Observations may well have been at 3 hourly
intervals day and night before 1881 but it is not possible to tell from material
available now. Moreover, practices were not static over such a long period.
Nevertheless, Todd oversaw a diligent and disciplined operation. According to
Gentilli, Charles Todd himself trained officers to observe weather and read
instruments and started Australia’s first system of daily weather reports based on
information and observations sent from all points of the network to the central
observatory in Adelaide.68

Charles Todd certainly took weather seriously. He was a dynamic participant in
all three Intercolonial Conferences on Meteorology, ensuring that South Australia
and hence the Northern Territory were part of a broader network of weather
measurement and study aspiring to encompass continental Australia, its off-shore
islands and the islands of New Zealand. Convened to present issues relating to the
study and communication of weather for ‘the consideration of scientific men
nominated by the several Australian colonies’, the conferences made vital
resolutions. The first conference, in 1879, agreed to standardise instruments - the
use of ‘mercurial barometers of either the standard or board of trade form;
thermometers of Kew or approved patterns … rain gauges of 8 inches collecting

64 Department of Trade and Customs Minute Paper, 2/4/1912, A106 G1917/2171, NAA, Canberra.
65 Commonwealth Bureau of Meteorology op. cit.
67 Minutes of the Proceedings of the Intercolonial Meteorological Conference Held at Melbourne, on
68 Gentilli, op. cit., p70.
69 Minutes of the Intercolonial Meteorological Conference Held at Sydney on the 11th, 13th, 14th
diameter'—along with the same local hours of observation and the adoption of Beaufort's scale for winds.\textsuperscript{70} Ensuring standardised instrumentation the colonies made collective orders to overseas suppliers and the instruments were then distributed in Australia.\textsuperscript{71} The same conference also assented to a monthly exchange of graphs showing 'barometer, velocity and direction of wind, temperature, humidity, rainfall' and daily exchange of telegraphs comprising barometric readings, dry bulb temperatures, maximum and minimum temperatures, humidity, direction and velocity of wind, state of weather, rainfall, sea disturbance, with 'a synoptical report of weather generally'.\textsuperscript{72} Largely unpublished, this material circulated within the network of observatories, little of it still in existence. The spread of the telegraph enabled more information to be exchanged and collated. Before the telegraph weather maps could only be constructed from historical data. Telegraphic communication allowed recent enough information for the construction of synoptic charts in the present. The 1881 conference resolved unanimously to adopt the same isobaric system as that used in America and Europe, drawn on a map including Australia and New Zealand.\textsuperscript{73} Delegates concentrated on refining this system as well as on forecasting in the third and final Intercolonial Conference on Meteorology of 1888.\textsuperscript{74} To further ensure comparability of measurements they agreed to exchange instruments and assess what, if any, differences existed between them.\textsuperscript{75} The 1908 establishment of the Commonwealth Bureau of Meteorology guaranteed standardisation of instruments and observations across Australia. However, the diligence of the colonial weathermen likely ensured that both had largely been achieved decades earlier. As part of the South Australia colonial and, later, state meteorological network, the Top End enjoyed reliable and diligent measurement and reporting of its various weather elements, especially its rainfall, from the early days of its post invasion history. In the history of its weather, major governmental changes such as the Commonwealth takeover of the Northern Territory in 1911 and even the formation of the Commonwealth Bureau of Meteorology matter far less than might be reasonably expected, given that so many weather reports were generated by government initiatives. Within a decade of Darwin's establishment thousands of data had been produced.

\footnotesize{\textsuperscript{70} Ibid., p4. \\
\textsuperscript{71} Ibid. \\
\textsuperscript{72} Ibid., p7. \\
\textsuperscript{73} Minutes of Intercolonial Meteorological Conference, 1881, op. cit., p17. \\
\textsuperscript{74} Minutes of the Proceedings of the Intercolonial Meteorological Conference held at Melbourne, 1888 (Melbourne: Government Printer, 1888). \\
\textsuperscript{75} Ibid., p16.}
Reporting

With the establishment of the local newspaper in 1873 some of these measurements circulated widely. Weather reporting in the Northern Times and Gazette was remarkable – as is discussed in detail in Chapter 7. Issued weekly till its demise in 1932, the NT Times and Gazette reported weather in two ways: tables of numbers and or descriptive, literary narratives, usually a paragraph long, appearing amid long columns of bite-sized pieces of news and commentary. In the press weather was rain. Enumerations came from official observatory and later bureau records. These figures straddled various time scales: weeks, months, years and decades. Moreover, reports were absent during the ‘dry’, as opposed to when rain did not fall. Such patterns of reporting probably, if implicitly, reinforced received understandings of Top End weather and climate. For now it is important to be mindful that in their detail and sense of how physical phenomena are connected, they enabled people to read the weather. Yet, they also reinforced the imported understanding of what was normal.

Weather routinely featured in government reports. From 1870 the heads of government in the Northern Territory sent regular reports to their masters in South Australia before 1911 and Canberra afterwards. Outlining events over the recent period these reports were issued at least annually for most of the period and quarterly for much of the 1880s. Weather was often, but by no means always included. Weather reports were of varying degrees of thoroughness. But, they were always in numerical, tabulated form, like other enumerated phenomena featured in these reports like population, crime, illness, imports, exports and so forth. The briefest reports included a table of rainfall totals from Darwin and a number of other NT locations, often appearing under a heading such as ‘meteorological’ or ‘weather’. Sometimes weather was just rain in official reports; often it also included temperature. Temperatures were always reported as monthly means and in later years these accompanied detailed long term monthly rainfall readings at Darwin, which themselves were presented with mean values for each month. When rainfall totals were analysed statistically it was always by calculation of means. This also applied to the most detailed reports. J Langdon Parsons’ report of 31/3/1885 included highest and lowest readings for each calendar month. These were then categorised according to ‘wet’ or ‘dry’ season and the mean values computed and

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76 For example, C J Dashwood, ‘Government Residents Report on the Northern Territory For the Year 1898’, Parliamentary Papers, South Australia, No. 45, 1899.
tabulated. No calculations of variance or spread were included. Again, variation was deviation.

Occasionally tables accompanied textual reports. The first quarterly report of 1885 included a section ‘The Climate of the Northern Territory’, which included the data discussed above. J A G Little introduced the section, declaring the Territory’s two annual seasons as the ‘wet season from October 1st until March 31st and dry season from April 1st till September 30th’, which ‘almost coincide with the position of the sun in regard to the equator’. In the 1920 Administrator’s report the section entitled ‘Meteorology’ comprised a few introductory paragraphs about the climate of the Northern Territory. Curiously, like J A G Little’s description 35 years earlier, it did not distinguish between locales or regions on the basis of weather and climate. Almost all of the Territory is in the tropics, so it seems to have been assumed that it was similar, climatically, across all regions, different locations being no more than variations on a dominating theme. This despite the Commonwealth Bureau of Meteorology by then having divided Northern Territory locations into ‘Upper’ – north of about 18 degrees south and ‘Lower ‘ south of this line of latitude. The Acting Administrator’s introduction stated:

the wet months are from November to April with the maximum rainfall in January – corresponding with the moisture laden North-west monsoon, while the dry months from May to October indicate the period of the South-east Trade winds, whose moisture has been precipitated over the wide areas of Queensland before reaching the Territory...the monsoon dies away at the autumn equinox and is succeeded by light and variable winds until the end of April, when the dry season commences, with the South-east winds.

Although the putative timing of seasons had changed over the intervening 35 years the sense of their regularity had not. The north-west monsoon was still determined by the regular, astronomical phenomenon of the equinox. April rain is acknowledged but uncoupled from the NW monsoon. Following this introduction a large table presents mean annual rainfall for 27 Northern Territory locations. Once

79 Ibid., p7.
80 Commonwealth Bureau of Meteorology, Under the Direction of H A Hunt, Results of Rainfall Observations Made in South Australia and the Northern Territory, Including All Available Annual Rainfall Totals From 829 Stations for all Years of Record Up to 1917 (Melbourne: H J Green, 1918) PP309 -310.
again weather is rain and measurements are presented in averages. Nevertheless in showing that average annual falls along the coast are at least 5 times that of any centre below 19 degrees south, the table undermines the sense of climatic uniformity conveyed in the introduction.

Between 1885 and 1898 the *Northern Territory Times Almanac and Directory* was published. The 1893 edition exemplifies the general format and specific treatment of weather. Incorporated into the general introduction a narrative by J A G Little states 'the average rainfall is about 65 inches. The wet season extends from October to April and the dry one from May to September'.\(^{82}\) Again the sense of a clockwork climate is conveyed. Further into the volume, among tables of population and pastoral rent statistics appear tables of rainfall returns – arranged by month, with calculated monthly means. As the only almanac written and published in the Northern Territory these representations of Top End weather and climate likely shaped how people conceptualised the weather and climate of the region and transmitted the imported paradigm.

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Charles Todd continued to oversee the production of South Australia’s Meteorological reports until his retirement in 1906. Until then annual weather reports encompassing the whole of South Australia and the Northern Territory were published as parliamentary papers and many reports from the 1880s onwards were also circulated as stand alone volumes. By 1880 the report was 305 pages long. Reports from many more centres had appeared and more measurements of weather phenomena were taken. For most locations rainfall was the focus. Volumes appeared in tables and means were commonly calculated. Observations and means were largely arranged by calendar month and the focus was on each calendar year. With larger centres such as Adelaide and Port Darwin measurements of temperature and pressure were also included. As with rainfall, calculation of mean was the only form of statistical analysis.\(^{83}\) Todd continued this format until the cessation of these reports in 1906. This diligence has bequeathed just some of the wealth of data examined in Chapter 4.

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\(^{83}\) Charles Todd, ‘Meteorological Observations Made at the Adelaide Observatory’, *Parliamentary Papers, South Australia, No.31*, 1880.
CHAPTER 4

A HISTORY OF RAIN

In 1918 an enormous work encompassing all weather records included in the press and official reports was published. Dwarfing Todd's voluminous reports, the Commonwealth Bureau of Meteorology's *Results of Rainfall Observations made in South Australia and the Northern Territory...until 1917* offers the only published comprehensive collation of monthly rainfall totals for numerous Northern Territory centres over the whole period of systematic measurement. It is also the only published work to include detailed enumerations of incidences of phenomena such as rain days, thunder, lightning, dew and fog at Port Darwin. Like rainfall totals for the other 800 or so stations this information is presented in tables, arranged by calendar months and statistically analysed in terms of means. Like more general official reports, variation was presented in a form in which it could only be conceived as aberration, not a pointer to inherent variability. But, '*Results of Rainfall Observations*' elucidates more about actual weather in the Top End than any material published before 1950, when the bureau published an update. Indeed, even the 1950 volume does not include as lengthy tabulations of monthly rainfall returns for Top End Locations such as Pine Creek and Daly Waters, nor is its coverage of extra-rainfall weather phenomena in Darwin as extensive as the 1918 opus.

The volume of data for Darwin is staggering. Barometric readings for each month from January 1882 to December 1916 in columns of 'mean', 'highest' and 'lowest' arrange the data for each month and the 'mean' of means over the period is calculated for each month. Temperatures for each month for the same period are presented as 'mean maximum', 'mean minimum', 'mean temperature', highest temperature, lowest temperature, number of days over 90 degrees and over 100 degrees. Mean Wet and dry bulb temperatures and relative humidity at 9am, 3pm and 9pm for each month are tabulated, along with the means of these. Rainfall includes monthly totals from 1870, their means, total number of raindays each month and their mean over the period. Under the rubric of 'phenomena', the number of days on which thunder, lightning, dew and fog were recorded is enumerated for each month from January 1882 to December 1916 and the long term averages for each phenomenon and each month are also calculated and included.

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1 Commonwealth Bureau of Meteorology, under the Direction of H A Hunt, *Results of Rainfall Observations Made in South Australia and the Northern Territory, Including All Available Annual Rainfall Totals From 829 Stations for all Years of Record Up to 1917* (Melbourne: H J Green, 1918
2 Ibid., p413.
3 Ibid., pp414 – 415.
4 Ibid., p419.
Mean figures are the ones seen to make sense of this panoply of data. They order it, structure it and make meaning of it. Such a mass of data enables an empirical assessment of the way both local weather and climate are understood. With such a detailed history of weather events and a numerical analysis of them, we can examine how well the concept matches historical reality. In other words, such extensive records enable the testing of the question how regular is the climate of Australia's far north? Conceived in terms of alternating periods of wet and dry, assessing this issue requires focus on rainfall.

'Wet' means rainfall. Dew is common during the so called 'dry': before 1916 it was recorded on 15 or more days during the months of August 1882, May 1883, June 1883, August 1883, August 1884, July and August of 1890, August 1892, August 1894 & 1895, September 1896, July 1903, August 1903, July 1904, July 1908, June 1909, August 1909, May, June, July and August of 1910, June, July, August and September of 1911, July of 1912, August 1912, August 1913 and June 1916, with only a handful of occurrences during The Wet over the whole period. Although far less common than dew, fog in Darwin is a moist phenomenon that almost only happens during The Dry. Human tactile sense certainly feels humidity to be a wet phenomenon. Mean 3pm humidity readings for the months of May 1882, each May from 1888-1893, May 1900, May 1910, Mays from 1914–1916; June 1889, June 1915 and June 1916, July 1895, July 1915 and July 1916; August 1883, August of 1892, and August 1916; and many, perhaps most Septembers and Aprils during this period, indicate many periods of palpable atmospheric moisture during The Dry. Moisture in forms other than rain made many incursions into the so called 'dry' months in Darwin, in the 35 years before 1916. With the seasons defined by rainfall or its putative absence, it is necessary to examine how regular Darwin rainfalls were in this period.

Means are an abstraction then believed to reflect reality. They might not reflect particular happenings but they are integral to stories told about weather and climate. Means were what organised oceans of data into information that people could make sense of. Means tell stories about climate in numbers and provide a measure for determining the normality, or otherwise of particular weather events. For much of the far north they tell a story of orderly, regular rainfall increasing in a linear fashion until rainfall peaks are reached then decreasing in a

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5 Ibid., p.420.
6 Ibid.
7 Ibid., pp.416 - 417.
Darwin's mean monthly rainfall for the 46 years before 1916 is highest during the month of January (nearly 400 millimetres), declining each month until July, which has the lowest average monthly rainfall of just over 1 millimetre (mm). On average virtually no rain falls between June and September, but means increase slightly in August and September before rising sharply and progressively each month from October to January.\(^8\) Mean monthly rainfall totals for Pine Creek, Katherine and Victoria River Downs exhibit the same orderly, linear pattern.\(^9\) Averages for ‘wet’ season months are not as high as for Darwin, so the extremes are not as pronounced. However, presented as means of rainfall volume measurements, the rain over the Top End looks remarkably reliable. Information on numbers of days rain fell each month is only available for Darwin. Means show the same pattern as rainfall totals: a peak in January, a low in July and steady, sequential increases and decreases in between.\(^10\) Examined through the prism of means, rain in the Top End does appear to conform to an orderly cycle of regular, alternating periods of wet and dry. Numbers seem to support the concept. At least according to this particular way of measuring weather, organising data and analysing it. Moreover, these averages were the basis for other significant scientific studies of weather over the

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\(^8\) Ibid., p309.
\(^9\) Ibid., p309-310.
\(^10\) Ibid., p419.
Top End and across Australasia, as Chapters 6 and 8 also attest. These studies tell important stories about weather and climate.

**Writing Rain**

The Commonwealth Bureau of Meteorology did not just collate, tabulate and analyse data. Almost from the outset it published its *Bulletins*, detailed studies of weather and climatic phenomena relevant to Australasia. Mean measurements were the basis on which classifications were made and conclusions drawn. Published in 1908 *Bulletin* number 1 was also reprinted from the *Official Year Book of the Commonwealth of Australia* and reissued, twice, with updated figures, as *Bulletin* No. 9, in 1914, and as a revised edition of *Bulletin* No.1 in 1933. Accordingly, material in these would have been read as issuing from authoritative sources. Authored by Commonwealth Meteorologist H A Hunt, the first *Bulletin – Climate and Meteorology of Australia* was a comprehensive survey of both. Rainfall, rainfall distributions across space, time (calendar months of the year), evaporation, barometric pressure, wind, cyclones, storms and temperature were canvassed. With rainfall absolute highs and lows for many locations were tabulated. For the most part rainfall and temperature means were calculated and these figures were the foundation of further analysis and discussion. As chapter 8 discusses in detail, annual average quantities of rainfall (and other phenomena such as temperature) were also the basis for the prominent maps produced by the bureau and federal government and included in *Bulletins* and other important studies of the spatial distribution of annual rain across Australia. The Tables, graphs and discussion in *Bulletin* No. 4 were entirely based on mean rainfall figures. 

Griffith Taylor's *The Australian Environment* used means to examine rainfall volumes, the ‘march of the rain belt’, rain reliability and the timing and duration of wet seasons. W S Watt's *Australian Rainfall in District Averages* did the same. Introducing his paper Watt outlined how the timing of wet seasons was identified: calculation of the ‘geometric mean of the twelve monthly means. Months with means exceeding this critical value are included in the wet season’. Geometric mean emphasis central tendency not spread. Where conventional mean

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12 Ibid., pp41-44.
13 Ibid., p49.
16 Ibid., pp20 – 22.
is sum of values divided by the number of values, geometric mean is calculated by multiplying the values and taking the nth root of this product, n being the number of values. By this method the northern half of the Northern Territory calculated to have a wet season starting in October and ending in April. In reference to the Top End, each of the other cited studies also portrays the region's climate as regular, orderly and cyclical. In Tropical Control of Australian Rainfall, E T Quayle puts this another way: 'variability of the weather so pronounced in the south of the continent does not extend to the tropical belt'. Each of these scientific studies is telling stories with a conceptual repertoire unable to recognise variability in the weather, let alone the climate. By definition, concepts such as the geometric mean exclude the possibility of variability as a characteristic of a region's climate. Accordingly, they portray a misleadingly ordered atmosphere enveloping the Top End, just like the techniques used to analyse the panoply of data gathered by such diligent efforts at measuring the weather.

Means and Reality

Averages are not complete distortions of reality. Means certainly reflect some truths. January and February are always wetter in Darwin than July and August. Except in instances of brief localised rainfall, Daly Waters is rarely wetter than Darwin. Tables of monthly rainfall totals show February 1885, March 1910, September and October 1904, as well as November of 1880 and 1896 being among the few calendar months recording higher rainfall totals than Darwin during the period from January 1873 to December 1915. No annual total rainfall in Daly Waters during this period exceeded that of Darwin. Comparisons between Borroloola, close to the Gulf of Carpentaria Coast, and Darwin yield similar results. Darwin, with significantly higher rainfall means for all 'wet' months and almost identical means for most of The Dry, was wetter each month between January 1890 and December 1915 except, February 1891, October 1894, March 1899 and 1901, October 1904, January 1906 and March 1912. Often means capture realities as many people would experience and perceive them. The idea of 'wet' and 'dry' has not endured merely because they were considered to be reflected in numbers, which themselves were understood to indicate truths in the physical environment. The concept also resonated with experiences, seeming to be verified by authoritative statistics. Of course, such a pervasive concept as that of 'wet' and

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19 Results of Rainfall Observations, op. cit., p419.
20 Ibid., p309.
21 Ibid.
22 Ibid.
‘dry’ would have organised people’s memories, experiences and narratives of weather and climate in the Top End in complicated ways too. Later chapters will examine this matter. Weather, even just rainfall, however, has dimensions not captured in means and the then prevailing modes of telling stories about the weather.

Weather happens in time, but is registered on calendars. Calendar months have little to do with weather: rain falling at the end of March will not stop once it hits the temporal boundary of April 1. Yet, in the Top End, as throughout the world, weather measurements are organised in modern meteorological discourse according to calendrical time and calendar months. However problematic this nexus might be, it nonetheless enables us to look at rainfall, in different blocks of time in the past. With this examination it is clear just how much rainfall volumes across the Top End vary, even during the same calendar month, from year to year. These historical variations call into question the notion of regular, reliable and hence predictable rainfall there, undermining the notion of unvarying, ordered tropical weather maintained by E T Quayle and others.

**Slices of Time**

A ‘history of Januaries’ reveals something different. In Darwin during the 46 years of records from 1870, the January rainfall totals ranged from a low of 68mm, in 1906, to a maximum of 708mm, in 1896. Further highlighting the variability of rainfall during the month regarded as the height of the wet, between 1870 and 1916, January rainfall exceeded 500 mm 14 times, 600mm 7 times; and failed to reach 250mm, 10 times and 200mm 5 times. Volumes vary wildly even in the middle of the season. Figure 2, overleaf, illustrates these fluctuations. This is by no means confined to Darwin. In Katherine totals failed to reach 100mm 5 times during this period and surpassed 300mm on 12. During the wettest January -1904 -704mm fell; the driest, 1883, saw 70mm. January 1895 saw the highest rainfall volumes at Daly Waters, some 588mm. With just 15mm, January 1883 was the driest there. Between these extremes, quantities of more than 250mm fell during 9 Januaries, 14 times less than 100mm fell. Rainfall totals from Victoria River Downs, Borroloola and Pine Creek show significant fluctuations. Historically, not only has actual rainfall at the same time of year occurred with notable variation in volumes, the extent of

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23 All quantities converted from inches to millimetres.
24 Results of Rainfall Observations, op. cit., p309.
25 Ibid., p419.
26 Ibid., p309.
27 Ibid.
28 Ibid., pp309 -310.
these variations has differed from location to location. This is also true of other months.

![Darwin, January Rainfall](image)

Figure 2: January Rainfall, Darwin, 1870-1942

![Darwin, April Rainfall](image)

Figure 3: April Rainfall, Darwin, 1869-1941

April is designated either ‘wet’ or ‘dry’. A combination of both conforms more to the locale’s rainfall history during that month than the practice of defining it as either one or the other. This is clear from Figure 3 above. There is not an April during this period when no rain falls in Darwin. But there were 2 Aprils, 1897 and
1906, when under 2mm fell and 13 when less than 25mm (or 1 inch) fell. 29 9 Aprils saw over 200mm of rain fall. During the driest April, 1897, 1.3mm was recorded; during the wettest, 1891, 603mm registered. 30 Falls under 25mm could result from one intense shower or band of thunderstorms. Both the volumes and variations in April quantities in Darwin suggest that sometimes the wet is still drenching the skies some years while during other Aprils it has well and truly retreated. October and November in Darwin show a similar pattern of presence and absence. 31 Aprils in both Pine Creek and Katherine show a stark alternation of rain and dry. 5 Aprils in Pine Creek and 3, further inland at Katherine experienced over 100mm of rain between 1874 and 1916. 32 During 5 Aprils no rain fell at all during this period in Pine Creek. No rain fell during 7 Aprils in Katherine then. 33 Pine Creek's highest April total, 219mm fell in 1910, Katherine's, 175mm, in 1873. 34 Much further inland, Daly Waters saw 11 Aprils pass without rain and 22 with falls under 10mm. 35 Still, totals surpassed 75mm 6 times, with a record high of 112mm in 1911. 36 Eastward, near the gulf, at Borroloola there were 5 Aprils between 1889 and 1916 when rain failed to fall and 4 when rain volumes either approximated or exceeded 100mm. 37

![Darwin, October Rainfall](image)

Figure 4: October Rainfall, Darwin 1869-1941

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29 Ibid., p419.
30 Ibid.
31 Ibid.
32 Ibid., pp309 -10.
33 Ibid.
34 Ibid.
36 Ibid.
37 Ibid.
Rainfall histories similar to those of Darwin occurred across the Top End during the transition from ‘dry’ to ‘wet’. This is usually most evident in November rainfall totals from across the region. To a lesser extent it is also seen in October (see Figure 4 above) and December rainfall totals too.

In many ways April and October are more similar than each is to either The Dry or The Wet. Monthly figures suggest that sometimes they can be wet and sometimes dry. Some years both will be wet, in others both dry and some years one will be wet and the other dry. Both months can be wet and dry, adding to the permutations experienced at this time of year over a number of decades. While it is tempting to categorise these months as being of the same season the data suggest otherwise. Much of the remainder of this chapter shows that this is not viable when the timing of weather is taken into account. But the data also show that rain in April is different to that in October. Figures 5 and 6 (overleaf) illustrate this clearly. Rain in April is much less likely to be associated with thunderstorms than is the case in October. Between 1882 and 1915 the number of thunder days did not match, let alone exceed, rain days during one April. Most of the time rain days were much more numerous than thunder days. In contrast Octobers exhibit a different profile. During 22 of the 33 Octobers during this period the number of thunder days equalled or exceeded the number of rain days. Thunderstorms were more frequent than rain in October during this period, suggesting that they are more generally. Unlike in April there are many days in October where thunder is heard and lightning seen when rain does not fall. It is reasonable to claim therefore that there is no empirical reason to class either April or October as Dry or Wet and that they represent different seasons from each other.

But a month is a large block of time. The published data do not show what times during the month the rain fell and how long it lasted. High volumes of rain can fall on a small number of days. Low volumes can fall on a large number of days and many permutations can ensue within these extremes. There are many kinds of rain and rain events. In Jamaica, Thomas Thistlewood distinguished no fewer than 88 distinct categories of rain in his weather records stretching from 1750 to 1786.\(^{38}\)

Even with a month as consistently dry across the Top End as July, monthly totals elucidate little when rain does fall. As Figure 7, below, shows one wet July has a big influence on the overall means. The wettest July in Darwin was that of 1900 when 65mm fell. According to published data rain fell on three days that month.

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39 Results of Rainfall Observations, op. cit. p419.
40 Ibid.
However, it cannot be ascertained from this data if the rain was caused by one system that struck the region for three days, three individual atmospheric contingencies that brought rain on three separate days, something in between; or, given that June 1900 recorded two rain days, whether an event that began in June continued into July. The emphasis on quantities neglects the second vital dimension of a concept of regular weather and climate: that of the temporal. A climate can only be said to be regular if its elements happen to similar degrees with similar timing each calendar year. In a climate defined by the presence and absence of rain and region such as the Top End, with such a long history of dependable rainfall measurements, the temporal dimension can be examined by looking historically at when rain actually fell. These unpublished, daily records show that Top End rainfall timing, along with volumes has, historically, been starkly unreliable.

![Darwin, July Rainfall](image)

**Figure 7: July Rainfall, Darwin, 1869 - 1941**

Meteorology is just one way to grapple with the atmosphere. It was the way of scientists, officials and even journalists in Australia’s far north over the years of the late nineteenth and early twentieth centuries. During this time weather was studied and measured according to particular and contingent practices: readings were taken at particular times, with specific, standardised instruments; they were recorded in certain ways, analysed according to statistical techniques blind to variation and its possible causes. Nevertheless, these herculean endeavours yielded vital and useful information. But, official and scientific attempts to understand the ocean of air embracing the Top End failed to see that these
methods and practises took time for granted. Even in a clockwork climate, with
weather depicted as happening on schedule or as aberrant when it does not, time
and timing were ignored. Environmental history not only looks at the stories told
about nature, but also at events that happen in nature. A very effective technique
in addressing the issue the predictability and reliability of rainfall is to look at when
rain fell, how long it lasted and when rain did not fall along with durations and
timing of dry spells.

Weather records are made on a variety of time scales. Weather events happen
on a range of scales: showers can last seconds or hours, rain can fall for days or
weeks, storms last for hours and days; cyclones days and weeks. Droughts can
endure for years. For almost of the period following permanent colonisation of the
far north measurements were recorded at least every 6 hours at Darwin and Daly
Waters. Recently measurements have come to be taken every hour. Subsequently
this mass of data produced has been arranged into daily, monthly and annual
weather statistics. While these make more sense to human social life than the
nature of weather events themselves, weather itself offers no temporal standards
for determining timing and duration of specific events. Like other events, they can
only be linked in time to a society's way of marking time. Nonetheless, particular
scales are useful for answering particular questions. Monthly figures more than
adequately address matters of quantity and variation between locations. Records
on scales of hours help with questions relating to weather and times of day.
Typically organised by months, daily rainfall figures can help with questions of
seasonal timing. Just as weather crosses geographical borders so too does it cross
man made temporal boundaries such as months, so it is necessary to link daily
readings across large periods of time, taking them out of categories into which
they have been arranged. Unfortunately lengthy, unbroken daily rainfall records for
most Top End centres are not yet known to survive to the present day. But, they do
exist for Darwin. Moreover, meteorologists maintain that information from one
centre is sufficient for determining wet – season onset.41 Through historical
research – rainfall records from Darwin Airport during the wet season from 1952 to
1980– meteorologists Neville Nicholls, John McBride and J Omerod were able to
establish wide variations in the date of onset of the wet season: from September 6
to December 4 according to one criterion and from October 9 to December 16
according to another.42 Date of onset is very important and this study not only
suggests marked variation but also inherent variability in the climate, refuting

41 N Nicholls, J McBride and R J Omerod, 'On Predicting the Onset of the Australian Wet Seasons at
42 Ibid.
enduring, received conceptualisation of the region’s weather and climate. What happens, though, after the rain comes? How long does it last? Does it go and come back? History can help answer this.

Sequencing Rain: Timing, Duration, Absence

On the first day of official records it rained heavily in Darwin.43 Three days later, on March 9, 1869 it rained heavily again. Rain did not fall for another 9 days, after moderate rain on the 18th, it was dry until light falls on the 21st; a day without rain on the 22nd was followed by heavy rain on March 23, moderate rain on the 24th and after a dry 25th, rain fell each day through to April 3.44 Clearly it does not rain every day during the wet. During the following March, it rained on only 3 days, but heavily – with 50.8mm- on 11/3.45 After more than a month of completely dry weather rain returned on April 15, retreated for five days and then returned for another five. Following a dry period from 25/4, heavy rain fall on May 1 and after eight dry days, heavy rain fell again on 9/5, after which no rain fell for months.46 The wet does not ease off in a regular fashion. Both March and April of 1875 experienced the same number of days without rain. The last week of March passed without rain; the first week of April saw the highest weekly cumulative rainfall totals since February 6.47 Moderate falls of rain happened each day April 11 -13 and after a fortnight long dry patch on April 28. Then, it did not rain again until 12/10.48 There are numerous years where the sequence and frequency of dry and wet days through March and April are similar: 1883, 1896,1898,1905, 1907, 1910, 1919 and 1938.49 In other years March has experienced longer dry spells, fewer rain days and even less total rainfall than the following April: 1870, 1874, 1887, 1891 and 1911.50 Indeed the heaviest concentration of rain over the entire 1873 -1874 wet season happened between 2/4 and 7/4.51 For the remaining years, where there are fewer rain days in April, there is no consistent pattern of dry intervals between days of rain. In many years, such as 1872, 1876, 1877, 1878, 1885, 1892, 1912, 1913, 1921, 1931, 1932, 1933 and 1937 the differences are extreme, with rain most days in March and on very few in April.52 In some years the intervals of dry in May are similar too and occasionally shorter than those in April, washing away a sense of a fading wet. These years include, 1872, 1881, 1918, 1923,
1931 and 1936. Most Mays, however during this period recorded no rain. The same applies for the Dry months of June, July, and August and many Septembers are without rain.

Yet Darwin frequently does not experience five straight months without rain. During the 73 year span of records at Darwin Post Office a five month period without rain only happened 8 times: 1874, 1875, 1877, 1883, 1896, 1925, 1932 and 1934, the longest recorded sequence of days without rain being the period from 24/4/1896 to 15/11/1896. Records show that the intervals of dry periods have varied remarkably over the years. In some years, such as 1876, two significant falls of rain punctuate the dry: no rain falls from May 3 until June 13, then nothing until September 22 and nothing until rain becomes much more frequent on October 29. In 1879 rain on May 27 and 28 and again on October 3 interrupted what would otherwise have been a long dry period between April 19 and October 14.

Rain patterns in 1882 were very different again. After an April with patchy rain, falling on just 4 days, rain was frequent and sometimes heavy during May. No rain fell from 25/5 until 18/6, a short gap ensued until 30/6, it was then dry before raining again on 7/10 and then a longer period of dry till 9/10 was interrupted by moderate falls on 24/9 and 5/10. 1886 saw an even patchier dry: no rain 23/4 – 10/5, high rainfall May 10 and 11, no rain 12/5 – 18/6, rain June 19, dry 20/6 until 2/8, rain August 3 and 4, dry until August 18, light fall on 19/8, dry again before a heavy fall on September 16, dry till 27/9, wet for a day, dry for over a fortnight, rain on 12/10, dry before frequent rain from 31/10, extending well into November. Such a pattern is not so uncommon. There are in fact 16 years where measurable rain fell at least once in at least two of the three ‘middle dry’ months of June, July and August. In other months, such as June 1904, when rain fell on 5 separate days, rain fell on multiple days during the same calendar month. There is no pattern to this. Rain falls more often than is widely believed during the dry and with no regularity.

We know from the work of Nicholls, Mc Bride and Ormerod that the onset of the wet is irregular. Extending slices of time from The Dry into and through The Wet also shows that the picture of regularly increasing instances of rainfall before a clear peak, painted by J A G Little, is a cognitive imposition on the environment. Rainfall in Darwin can be interrupted, repeated or continuous during the months of

53 Ibid.
54 Ibid.
55 Adelaide Observatory, Daily Rainfall, Darwin PO, 1876.
56 Daily Rainfall, Darwin PO, 1879.
57 Daily Rainfall, Darwin PO, 1882.
58 Daily Rainfall, Darwin PO, 1886.
59 Daily Rainfall, Darwin PO, 1869 –1942.
60 Daily Rainfall, Darwin PO, June 1904.
the so-called wet. Examples abound of beginnings of wet that are not gradual and progressive. Frequencies of rain were very similar, as were the intervals of dry, throughout the months of October and November in 1873, 1875, 1879, 1883, 1887, 1892, 1895, 1897, 1902, 1911, 1913, 1915, 1916, 1918, 1921, 1922, 1925 and 1935. In some of these years, such as 1925 rain fell infrequently in both months. In others, like 1895 rain was frequent and substantial. In years such as 1874, 1899, and 1914 rain was more frequent and dry spells shorter in October than November. In fact, in 1914, after 2 days of rain in August no rain fell in September, followed by 18 days with rain in October and no periods with more than 2 consecutive days without rain, 12 in November, with a dry interval extending to 6 days and 4 in December, with 22 days between 2 of the falls. Also, there are, throughout this period, years where no rain falls throughout October and yet no dry patches in November exceeding 7 days: 1881, 1891, which did not experience any three consecutive days without rain, 1926 and 1941. In other words, times when the increasing frequency of rain was rapid and discontinuous with earlier rates. There are many other less extreme examples of sudden onset of rain at this time of year. The periods of October 15 to 17 in 1879, November 21-23, 1881, November 6-8, 1888, October 27 – November 1, 1890, October 30 – November 8, 1904, are several instances where large volumes of rain fell over consecutive days before spells of much drier weather.

Temporal distributions of rain and dry during the core of The Wet also varied remarkably. Taking a time sequence from the start of December 1875 to the end of March 1876 we see: 4 consecutive days of rain, 5 consecutive days of dry, rain on 8 of the next 9 days, 4 days without rain, 1 day with rain, the next without, then 6 consecutive days with rain, 1 without, 8 consecutive days of rain, 4 dry days, 1 wet, 4 dry, 1 wet, with high rainfall, the 6 dry days, followed by 7 consecutive days with rain, 1 dry day, 7 consecutive days with rain, 1 without, 1 with, 4 without rain, 1 with, 4 dry days, 1 wet, 1 dry, 2 wet, 1 dry, 6 wet, 4 dry, 15 wet, 1 dry, 2 wet and 7 dry. There is no such thing as a typical season. But this was chosen because there were no unusual or lengthy periods without rain; yet there were still many pauses in the rainfall. The parameters were chosen because they were when frequent sequences of rain began and ended. The 1891 -1892 wet began in earnest on November 3. Between then and December rain fell on 24 days and there were no periods

62 Ibid.
64 *Daily Rainfall, Darwin PO*, 1869-1942.
65 Ibid.
66 *Daily Rainfall, Darwin PO*, 1875 -1876.
without rain of over 2 consecutive days. Then there were 12 days without rain, 1 with, 3 without, 1 with, 1 without, 1 with, 6 without, 1 with, 1 without, 9 with, 2 without, 1 with, 2 without, 5 with, 1 without, 1 with, 1 without, 6 with, 3 without, 1 with, 2 without, 1 with, 8 without, 1 with, 3 without, 1 with, 4 without, 1 with, 2 without, 7 with, 1 without, 6 with, 2 without, 1 with, 1 without, 3 with, 2 without, 3 with, 1 without, 4 with, 2 without, 2 with, 5 without, 1 with, 2 without, 1 with, 4 without, 1 with, then no rain from 13/4 - 8/7.67 Darwin rainfall is not rhythmic. More often than not there were periods without rain of 5 or more consecutive days some time between the beginning of January and the end of February. Even more frequent were dry periods of 3 consecutive days.68 More significant periods of dry during the wet have occurred. No rain fell between 29/12/1929 and 8/1/1930, before several days with moderate rainfall. Just a fortnight later, on 29/19 days of dry preceded 14 consecutive days of at times heavy rainfall.69 Whole weeks without rain, deep in The Wet, also occurred in January 1873, between 25/1 and 1/2, 1874, in January 1877, February 1880, February 1893, between 9/2 and 18/2 1900, in January 1901, January 1907, January 1909, February 1911, January 1912, January 1919, January 1924, February 1927, January 1928, between 6/2 and 17/2 1931, January 1936, February 1937 and February 1941.70 Lengthy periods of consecutive rain days have been recorded. The longest run of consecutive rain days happened between 6/3 1879 and 26/3 1879, inclusive.71 At least 1 period of about 10 consecutive days of rain occurs each wet and multiple periods of at least 5 days in length are also common.

Darwin's rainfall comes in pulses and beats. Its rhythms are not regular. Nor is it reliable in its timing. The timing of rain is as varied as the quantities that fall. It is not, however, completely chaotic. From lengthy historical records of rain we know that while it sometimes falls in the middle of the calendar year, it has never fallen in large volumes or over long periods of time. These records tell us that raindrops fall on The Dry from time to time. They also tell us that dry makes frequent incursions into the wet. But, despite irregularities in timing and volume substantial rain does fall at some stage in the first and or last months of the calendar year. Looking at when in time rain has been recorded in Darwin we know that the arrival and departure times fluctuate from year to year. Darwin's rainfall

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67 Daily Rainfall, Darwin PO, 1891-1892.
68 Daily Rainfall, Darwin PO, 1869-1942.
69 Daily Rainfall, Darwin PO, 1929-1930.
70 Ibid.
71 Ibid.

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history clearly shows that the alternations of periods of rain and no rain and the durations of each varies from year to year, as unique, contingent elements in the atmosphere acting this way or that, reaching critical transition points or not, bubble away minute by minute in a vast array of ever-changing combinations. Conceptualisations are necessarily simplifications, but the dominant conceptualisation of the weather and climate of the Top End is too at variance with reality to remain tenable. It speaks of regularities that historical records demonstrate have not played out in time. It compresses what could be 6 seasons most years into two and lacks the temporal flexibility to capture reality, even in simplified terms.

History, however, also explains how such an erroneous idea has endured. Until recently weather investigators employed analytical techniques that produced data independently conforming to the idea of a regular ‘wet’/’dry’ climatic dyad. This happened because they examined only the quantitative dimension of rainfall and even then neglected variation in volumes until relatively recently. The stories they could then tell were based on material unable to see its vital features, such as its variability. In many ways this would agree with casual and vaguely remembered experiences of rainy Januaries and parched Julys in Darwin and across the Top End, further reinforcing the received understanding of climate. Transforming rainfall data into sequences of daily events adds the second, necessary aspect of weather, time – because it happens in time, at a time and for a time. Stories about weather need both dimensions. But transforming this data into sequences of events, on a daily scale, also converts it to something amenable to people’s experiences generally and of places, more specifically. In Chapters 7 and 8 this will help inform my examination of weather and climate in Top End literature, biography and science. As Chapters 1 and 2 show, ideas of season do not just issue from the weather. Indeed, in non indigenous, post invasion Top End society these ideas paid little heed to what actually happened in the skies, even as diligent men energetically measured and analysed the weather. The answer to the conundrum of how an errant and inadequate idea of weather and climate persisted for so long may lie as much in the lives and minds of the people of non-indigenous society as it does in the ways we have tried to make sense of the atmosphere. Chapters 5 and 6 will show that newcomers’ experiences and understandings of wind and heat in the region indicate that this misconception of weather and climate was impervious to physical processes.
CHAPTER FIVE

BREEZES AND TEMPESTS

Wind is the truly ethereal element. We cannot see it; only its effects. We feel it on our skin, in our hair and through our clothes; and, especially in a hot climate, we bemoan its absence. Wind is integral to our experience of weather. Wind is, however, nothing less than one of the makers of weather. It is the means by which the wet, the dry and everything in between take flight, the means by which they come, go and stay. Since the labours of Halley and Hadley the workings and role of the winds have been well understood: they redistribute heat throughout the global atmosphere. Such understandings of thermal equilibrium, differential heating across latitude and the differing capabilities of land and sea to absorb or reflect heat energy are modern – coming, as Chapter Two demonstrated, just three centuries ago. Before then winds were understood to be exhalations from the earth. This was the view of Aristotelian natural philosophy as well as of manifold mythologies. Cultures as diverse as the Ancient Greeks, the Balinese, Hindu Indian and numerous Polynesian societies have spoken of winds coming from within the earth, usually a mountain.¹

Indeed air does move vertically. George Hadley in particular explained how rising columns of warm air animate this grand exchange of heat and cold. Huge, dynamic convection currents flow like airborne rivers through the great aerial ocean. Upwards from the soup above tropical lands and seas, then, aloft, cold and desiccated, the air moves away from the tropics for perhaps 25 or more degrees of latitude before descending to the ground and heading for the tropics. Unfortunately in depth study of this process is beyond the purview of this study. While it was perceptively theorised long ago, verification only came with high altitude meteorology. Although weather balloons were first used during the early twentieth century, the widespread systematic use of these balloons, fitted with reliable, sophisticated instruments did not eventuate until after World War II, when they were used with other technologies developed during the war such as radar and later used with newer technologies such as satellites. Like meteorology in northern Australia before the Second World War this study is confined to what was observed and recorded at or near the bottom of this atmospheric ocean. However, the ripples and swells of the breezes and tempests blowing over the Top End are quite compelling. This chapter complements the general and global material of Chapter 2 with an examination of winds more specifically and locally. It offers a brief history of

¹Lyall Watson, Heaven’s Breath: A Natural History of the Wind, (Sydney: Hodder and Stoughton, 1984), pp301-308.
the region's cyclones from 1839-1940 and before that historical study of the Top End's more typical and, usually, more anodyne flows of air. This history of 'typical' winds is a counter to the imported understanding of reversing winds and switching seasons. It demonstrates that, like rain, wind is not so orderly. The history of cyclones aims to show how variable their occurrence is in the Top End and, accordingly, how this contributes to the region's climatic variability.

'Breezes'

Prevailing winds do blow across the region at certain times of the year. In this sense the imported understanding is to some extent accurate, perhaps more so than with rainfall. Introducing its section on 'Tropical and Continental Weather Systems', the contemporary meteorology textbook *Weather and Climate of Australia and New Zealand, 2nd edition*, outlines tropical Australia's wind regime:

> The tropics in the Australasian region are dominated by two global-scale circulations: the easterly trade wind flow, which is warm and moist at low levels (at least over the oceans and on the windward coastal margins) but dry aloft; and the monsoon westerly flow of the austral summer, which is very warm and moist through a large depth of the atmosphere and overlain by easterly flow.2

However, this colonial import also elides vital subtleties and complexities. Complexities, I might add, that meteorologists have identified and come to understand in recent decades; complexities at the very least indicated in weather records from the Top End dating from up to a century ago.

Before proceeding, a word about sources and methodologies. The coastal location, Port Darwin, while providing the only extensive, readily accessible and reliable record for the period we are studying receives convection driven seabreezes at all times of the year. Local factors commonly overwhelm more regional breezes in the afternoons. Darwin's location at the turn of the coastline exacerbates this. While Darwin city and its immediate environs are closest to a shore that faces west and north-west, it is also close to a lengthy north facing coastline. Consequently, sea-breezes blow into Darwin from every point of the compass from the south-west, through the north-west, to the north-east: from a bearing of 225 degrees, through 315 to 45 degrees. Accordingly, records for 9am

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wind observations, before the effects of local heating take flight, are more useful in discussing broader wind patterns. Another solution to this problem is to examine wind observations from Katherine, too far inland to receive sea breezes and far enough inland to indicate penetration of monsoonal winds into the interior. Accessible wind records for Katherine, however, are not available for the exact period examined here. Instead a long, quality controlled data set exists for the period from 1943 onwards. In the absence of any reason to believe that wind patterns were significantly different before these records were taken and given their large volume and statistical soundness I will extrapolate from the Katherine wind data in the following analysis. As well as being the only non-Darwin Top End location currently affording detailed wind records Katherine also allows a more regional, rather than strictly local, view on the winds above the far north of the Northern Territory. Needless to say, a vital starting point is to acknowledge a plethora of local variations due to topography, shore lines and the like. The calendar months chosen conform to the widespread practice in meteorology and climatology of using records from January and July—typically the months of greatest thermal extremes globally—with April and October providing midpoints for observations. In Australia’s far north January and July well represent what are most frequently the wettest and driest times of year, with April and October regarded as times of turning for weather and seasons.

Wind roses are history in graphics. While they do not tell us exactly what happened when, they do tell us how often wind has blown from a particular direction at a particular time. According with conventional meteorological practice they tell us on what proportion of occasions winds have been recorded as blowing from each of eight directions—the four cardinal points of the compass and the midpoints between each—at 9am and 3pm each calendar month. While this method is susceptible to earlier criticisms of approaches using categories such as calendrical time, discrete points in time and just two locations in space it nonetheless enables identification of historical changes in the winds across time of day and time of year. From these we can identify prevailing patterns of wind across the region.

As with rain, wind patterns have been oversimplified. It is not the case of south easterlies or easterlies blowing for six months of the year being reversed during the other six. However, the wind rose of 1661 observations taken at 9am during the month of January between 1885 and 1941 at Port Darwin Post Office does show that winds from the west and north-west are the most prevalent at this time
of year. On less than 20% of occasions wind flows in from eastern points of the compass. Moreover, the strongest winds most frequently come from the west and north-west, consistent with a tropical monsoonal pattern. As south-east trade winds are almost always blocked from reaching the Top End from other systems such as Kimberley/Pilbara Lows and low pressure cells generated by heat between the September equinox and the March equinox, the winds with an easterly component probably issue from local storms and or low pressure cells located to the north and east of the Darwin area. This pattern is even more emphatic at 3pm, with winds coming from various ‘easterly’ points on less than 10% of occasions. Convection driven sea-breezes largely account for the differences between 9am and 3pm observations.

Winds over Katherine of a January morning have a distinct torpor. On no less than 35% of occasions between 1943 and the present, it was calm at 9am during January. About the same number of times the wind has blown from westerly points of the compass. In contrast winds from the eastern half of the compass blew on merely 10% of 9ams. Moreover, winds were commonly light, with speeds of over 20 kilometres per hour recorded less than 5% of the time. Of a January afternoon winds blow more often and are notably stronger when they do. Calm conditions have been observed only 20% of the time at 3pm; wind strengths exceed 20kms/h more than 10% of the time. The strongest winds come from almost all points of the compass, suggesting frequent thunderstorm activity. Winds with a westerly component blow just under 40% of January 3pms. At the same time, winds from the eastern points of the compass were observed about 20% of the time. Too far from the sea to receive local sea-breezes, this suggests the working of monsoonal winds over the region and way into the hinterland—though certainly not everyday; certainly not for the same periods from year to year.

April presents an almost complete reversal of January patterns. In Darwin they blow, indeed, often gust, just over 50% of the time from the south-east during April at 9am. More than 20% of the times the airs blow from the east at this time. Since differences between land and sea temperatures cannot explain the less than 10% of westerly winds blowing of an April morning, these are likely pointers to lingering or late coming monsoonal troughs, low pressure cells, even the occasional tropical cyclone. Put another way, the presence of various ‘westerlies’

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at this time is a signature of wet during the ‘dry’. By 3pm, the forces of thermal equilibrium have well and truly done their work with easterlies and south-easterlies recorded only half of the time.\(^8\)

Calm is still common at 9am in Katherine during April.\(^9\) In contrast to 3pm, when wind is absent just 8% of the time, it is calm about 31% of the time at 9am. But the wind regime is markedly different compared to January. Easterlies and south-easterlies dominate. At 9am these two winds account for over 45% of all observations. At 3pm easterly winds alone are observed more than half of the time and south-easterlies are registered in over 20% of observations.\(^10\) Blows from western points of the compass are rare, indicating that monsoonal activity this far from the coast is most uncommon during the month of April.

80% of the time winds blow from either the east or south east at 9am on a July morning in Darwin.\(^11\) Winds from the western half of the compass are almost unheard of. In concert with concurrent low rainfall and low levels of humidity this indicates that the trade winds have a stranglehold on the atmosphere above the Top End, mid year. This really is dry in the ‘dry’ – the one truly predictable time of the year. Over 60% of the time one of the many sea-breezes that visit the Darwin locale balm the skins of its inhabitants by 3pm.\(^12\)

July in Katherine is similar, wind wise, to Darwin in July and Katherine in April.\(^13\) The only significant difference is that fairly gusty southerlies are recorded about 10% of the time at 3pm during July. Most likely caused by strong, slow moving high pressure cells in temperate latitudes these winds indicate the fairly rare occasions on which southern air masses surge deep into the Top End and illustrate that this region’s weather is not always dissociated from that in Australia’s south.

No winds dominate during October mornings in Darwin. 1621 observations taken at 9am during the Octobers from 1885 through to 1941, show that easterlies and south-easterlies blow about one day in three while westerlies and north-westerlies blow about one day in four.\(^14\) North-easterlies, northerlies and southerlies are not uncommon either. In contrast to the imported understanding of one wind regime dominating for half of the year and its opposite for the other half,
Darwin's wind history shows that this is a period of the year when neither tends to dominate. Wind wise, this is in between time: sometimes neither 'monsoon' nor trade blows, sometimes both and often something else. Indeed on 18% of occasions winds have been calm at this time. October afternoons, commonly among the hottest of the year, especially in the hinterland, almost never see easterlies and south-easterlies.\textsuperscript{15} The intensely heated landmass generates vigorous sea-breezes that cancel out any land-breeze or trade wind. Though, as 9am October observations indicate, trades are not near as common in October as in July and the six weeks either side.\textsuperscript{16}

Winds with a westerly bearing are more dominant than those from the other half of the compass at 9am of an October morning in Katherine.\textsuperscript{17} Where the various westerlies account for more than 30% of observations their opposites blow about 10% of the time. Northerlies are the single most common winds in Katherine at 9am during October and it is calm at this time on more than one in four occasions. While there is a distinct change in wind pattern from July, the fact that easterlies dominate in the afternoon indicates that a monsoonal airflow is rarely established over this region during the month of October. Winds from eastern points of the compass are about four times as common as the various westerlies at 3pm in October.\textsuperscript{18} While the trades do not shape the weather here as decisively as they do around the middle of the year, they are still influential. Also, the contrast between October 3pm observations in Darwin with those in Katherine indicates just how significant sea-breezes are in the vicinity of Darwin. Comparison of mean 3pm October humidity levels for Darwin Post Office and Katherine Aviation Museum also points to this: 53%\textsuperscript{19} compared with 28%.\textsuperscript{20}

Distinct patterns are evident. When the continental landmass is heated north Australia inhales airs from the west and north, breathing out when the lands are cooled. Linked to global factors such as the heating and cooling of the behemoth of Asia and other global circulation patterns, air flows above the Top End are also shaped by other local factors. This ebbing and flowing of air, like the rains they bring or take away, is irregular and variable, yet the cycle has been observed by newcomers every year. The steady flows are disrupted and deflected by sea-breezes, all year round; by low pressure cells, and frequently spectacular

\textsuperscript{16} Records for all calendar months are available at http://www.bom.gov.au/climate/averages/tables/cw_014903.shtml
\textsuperscript{17} http://www.bom.gov.au/clim_data/cdio/tables/pdf/windrose/IDCJCM0021.014903.9amOct.pdf
thunderstorms when the aerial ocean is soupy. Tropical cyclones, however, are the most powerful and significant disturbances.

TROPICAL CYCLONES

Cyclones punctuate Top End history. These swirling whirlpools of air have destroyed the north coast's chief settlement on no fewer than three occasions. The most recent, Cyclone Tracy, has assumed legendary proportions. In 1839, some thirty years before Darwin was established a cyclone demolished the embryonic settlement of Victoria. Darwin itself was blown away by cyclonic furies in 1897. In 1937 another cyclone caused serious damage. Yet, few remember, even in the Top End, and this is almost completely unknown throughout the rest of Australia. This succession of repeated beginnings, endings, year zeros and recalibrations of time lines remains forgotten despite efforts such as meteorologist Kevin Murphy's to keep them in public memory.21 Taking a fresh look at sources included in Murphy's opus, and examining other documents that have since become available, the remainder of this chapter is a history of cyclones which buffeted various Top End settlements between 1839 and 1940. Ineluctably it has gaps, particularly a gaping hole over Arnhem Land due to the much later arrival of Europeans and their technologies of weather measurement. One curiosity, at least from the perspective of the present, is that none of the cyclones were named. Queensland meteorologist Clement Wragge did name cyclones and even low-pressure systems in the 1890s and early 1900s. But the Bureau of Meteorology did not start naming tropical cyclones until 1964. When Wragge left Australia for New Zealand in 1908 the practice ceased.

Unsettling Settlements

Winds were a concern even before founders of Port Essington set sail. Delays in departing Sydney caused considerable concern that the founding party's ships would get to Torres Strait after monsoonal westerlies began to funnel along the waters to Australia's immediate north. Consequently, as Peter Spillett notes, authorities feared that unnecessary tarrying in might mean postponement of up to twelve months.22

The Orontes, Britomart and Alligator turned into Torres Strait weeks after the expected turning of the seasons. Carrying many month's supply of salt, bread,

21 Kevin Murphy, Big Blow Up North, (Darwin: University Planning Authority, 1984).
sugar, as well as tropical fruits and seeds, iron tanks, prefabricated accommodation for the commandant and assistant surgeon, a pre-built building for use as a hospital, another for a church, they nevertheless made it to Port Essington without incident. On November 3 1838 Captain Bremer and Captain John McArthur chose the site on which would endeavour to realise their aspirations to build a trading port populated by Chinese, Javanese and British people. However, as Darwin based architect David Bridgeman has observed in his studies of Top End architecture, the British neither drew on their vast experience in other tropical colonies in constructing a built environment at Port Essington nor did the experiences at Port Essington influence later housing in tropical Australia. The shelter designs of Aborigines or Macassan sojourners were also lost to architectural posterity. In architectural history this settlement, built, destroyed, rebuilt then dismantled/left to the elements, is a fragment. Nothing was learned even from the first threat to its existence.

The first threat was barely a year into the settlement’s life. As outlined in Chapter 3, on November 26, 1839, a cyclone blew the fledgling settlement of Victoria away. Not a single building was spared. While Government House remained intact, it had been lifted off its foundations and carried nine feet before being dropped. Scarcely more than 30 hours before the cyclone struck a ‘most tremendous thunderstorm came on without any previous warning’, lashing the locale for nearly five hours. While this may seem a fitting portent neither this nor the strong south-easterlies accompanying drizzle the following day were seen as anything other than the change of monsoon. But Owen Stanley’s compelling account of the ensuing destructive reality is worth repeating in detail:

Between seven and eight o’clock the wind drew round to the southward and the barometer began to fall rapidly: at ten it blew furiously from the same quarter and, the barometer was as low as 29.10; many of the trees were blown down at this time. At midnight the wind drew round to the eastward, and blew a perfect hurricane, before which nearly everything gave way; the trees came down in every part of the

23 Ibid., pp21-22.
25 Peter Spillett, op. cit., p57.
26 Owen Stanley, H M S Britomart, Port Essington and the Passage to Timor and Swan River, National Archives of Australia (NAA), Darwin, E490/2, November 1839, Sunday, December 24th (sic).
27 Ibid, Monday 25th.
settlement, the marines' houses were all blown down, the church only finished a week shared the same fate: - the barometer fell to 28.52.  

Both the numbers and the words tell a vivid story of destruction. Stanley continued, as did the tempest:

About two am the wind shifted suddenly to the northward, from which point, for about half an hour, its fury was tremendous.  

Before long a storm surge of 'ten feet and a half' above the usual high water mark hit, washing away the pier, boat houses, stores of food and, almost, H M *Pelorus.*  

While the *Pelorus* did not wash away, it was driven into mud. Its log records that 'about midnight struck the ground very heavily, wind veering to all points of the compass.' The entry for Monday 25\textsuperscript{th} concludes pithily: 'Sea breaking over ship.'  

After a night of violent northerlies a grey morning revealed 8 of the crew missing, along with all of *Pelorus*' boats. The wind eased significantly but still brought squally rain for the remainder of the week. None were found alive; the sea relinquished their bodies intermittently till December 19.  

The sequence of winds indicates something of the path of the cyclone. Forming to the north-east of Port Essington it travelled westwards, over the warm waters off the north coast. The consistent and strong rain accompanied northerlies indicate that it remained to the west for some days. That it caused distinctive wind changes and several days of potent south-westerlies, a couple of the days coinciding with the northerly blows at Victoria, indicates that it was a large system. That it also caused a noticeable disturbance in the winds and weather along the Victoria River, some 500 kilometres to the south-west the same days it struck Port Essington gives an indication of its bulk. Indeed John Lort Stokes account aboard the *Beagle* reveals that the southern edge of the cyclone also brushed the Victoria River district of the western Top End, on November 25 and 26 1839. Stokes' account began:

My journal of this day begins with remarking a very extraordinary change that took place in the winds.

\begin{footnotesize}
\begin{itemize}
\item[28] Ibid.
\item[29] Ibid.
\item[30] Ibid.
\item[31] Log, H M Sloop, Pelorus, NAA, Darwin, E490/2, November 1839.
\item[32] Ibid.
\item[33] Peter Spillett, op. cit., p59.
\end{itemize}
\end{footnotesize}
Stokes, of course, was not alone in holding strong expectations about what to expect when, weatherwise. But the precision in timing and direction is no less evident for this. While no barometric anomalies were observed:

Dense masses of clouds covered the sky, enveloping everything in gloom; which, though so far agreeable as to reduce the temperature to 75 degrees, had the most singular effect after the constant bright sunny days we had experienced.\(^{35}\)

This region did experience heavy rain. But from Stokes' account this was far shorter lived than at Port Essington.\(^{36}\)

It is unclear how those who experienced the cyclone understood it. At this time the very nature of storms and cyclones was being vociferously debated, especially in the United States. Descriptions of wind sequences had long been published in natural history treatises and maritime manuals and logs. As early as 1698 Captain Langford detailed such a sequence of wind shifts in real time in describing a hurricane he had recently experienced in the Caribbean.\(^{37}\) This article in *Philosophical Transactions* is considered to be the first publication to imagine and describe Hurricanes as a kind of whirlwind. Thorough understanding of the kinetics of cyclones and hurricanes was still centuries away, but intense interest in this problem from the 1820s onward enhanced awareness to the point that people could read the winds and act accordingly by the second half of the 19th century.

By the middle of the 19th century mid-latitude lows and tropical lows, storms, cyclones and hurricanes were understood to be the same kind of phenomenon, with the same core structures. Differences resulted from variations in the specific environment in which each particular cell or event emerged, developed and decayed; as well as between the kinds of atmospheric disturbance each became. For several decades the core characteristics and mechanisms were in dispute. Although this was discussed in Chapter Three, in relation to the practice of recording wind sequences in ships' logs, it warrants recapping and expanding here to aid understanding of storm and cyclonic systems.

\(^{35}\) Ibid.
\(^{36}\) Ibid.
William Redfield learned about the structure of storms from studying their effect on the landscape. Natural philosophers then often saw events of sea, sky and land as interconnected rather than contained and isolated. Journeying through New England in 1821 he observed that the alignment of fallen trees from a recent storm reversed after a certain point. From this he concluded that the storm had a circular or 'whirlwind' structure.\(^{38}\) Galvanised he collected detailed case studies from mariners and other record keepers, publishing an article in the *American Journal of Science* in 1831.\(^{39}\) This was just the first of many papers arguing for the circular motion of storms, including tornadoes and tropical hurricanes, which Redfield published through to 1856, some of which exploited the relatively new technology of the weather map.

Seeing weather as a spatial problem German physicist Heinrich Brandes developed the first weather map in 1816. Coming before telegraphy's offering of copious information from the 'present' it was based on historical data. Its main innovations were the application of the general cartographical symbol of the isoline to air pressure in isobars and the placement of wind and air pressure on the same map. Using maps of wind and pressure, Brandes concluded that storms and lows were rotary systems generated by the inward flow of air toward a centre.\(^{40}\) Globally focussed, Brandes' student Heinrich Dove sought to understand the development and decay of mid-latitude storms in terms of the conflict between tropical and polar air. Describing, in 1828, the approach of what he conceived as a line of low pressure he noted that winds turn completely through all points of the compass, and concluded that a law of turning applied.\(^ {41}\)

By the late 1830s opinion was also divided in the US. In conflict with Redfield, James Pollard Espy circulated papers maintaining that storms and hurricanes were caused by the inward rush of air toward a centre. In 1841 his significant opus, *Philosophy of Storms*,\(^ {42}\) took this to a larger audience. Just as Redfield's theory insufficiently explained many observations, so Espy's explanation was inadequate. With an 1843 paper by mathematician Elias Loomis came a satisfactory explanation: airflow in a storm system does flow inward but also circulates around a centre.\(^ {43}\) With a basic, universal structure for lows, storms, cyclones and hurricanes identified observers could begin to read a storm from the winds it generated.

\(^{40}\) Mark Monmonier, op. cit., pp19-23.  
\(^{41}\) Ibid., p29.  
\(^{43}\) Cited by Mark Monmonier, op. cit., p70.
This insight was indispensable to navigators. Enabled to read the winds they could identify, even locate storms and seek to avoid or use them to their advantage. In 18 memoirs published during the 1840s Henry Piddington, President of the Marine Courts Calcutta, examined the intricacies of the winds and seas relating to a variety of individual hurricanes from the reports and log books of ships in the vicinity. In 1848 his efforts culminated in his *The Sailor's Hornbook for the Law of Storms*. Encyclopaedic in its detail and scope the *Hornbook* was a manual that incorporated historical case studies of storms and cyclones, narrated in terms of sequences of winds, lessons based on actual weather events and, most innovatively, its transparent storm cards. Intended to be superimposed on any map or nautical chart, each card illustrated the movement of air around a low-pressure cell in each of the hemispheres. In moving the card in accordance with motions indicated by the observed sequence of wind directions over a particular period of time one could ascertain the location of the core of the system relative to the observer and estimate well the recent path of the system. Indeed these storm cards enabled users to envisage possible contingencies. Adding to a user’s ability to locate a storm’s core and approximate, recent movement, the Hornbook included tables indicating the position of a storm’s core given observed winds of a particular direction for 16 points of the compass. One table was for the northern hemisphere; the other for south of the equator. Popular navigation manuals, the Hornbooks were published in seven different editions, the latest in 1889. As instruction books their ideas, especially key ideas such as interpreting the meaning of wind sequences would have been transmitted to inestimable numbers of people. Many no doubt learned through oral instruction on the decks of ships rather than by reading. Nevertheless, important late 19th century works on weather and climate such as Henry Blandford’s *Indian Meteorologist’s Vade-Mecum*, the most popular book on tropical meteorology of the period and, Ralph Abercromby’s *Three Essays on Australian Weather*, published in 1896, incorporated this material. All included outlines and discussion of storm, cyclone and low-pressure cells as understood since Loomis.

Between the abandonment of Port Essington and the establishment of Port Darwin British and European mariners gained a sophisticated understanding of storms and cyclones. During this time Macassans continued their annual sojourns to collect trepang. Indeed many Aboriginal groups lived throughout the region. But no

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evidence has yet surfaced to indicate whether or how many cyclones hit the far north coast and its hinterland between the late 1840s and 1869. With settlement and observation posts confined to Darwin and several post along the sinews of the Overland Telegraph it is possible that cyclones in the vicinity of Arnhem Land, the Gulf of Carpentaria and the Victoria River district would have been missed prior to the spread of colonialism and its technologies to the Roper-McArthur and Victoria River districts during the 1880s.

The first post-settlement cyclone blew into Darwin in the middle of January 1882. The barometric curve for Port Darwin, drawn by Adelaide Observatory, for that month shows a distinct drop in air pressure between the afternoon of January 14 and the morning of January 18, with the lowest pressures being recorded during the early hours of January 16. The barometric curve Jany 1882, NAA Darwin, E490/2, January 1882. In the 24 hours to 9am, 15/1 2.22 inches (approximately 55mm), was recorded at Port Darwin, with 2.44 inches (approx 60mm) in the next 24 hours and 2.61 inches (about 65mm) during the following 24 hour period. The strongest winds blew from the north west registering 5 on the 0-6 wind scale then employed to determine wind force. Force 4 north westerlies were recorded at all other observations between 9am 15/1 and 9am 17/1. The persistence of north westerly winds indicates that the eye did not pass over Darwin and that the cell of the cyclone remained to the west of the settlement, over either or both the Timor Sea or Joseph Bonaparte Gulf. Nevertheless, the system was extensive, with a significant drop in air pressure recorded as far south as Daly Waters between January 15 and January 17. Under the headline 'The Late Gales – Great Destruction of Property', the Northern Territory Times and Gazette (NTTG) of 21/1 detailed the tempest and its effects as in the order of things by beginning the article thus:

We have annually about this time to chronicle the effects of the change of monsoon, and this year is proved no exception to the rule.

A second item in that edition's News and Notes column recorded that:

On Sunday evening last a strong gale with heavy thunder and lightening(sic) passed over Palmerston doing some damage to buildings and sheds. The following evening, about the same time, we had a reptilation uprooting trees and sending the roofs of verandas flying

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46 Barometric Curve Jany 1882, NAA Darwin, E490/2, January 1882.
47 Meteorological Observations made at Port Darwin during January 1882, ibid.
48 Ibid.
49 Barometric Curve, Jany 1882, op. cit.
50 Northern Territory Times and Gazette, 21/1/1882.
about in all directions, it was only the substantial buildings that escaped uninjured.51

Darwin was a substantial settlement by then. Physically, it was a rectangle hewn into what locals still called a jungle. Atop a plateau, the base of which was bounded by water on three sides, surveyor George Goyder superimposed a grid of streets and byways within the geometric clearing. Settled on the Wakefieldian scheme, the town was divided into 1,473 half-acre blocks to fulfil the land orders that had been sold in Adelaide and England in 1866.52 Wooden houses were built as needed. In August 1869, just six months after settlement began, the 'Theatre Royal', built from superfluous material, held its first Saturday evening concert. While much of the hinterland had already been surveyed, its sweating forests closed in on the colony, confining it to the coastal fringe. The waters linked Darwin to the outside world and contact came with the occasional ship. But this isolation lasted just three years. In 1872 the linking of The Overland Telegraph from Adelaide, with the British Australian Telegraph undersea cable from Java anchored the fledgling settlement in place. Within three short years Port Darwin had become Australia's telecommunications link with the rest of the world. No longer would news need to travel with the winds.

By then the Indigenous Larrakia, custodians and occupants of the land for millennia were being displaced. Their consent had not been sought; nor, as Kathy De La Rue notes is there any evidence of their advice being sought about the environment, sources of water, food and medicine.53 In contrast many Larrakia were exploited as cheap domestic labour and on various public and private projects.54 Until the cyclone struck in 1882 the tents, log huts as well as homes and stores built of iron dating from and growing out of the original encampment still stood. The layout of the township was much as Goyder had drawn save for the inclusion of two new squares – Temira and Larrakeyah – and the four additional new streets that resulted from this modification.55 Following the discovery of gold by an Overland Telegraph construction party in the hinterland near Yam Creek the first Northern Territory mining boom saw an influx of people between 1872 and 1874. As people needed them they either erected more tents or built cottages of bark, slab or logs and indeed, any material at hand. Considerations of weather were certainly not front and centre, however, with the emergence of the verandah in 1870s Darwin

51 Ibid.
53 Ibid., p14.
54 Ibid., p16.
55 Ibid., p25.
comes evidence that at least some were giving thought to the environment that
enveloped them.\textsuperscript{56} That the 1882 cyclone caused such widespread damage is
therefore not surprising.

By then Darwin was not a fledgling settlement: in 1873 a church was built,
schools for children and adults opened and a local newspaper ran off the press. The
first horse races were held on Easter Monday 1873.\textsuperscript{57} During the extant gold rush
shops and hotels sprang up in both Port Darwin and Southport, on a southern arm of
Darwin harbour. With a shortage of labour to work the mines \textsuperscript{187} Chinese labourers,
the first group imported into the Northern Territory, arrived in Darwin from
Singapore in August 1874.\textsuperscript{58} The town’s first hospital, built of wood, had been
opened in June 1874 and a stone ward was added in 1875. In 1876 the first
government school was established in Port Darwin. Lured by the promise of gold,
Chinese miners came and went in large numbers. According to Kathy De La Rue, in
the several years from 1878 there were never fewer than 2000 Chinese in the
Northern Territory, and sometimes over 4000.\textsuperscript{59} While many headed for the
hinterland mine fields and a stream of disillusioned men flowed the other way, to
Singapore and Hong Kong, the Chinese in Port Darwin were numerous and
enterprising enough to have created their own community.

Indeed by the 1880s Chinatown was the commercial and service hub of Darwin.
Reporting on the Chinese community in 1888, Inspector P Foelshe, chief of police,
noted that members of the Chinese community owned and ran 39 stores and green-
grocers’ shops, three carpenter’s shops, two shoe maker’s shops, three laundries,
five tailoring establishments, 32 fruit and vegetable gardens, six gaming houses
and seven brothels.\textsuperscript{60} Solidifying the sense that the settlement had become a town
the striking Residence for the Government Resident, dubbed the ‘House of Seven
Gables’ by the \textit{NT Times}\textsuperscript{61} was completed in 1879 and by 1881 three banks were
trading there. Two of them were known locally as the tin bank and the stone bank
owing to their distinctive appearances. Substantial buildings such as these survived
the 1882 cyclone intact. What did not survive was rebuilt, but without regard for any
future cyclones or blows. Signifying how undeterred the colonisers of the Top End
were by its violent elements, the foundation stone for Palmerston Town Hall, the
Northern Territory’s first municipal building, was laid in August 1882, just seven

\textsuperscript{56} David Bridgeman, op. cit., pp76-77.
\textsuperscript{57} Kathy De La Rue, op. cit., p34.
\textsuperscript{58} Ibid., p39.
\textsuperscript{59} Ibid., p56.
\textsuperscript{61} \textit{NT Times}, 17/5/1879.
months after its first cyclone. Indicating the efficiency of local builders, it was opened on 5 March 1883. Built of porcelanite, a local sandstone, the Town Hall and similarly constructed government buildings were, as David Bridgeman comments, symbols of permanence. By the 1880s this community of great social, demographic and physical flux had finally gained the appearance of solidity. This did not last.

1897: Darwin’s First Year Zero

We do not know exactly how many people lived in Palmerston in 1897. The 1896 Government Resident’s Report estimated the entire Territory’s population comprised 1,500 Europeans, 2,500 Chinese and 400 ‘Others’. ‘Others’ means non-Aboriginal people. Numbers in Darwin varied depending on the weather. With many involved in alluvial mining, numbers fell with the first falls of rain. Once the land dried up, miners returned to town. At any given time perhaps more than half of these people resided in Darwin and, circa 1897, perhaps 70–80% resided there in the dry. Numbers of Aboriginal people are unclear.

In the 1890s human intervention in Palmerston’s physical environment went beyond constructing buildings, grading roads and building wharves. On the northern skirts of the town large sections of ‘jungle’ had been cleared for an experimental garden. In 1897 these botanical gardens grew rice, peanuts, various rubber crops, divers hemp plants, cocoanuts, grasscloth, spices such as cinnamon, ginger, turmeric, and pepper; indigo, cactus, cotton were all being cultivated along with grape vines, seven varieties of figs, Giant Kew Pine Apples, Honey Jaks, leaves of Assam Tea, Galangal Roots and Kola nuts – to name its important cultivations. Colonisation here, as elsewhere, had many faces. Nevertheless, material goods and travellers from afar almost entirely came by ship. Indeed, the vicissitudes of sea and sky showed on the very paper on which the weekly NT Times was printed. This edition fawn, that edition mauve, another crinkled with watermarks. First issued just 6 days after its founding editor landed in Darwin in November 1873, the NT Times came out every week, with the exception of the single issue due out the day after the 1897 cyclone. Like most buildings in Darwin the paper’s offices were destroyed during the early hours of January 7. The parallel fibres of the Overland Telegraph strung across the continent had been augmented somewhat in 1888 by the parallel iron ribbons of the ‘transcontinental railway’, then penetrating just 250 kilometres

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62 Kathy De La Rue, op. cit., pp64-65.
63 David Bridgeman, op. cit., p77.
64 Government Resident’s Report on the Northern Territory for 1896, Parliamentary Papers, South Australia, No.45, 1897, p20.
into the inland, far short of its destination. Yet, late nineteenth century Palmerston was a decidedly maritime town – more connected to the waters rimming it to the north and west than to the giant landmass to its south.

Rain came late in 1896. 1896 saw one of the longest dry spells in Darwin - not a drop was recorded from 25/4 till some spits fell on November 16. In contrast August was the only month of 1895 not to record rain in Darwin and July and August were the only calendar months of 1898 experiencing completely dry weather. 1897 saw a longer dry patch, lasting five months – still two months short of 1896. Light, patchy showers fell on Darwin most days from 16/11 until an intense thunderstorm brought the first heavy fall of the season on November 26. Rain was more consistent throughout December, falling most days with particularly heavy falls on the 11th, 12th, 19th, 22nd, 28th and 31st in a pattern seen as typical for the time of year.

1897 began in distinctly grey hues. Cloud cover was almost total for the first week. The Port Darwin meteorological register shows winds were either calm or light for much of the first five days of the new-year. In a notable and unexplained departure from international practice winds in Darwin were not classified according to the Beaufort Scale. They were classified on a scale of 0-6. Of 40 ratings, 33 were classified as either 0 or 1. The entry for January 4 and its clipped economical parlance offer a taste: 'Midnight: calm, few clouds, close; 3am: calm, few clouds, close; 6am: NE light air, raining steadily; 9am: NW fine, light, fine, close; midday: W moderate, threatening, dull warm; 3pm: NW, stormy, cloudy, threatening, dull, cool; 6pm: calm, fine, cloudy; 8:30pm: heavy shower; 9pm: NW, gentle, overcast cool, raining heavy (rain 1.300inches)'. During this period, at least in Darwin, official rainfall figures were summed every 12 hours at 9am and 9pm and, as is still the case, daily rainfall is the total rain over a 24 hour period prior to 9am on any given calendar day. The 1.3 inches of rain (33millimetres) is the measured rain between 9am and 9pm on 4/1/1897. While one report described the weather as cool, at no stage, day or night, did the self-registering dry bulb thermometers record a temperature under 78 degrees Fahrenheit – or 25 Celsius. Moreover, with the lowest wet-bulb temperature recording during the first five days of January 1897 at 74 degrees F, or a little over 23 degrees C it was as humid as residents would have expected for the time of year.

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67 Adelaide Observatory, Daily Rainfall, Darwin Post Office, 1895 and 1898.
68 Adelaide Observatory, Daily Rainfall, Darwin Post Office, 1897.
70 Meteorological Observations, Port Darwin, January 1897, NAA Darwin, E490 January 1897.
71 Meteorological Observations, Port Darwin, January 4, 1897, ibid.
72 Meteorological Observations, Port Darwin, January 1897, op. cit.
The first sign of atmospheric disturbance came just 16 hours before worst of the cyclone struck. The moderate easterly wind recorded at midday on 6/1, accompanied by 'stormy' sky and drizzling rain would have given those who noticed a little angst. To grasp the significance of this we must recall the earlier discussion about prevailing winds: during drier periods of the year easterlies prevail in the Top End, driven by strong high-pressure systems in the south. By the southern summer these highs travel way too far to the south to influence Top End weather. Once enough heat is generated in the inland of NW Australia - some time between September and November – a heat low over the Kimberley/Pilbara directs a more westerly airflow over the Top End. In concert with this, the global dynamics of the southerly movement of the inter-tropical convergence zone brings the north-west monsoons to the north coast and to varying swathes of the inland tropics. These forces overcome airflows from the south, sealing the north off from any southern atmospheric influences. By the 1890s scientists and mariners understood these dynamics and the staff at Port Darwin Met Station in all likelihood understood that these easterlies and heavy skies pointed to a disturbance in the aerial ocean around them. Strengthening easterlies at 3pm were a bad sign. The total cover of thickening ‘cumulus plus nimbus’ did not augur well either.

Although the barometer had been abnormally low from mid afternoon it was not to register rapid falls until mid evening. Over the previous three days atmospheric pressure declined steadily but quite slowly – not inconsistent with the development or approach of a monsoonal trough or tropical low. The strong easterlies continued all afternoon and light, fleeting showers scudded Darwin. Either a tropical low, or tropical cyclone was in the vicinity. Even today, with the atmosphere studied in its three dimensions, with high altitude weather measurements, radar and satellite imagery, the movement of these systems is very difficult to predict. In 1897 Darwin, only the movement of high altitude clouds hinted at wind movements aloft. Weather measurements and the study of the atmosphere could only examine dynamics close to the surface of the earth. In any case the skies had completely closed in on Darwin by 9pm on January 4, so observations of the wind and precise measurement of atmospheric pressure were all people could use to anticipate what might happen. Sequences of readings at different times and different places need to be assessed and from this the approximate locations and hence movement of the system can be approximated. The clockwise flow of air

73 Meteorological Observations, Port Darwin, January 6th, 1897, ibid.
74 Ibid.
75 Ibid.
76 Meteorological Observations, Port Darwin, January 1897, op. cit.
around lows and tropical cyclones in the southern hemisphere was understood by the 1840s. For people in any location, monitoring the sequence of observed winds and time series of barometric pressure readings could give a sense of how the system has moved and where it was located at the time most recent readings were taken. With this anyone with an understanding of the movement of air around these systems could outline various contingencies depending on the movement of the system. Conversely, having done this, observers could read subsequent sequences of wind to indicate whether the cyclone was approaching, receding, or passing close by. The weathermen, mariners and I suspect many Aboriginal people, would have understood the appreciable increase in wind from force 3 at 6pm to force 4.5 at 9pm and the change of winds to northeasterlies to indicate that the cyclone was coming closer, moving in from the Timor Sea. At this stage it could move west, turn back to the north, shoot off to the east, or continue south and strike Darwin. The people had no way of knowing what would happen. They just knew that for the first time in 28 years a cyclone could be close enough to cause imminent destruction.

Just after 9pm the barometric pressure took a dive. By 10pm it was in free-fall and torrents of rain had begun falling. At midnight the air was almost saturated: 76.5°F on the dry bulb thermometer; 76 on the wet - and it was moving rapidly. Had it not strengthened to a force five, the easterly turn may have been a good sign. By 3am the winds were force 6—the maximum on this scale—and blowing again from the northeast. The entry in the register describes the conditions: winds ‘NE blowing with hurricane force’. Yet they were to get stronger, literally blowing off the scale. Next to an asterisk on the bottom of the page for January 7, 1897, the meteorological register records:

4am, Baro 28.784 blowing hurricane from NE. 4:10am Baro 28.80, wind change suddenly to NW W & SW blowing with much greater force than before. 5am Baro 29.140 wind SW still blowing with hurricane force.

The core of the cyclone approached the town from the west and passed just to the south, feeding off the warm waters of Darwin’s massive harbour. The strong winds continued for several hours: still force 5.5 at 6am, force 5 at 9am and force 4.5 at noon. Heavy rain stopped falling by 9am. During the afternoon winds moderated and showers fell intermittently.

77 Barograph Record made at Palmerston, January 4-January 8, 1897, NAA Darwin, E490, January 1897.
78 Meteorological Observations, Port Darwin, January 7, 1897, ibid.
79 Ibid.
80 Ibid.
Unfortunately the structure of these reports – with measurements taken every three hours and rainfall summed every twelve limits what we can know about the pulses of rain during this event. From these categorical slices of time we can tell that a very heavy 10.600 inches or 265 millimetres fell between 9pm on January 6 and 9am January 7. We cannot tell from them if the intensity was constant. Intuition about weather and experience in this region suggests that it would not have been.

The memoirs of Dudley Kelsey, a Post and Telegraphs employee on duty at Port Darwin that night, support this intuition. Kelsey confirms that the worst of the weather struck between 3am and 5am. The telegraph line circuit failed just after 3am and with intense rainfall the telegraphs office began to flood. A store opposite the office literally disintegrated and blew away. In just one and three quarter hours 7 inches or 175mm of rain were registered in the gauge. To put this in perspective, Canberra’s median annual rainfall for the period from 1939 is 617.2 mm. Kelsey detailed the damage in the cyclone’s wake:

most of the town buildings were blown down or wrecked. All the large trees were uprooted and the smaller ones had all the branches stripped of foliage. Many strange happenings occurred during that storm. Roofs of bulk stores...were bodily lifted from their wall plates and carried a distance of half a mile or more into the harbour, and were never seen again.

Iron telegraph poles were bent like thin wire and sheets of galvanised iron were wrapped around the poles like crinkled paper. On the Harbour the pearling fleet consisting of 18 to 20 luggers had a bad time, most of the boast being sunk during the storm.

The town itself presented a most terrible picture. Well built houses, attractive and well furnished were destroyed beyond repair. Stores with huge stocks of general merchandise were razed to the ground and the stock mostly ruined. The places that held together were invaded by homeless people...

Across the harbour at Point Charles Hugh Christie reported similar destruction. Reporting to the Government Resident on 8/1/1897 the head lighthouse keeper described what he saw at daybreak:

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81 Dudley Kelsey, NAA Darwin, E490, January 1897.
the whole forest is denuded of leaves, thousands of trees being torn up or broken off, such a scene of devastation I've never witnessed.83

In more prosaic language Christie also noted that the cyclone had sucked the paint from the lighthouse window frames and the bark from surrounding trees.84

Hugh Christie's account of the actual storm is most revealing. By 10pm the barometric pressure was already lower than at any stage in Darwin. At 1:45am atmospheric pressure reached its nadir: just 28.36 inches on the barometer with calm conditions. The eye in fact had moved over Point Charles. The wind had been blowing from 'E to ESE' then veered to the north before vanishing. At 2:30am as the pressure rose to 28.42 inches the wind quickly picked up from the 'W to SW'. Less than 30 minutes later Christie says 'the full force struck us, the front part of my roof with verandah was torn off and thrown over the cliff into the sea...inside the house was a chaos of flying books, papers, photographic items, and outside was flying iron, stones and trees.'85 Indeed so extensive was the damage that Charles Todd noted in his annual report to parliament on South Australia's weather - almost always published as paper 31 of the parliamentary session in which it was tabled - that the beam of Point Charles lighthouse could be seen from Darwin township at night for the first time since it began operations.86

Weather records show that heavy rains extended far inland. Pine Creek, about 230 kilometres inland from Port Darwin had record-breaking rains of 262.9mm (11.26 inches) in the 24 hours to 9am, 8/1/1897 and Katherine a further 80 kilometres inland had 103.9mm (just over 4 inches) during the same period.87 Closer to the coast, Todd reports, the McKinley 'overflowed its banks to a width of half a mile.'88 The destructive winds, however, did not penetrate far inland. Early reports indicated that timber along the railway had been levelled for about 50 miles inland. Having inspected the damage JAG Little reported to Todd in late February that:

84 Ibid.
85 Ibid.
86 Charles Todd, 'Rainfall in South Australia and the Northern Territory During 1897, Parliamentary Papers, South Australia, No. 31, 1900, p16.
87 Commonwealth Bureau of Meteorology, Climate Data Online: Daily Rainfall, Pine Creek, 1897, Daily Rainfall, Katherine, 1897, both accessed 1/3/2011.
88 Charles Todd, op. cit, p16.
Judging from reports the track of the storm, as shown by trees blown down or stripped of branches and leaves, did not extend further inland than about forty-five or fifty miles.\(^8\)

Starved of the energising heat of warm seas the cyclone had decayed quickly as it moved inland.

The 1897 cyclone was lethal. We do not, however, know exactly how many people perished. The *NT Times* of 25/1/1897 reported 28 deaths – 15 on the water and 13 on shore.\(^9\) However, A Commonwealth Bureau of Meteorology Bulletin published in 1925 suggests that this storm, labelled the ‘great hurricane’, took even more lives at sea.\(^1\) On land, the problems of establishing Aboriginal casualties, in this time before the advent of intense surveillance, make it even more difficult to be sure of a final death toll. According to the *NT Times* hundreds of people were shelterless ‘while the air was thick with sheets of iron, timber and branches of trees.’ Surveying the carnage the report makes it clear that few dwellings were spared. Among ‘business houses’, the stores of Allen & Co. and Rundle Bros and Co. and their goods were smashed, flattened and or ruined by water. Armstrong and Lawrie’s butchering establishment was ‘razed to the ground’ and Mr Lewis’s bakery ‘had nothing standing but the oven.’ Entire blocks and most of Chinatown had been levelled. The ‘Tin’ bank fared better than the ‘Stone’ bank but still sustained notable damage. All government buildings were damaged but few were completely ruined. The Botanical Gardens were all but destroyed and the railway lost many sheds and cottages and, most spectacularly, a locomotive was reported to have been buried in debris.\(^2\) The damage to private dwellings was too extensive for even the *NT Times*’ comprehensive report to detail thoroughly. Even more remarkable than the comprehensiveness of the report is the way it covered the sequence of events during the cyclone. The beginning is worth quoting at length:

The storm which broke over the city on Wednesday the 6\(^{th}\) inst. Culminated in one of the most destructive cyclones ever recorded. From a fairly stiff blow about 8pm the wind increased to hurricane force by 11:30pm or midnight and from then on till nearly 5am it raged with terrific fury. At first the wind was in the east, then it quickly shifted to northeast, and, after blowing from that direction for a long time veered around to the northwest. Accompanying the wind was a downpour of

\(^8\) J A G Little to Charles Todd, Charles Todd, op. cit., p16.
\(^9\) *Northern Territory Times and Gazette*, ‘Terrible Hurricane at Port Darwin”, January 25, 1897.
\(^2\) *NT Times and Gazette*, op. cit.
rain such as even our tropical records have never equalled. Shortly after
the wind shifted to the northwest the city began to tumble into ruins. ³³

Such detail about the sequences of winds is distinctive. Reports in other
Australian newspapers such as the Melbourne Age described the strong winds but
did not detail the sequence of their change over time. ³⁴ The NT Times report shows a
remarkable attention to the actual weather events, in addition to their effects on
the town and its people. What sounds like pedantic, even unnecessarily technical
detail has a far greater significance. This is neither a rhetorical flourish, nor a mere
adornment to the report. Circulating in a town newspaper it transmitted important
detail to readers about the workings of the atmosphere that enveloped Darwin.
Vital details that many readers knew how to read. It would be repeated in reports of
future cyclones that almost struck Darwin, affording an understanding of the
environment unavailable in reports of admittedly vital numerical measurement of
weather phenomena.

Between Darwin’s Cyclones

Physically Darwin was all but destroyed. January 1897 represented a new beginning:
a new town, with new buildings as well as an historical time line calibrated by a new
reference point. The rupture from before was by no means complete; to the contrary
Palmerston rebuilt quickly and resumed its functions speedily. Nevertheless, THE
CYCLONE, of 1897 would be an important temporal landmark, at least until Darwin’s
second destruction, at the hand of men, in 1942. And the first cyclone, after THE
CYCLONE, came in March 1898.

Fortunately for the recovering town the worst of this cyclone struck elsewhere.
The Daly River region, about 150 kilometres to the south bore the brunt. The
meteorological register records that 746 points (approximately 180mm) of rain fell,
noting ‘heavy clouds gathering from all points of the compass, drifting for the most
part northwards. Heavy rain, without but a lull the whole night...NNE winds’. ³⁵ With
direction recorded it seems that the cyclone cell did not pass over the region. From
the constancy of north-northeasterly winds it seems to have been over the waters
off the western Top End before either dissipating or moving further west. Nonetheless handwritten comments on the instructions page of the meteorological
register written around the rules for measuring and reporting rain indicate how

³³ Ibid.
³⁴ Comparison drawn with extensive report of 1897 Cyclone in Melbourne Age, 11/1/1897.
³⁵ Meteorological Register, Daly River for March 1898, NAA, Darwin, E490, March 1898.
bountiful rains were in the region. Continuing earlier remarks the observer states ‘on the 29th the Daly River went over the banks at the Mission Station and rose 39 feet 10 inches on the ordinary dry season level’.\textsuperscript{96} An improvised table of barometric readings indicates that the lowest pressures were recorded at 2pm and 5pm March 28 and that the pressure rose significantly over the subsequent 48 hours.\textsuperscript{97} Lack of significant rainfall after March 28 at Port Darwin, Pine Creek and Katherine, indicates that the system did not move either north or east, and the same for Victoria River Downs shows it did not move south.\textsuperscript{98}

The next 15 years were remarkably quiet. No cyclones even approached any of the Top End’s colonial settlements. Cyclones may, however have approached, even crossed the far north east coast but without observatories to record this no evidence exists to tell us one way or the other. Even the January 1913 cyclone was quite gentle. Surviving records show that it brought rain to Darwin (renamed from Palmerston after the 1911 Commonwealth takeover of the Northern Territory) and its surrounds. The General Monthly Remarks from Point Charles for January 1913 place the event in its meteorological context:

Weather still peculiar. Early part of month very hot & less than usual rain, most of which came from S & E with thunderstorms. The last two days very heavy rains & wind veering suddenly from west swest (sic) gales to SE later to NE with almost hurricane force.\textsuperscript{99}

Rains certainly were heavy on the 30\textsuperscript{th} and 31\textsuperscript{st}. 446 points (approx 110mm) registered on the former; 560 points (about 140mm) on the latter. Only minor damage was reported. However, as the \textit{NT Times} of 6/2/1913 reported, this ‘sinister weather’ was severe enough to remind old timers of the 1897 cyclone.\textsuperscript{100} In fact this was one of the rare occasions in the period 1900 -1937 when the 1897 cyclone was explicitly mentioned in the local press.

Another cyclone struck the Daly River region in January 1914. Surviving records are scant and this system has left its mark primarily in rainfall figures showing that Daly River Experimental Farm and Victoria River Depot recorded the highest falls – 594 points (nearly 150mm) and 717 points, (nearly 180mm), on

\begin{footnotes}
\item[96]Ibid.
\item[97]Ibid.
\item[98]Bureau of Meteorology, \textit{Climate Data Online}, Rainfall March 1898, for station sites 014016, 014933, 014902 & 014825, respectively.
\item[99]Meteorological Observations, Point Charles Lighthouse, January 1913, NAA Darwin, E490, January 1913.
\item[100]\textit{NT Times}, 2/6/1913.
\end{footnotes}
January 5. The *NT Times* of 8/1/1914 describes the wind sequences experienced in Darwin indicating that the cyclone was mostly over the warm waters off the western coastline of the Northern Territory.

Two cyclones struck the Top End during 1915. The first came in the last days of February. At this time the standard table of official observations from the Commonwealth Bureau of Meteorology comprised horizontal lines for each day of each calendar month, with vertical columns for ‘Rain during previous 24 hours recorded at 8:30am’, ‘wind’, itself divided into two columns: ‘direction from’ and ‘Force 0-12’ – the Beaufort scale having been adopted when the Commonwealth took charge of Northern Territory meteorology in 1908. ‘Cloud, scale 0 to 10’ came next, followed by a half-line space for each day’s ‘State of Weather at 8:30am’. This page was complemented by a second page for monthly weather comprising a horizontal line for each day in which ‘remarks on the weather during the 24 hours (frosts, rain, hail, &.)’. Standard official monthly observations were rounded off with a section headed ‘General Monthly Remarks’. Under this heading observers are requested to ‘kindly note here notes on stock, crops, insect and bird life, the growth and flowering of plants, state of the river (if any), and peculiarities of the season’. Official weather was not just about numbers. Kinds of events were categorised on scales and pithy narratives enabled sequences of events to be outlined. Within these narratives, information such as type of cloud, not covered in standard tables, were frequently included to provide a more complete picture of the ripples, waves and eddies in the great aerial ocean. Particularly noteworthy is that these clerical procedures of recording weather also aimed to discipline observers into paying attention to connections between weather, the water, and the land more generally and weather, plant life and animal life more specifically. While this is unsurprising given government efforts at experimental agriculture in the Northern Territory during the early twentieth century, this explicit connectedness to other parts of nature stands in contrast to how weather records have been taken and used by the weather bureau since about 1950.

February 1915 was languid. In his remarks on the weather during the past 24 hours, the observer at Melville Island noted ‘light NW winds and calm greater part

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101 Cyclone 1-5 Jan 1914, NAA Darwin, E490, January 1914.
102 *NT Times*, 8/1/1914.
103 This and all subsequent quotations and material discussed in this paragraph come from the template provided by Meteorological Observations made at Melville Island, Division 2, South Australia (sic), During the Month of February 1915, NAA, Darwin, E490, February 1915.
of the month'. In fact, brackets preceding this remark, and an absence of any other entries before the 26th reinforce this. The second entry told a different story:

Cyclone from 4am until noon, wind started from SW and went around to NE then abating...lightning and heavy thunder and heavy rain.

Entries in tables of the accompanying previous page support this showing just under 100mm for 25/2 and just over for the 26th, with winds on the 26th ‘SSW to NE’ at ‘cyclone’ force with low cloud; no rain and light NW winds were recorded on the 27th. On adjacent Bathurst Island an almost identical sequence of events played out:

Cyclone lasting from 1am till noon. Barometer fell in half an hour from 30 to 29.7, returned to normal in two hours- great damage to buildings, crops and shipping.

Wind started southwest and gradually turned northeast.

In contrast to both Bathurst and Melville Islands, both of which received over 200mm of rain from this system, Point Charles and Darwin recorded less than 50mm. With Cape Don Lighthouse yet to be built there were no official weather stations to the east of the Tiwi Islands before 1917. Home and Territories Department correspondence on shipping damage from the Harbourmaster of Darwin indicates that the cyclone tracked east from Melville Island. Two vignettes from the harbourmaster’s memorandum to the Administrator give a sense of how this locale was affected:

Captain Edwards luggers Lelia D16 and Afric D9 were anchored at Okley Island; the Lelia D16 heaved up anchor on 25th February, wind blowing a gale from the East, blew her over to Cape Croker. In the meantime they had cut the mast down. The weather here became calm for a while, and blew again in a hurricane force from the nor’west and blew the Lelia D16 on to Darch Island, leaving her high and dry a wreck. The crew landed and remained on the island taking all gear out of the boat and placed it on the island; then they left for Bowen Straits in a dinghy, six men arriving on the 6th inst.

The second is as poignant as the first is dramatic:

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104 Ibid.
105 Ibid.
107 Cyclone 26 February 1915, Ibid.
...From Point Danger to Bowen Straits and Croker Island clearly shews (sic) with the naked eye that this portion of the mainland and island suffered considerably from the blow; trees are stripped of leaves and blown down...we have been informed that the full force of the blow was felt there (Port Essington), and the Jane B was swamped and blown on the reefs; about six natives lost their lives. Jimmy Kafor is missing. 109

Evidently the eye passed close to Croker Island and Cape Don and may have even crossed the Cobourg Peninsula. East of Port Essington all documentary traces disappear.

Just before Christmas 1915 a cyclone almost struck Darwin. Reported in the NT Times as a ‘big blow’, 110 it was more distinctive for the widespread rain it brought. 871 points (approximately 215mm) fell on Oenpelli, in the far west of Arnhem Land, on December 22. Slightly under 200mm (790 points) drenched Point Charles on 23/12. Darwin Post Office recorded just over 200mm between the 22nd and Christmas Eve. Over 250 kilometres away Katherine reported 416 points (over 100mm) on December 24. 111 The path of this system is impossible to ascertain on available evidence but it does seem to have penetrated further into the inland than earlier recorded cyclones. While distinguished by this widespread heavy rainfall, its winds nonetheless cut a swathe of destruction through the landscape. Reporting from Point Charles Lighthouse, Hugh Christie, painted a vivid picture:

The country until the 23rd looked well, but the cyclone has made serious devastation. Thousands of trees were uprooted or broken off & the forest is almost impassable with fallen timber, that which remain are bare poles. We appear to have been on its eastern edge as natives describe the ravages on the islands 13 to 20 miles SW as terrible, whereas to the eastward toward Darwin it seems to have eased off considerably. 112

From this we see how localised effects of cyclones can be. While the lush verdure of the eastern Cox’s Peninsula was barely marked, the western side, just 50 kilometres way was transformed into a landscape of toothpicks.

109 Ibid.
110 NT Times, 30/12/1915.
112 Meteorological Observations, Point Charles Lighthouse, December 1915, ibid.
'Cyclone started at 10:30pm on 31st March'.\footnote{113} Indeed the general monthly remarks of the March 1917 Meteorological Register for Point Charles Lighthouse recorded nothing else. Daily observations show that winds were SW at force 3 during the morning of 31/1, force 9 from the E 24 hours later and easterly at force 4 on the morning of April 2nd.\footnote{114} The heaviest rain fell on Melville Island on the 30th and 31st of March but came two days later to Point Charles and Darwin.\footnote{115} Meteorologically this cyclone was fairly insignificant. A 'usual visit of myriad horse stingers' in the first half of the month and magpies during the latter half, and not the cyclone, featured in the general monthly remarks for Darwin for April 1917.\footnote{116}

In January 1919 a very different scenario unfolded. A common but till then largely undocumented event occurred: a cyclone moved into the Top End from the east, over the tepid waters of the Gulf of Carpentaria. From the recorded wind sequences at South Goulburn Island – off northern Arnhem Land – the eye seems to have passed to the south of far northern Arafura and Gulf coasts.\footnote{117} The daily remarks for that place and month simply record that ‘the cyclone began 10th ended morning of the 13th’ and the general monthly remarks inform us that many trees were uprooted and that rain was unceasing.\footnote{118} Heavy rain fell as far south as Borroloola and the heaviest rain fell far to the west, in Oenpelli. However from the insignificant rains recorded in Darwin during this period we can conclude that the system dissipated long before approaching the western Top End.\footnote{119}

Within weeks another cyclone stalked the Top End. Bringing heavy rain to Point Charles, Darwin, the Tiwis, Oenpelli and Cape Don between March 5 and March 7, this event is distinguished by the devastating storm surge that swept away much of Bishop Gsell's mission on Bathurst Island. His report eloquently speaks for itself:

During the night the wind and rain doubled in fury as the seas thundered on the beach...towards ten o'clock trees began falling and its was not long before our more fragile buildings collapsed. That awful night wore on until, at five o'clock in the morning the elements seemed

\footnote{113} Meteorological Observations made at Point Charles Lighthouse, March 1917, NAA Darwin, E490, April 1917. 
\footnote{114} Meteorological Observations, Point Charles Lighthouse, March 1917 and April 1917, Ibid. 
\footnote{115} Cyclone 1 April, ibid. 
\footnote{116} Cyclone 1, ibid. 
\footnote{117} Meteorological Observations Made at South Goulburn Island, January 1919, NAA Darwin, E490, January 1919. 
\footnote{118} Ibid. 
\footnote{119} Cyclone 10-13 Jan 1919, Ibid; Bureau of Meteorology, Climate Data Online, Rainfall, January 1919 for station site, 014016.
even more frenzied as more trees and huts fell. Finally a tidal wave came rushing in and carried away the lot.\textsuperscript{120}

Unfortunately only rainfall observations survive from Bathurst Island Mission for this time. Observations taken on Melville Island and at Point Charles are too distant to help us understand what exactly happened locally. Moreover, given that storm cells can be generated by cyclones, causing brief periods of even more intense winds, the practise of recording wind at discrete points in time, such as every 24, or even 6, hours, is a veil against understanding local events such as this. A contributing factor to the surge is that the cyclone struck the island just three days after a peak spring tide. Also, the worst of the cyclone hit perhaps as soon as one hour before high tide. Whether the contingency of a severe storm embedded in the cyclone is yet another element in this confluence of cyclone and high tides cannot be determined on available evidence.

Cape Don was not spared the ravages of this cyclone either. The keeper of the newly opened lighthouse reported that thousands of trees were denuded of leaves and that the winds made the 118 ft tower of reinforced concrete ‘sway alarmingly’. At Cape Don the lowest reported pressure was 29.11 or 985.7 hectopascals at 3pm on the 6\textsuperscript{th} and from the sequence of winds outlined the eye travelled to the south of Cape Don.\textsuperscript{121}

1920 was the second time a cyclone approached Darwin just before Christmas. Heavy but far from phenomenal rains fell on Darwin and Point Charles on the 22\textsuperscript{nd}. Oenpelli recorded substantial rain on December 22 and 25 while Roper River Mission reported heavy falls on the 21\textsuperscript{st} and 22\textsuperscript{nd}. The daily weather remarks entered for Darwin on December 21 and 22 note that it was ‘oast heavy rain squally’ and ‘raining all night, stormy, gusty showers’, respectively.\textsuperscript{122} Without data on windspeeds and pressure it is, in fact, impossible to distinguish these weather events from those typically accompanying a monsoon trough or tropical low in this region.

Furies felled the nascent settlements on the Vanderlin Islands during January 1921. No weather records from these islands, in the south west corner of the Gulf of Carpentaria, survive. Indeed, it is not even clear if any meteorological records were taken there at the time. The earliest records available through the Bureau of Meteorology for Vanderlin Island, Centre Island and Bing Bong, the nearest point

\textsuperscript{120} F X Gsell, Bishop with 150 Wives: 50 Years as a Missionary, (Sydney: Angus and Robertson,, 1955), p126.
\textsuperscript{121} Meteorological Observations, Cape Don Lighthouse, March 1919, NAA Darwin, E490, March 1919.
on the mainland, go no further back than the 1950s. Nevertheless we learn from Home and Territories Correspondence that all new buildings, gardens and fences were destroyed by cyclonic winds on January 9th. Stores of provisions were ruined and ships driven ashore. A telegram from the Administrator in Darwin states:

Hurricane blew seventeen hours great violence stop At date sixth February roads impassable to Borroloola and weather too rough for boats in Gulf.123

Widespread rain did not penetrate far inland. Although Borroloola did record 55mm of rain on the 9th, it in fact received both below mean (192.8mm) and below median (159.2mm) rainfall for the whole calendar month.124

The cyclone that struck during March 1922 is more significant for the rain it brought across the entire southern half of the Top End. Notably no severe falls were recorded, but substantial rain, for periods of 4-7 days in places as far apart as Borroloola, Katherine, Timber Creek, the Roper River Mission.125 On paper this looks like an active monsoon trough but has been classified a cyclone by the bureau.

Known, notoriously, as the ‘Douglas Mawson’ cyclone, the big blow of March 1923 is among the best documented. Two factors account for this: that it sank the steamer Douglas Mawson in the Gulf of Carpentaria with the loss of twenty lives and the cyclone’s remarkable range. H E Whittingham of the Bureau of Meteorology Brisbane, has written detailed reports, and these, along with detailed reports from Groote Eylandt mission are supplemented by data from the bureau.

Between March 21 and April 3 this system traversed much of Australia’s far north.126 Maps included in H E Wittingham’s case study, itself appended to a bureau paper on the 1964-65 Cyclone season, chart the path and location of this tempestuous vortex throughout its entire life.127 Forming about 400 kilometres east-south east of Cape York on 21/3 it headed in a west-north westerly direction for four days before tracking northwards between Badu Island and Cocoanut Island, in Torres Strait. Over the next 24 hours, between 9am on 26/3 and 9am March 27, the cyclone accelerated and looped, tracing an almost elliptical curve before

123 Home and Territories Correspondence File, NAA Darwin, E490, January 1921.
124 Bureau of Meteorology, Climate Data Online, Rainfall, January 1921, for station site 014710.
125 Cyclone Mar 1922, NAA Darwin, E490, March 1922.
126 Times and dates given by Wittingham are Greenwich Times – usually 23 hours on each particular date; I’ve converted these to local time, so 23 hours on March 20 and April 2 in Wittingham’s studies become 9 hours March 21 and April 3 and so forth.
127 All details in this paragraph come from this paper unless otherwise noted: H E Whittingham, Appendix 1, Douglas Mawson Cyclone, NAA Darwin, E490, March 1923.
intersecting its early path and turning for the west at a point over the Coral Sea about 200 kilometres south east of Cape York. By the next morning it had crossed the coast and was half way over Cape York Peninsula near McDonnell, about 75 kilometres south of the cape. During the afternoon it crossed the western coast of the peninsula, into the Gulf of Carpentaria in the vicinity of Coen River. Perhaps an artefact of the paucity of available observations, Whittingham’s chart shows the cyclone tracking in an almost straight west-southwesterly path across Groote Eylandt and then Roper River Mission over the next three days. Decaying into a tropical low its path curved to a more westerly and then west north westerly path on April 1 before crossing into the waters off the western Top End late on April 2nd or early on the 3rd. Charts on the Bureau of Meteorology’s online tropical cyclone data base both corroborate these details about the cyclone’s track and confirm that the cyclone did not reform after entering the space above the warm waters of Joseph Bonaparte Gulf.128

Unsurprisingly the cyclone was felt across a massive area. According to Whittingham, rough seas were observed as far North as Port Moresby, as far south as Cooktown and salt deposits were noticed on banana plantations throughout the Torres Strait Islands. So violent were waters in the Gulf of Carpentaria that Normanton’s shire clerk stated to the subsequent Marine Board of Enquiry(sic):

There must have been an exceptional upheaval in the Gulf, as the breakers were coming into Karumba at Easter mountains high, and of a very dirty muddy colour...the flats around being inundated for miles. 129

Waters also surged over much of the coast to the west. In the Vanderlin Island /Port McArthur region waters rose to 18 feet above spring tide levels and more than 20 feet above the highest tides on Groote Eylandt.130

The floods even took the weather bureau’s records! The notes for Emerald River, Groote Eylandt, for March 1923 begin ‘Owing to flood the rain records for March were washed away’. 131 The narrative ends with loss, destruction and recoveries: lost and later found rain gauge, lost thermometer, intact measuring

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129 Quoted in H E Whittingham, op. cit, p85.
130 Ibid.
glass inside a wrecked house.\textsuperscript{132} Even before the cyclone it had been a wet month. The observer, and head of the Mission at Emerald River, H L Perriman estimates that about 18 inches – 450mm had already fallen before the 28\textsuperscript{th}. In the 24 hours to 8:30 am March 31\textsuperscript{st} the register notes that 1400 points (350mm) had been recorded and that the gauge had been lost, presumably after the reading had been taken.\textsuperscript{133} Perriman’s detailed account of the cyclone is compelling: strong easterlies started blowing on the 28\textsuperscript{th}, strengthening during the 29\textsuperscript{th} they veered toward the south east and brought heavy rain – 6 inches by 8am on the 30\textsuperscript{th}. As the gale force winds blew and rains unceasingly fell trees were blown down and the mission house was isolated by rising flood waters. With the river bursting its banks the waters could go nowhere but up, forcing Perriman and 14 others to seek refuge on the upper level of the mission house. Before long the front wall of house blew in, the roof peeled off and the waters rose to 23 feet -the level of the 2\textsuperscript{nd} floor of the mission house.\textsuperscript{134} As the house collapsed to an angle of 45 degrees they spent the night in ‘pitch dark, with the howling wind and piercing rain, with thunder and lightning at intervals...expecting at any moment for the end to come’.\textsuperscript{135} During the afternoon of March 31 winds and rain abated. In a second stroke of good luck, after surviving these furies, most of the flour and tinned food had not been damaged; after the floodwaters receded the survivors of this merciless tempest spent that night in wet blankets, under a makeshift shelter. The once verdant landscape had been rendered a wasteland:

At the rear of the Mission site there was a wonderful tropical jungle, edged by some paperbark swamps. This jungle was completely destroyed, and never regained its growth again. It took some time before the hardwood trees regained their leaves again. For some time after the flood there was an absence of bird and animal life –except for a few large centipedes, and soon mosquitoes became very plentiful and gave us a bad time. We lost all our lovely birds of the island.\textsuperscript{136}

In an unsurprising conclusion to his account, H L Perriman tells us that the second Mission site was located above the 23-foot flood level and had an easy escape to the hills.

\textsuperscript{132} Ibid.
\textsuperscript{133} Ibid.
\textsuperscript{134} NAA Darwin, E490 March 1923.
\textsuperscript{135} Ibid.
\textsuperscript{136} Ibid.
Nearly six years passed before the next cyclone struck the Northern Territory. During this hiatus twelve cyclones formed over the Coral Sea, with four travelling as far south as the vicinity of Lord Howe and Norfolk Islands. Off the west coast things were calmer, with only eight cyclones forming over the Indian Ocean during that period. None of these systems even approached the Top End or its adjacent waters. Like its predecessor, the February 1929 cyclone tracked westwards across the warm waters of the Gulf of Carpentaria however, its winds were far less destructive. Indeed no indications of its wind strength survive. The Bureau of Meteorology record of the cyclone notes that no wind was recorded at Katherine, just 400 or so kilometres from where it made landfall. This system’s signature was rainfall and even then in the worst affected region — the eastern Roper River—accumulated falls summed to under 200mm in contemporary parlance.

The next ‘seasons’ were far more active than the previous few. In early January 1930 another cyclone followed an almost identical path across the Gulf to the Roper McArthur region. After crossing the coast close to Borroloola it arced toward the south-west before quickly decaying. Winds were unexceptional – Perriman’s notes for the 7th on Groote Eylandt state that ‘a very strong wind came up during the night with rain and lightning’. Rainfall was also unexceptional. While measured volumes were unremarkable (no rain gauge received more than 400 points, or 100mm) the spread of rainfall is noteworthy. This system brought rain across the entire base of the Top End: from Borroloola in the east to the Victoria river basin in the west.

Forceful winds and flooding rain again beset the Roper McArthur region in 1931, twice. From surviving documents the status of the weather system which brought these is confusing. Although the Bureau of Meteorology created two tropical cyclone case study files for the Northern Territory, the bureau’s online tropical cyclone database shows that no actual tropical cyclones hit the Northern Territory that season. An unnamed cyclone formed south of Groote Eylandt and moved eastwards across the Gulf of Carpentaria, crossing the western coast of Cape York Peninsula 28 hours later. Fifteen hours later it crossed the peninsula’s east coast north of Cooktown before tracking to the southeast. After five days it approached the Wide Bay region where it tarried and looped for 48 hours before

138 Ibid.
140 Bureau of Meteorology, Online Tropical Cyclone Database, Tropical Cyclone Tracks, 1929-1930.
142 Tropical Cyclone 6-8 Jan 1930, NAA Darwin, Ibid.
tracking toward the east and dissipating about half way to Vanuatu.\textsuperscript{143} Cyclone or not, the system brought about 200mm of rain to Roper Bar between January 26 and 30 and an observation from Roper Mission noted on 31/1 ‘River about 24ft above the high water level –the highest flood since 1916’.\textsuperscript{144} Much closer to the core of the system H L Perriman was unequivocal that this was a hurricane:

> We had a big blow near the near the end of January with very heavy rains, about 22 inches in 3 days. This brought a big flood, which did considerable damage, washed away our bridge, broke up our irrigation pumping plant, damaged the sawmill, washed away about 30 cypress pine logs, washed away 5 fences which run to the river, also washed away our nice new jetty, besides damaging our property, roofs etc...
> When the heavy rains and hurricane were upon us there was hardly a dry place anywhere as the terrific wind blew the rain horizontally through every crack and opening.\textsuperscript{145}

There is no trace of an April 1931 cyclone on the tropical cyclone database. Yet what Perriman describes on Groote Eylandt in his entries for the 8\textsuperscript{th}-10\textsuperscript{th} of April definitely resembles a cyclone. In the 48 hours to 8:30am, 9/4/1931 over half a metre of rain was registered at Emerald River Mission. Winds were ‘very strong’ ‘changing from SE to S’ ‘S to SW’ then ‘SW to W’.\textsuperscript{146} In the absence of quantified measurements of wind speed and central pressure it is impossible to determine whether this was a short-lived cyclone or a vigorous tropical low. In any case waters on Groote Eylandt rose to within a foot of the 1923 flood levels.\textsuperscript{147}

The 1932 cyclone was extraordinary. Its blows were not particularly forceful. The intensity of its widespread rains was in line with events already experienced in the region.\textsuperscript{148} Uniquely during the period of this study, this cyclone spent its whole life over land. Tropical cyclones generally feed off the vast reserves of energy stored in the soupy airs above warm tropical seas. Forming on January 30 east of Katherine this system headed north to western Arnhem land before making a sharp turn and accelerating southwestwards. Passing to the south of Wyndham on February it tracked westwards across the Kimberley and arced towards a more south-

\textsuperscript{143} Bureau of Meteorology, Online Tropical Cyclone Database, Tropical Cyclone Tracks, 1930-31.
\textsuperscript{144} Cyclone 26-30 Jan 1931, NAA Darwin, E490 January 1931.
\textsuperscript{146} Meteorological Observations, Emerald River for April 1931, NAA Darwin, E490 April 1931.
\textsuperscript{147} Perriman in Keith Cole, op. cit., p56.
southwesterly direction, starving above the infinity of dust and sand 300-400 kilometres south east of Broome during February 3.49

For five days in January 1935 a cyclone tracking south over western waters of the Gulf of Carpentaria brought fierce conditions to much of the northern and eastern Top End. The tropical cyclone database maps show that it formed on the 15th not far to the south east of present day Nhulunbuy. After gliding in a south-southwesterly direction for just over 18 hours the system made an abrupt 90 degree turn toward the east-south east and then cut a bass clef shaped path through the skies before disintegrating about 200 kilometres north of Alice Springs on January 21.50 Unsurprisingly this cyclone dumped heavy rain on Borroloola and Groote Island. But this event is particularly interesting because it illustrates just how widespread the effects of these systems are and that cyclones do not materialise from nothing, often intensifying from tropical lows and monsoon troughs, which cause significant weather even before a cyclone becomes an integrated structure. The notes inherent in that month’s meteorological observations for Cape Don record ‘cyclonic conditions’ for the 13th, 14th and 15th January 1935, with 1358 points (about 275mm) in the 24 hours to 8:30, 13/1 and a further 900 or so points in the following three days.51 Winds only veered from the west to south west here. About three hundred kilometres further east, at Milingimbi in the Crocodile Islands rains were heavy, but not as heavy, and the winds turned through all points of the compass:

(Jan 14) Wind NW to NE, lightning in rain
(Jan 15) Wind NE to E to SE increasing in force – severe cyclone
(Jan 16) Wind S, strong with heavy rain, then to west
(Jan 17) Wind west, strong; heavy rain at night

Rain persisted until the eye of the cyclone was more than 1000 kilometres way. With the advent of satellite and radar technology in the following decades we have been easily able to see that cyclones have arms – spiralling curves along which flows of instability and moisture form rain bands extending from way beyond the periphery of the cyclone towards its core. It seems that Milingimbi was in this river of saturated, unstable air and this cyclone was the first in the Northern Territory sufficiently documented to indicate this characteristic.

49 Bureau of Meteorology, Online Tropical Cyclone Database, Tropical Cyclone Tracks, 1931-32.
50 Ibid., 1934-35.
Darwin 1937

Darwin was struck by a second cyclone in 1937. By then it was a much larger 'city' than it had been when the furies of 1897 blew much of the settlement apart. According to the NT Administrator's annual report on June 30, 1936 the population of the Northern Territory was '5675, consisting of 3,768 Europeans, 809 'Asiatics', fourteen other races and 1,084 half-castes'. No figures for Darwin are given but a majority of the Territory's non-Aboriginal population was thought to have lived in Darwin at this time. Under the intense surveillance of Cecil Cook Aborigines here were more finely differentiated and precisely counted than the non-Aboriginal population. Divided into 'Full Bloods' and 'Half-castes' people in each of these categories were further divided into groups of 'Adults' and 'Children' and then further into 'Male and Female'. In stark contrast to the rest of the population, people for each of these categories were enumerated for 22 different locations. Tabulated figures show that among the 'full bloods' there were 1,530 adult males, 1,085 adult females, 300 male children, 310 female children; and among 'half-castes' there were 58 adult males, 109 adult females, 52 male children and 79 female children in Darwin in 1936. Four government schools operated in Darwin, including a school for 'mixed blood' Aboriginal children at Kahlin compound. During the 1934-35 season 16,938 bags or 423 tons of crops were 'exported' – more than half to the markets in Sydney and over 42,000 pounds worth of goods were exported from Port Darwin in the year ended 30th June 1936.

By 1937 Darwin had come to play a major role in Australian aviation. Local meteorology geared itself to the needs of aviation. In 1919, Ross Smith landed in Darwin and became the first person to fly from Britain to Australia in less than thirty days. Within this period two flights a week, in each direction, came to operate on the Sydney to London route and all flights landed in Darwin. Another route connected with Adelaide in Darwin, itself connecting with Perth at Daly Waters. To paraphrase David Bridgeman, among others, Darwin had become Australia's 'front door'. As George Mackey, head of the Bureau of Meteorology office in Darwin from September 1937 to 1941, recalled in an interview conducted by the Northern Territory Archives Service (NTAS) Oral History unit, the bureau's Darwin office was

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154 Aboriginal Census, Ibid., p324.
155 Ibid.
156 Ibid., p328.
157 Ibid., pp325-329.
158 David Bridgeman, PhD Thesis, op. cit., p111

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responsible for providing flight forecasts.\textsuperscript{159} Notably, meteorology here had ceased to be a two-dimensional endeavour. However, commercial aircraft were not pressurised and so flew at low levels. And the extent of this third dimension in the study of the atmosphere must not be overstated: the only upper air data for tropical Australia came from pilot balloon observations in the vicinity of Willis Island from 1924 and, after 1934, from balloons released from Darwin.\textsuperscript{160} By 1937 upper-air soundings, at altitudes of 5,000 and 10,000 feet were taken at Koepang on the coast of the west of Timor. With aviation routine weather reports became more detailed. Significantly, wind strength was measured as a whole number velocity in miles per hour and not as an estimated category of force. At aerodromes, such as Darwin’s, and nearby observatories winds were recorded on the hour, every hour, as well as at the routine times more broadly practiced by the bureau.\textsuperscript{161} Given this ever tightening nexus between meteorology and aviation in Darwin during the years preceding and during World War II, it is unsurprising that the Royal Australian Air Force (RAAF) undertook a sophisticated study of the 1937 blow.

Early on March 11 wind gusts of 98 kilometres per hour were recorded.\textsuperscript{162} As the introduction to the RAAF’s case study notes, this cyclone warrants attention not only because of the destruction it brought to Darwin but also because as an integrated tropical depression it later interacted with systems in the Coral Sea, bringing severe rains and flooding to much of Queensland.\textsuperscript{163} For the first time we can study a Top End cyclone in connection with the weather systems that surround it. Using standardised charts of surface-level pressures the study constructed maps showing changes in pressure over 24 hour periods – giving a sense of how systems are developing. The chart for March 6 showed nothing unusual: a building high over southern Western Australia and a dip in the isobars near the Gulf of Carpentaria. While there were insufficient measuring stations over the Timor Sea to chart the airs above it in detail, light variable upper winds at Koepang unequivocally ruled out the possibility of a cyclone over the Timor Sea.\textsuperscript{164}

Charts for March 7 over Australia illustrated a typical pattern. Lowering pressure over the Gulf of Carpentaria drew monsoonal trough southwards there, but elsewhere the trough remained to the north of the continent. Further north, however, one of the many contingencies necessary for the development of this

\textsuperscript{159} Interview with George Mackey, Northern Territory Archives Service (NTAS), 1195, PB 215, pp 11-13.
\textsuperscript{160} Ibid., p4.
\textsuperscript{161} Wind Record for the Month of March 1937 & Meteorological Observations made at Darwin, March 1937, Folder 6, NAA, Darwin, E490 March 1937.
\textsuperscript{162} Extract from Weather on the Australian Station, NAA, Darwin, E490, March 1937.
\textsuperscript{163} Ibid.
\textsuperscript{164} Ibid.
cyclone was underway. Over the Celebes and much of the Indonesian Archipelago, air pressures began to rise, simultaneously falling over northern Australia - indicating southward movement of the monsoon trough and a building of forces pushing it further south. This is standard for the movement of monsoon troughs in the region. However, the RAAF study states that ‘these changes probably lent impetus to the developing cyclone’. Moreover, upper level winds at Koepang and Darwin on March 7 indicated that an intensifying low had formed over the Timor Sea.

This disturbance is evident on the chart for March 8 as a tight curve in the isobars to the west of Darwin. According to the RAAF report, the Intertropical front, or monsoon trough, had crossed the coast of Arnhem Land but it was the strengthening upper level westerlies at Koepang in concert with changes in the surface winds at Koepang to south-westerlies and at Melville Island to building north-westerlies, that signified the development of a closed cellular system and the likelihood of cyclone development.

By March 9 the vortex had moved about 150 miles (250 kilometres) closer to Darwin. That day's chart showed a distinct, tightening cell of falling pressure closing around Darwin and the region 200 or 50 kilometres to the north-west. With strong upper-level winds at Koepang and Darwin it is not surprising that the bureau issued a cyclone warning for Darwin and waters to the north and west during the afternoon of the 9th.

Thick low cloud above Darwin obscured soundings from higher altitudes on March 10 but that day's chart shows a cyclone approaching Darwin from the northwest in the form of rapidly decreasing pressures across the whole north-western Top End, from the Daly River Region to the Cobourg Peninsula, the Tiwi Islands to Pine Creek, even Katherine.

'The cyclone centre passed Darwin at 0125 hours Darwin time on the 11th, the minimum pressure reading, corrected to mean sea level being 28.980 inches' (975hPa), according to the RAAF study. At 9am cyclonic force squalls were still blowing from the south-west, bringing rain. By then the cyclone was about 80 kilometres to the east. Indeed the continent-wide synoptic chart compiled at Brisbane for 9am 10th and 11th of March 1937 corroborate the scenario illustrated by

\(^{165}\text{bid.} \quad ^{166}\text{bid.} \quad ^{167}\text{bid.} \quad ^{168}\text{bid.}\)
the ‘pressure change’ maps used in the RAAF study.\textsuperscript{169} By the 13/3 the system weakened into a tropical low but had sped to the air above the south-eastern corner of the Gulf of Carpentaria.

A slightly different narrative of events can be constructed from the bureau’s tropical cyclone database. There is certainly no disagreement over the strength of the cyclone, nor over the time it hit Darwin or the path it took afterwards. With the benefit of more information than was available to those who drew the daily charts, however, the bureau has been able to draw a cyclone track map based on observations from more frequent intervals than every 24 hours. From this it is clear that rather than taking a linear path in from the Timor Sea toward Darwin the system changed direction to the west – southwest of Bathurst Island. It subsequently looped around Bathurst Island between March 8 and March 10, crossing Melville Island in the process. It then tracked across Beagle Gulf in a south-south-westerly direction toward Cox’s Peninsula before turning toward the east-south east not far to the west of Darwin. It is clear that the eye did not cross Darwin and its immediate surrounds – the central pressure of the eye at 1am 11/3 was 955hPa and the lowest pressure recorded at Darwin Aerodrome was 975hPa.\textsuperscript{170}

Wind was much more of a problem for Darwin than rain. Scarcely 2 inches or 50 millimetres fell in Darwin in the 24 hours to 9 on March 11.\textsuperscript{171} This system brought more significant falls of over 150mm to Koolpinyah, just 40 kilometres to the east of Darwin and over 125mm to Manton Dam not much further to Darwin’s southeast. Similar falls were reported at Mataranka and Tipperary Station well into the hinterland and the highest recorded falls came from the Daly River, summing to about 175mm.

As with the 1897 cyclone, Darwin’s newspaper paints an arresting picture. During the 1920s Darwin gained a second newspaper – the \textit{Northern Standard}. For several years the \textit{NT Times} and \textit{Northern Standard} competed but from 1932 the latter became Darwin’s sole local newspaper. As with its predecessor, its articles were detailed and literary. The \textit{Standard’s} accounts of the 1937 cyclone are compelling. The beginning of the 2000 or so word article in the 12/3 edition, under the headline ‘Destructive Cyclonic Storm’, reveals something of its flavour:

\textit{Leaving a trail of destruction in its wake a cyclone of great intensity struck the town on Wednesday night and raged throughout the hours

\textsuperscript{169} Synoptic Charts, Brisbane, March 8-13, 1937, NAA, Darwin, E490 March 1937.
\textsuperscript{170} Bureau of Meteorology, \textit{Online Tropical Cyclone Database, Tropical Cyclone Tracks}, 1936-37.
\textsuperscript{171} This and all other rainfall figures here come from the file :Cyclone March 1937, NAA, Darwin, E490 March 1937.
of darkness and diminishing as the new day advanced. When dawn broke on Thursday a scene that it is hard to find words to describe was disclosed. Houses were blown down, buildings unroofed and damaged trees blown over and those left standing were denuded of foliage and were, for the most part, broken wreckage....during the early hours of the morning the tempest reached its highest velocity and it raged and tore to such vicious purpose that hardly a home or business house in Darwin did not suffer some damage.\textsuperscript{172}

Destruction was widespread but unlike the 1897 cyclone this did not destroy the entire town. While there is no evidence of attention being paid to engineering buildings better able to withstand cyclonic furies during this period between cyclones, far fewer buildings in Darwin 1937 were as makeshift as those 40 years earlier. With the town becoming more settled, and with the NT having become a Commonwealth responsibility, construction in the lead-up to 1937 was of a better standard than the buildings of Darwin before 1897. Moreover, the two cyclones were not the same. One distinct continuity from 1897 to 1937 and from the NT Times to the \textit{Northern Standard} was the inclusion of wind sequences in the reports of the cyclone. With winds howling from ‘the east to N.NE and later to North-East’,\textsuperscript{173} structures were not buffeted from the variety of directions they were in 1897, which is now understood to be more damaging than winds from similar directions. Moreover, the 1897 cyclone brought lower air pressures to Darwin, though without quantified wind speeds for 1897 and in the absence of detailed information enabling comparisons between the pressure gradients of the two systems it is impossible to state with certainty which cyclone brought the strongest blows to Darwin.

Nevertheless the damage catalogued by the \textit{Northern Standard} was serious and widespread. Hickey’s Mart was destroyed, its stores waterlogged and Low Wah’s blacksmith shop smashed beyond repair. Roofs were wrenched from L Tang’s shop, Alinio’s barber shop, A. S. Drysdale and Co.’s garage, as well as the premises of enterprises ran by Goon Pan, Okada, E Yuan, Fong Lau and Jolly and Co., just to mention a few. The kitchen of the Imperial Café, and the Star Theatre were wrecked...indeed the numbers of damaged buildings featured in the \textit{Standard’s} article tallies to the hundreds.\textsuperscript{174} Yet, a Department of the Interior report states

\textsuperscript{172}Destructive Cyclonic Storm’, \textit{Northern Standard}, 12/3/1937.
\textsuperscript{173}ibid.
\textsuperscript{174}ibid.
'there is no shortage of supplies' and that damage at 'the Darwin school' was so slight that school could be resumed 'on Monday', just four days after the cyclone.\footnote{Acting Administrator to Secretary, Department of the Interior, 13/3/1937, NAA Darwin, E490, March 1937.}

The cyclone took one life in Darwin. However, as the \textit{Northern Standard} reported on 16/3, many were left homeless in its destructive wake. Cleaning up and repairs were underway in earnest; across Darwin 'the sound of hammer and axe is heard from early morning until late at night' and every available builder is repairing storm damage.\footnote{’After the Storm’, \textit{Northern Standard}, 16/3/1937.} A number of interviews with people who experienced the 1937 tell us more about this event. None were interviewed specifically about the cyclone, but were asked questions when it was obvious that they were living in the area at the time. All interviews were conducted well after Cyclone Tracy had devastated Darwin. Interviewees who experienced both are unanimous that Tracy was much more severe and so it is very likely that the 1937 cyclone has been re-evaluated in relation to the more recent calamity and has far less psychological impact in the post-Tracy period. Nonetheless, what they offer contributes to a richer picture of the 1937 cyclone and its immediate aftermath in Darwin.

Speaking with Ann McGrath, Lily Ah Toy tells of the consequences for various family members. ‘My mother’s house was alright because it was solid – good with bush timber’, she says, comparing with her sister’s house where ‘her kitchen was flattened because hers was built on dressed cypress pine’.\footnote{Interview with Lily Ah Toy, NTRS TS 1, P 33.} Others speak of the physical manifestations of the cyclone. The screaming tempest drove salty water across lands adjacent to the harbour. George Haritos, a 9 year old boy at the time, recalls that:

\begin{quote}
a lot of salt water killed all the green; anything green was killed by salt water. It’s an eerie feeling. You come out in the morning and all you can see is just dead sticks, not a green leaf to be seen anywhere. The same thing happened in Tracy.\footnote{Interview with George Haritos, NTAS, TS 662, p 11.}
\end{quote}

Tom Baird describes sight of many dead birds among fallen trees and the drama of waves crashing over the cliffs at Fanny Bay, near the entrance to Darwin Harbour.\footnote{Interview with Tom Baird, NTAS, TS 155, p 34.} A charming vignette from Jean Harris tells us that life does not completely stop just because a cyclone is raging:

\begin{quote}
\end{quote}
It kept on blowing - - when I was trying to get my husband's breakfast it kept on blowing the primus (stove) out, and I was inside the house. But one window, as it blew out my husband grabbed it and I held it and he got some nails and we banged it to.180

Cederic Patterson eloquently captured the experience of the cyclone itself when he described being in his home after the windows had blown in as being 'like standing facing a fire hose'.181

With the widespread destruction, however, came serendipity. Since the Commonwealth takeover significant numbers of public servants resided, or at least sojourned, in Darwin. It was standard practice to house Commonwealth employees in purpose built houses designed and constructed by the Works and Services Branch of the Department of Interior, based by the 1930s in Canberra. Architects at the Department of Interior were, of course, not quarantined from broader architectural trends and so art-deco aesthetics influenced the design of 1930s buildings in Darwin such as the Commonwealth Bank and the Sergeant's Mess at Larrakeyah Army Barracks.182 Ideas about internal spaces were also in flux and open to influences from beyond Britain and North America. In 1936 the Architects at Works and Services designed an entirely new style of house for Darwin. Characterised by large open interior spaces, themselves with large surface areas of the walls open to cooling breezes, these houses were a prototype of a new variety of houses designed and built as adaptations to Darwin's weather and climate. According to David Bridgeman the design was influenced both generally by the colonial Architecture of tropical South-East Asia and specifically by the traditional Perak House of northern Malaysia.183 After the 1937 cyclone the Commonwealth had many public servants and their families to house. Only a handful of these homes, colloquially known as 'Burnett' Houses, after the architect who designed most of them, stand today. Most were later destroyed by the two subsequent ruptures in Darwin's history – the air raids of World War II and Cyclone Tracy. Indeed it was not until the ravages of Cyclone Tracy that engineers and architects finally designed buildings to cope with this most destructive element of the region's environment. After nearly 70 years of continuous settlement some in Darwin at last could live in housing built for the climate, but the region would have to wait another 40 years before buildings were constructed to withstand its most dangerous kind of

180 Interview with Jean Harris, NTAS, TS 843, pp9-10.
181 Interview with Cederic Patterson, NTAS, TS 600, p5.
183 Ibid. pp57-59.
weather. In any case the period between the construction of the first Burnett Houses and the air raids was quiet. Between 1937 and 1942 cyclone activity in Australia was confined to the Queensland and West Australian Coasts.

Only one cyclone hit the Northern Territory. Indeed, for 8 days in March 1940 this vortex swirled not only across the entire base of the Top End, but also from way out into the Coral Sea, across Cape York Peninsula, the Gulf of Carpentaria, over the Top End and Kimberley out into the Indian Ocean and down to Broome before perishing over the desert. At 8:48am, local time on March 24th Groote Eylandt recorded at maximum wind gust of 66 miles per hour, coming from the north-west as the system passed to the south. Just 24 hours later the air merely sighed from the east at 1 mile per hour. In the 24 hours to 9am on March 25 1175 points or a little under 300mm fell into the gauge at Emerald River, during the same period Borroloola received 100mm, Katherine 110mm and Maranboy 125mm; two days later a little over 50mm fell at Timber Creek in the west.

Winds bring delight; winds destroy. In the Top End the balmy evening seabreezes, refreshing monsoonal squalls, thundery tempests, the sometimes temperate south east trades and cyclonic furies are a simple elemental fact of life. Yet even the more prosaic of these are not as predictable and orderly as they are thought to be. Just as earlier chapters showed that rain regimes here are much more complex than they've been understood to be, this analysis of wind history shows that events subvert received ideas of season. This is not to confuse weather with climate but to acknowledge that exceptions to the rule are far too numerous for the ‘rule’ to remain unchanged. On the other hand, the anarchic world of tropical cyclones may not be quite as lawless as it seems. No neat patterns emerged from this history. There are no tidy cycles in time and geographical grooves for these atmospheric behemoths. However, the clusters in time with the more than dozen cyclones between 1913 and 1923 contrasting the virtual absence of cyclones over the preceding 15-year period might be quite revealing. This is to some extent an artefact of the spread of modernity’s endeavours across the Northern Territory at the time and the ever-widening net of telegraph wires cast over the region with this expansion. Nevertheless, one period is characterised by distinct absence; the other by vigorous activity. While these differences are more like alternations than regular

\[\text{[Bureau of Meteorology, Online Tropical Cyclone Database, Tropical Cyclone Tracks, 1939-1940.]}\]
\[\text{[Meteorological Observations made at Groote Eylandt, March 1940, NAA Darwin E490 March 1940.]}\]
\[\text{[Cyclone 23-26 Mar 1940, NAA Darwin, E490 March 1940.]}\]
cycles they might well point to irregular cycles or alternations in the atmosphere that take place over larger scales of time, making for significant variability from one calendar year to another. Indeed late 19th and early twentieth century meteorologists such as Charles Todd and Gilbert Walker (in India) suspected global teleconnections played a significant role in influencing weather. During the early twentieth century Gilbert Walker actually identified various interconnected weather patterns that we now understand as the El Nino Southern Oscillation (ENSO). Air-flows operate on a variety of time scales: hours, days, years, perhaps even decades. The patterns of presence and absence so evident in this cyclone history cannot be completely accounted for by ENSO or even more recently discovered complex phenomena such as the Indian Ocean Dipole. Of course they most likely play a role and, there probably are other phenomena we are yet to become aware of that also exert influence. However, it looks like atmospheric phenomena operating on a larger time scale than the year, and reaching across much of the globe provide enabling conditions for certain weather events to emerge.

Whether systems like cyclones develop also depends on a plethora of more local contingencies. Their subsequent behaviour depends on both local and more distant contingencies. In the case of Top End cyclones these include the strength and location of high pressure systems to the south and the location and force of monsoonal troughs as far away as the northern hemisphere tropics. With these and other contingencies ever-changing, prediction is difficult but becoming more reliable. Nonetheless, those who experienced these cyclones in the NT could not have envisaged the interplay between the global and the local; between elements acting on short time scales and those on much longer ones. Even now, these are intriguing mysteries to investigate.

Having examined winds, it is now time to turn to the element animating them: heat.
CHAPTER SIX

HEAT

Heat has a controversial history in Australia. Contemporary arguments about global warming have earlier reverberations in debates over heat and ‘white’ Australia. Specifically, from the 1850s till the 1940s debate raged internationally over whether ‘whites’ could settle in and develop the tropics. Ideas of climatic determinism were pervasive in European scientific, intellectual and governmental circles. People were understood to be shaped by the climates they and their ancestors inhabited. This resonated, often at fever-pitch, in Australia for a number of reasons. Firstly and most evidently, a large portion—over a third—of continental Australia is within the tropics. Secondly, Australia, especially its tropics, was sparsely populated. In contrast, neighbouring tropical landmasses, such as the islands of Indonesia, continental south-east Asia, China and Japan were seen as bursting with energetic populations coveting Australia’s spaces—especially those of its ‘empty north’. Conflicting with this was the view the Australian colonies and later the Australian nation developed of itself from the late nineteenth century as a homogenous, ‘white’ community. The state and much of the population imagined Australia as ‘white’. White Australia was the sine qua non of the Australian imagined community.¹ The possibility that a third of the continent could not be developed by ‘white’ people posed an existential threat.

It was heat, particularly the combination of heat and humidity, which generated this threat. Historians such as Warwick Anderson, David Walker, Alison Bashford, Libby Robin, Alan Powell, David Carment, Diana Giese, Timothy G Jones, Regina Ganter, Peta Stephenson, Henry Reynolds and Marilyn Lake have more than ably examined issues of race and climate as they relate to either Australia or the development of the north, particularly the Top End. Rather than retrace their steps this chapter draws upon their insights to contextualise a modern history of heat and humidity. In addition to these studies, this chapter also uses important publications on race, climate and northern development of the period. It also expands on the broad points made earlier, probing the anxieties heat provoked. But in sketching a history of Top End heat this chapter also provides more evidence that concepts of Top End weather, climate and seasons were demonstrably at odds with what happened, weatherwise. Moreover, it will also show that the debates over whether ‘whites’ could develop the tropics were based on a mistaken view of

weather and climate and a comprehensive forgetting of important aspects of colonial invader history in Australia’s far north.

**Heat, Race and Tropical Development – Global Perspectives**

Debate about race and climate raged internationally during the late nineteenth and early twentieth centuries. Chief among preoccupations was the question of whether whites could develop tropical places. This debate was in fact a modern incarnation of ancient ideas. Around 400BCE Hippocrates postulated that both race and individual physiology were shaped by climate and weather. “Asians” had a different “character” than Greeks:

> the cause of this is the temperate climate, because it lies toward the east midway between the risings of the sun, and farther away than is Europe from the cold.²

This idea and many supporting examples abound in *Airs, Waters, Places*. Hippocrates postulated that the body comprises four humours which are influenced by the four atmospheric elements, or the two extremes of two dyads: hot/cold; wet/dry. Changes in weather can determine individual health and illness while climate — patterns of change and recurrence of these elements over the long-term — shapes ‘racial’ disposition.³ But, as we saw in Chapter 2, these very old ideas were alive and well in Colonial South Australia.

With the emergence of modern science, race became a fundamental scientific concept. Before then, race generally referred to societal groups; it was not a biological concept. Afterwards, race was not just a means of classification; it was generally (mis)understood to be a pointer to all manner of essential human differences.⁴ Classification itself became a particularly influential practice with the publication of Linnaeus’ *Systemae Natuarae* in 1735. Linnaeus himself ventured to categorise humans into racial types. This system and practice of classifying all living things on the basis of visible and inevitably superficial characteristics fitted well into a grand idea from antiquity still in currency in early modernity. Both theological and quasi-scientific, the idea of the Great Chain of being put God’s creation in an order. This order was linear, hierarchical and charged with notions of

³ Ibid., pp71-107.
relative strength, worth and value. According to Arthur Lovejoy, the principles underlying this old idea attained a variety of novel manifestations and enjoyed their widest diffusion and greatest acceptance following the transmission of Linnaen ideas of biological classification. The concept of race endured many decades when opinion was divided over whether humans were in fact a single species. It was conceptually amenable to both monogenetic and polygenetic viewpoints. It was portable enough to feature in broader worldviews that both accepted and rejected Darwinian evolution by natural selection. Anatomist Robert Knox, president of the Anthropological Society of London, typified mid-nineteenth century scientific thinking. His influential *Races of Man*, first published in 1854, combined Aristotle and Linnaeus in creating an essentialist, immutable hierarchy of humanity. Scientific opinion was not quite unanimous. Alexander von Humboldt was alone among major scientists in arguing that race was not a biological category. Humboldt also strenuously rebuked notions of ranking based on essential qualities. In 1748 David Hume circulated nine points of rebuttal against the notion of 'national characters' and the climatic determinism underlying it. These included the most persuasive observation that colonisers retain worldviews and customs of home in distant colonies and that neighbouring peoples can be very different. During the mid-nineteenth century these cosmopolitan strains of Enlightenment thinking were engulfed by its imperialist and racialist strands. Just as time had become purely natural in the seventeenth century, so 'race' became natural during the nineteenth.

Decades later and throughout the first half of the twentieth century, eugenicist thinking was another current in this overpowering flow of ideas. During this time, before the danger, emptiness and scientific invalidity of the idea of race came to be understood, race organised how Europeans, neo-Europeans and most literate people saw humanity. It was integral to international scientific endeavour. People were categorised. Anything that could be measured was and comparisons were made. These metrics were so influential as to change how science dealt with numbers. According to historian Audrey Smedley, eugenic studies were integral to the introduction of English mathematician Karl Pearson’s statistical techniques – correlation coefficients, p-value, chi-square and statistical hypothesis testing theory – to American universities and the routine use of statistical techniques such

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as calculations of means and standard deviations in biological sciences.\(^9\) As with Linnaean classification, superficial, visual inspection was the basis for initial categorisations.

Climate was integral to such assessments. During this period ideas of 'tropical races' and 'temperate races' were run of the mill and commonly understood. Australian writer and parliamentary representative Charles Pearson exemplifies this. Historian David Walker says of Pearson's 1894 opus, *National Life and Character: A Forecast*, that 'it is doubtful that any book with an Australian inspiration has ever had a greater impact among intellectuals in Britain and the United States'.\(^10\) Indeed Walker, and Henry Reynolds and Marilyn Lake, detail how Pearson's work influenced no less a statesman than Theodore Roosevelt.\(^11\) Notions of superior and inferior races were utterly uncontroversial grist for Pearson's mill. As was the Hippocratic idea that races were products of and suited to particular climates. According to Pearson tropical climate, or "the hot damp zone" is "deadly to the native of the Temperate Zone".\(^12\) Chapter 8 of this thesis sketches how climate increasingly came to be determined in isothermic, rather than geographical terms from the late nineteenth century onwards. With this development, race became a concept based on mean temperatures as well as geographical location. Not only were claims of the ineluctably lethal nature of tropical climates restated numerous times throughout *National Life and Character*, but as Marilyn Lake and Henry Reynolds show, this work as a whole was used by others to claim that temperate lands were for whites only. Accordingly, Pearson was used to justify race based immigration restriction to Australia, New Zealand, South Africa and North America.\(^13\)

Australia alone, among these, had vast tracts of tropical land. To people and a worldview blind to indigenous peoples, this was the 'empty north' and it occasioned much anxiety. Development of Australia's tropics was an ongoing concern in Australia as well as the US and UK. Theodore Roosevelt concurred with the overwhelming majority of Australians that Australia should be a white continent, but was concerned about the 'empty north' juxtaposed to teeming Asia. As late as the 1930s a meeting of the Committees of the Empire Parliamentary Association met in Westminster to examine *The Possibilities of the Northern*

\(^10\) David Walker, *Anxious Nation*, (St Lucia: University of Queensland Press, 1999), p2
\(^13\) Marilyn Lake and Henry Reynolds, op. cit., pp77-80.
Territories of Australia, with Special Reference to Development and Migration, to quote the title of the ensuing report. Shortly afterwards the Dean of Canterbury gave a speech condemning the immorality of Australia coveting land it did not use while millions in Japan struggle with so little land.\textsuperscript{14} Within Australia anxieties about the ‘empty north’ and putative invasions even animated cultural works. Modelled on earlier works in the same genre dealing with England and California, these invasion narratives included William Lane’s \textit{White or Yellow?} (1888), Kenneth Mackay’s \textit{Yellow Wave} (1895) and C H Kirmess’ \textit{Commonwealth Crisis} (1908).\textsuperscript{15} Politically, invasion fears motivated one of the most significant governmental events in settler Northern Territory history – the Commonwealth takeover from South Australia in 1911. Discussing the debate over the Northern Territory Acceptance Bill, David Walker shows that this was not a proposition with unanimous support in Federal Parliament. Alfred Deakin represented the bill as integral to the establishment of a national approach to defence.\textsuperscript{16} Dissenting parliamentarian William McWilliams encapsulated the powerful influence of fears of the ‘empty north’ when he stated that ‘there would be no chance of this bill passing, if it were not for the bogy of invasion’.\textsuperscript{17} South Australia had administered the Northern Territory since it took over from NSW in 1863. Widely perceived as a drain on South Australia’s resources, by the 1900s South Australia was happy to divest itself of the problems of developing the tropical lands of the Top End.

\textbf{Heat, Race and Developing the Top End}

The issue of whether whites could develop the Top End was in contention for almost the entire period of this study. The lines of the Overland Telegraph had scarcely tied Darwin to its place when argument began. As early as 1872 South Australia’s treasurer said in parliament that if the Northern Territory were ever to be populated substantially, this could only be by ‘coolie labour’.\textsuperscript{18} And so a long and at times unintelligible argument began. At the time the already lengthy history of British problems with health and the ‘tropical climate’ in India gave it credibility. Just as global race anxieties and debate had multiple components - issues of hierarchy, fitness for climate, fears of miscegenation, degeneration etc – so local concerns were also multifaceted. Along with more ‘global anxieties’, local debate included questions about whether whites could labour in the tropics, whether

\textsuperscript{14} David Walker, op. cit., p126.
\textsuperscript{15} For detailed analysis see ibid, pp101-112 and Neville Meaney, ‘The “Yellow Peril”: Invasion Scare Novels and Australian Political Culture’ in Ken Stewart (ed), \textit{The 1890s: Australian Literature and Literary Culture}, (St Lucia: University of Queensland Press, 1996).
\textsuperscript{16} David Walker, op. cit., p122.
\textsuperscript{17} Quoted in ibid., p124.
\textsuperscript{18} J H Barrow, Parliamentary Debates House of Assembly SA ,1872, p1873.
tropical illnesses prohibited white development, whether women could adapt to and settle in the tropics and whether white people could adapt over generations. Debate generally conflated these and other related issues. The following discussion focuses on the issue of white labour and its viability in the Top End for a number of reasons. It was probably the most widely argued aspect of the race and climate debate and the most coherent to analyse. Of all components it is the most interesting because it entails energetic opposition to the White Australia Policy when it was fundamental to ideas of Australia as a national community. Lastly, it is particularly revealing about colonial invader society in the Top End, South Australia, and the then newly minted Commonwealth of Australia.

Treasurer Barrow’s remarks did not go unanswered for long. In 1874 Captain Douglas was dispatched by the South Australian Colonial Government to Singapore. No fewer than twenty mining companies had petitioned the South Australian government for cheap Asian labour. Douglas’ task was to “engage two hundred (200) Chinese coolies for service in the Northern Territory”, either in the employ of private enterprises or to labour on public works. In 1874 the South Australian government approached the government of Japan to allow 200 or so men to migrate to the Northern Territory to labour on and develop its land. The offer was refused. In 1880 the South Australian parliament passed a bill allowing Indian coolies to enter, settle in and develop the Top End; it failed to gain Royal assent. However, throughout most of the 1870s South Australia was open to non-white migration. Owing largely to the discovery of alluvial gold at Twelve Mile, the Chinese population of the Northern Territory was enumerated at 4108, in 1881. For decades the number of ‘Chinese’ would eclipse that of whites in the Top End.

Undeterred by London, South Australia pushed ahead with plans to import Indian labourers. Parliamentarian T Playford toured the Northern Territory north of about Pine Creek and west of the Alligator River system in 1892 to identify land that prospective Indian farmers could cultivate. His report to parliament indicates that a belief in the inability of whites to labour in the tropics underlay his and the South Australian Parliament’s endeavours. Tellingly, Playford asserts that:

> It is generally admitted that Europeans cannot stand field work in tropical climates, therefore on the ground that European labour is not cheap, and secondly on the ground that the labourers cannot

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20 Secretary Deering to Captain Douglas, South Australia, Parliamentary Papers, No. 38, 1874, p1.
stand the climate, it is not possible to employ Europeans at tropical agriculture.\textsuperscript{22}

By then C E Millar and his team of Chinese workers had built the more than 200 kilometre-long railway line from Port Darwin to Pine Creek. Opened in 1889, after a five year construction period, this major project and symbol of progress gave credence to such claims.

With a comprehensive parliamentary inquiry in 1895 this idea was reiterated with even greater authority. Charged to “inquire into and report upon all matters relating to the Northern Territory, with a view to a further development of its resources”, the investigation drew on a considerable range of expertise.\textsuperscript{23} Maurice Holtz, director of Darwin’s Botanical Garden stated unequivocally that white men cannot labour in the Top End’s climate.\textsuperscript{24} So did mining company proprietor John Lewis.\textsuperscript{25} Most expansive was John Langdon Parsons, who by then had been minister controlling the Northern Territory, Government Resident of the Northern Territory from 1884-1890 and member for the Northern Territory in the South Australian Parliament from 1890 -1893.\textsuperscript{26} Parson’s testimony crystallised the thinking of those who doubted that whites can labour in the tropics:

The South Australian Parliament must recognise the unalterable laws and facts of nature which make the northern portion of the Northern Territory, which is in the middle of the tropics, a distinctly tropical country. It must be accepted that tropical agriculture can only be carried out by tropical, that is coloured cultivators. All the Aboriginal races within 13 degrees of the equator are coloured.\textsuperscript{27}

Parsons could almost be channelling Pearson. But there is no doubting Parsons’ commitment. Just months after the newly federated nation-state of Australia legislated to comprehensively ban all non white immigration to Australia, Parsons restated his case in a paper read before the South Australian Branch of the Royal Geographical Society of Australasia on 4 July 1901. Titled \textit{Northern Territory of South

\textsuperscript{22} T Playford, \textit{South Australia, Parliamentary Papers,} no.97, 1892, p.4.
\textsuperscript{23} ‘Report of the Northern Territory Commission’, \textit{South Australia, Parliamentary Papers,} No. 19, 1895, p vi.
\textsuperscript{24} Ibid., p16.
\textsuperscript{25} Ibid., p26.
\textsuperscript{27} J L Parsons, testimony 27/2/1895, ‘Report of the Northern Territory Commission,’ op. cit., p38.
Geographer Griffith Taylor came to a very different and distinctive opinion. Investigating this question, he looked more at the issue of comfort, rather than physiological capacity. In *Bulletin* No. 14 for the Bureau of Meteorology he identified zones and places of relative comfort and discomfort. Unlike most climate-based studies that simply relied on calculations of average temperature, Griffith Taylor used wet bulb temperatures, composites of measures of both heat and humidity. As Griffith Taylor claimed “there is no doubt that wet bulb temperatures vary more in accord with the sensations of heat experienced by man” than do conventional dry bulb temperatures.28 Using wet bulb temperatures as an indication of levels of human comfort, Griffith Taylor constructed dozens of climographs to indicate comfort levels for different places, in a variety of climate zones, at different times of the year. In an admittedly experiential vein, he set the limit at which ‘white’ people experience serious discomfort at 70 degrees Fahrenheit or 21.1 degrees Celsius.29 For this region Griffith Taylor could obtain data for only Darwin and Daly Waters. He concluded that Darwin is often uncomfortable all year round and too uncomfortable for Europeans for about 9 months of the year. The combination of heat and humidity, he determined, make Daly Waters too uncomfortable for half of each year.30 The question was not whether whites could labour in the tropics but, as historians Carolyn Strange and Alison Bashford have commented, whether they should or would, given the discomfort of doing so.31 Griffith Taylor’s authoritative answer was a resounding no.

Medical authorities drew various conclusions. In 1920 the Australasian Medical Congress ruled that there were no insuperable difficulties to European people settling in, labouring in and developing Australia’s tropics. Indeed by the 1920s degenerative effects of heat were no longer acknowledged by medical authorities.32 In 1926 Dr Raphael Cilento, medical officer for the Townsville based Australian Institute for Tropical Medicine published a detailed report that found that there are no barriers to European people settling in and adapting to tropical climates. *White Man in the Tropics* individually examined many issues commonly conflated in this debate: heat, humidity, exposure to the sun, hygiene, diet,
housing, communications and services. The most important conclusions Cilento drew were that there is no empirical evidence that tropical heat raises body temperature,\(^33\) that ‘discomfort experienced by Europeans in the tropics is largely a matter of clothes and house ventilation’,\(^34\) and that neurasthenia, a reputed scourge of ‘whites’ in the tropics, was caused not by the climate, but by overfeeding, lack of exercise, poor hygiene and overwork.\(^35\) Whites could certainly labour in the tropics and seemed to be adjusting to the climate.\(^36\) Interestingly, this thorough and methodical study ends with a 22-page discussion of tropical housing and optimal designs based on needs for shade and ventilation. Complete with elaborate sketches and floor plans it details examples from the Federated Malay States and India, which, as we saw in Chapter 5, were the basis for the acclimatised tropical bungalows built in Darwin from the late 1930s.

This by no means ended the debate. In 1932, no less learned a man than medical doctor, anthropologist and geologist Herbert Basedow spoke of how tropical climate was anathema to white settlement.\(^37\) Basedow endorsed Japanese, Chinese, Indian and Polynesian labour in northern Australia, on climatic grounds, to the Empire Parliamentary Association in London. Indicating that his was still not an idiosyncratic view, none of his questioners challenged him, some endorsed this view and the chairman, the Right Honourable L S Amery, reaffirmed the difficulty climate presents to white labour in tropical Australia.\(^38\)

A Grenfell Price’s study *White Settlers in the Tropics* indicates how unsettled this issue was in the 1930s. This study considered the question of white labour and development in the tropics through detailed historical sketches of many tropical colonies and ex colonies of Europe, including those of north Australia. These histories were contextualised and examined with important local climatic and geological data. In both the introduction and in a particular section concerning ‘White Energy and Health’ in ‘Tropical Australia’, Grenfell Price states that the issue of whether white people can live in and develop tropical Australia is equivocal.\(^39\)

\(^{34}\) Ibid., p29.
\(^{35}\) Ibid., pp34-35.
\(^{36}\) Ibid., p92.
\(^{38}\) Ibid., p17.
Forgotten Labours

Grenfell Price’s study of the Northern Territory contains a distinct silence. In this it is far from unique. His earlier work, *History and Problems of the Northern Territory, Australia*, betrays the same absence, as does the chapter about Northern Territory history in medical doctor, D Hastings Young’s 1922 opus *A White Australia: Is it Possible?* Each of these works do not discuss the labours involved in constructing the 3200 kilometre Overland Telegraph from Adelaide to Darwin, a remarkable feat that took scarcely two years. Even J G Knight, who described it as ‘an instance of pluck and enterprise of which the colony can be justly proud’, did not detail the efforts involved in the construction, nor importantly, those who made them, in his 1880 work *Northern Territory of South Australia*.40 This is significant because this momentous work was not undertaken by imported labour. After contracts were signed Charles Todd and South Australian officials did not even have time to discuss the issue, let alone venture to Asia to recruit workers. Government overseers and private contractors gathered their workforce in Adelaide. Those working on the northernmost section— from Darwin to about 600 kilometres inland—were recruited in Adelaide and set sail for Darwin in August 1870. The contract signed by their overseers Messrs Darwent and Dalwood and tabled in the South Australian House of Assembly indicates the arduous work these labourers would undertake. Instructions specified that:

All scrub, underwood, or overhanging trees, or limbs, to be cut down, so as to leave a clear space of fifteen feet on each side of the line.41

All endangering trees must be ‘cut down and removed from the line’.42

Poles must be made from best available hardwood in the locality and:

Stripped of bark, be twenty feet long, nine to ten inches in diameter at the butt and five to six inches at the top.43

Twenty poles were to be built to the mile, all planted in holes four feet deep. Several stations, each with seven rooms, at least 14ft by 12ft, with stable and store room

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41 Construction of Overland Telegraph, Agreement with Messrs Darwent and Dalwood, *South Australia, Parliamentary Papers,* No. 82, 1871, p2.
42 Ibid.
43 Ibid.
also had to be built along the line. Moreover, work teams carried all supplies and materials.

This was herculean labour. Yet, these workers constructed ninety miles (144 kilometres) of the line in the first seven weeks. Even more astonishing is that this work was conducted between September 15 and November 8. Notwithstanding the variability of the Top End climate this is a reliably hot and humid time of year. If we take mean 3pm wet bulb temperatures for the Octobers between 1885 and 1916 in Darwin we can see that these were almost certainly above 23°C and perhaps in the vicinity of 26°C. This team did not suffer illness as a result. Problems came a couple of months later with intense rain. This work, in extreme heat and humidity, demonstrated that there really was no question that Europeans were physiologically capable of energetic labour in the tropics. This question was answered even before it was debated.

But the answer was quickly ‘forgotten’. Studying failed efforts to develop the north, Libby Robin identified powerful forces of amnesia at work here. Colonial and Federal Governments had been so focused on ‘improvement and development’ that they paid little heed to the past and, at times studiously ignored failures. Invader Top End history during the late nineteenth and early twentieth centuries is replete with ‘failures’ and unfulfilled promises. Deborah Rose argues persuasively that forgetting is an inherent quality of modernity, especially on frontiers regarded as terra nullius. Forgetting something as important as the efforts that produced the Overland Telegraph seems not so unusual. Nor is it peculiar to this time. Recently vocal elements of Australia’s body politic and commentariat have promoted a large-scale relocation of Australian agriculture to the north. They are clearly (wilfully?) oblivious to the region’s history and even relevant recent works such Libby Robin’s. Amnesia has its uses. Entrepreneurs and officials who wanted cheaper labour needed compelling reasons to import people from China or India in a whitening and then White Australia. Climate, indeed, immutable, unassailable nature was (and is) more potent than cost. Powerful economic, developmental, governmental and cultural interests fuelled the forces of forgetting. Subsequent argument about race, climate and labour took place without reference to perhaps the most comprehensive answer to the question on offer at the time. Supporters of ‘white’ Australia were numerous and vocal, but, curiously, they do not seem to have drawn

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44 Ibid. p6.
46 Ibid.
47 Results of Rainfall Observations, op. cit.
on the example of the Overland Telegraph to bolster their case. This argument about race and climate also failed to grasp the nature of heat in the region.

A History of Heat in the Hinterland

Temperature records are far less extensive than rainfall records. Given the importance of temperature and humidity to local, national and international debates about the development of the tropics generally, and of the Top End specifically, this seems surprising. The humidity record is even less extensive. Yet, temperatures were recorded in detail during the first days of Darwin. Maximum and minimum wet and dry bulb temperatures as well as the same for 9 am, 3 pm and 9 pm daily observations survive from March 1869.\footnote{Depot Fort Hill, March 1869, NAA Darwin, NTAC 1976/106 VOLUME 50} Similar records survive from Escape Cliffs.\footnote{Meteorological Observations Adams (sic) Bay, NAA Darwin, ibid.} Records of monthly average temperatures survive for Port Essington and for Fort Dundas, based on, at least, daily observations. Seaborne and overland explorers routinely recorded daily temperatures. However, unlike other Australian newspapers, the Darwin press seldom reported temperature and humidity. This did not become routine until the 1930s. Surviving temperature records for Darwin Post Office available through the Bureau of Meteorology only go back to 1885; rainfall extends to 1869. But correspondence with the Northern Territory Government Resident indicates that temperature records were taken at Top End locations as early as 1873.\footnote{"Return of Temperatures", Northern Territory Archives Service (NTAS), NTRS 790, Government Resident, Inwards Correspondence, A274, 1874.} All things considered it seems likely that temperature records were not collated and calculated into means. Or, they might have been lost.

Comparisons across Top End stations certainly suggest a pattern. Pine Creek is the most extreme example. Rainfall records date to 1874; temperature and humidity observations only from 2000 to the present. For Daly Waters, rainfall records from 1873 to the present survive but the longest run of temperature and humidity records for one station in the area are for the period 1926-1986. Similarly, Katherine rainfall statistics date from 1873, however, the longest run of temperature and humidity statistics at one station is for the years 1937-1985. Rainfall records for Borroloola survive from as early as 1889 but the longest uninterrupted period for temperature and humidity records is for 1987 to the present. Comprehensive rainfall records for Victoria River Downs survive from 1885 but the only reliable observations for temperature and humidity available to us are for the period 1965 to 2010. The situation is even more complex if we look at daily, instead of monthly, records and for records within each day. In some locations they
might not have been taken. It is more likely however, that many of these were taken but not collated or preserved with the same sense of importance as rainfall records.

Nevertheless heat observations are extensive enough to be useful. In the case of Darwin we can outline a detailed history for this period of study. For other locations, such as Katherine, we can extrapolate from more recent records. Notwithstanding the complications of anthropogenic climate change we can still draw out important issues from these more recent records. To militate against confounding these records with global warming, I will only use records where the bulk of observations come from before 1980 since warming has been most starkly observed in the period since then.\(^5\) Accordingly, only records from Darwin Post Office, Katherine and Daly Waters will be used, but they are more than adequate to the task.

As with rainfall, different time scales tell different stories. Most commonly, whether in scientific, governmental or even tourist literature, monthly means are used to describe heat. On the bureau of meteorology web site, monthly means for temperature, rainfall and humidity are the most prominent and the easiest of all climatic data to access. This is, of course, because they give vital clues as to the nature of a locale’s climate. In the case of Darwin this is both misleading and inadequate. Chapter 4 has demonstrated that this is the case for rainfall. But, this is also the case for a more stable measure such as temperature. Monthly average temperatures suggest very little variation in Darwin across the whole year. For the period 1882-1942 the mean monthly average maximum temperature for Darwin Post Office has been calculated as 32.4 degrees Celsius for January, 32.2 for February, 32.7 for March, 33.5, 32.6 and 31.2 for April, May and June respectively, 30.6 for July, 31.7 for August and 33.0, 34.1, 34.2 and 33.6 for September, October, November and December.\(^5\) Superficially this seems to confirm the notion of tropical weather as being the same day after day after day, flipping only between extended periods of wet and dry. Minimum temperatures are of less interest because they offer little on the question of whether people can labour in the tropics and because most people are less exposed to these conditions than those during the day. While monthly means may be too general to capture certain intricacies of both weather and climate, average monthly minimum temperatures for Darwin destabilise this idea of the Top End as a place of constant heat. Although the mean

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minimums for the calendar months October to March inclusive are all at or above 25 degrees Celsius, the averages for the months of June, July and August are 20.8, 19.6 and 20.9 respectively. With the mean minimums for Darwin in April calculated at 24.4 and those for September at 23.3, this at the very least indicates something different in the quality of the air masses enveloping Darwin during the middle of the year. Accordingly it also undermines the idea of a unified ‘Dry’ between April and October.

Comparisons between coastal Darwin, on the one hand, and inland Katherine and Daly Waters, on the other, add an important dimension to this analysis of heat in Australia’s Top End. Most evident is the strong influence of the sea and sea-breezes (as discussed in Chapter 5) in moderating thermal forces. Even average figures from Katherine and Daly Waters indicate how extreme ‘monsoonal’ climates can be. Average monthly maximum temperatures for each month for Katherine, calculated for the period 1937-1985, in degrees Celsius are, 34.9, 34.3, 34.5, 34.0, 32.1, 29.9, 30.1, 32.5, 35.4, 37.7, 38.0, and 36.5 for each respective calendar month in chronological order. Not only are the magnitudes different compared to Darwin but so is the general temporal pattern. There is no rise in temperature during the transition from ‘Wet’ to ‘Dry’ in Katherine. Periods without sun are not as prolonged in Katherine as they are in Darwin so the rains do not retard temperature to the same extent in Katherine. But in Chapter 5 we also saw that cooler south easterly winds are more frequent in Katherine in April than they are in Darwin. October, November and December are not only much warmer than the rest of the year in Katherine, days in Katherine then are much warmer than they are in Darwin. Again this reflects the moderating influences of convection-driven sea-breezes. It also reflects that rains often arrive later in Katherine and that during this period – between the spring equinox and the summer solstice when the increase in solar energy over the land is intense – rain is often less frequent here than it is in Darwin and falls are of less intensity and duration.

Katherine minimum temperatures are also revealing. During the period October to March mean minimums hover in the 23 to 25 degrees Celsius range. From then they fall sharply till July: 20.4 for April, 17.1 for May, 14.0 for June to a trough of 13.2 for the month of July. In August they rise to 15.5, with a sharp increase in warmth to 19.5 in September. Just as nights in June and July are usually

55 This and immediately following Darwin statistics from ibid.
57 Ibid.
distinctly cooler than other months in Darwin so the four calendar months May to August often appear to be distinctly cooler at night than the remainder of the year. This most likely points to cooler airs lingering longer over the Katherine region and, without an interaction between sea and land, more frequent and perhaps longer periods of calm. \( ^{58} \)

Patterns for Daly Waters are very similar to those for Katherine. The period between the spring equinox and the summer solstice is the warmest time of the year. Using monthly means for the years 1926-1986 we can see that high mean maximums for September, October, November and December of 35.0, 37.7, 38.4 and 38.2, respectively, indicate that this is a reliably hot time of year and that incursions of cooler air almost never happen. \( ^{59} \) From the high mean maximum temperatures of 36.5 and 35.5 during January and February, the months of highest average rainfall, we can see that the rain does not have the same dampening effect on heat as it does in Katherine and, especially Darwin. From Chapter 4 we can see that rain events tend not to last as long in Daly Waters and that Januaries and Februaries with little rain are more common in Daly Waters than further north. Minimum means and the differences between average maximums and minimums for Daly Water suggest that relative periods of ‘dry’ are longer in the southern parts of the Top End than in the north. That air is drier over semi-arid places than on the coast is unremarkable, but duration of periods of relative dry is revealing. The plateau of warm minimums is not as high nor as expansive in timing. The means are in the 23 to 24 degree range and for the period November to February. Compared with Katherine, a comparison in which coastal influences are not a factor, it seems that the air is often drier and that southern influences, while infrequent, might affect Daly Waters from time to time during the ‘Wet’ and that the ‘Wet’ there is usually shorter and more irregular than further north. Compared to the rest of the Top End, nights and early mornings are commonly much cooler in Daly Waters, with means below 20 degrees Celsius for every calendar month April to September, inclusive, despite very similar maxima to those in Katherine. In June and July these means are as low as 12.9 and 11.8. The fact that the difference between mean maximums and mean minimums is over 15 degrees for the months May to October inclusive indicates how consistently dry the air is over this region during this period. Such differences occur in Katherine for the months May to September but do not occur in coastal Darwin. I will discuss humidity explicitly and in more detail later in the chapter. It is clear, however, even from general temperature data that the

\( ^{58} \) Wind prevents temperatures from falling as markedly as they would under calm conditions.

notion of the wet/dry dyad across the northern third of the Northern Territory is problematic. Neither the wet nor the dry seem unified in terms of an important element such as heat. Furthermore, with heat, as with rain, there are indications that even average durations of each vary across the Top End. But, heat’s history is even more complex.

To understand the nature of heat we need to read the ample data and statistics differently to how they have been read. Influenced by the thinking of Quetelet, Laplace and Condorcet which by then shaped scientific practice scientists and officials looked at the conventional monthly means, taken over decades, as yielding the truth about weather and climate. Questions about development of the tropics were based on ideas of climate for which these means were the very foundation. To get a more complete picture we need to look at variations in time. As with rainfall the scale of the month is illuminating. Although not as precise as daily data, comparisons of statistics for the same calendar month across many years can point to a small range of probable events and variations in their occurrence from year to year. Such comparisons can point to extremes of heat and cold as well hint at variations in periods of marked heat or cold. As with rain, frequent, repeated variations point to variability. Unlike rain, temperature is not a cumulative quantity and so abstractions such as means, rather than raw data, are integral to the analysis of heat.

Nevertheless, these somewhat abstract numbers are telling. Examining mean monthly maximum temperatures for Daly Waters during the period 1926-50 we can see that there are enormous variations for the same calendar month in different years. During these twenty five years the means for the warmest five years ranged between 39.7 degrees Celsius and 40.3 Celsius. The coolest, in contrast, was 32.6, with another two below 34 and the other two of the coolest five between 34 and 35. These are monthly means, indicating that prolonged and significant differences in the intensity of heating occur at the same time of year in the interior of the Top End. A thermal history of Aprils indicates the same large variations. Means for the warmest five range from 35.8 to 36.8 degrees Celsius; means for the coolest five from 30.8 to 32.4. Even in July, when rain is seldom a factor, differences between warmest and coolest are substantial: the warmest five cluster around 30.5 degrees, the coolest five around 27.5. October during this

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60 The two official stations at Daly Waters only offer 25 and 28 year periods of unbroken data prior to the 1980s. This set of 25 is used because it coincides most with the period of this study. Statistics for this section come from, Bureau of Meteorology, Climate Data Online, Mean Monthly Maximum Temperature, Daly Waters, site number 014618, accessed 26/8/2011.  
61 See Summary Climate Statistics, Daly Waters, op. cit., for rainfall information.
period were consistently hot but to varying degrees. Averages for the warmest five for maximum temperatures surpassed 39°C; means for the ‘coolest’ five ranged from 34.1°C to 37.0°C. Means for all other calendar months exhibited similar variations.

Mean minimums for the same calendar month also differed substantially from year to year. Januaries ranged from 26.8°C to 22.8°C, Aprils from 22.1°C to 16.6°C, Julys from 14.3°C to 9.8°C and Octobers from 24.1°C to 17.9°C. Despite the received thinking about the tropics, heat is not an unvarying element, nor is its intensity reliable or particular. Of course Daly Waters is semi arid.

Katherine, however, is not. Indeed most years it experiences bursts of rain and spells of humidity rare outside the tropics. The largest complete monthly temperature data set for the Katherine region not significantly influenced by post-1980 figures comes from Katherine Council observatory for the period 1941-1985. While this does not coincide with the period of this study this is a substantial enough body of data from which to identify important patterns and extrapolate these to the earlier period. The warmest five Januaries experienced averaged maximums of between 36.6°C and 37.8°C; the coolest five ranged from 30.1 to 33.5 degrees Celsius. For any given January there is a 1 in 8 chance of the mean maximum exceeding 36.6 and the same probability of it failing to reach 33.6 degrees. The five highest mean maximums for April ranged from 35.7°C to 37.4. Of the lowest five, the mean for the coolest was 30.9°C and 32.4 for the warmest. Variation was not as substantial for maximum temperatures for Julys, but still notable when we consider that we are dealing with mean monthly temperatures, not isolated daily extremes. The five highest means were in the 31.5 to 31.9°C range and the five lowest were between 27.7 and 28.5. For the Octobers, the warmest five, in terms of mean monthly maximums, averaged from 39.0°C to 39.5°C; the coolest from 35.2 to 36.4. Similar patterns can be identified for other calendar months.

January minimum temperatures in Katherine are remarkably consistent. 42 of the 44 means for this period are within 1.1 degrees Celsius of the long-term mean. Only the absolute extremes of 27.7°C and 19.5°C do not cluster so tightly around the long term average. Nevertheless, the other four warmest in the 24.6 to 24.8°C were

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62 Bureau of Meteorology, Climate Data Online, Mean Monthly Minimum Temperature, Daly Waters, site number 014618, accessed 26/8/2011.
63 Statistics for Katherine maximums all come from Bureau of Meteorology, Climate Data Online, Mean Monthly Maximum Temperature, Katherine Council, site number 014902, accessed 26/08/2011.
64 Statistics for Katherine Minimums from Bureau of Meteorology, Climate Data Online, Mean Monthly Minimum Temperature, Katherine Council, site number 014902, accessed 26/08/2011.
almost certainly appreciably warmer than the other four coolest, which recorded means around 22.9°C. Aprils are the opposite of Januaries. The warmest five for minimum temperatures averaged from 22.4 to 23.8 degrees Celsius. The coolest five, with means from 14.6 to 18.3, would have felt like completely different seasons to the warmest. Variations among Julys are also stark. Seven during this period were above 15 degrees Celsius, three of which exceeded 17°C. Means for the five coolest were all below 11, the two equal coldest averaged 9.9°C. On five occasions people in Katherine endured mean October minimum temperatures between 24.8 and 25.6 degrees Celsius. The five coolest Octobers for minimums would have been much easier to bear: three were around 20.5°C; the means for the other two were 21.7°C and 22.1°C.

Variation is not just substantial in magnitude but is commonplace in Katherine, as well as in Daly Waters. Like rainfall data, temperature data indicate inherent variability in the climate, as well as weather, of the Top End. Without daily records we cannot account for all of these variations. However, given the characteristics of this region and factors affecting temperature we can identify likely influences. As with rain, threshold months such as October and April – months when, according to the imported understanding of weather and climate, dry turns to wet and then wet to dry – show obvious variability. Temperature data offer further evidence that in Katherine these months can be different seasons in different years, undermining any notion of a timely division between wet and dry. This is even the case for Daly Waters, particularly in April, where rain is neither frequent nor voluminous, but where large variations in mean temperatures, from one year to the next suggest that while it is not wet in terms of rainfall, Aprils in Daly Waters can be wet as far as humidity is concerned.

We cannot identify seasons purely through temperature data. But heat and hence temperatures are an important component. The markedly different temperature profiles between all of the four months in both Katherine and Daly Waters gives rise to the proposition that each falls within a different season to the other. This is not to say that the Top End has four annual seasons but that it arguably has at least four seasons per year. At the very least temperature data throw into question the viability and even utility of the imported understanding according to which two would be seasons of 'The Wet' and two seasons of 'The Dry'. Heat, ineluctably, is an element of weather and climate. Yet, the received idea of climate effectively ignores it. This is consistent with the idea of tropical temperature being fairly constant year round, or, at the very least, it accords with the notion that tropical heat is consistently above important thermal thresholds for
certain vegetation and, in particular, crops, to grow. Reflecting on this we can see then that western ideas of season seem strongly influenced by numerous assumptions or, at the very least, are formulated and operationalised according to particular utilitarian priorities, such as growing crops. If temperatures are constant, either in absolute terms or practically, for the purposes of exploiting the land, temperature does not need to figure in ideas of climate and season. As we saw in Chapters 1 and 2, season is not exclusively or even intrinsically about the weather.

But this chapter demonstrates that temperatures actually vary far too much within years and between years not to feature in understandings of Top End seasons and climate. Heat melts way the idea of ‘Wet’ and ‘Dry’, just as the rains dissolve it. In terms of the wet/dry dyad, temperature data show that some wets and dries are longer than others, and the length of the same season can sometimes vary between Katherine and Daly Waters. There are a variety of wet seasons and a variety of dries, all within the same year. Thinking about the underlying causes of the temperature statistics we also know that the same calendar month can be wet some years, dry others, that it can be both wet and dry and perhaps somewhere in between. Months that are both wet and dry can be so because a period of dry intercedes two periods of wet; or the reverse. They can be both wet and dry because dry gives rise to wet, or the reverse and this can happen by way of the introduction or displacement of rain. ‘Simultaneous’ wet and dry can happen when a humid air-mass is driven north by forceful dry south-east trade winds in the same calendar month, or the reverse. It can occur when the air is consistently near a threshold between wet and dry, an admittedly subjective tipping point, meaning that some people would feel the same conditions as wet and others would experience it as dry. Of course on such subjective measures wind, clothing and physical activity are also factors in these kinds of perceptual judgements. Nevertheless, numbers are telling. In addition to the way they problematise the idea of ‘Wet and Dry’ as a seasonal template for the region they also point to differences within inland parts of the far north. Based on the numbers there is a prima facie case that the period of consistent ‘cool’ and dry weather is confined to June and July most years in Katherine, but that it can frequently extend into May and August in Daly Waters. Rain and particularly cloud cover seem to have a stronger influence on limiting temperatures in Katherine in January than is the case in Daly Waters, but the effect is greatest, most years, in Daly Waters in February. This discussion has so far concentrated on the temperature history of the inland Top End to help show that spatial differences are not due to influences of the seas that border the region on
three sides. Variable weather patterns influence the climate and heat is an important element of the seasons.

**Heat and Humidity in Darwin**

Despite the moderating effects of the seas this is also the case in Darwin. Indeed the more voluminous surviving data from Darwin yield even greater insight into the complexities of Top End weather and climate. Daily temperature data survive for Darwin from 1885, even for Darwin Post Office, which closed temporarily after the first of scores of air raids on Darwin in February 1942 and then closed permanently in 1962. These are easily accessed at the bureau’s climate data online site. Even more useful than the maximum and minimum temperatures available are the surviving dry and wet bulb temperature readings for Darwin Post Office. Unlike the figures we have been using, these allow us to get a sense of humidity levels, as well as heat, in the most absolute sense. At my request bureau staff in Darwin collated daily 9am and 3pm wet and dry bulb temperature observations for each day from April 1885 through to February 1942. While I will draw on this treasure trove of material my emphasis will be on detailed tables of numbers published by the Bureau of Meteorology in 1918. Part of a series of rich studies of weather and climate by numbers undertaken by the bureau for each state and territory during the 1910s, *Results of Rainfall Observations made in South Australia and the Northern Territory* is the only surviving document of the time that circulated such detailed enumeration about weather in Australia.65 Indeed it may be the only publication of the period to reveal so much detail about temperature and humidity in places such as Darwin. This nondescript gem offered any who were interested intricate detail about weather and climate in Darwin. From the literature of the period it seems that this source was never used. I use it now, not only to reconstruct Darwin’s heat and humidity history during the period 1882-1916, but also to reveal what may have been understood in the counterfactual circumstance of this rich source being used by scientists, geographers and officials and circulated in broad and frequent conversation during the 1920s and 1930s.

*Results of Rainfall Observations* tells some arresting stories. Including tables of mean dry and wet bulb temperature for each calendar month from January 1882 to December 1916, as well as relative humidity levels, it gives us a good idea of how it felt to be in Darwin at certain times. More importantly, in detailing both temperature and humidity levels it somewhat elucidates the conditions under which people in Darwin had to labour, offering vital and detailed context to

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65 *Results of Rainfall Observations made in South Australia and the Northern Territory*, op. cit.
questions about tropical development preoccupying scientists, officials and medical professions during this period. Measurements for dry bulb, wet bulb and humidity are provided for 9am, 3pm, and 9pm. Given the intense interest in the issue of tropical climates and physical labour I will look at enumerations for 3pm. Although levels for 9am coincide with the working day, 9am levels of humidity are still influenced by the rise in atmospheric moisture due to the lack of evaporation overnight. Accordingly 3pm levels are more indicative of conditions under which most people would have been undertaking physical labour and perhaps the extremes of heat they had to contend with. All temperature statistics in the original document were provided in degrees Fahrenheit; here I’ve converted them to Celsius. Lastly, a word on terminology. Dry bulb temperatures are the conventional temperatures recorded in reports, usually of maxima and minima in the 9am, 3pm and 9pm observations, and measured, during this period, by a mercury thermometer. Wet bulb temperatures were similarly measured by mercury thermometer. However, while dry bulb thermometers measured thermal energy, wet bulb temperatures measured a combination of heat and atmospheric moisture. Wet bulb thermometers are conventional thermometers where the bulb is covered by a moist muslin bag. The cooling effect of the moisture evaporating from the muslin bag results in the wet bulb temperature being lower than the dry bulb temperature. When the difference between dry and wet bulb temperatures is low, there is little cooling due to little evaporation and little evaporation because there are high levels of moisture in the atmosphere. Conversely a large difference between dry and wet bulb temperatures indicates low moisture levels in the air. Since the potential moisture content of the atmosphere increases with temperature a five degree difference at a dry bulb temperature of 30°C indicates larger absolute moisture than the same difference at 10°C. Wet Bulb is an indirect measure of humidity but the single best measurement of human comfort. Investigators of no less distinction than Griffith Taylor used wet bulb temperatures to enumerate comfort in their studies, as we have already seen. Relative humidity, more straightforwardly is the ‘ratio of measured water vapour in the air to the amount it can hold when saturated’. Relative humidity levels are expressed in percentages and can be misleading if not interpreted in relation to temperature.

Januaries in Darwin are consistently hot and humid. However, they are hot and humid to varying degrees. Indeed the variations for Januaries between the years 1882 and 1916 were almost certainly appreciable for anyone who experienced at least five. The five highest mean 3pm dry bulb temperatures were in the range

67 Ibid.
31.5°C to 32.8°C; the lowest five were all between 29.5°C and 28.2°C. Wet bulb temperatures, especially means, do not vary in the manner of dry bulb temperatures. Nevertheless, even during a period of consistently low evaporations and a watery atmosphere there are noteworthy differences between Januaries. The highest five were in the vicinity of 27.2°C and the lowest around 25.4 degrees Celsius. Crucially every single January exhibited heat and moisture levels far above the 70°F or 21.1°C comfort threshold used by Griffith Taylor. The wet bulb temperatures indicate relative humidity levels were high even at high temperatures: the highest five were in the range of 74-77%, the lowest five between 64 and 58%. Synthesising data, we can reconstruct the weather of two markedly different Januaries to illustrate how weather at this time of year can yield very different experiences. In 1901 the 3pm dry bulb mean was 32.8°C and the 3pm relative humidity was 58%. 168.9 mm of rain was recorded for the entire month, falling on 11 days, with heavy falls occurring on just 3 of these. In 1904 the average 3pm dry bulb was 28.2°C and the relative humidity 77%. A diluvian 706.5 mm of rain fell on Darwin that January and there were only 6 days on which rain was not recorded. It is as if the two Januaries exemplified two vastly different seasons.

Temperatures and humidity problematise the very idea that April could be in either a wet or dry season. They also show the extent to which heat can vary in Darwin in the immediate aftermath of the autumn equinox. The 3pm dry bulb mean for the very warmest month was a scorching 34.2°C, in 1906. The four next warmest averaged around 33.5°C. The mean for the coolest April, in terms of 3pm dry bulb temperatures, was a much lower 29.5, with the means for the other four coolest clustering around 30°C. Another way of understanding this is that in any five year period Darwin is likely to experience an April as warm or warmer at 3pm than 33.5°C and one with a mean at or lower than 30°C. This is a time of year where, even in the coastal tropics, contrary to common thinking, there is notable thermal variation and, indeed variability. Wet bulb means reinforce this. The highest four for the Aprils during this period are near 26.5°C, with the highest at 26.7°C. The fifth coolest still averaged 26°C. The five coolest were in vicinity of 24°C, plus or minus 0.4, and the lowest mean during this period was 23.7°C. These numbers indicate that the ‘Dry’ month of April, despite evident variations from one revolution of the sun to another, is consistently hot and humid. Despite being ‘Dry’, at least by some definitions, it is consistently beyond Griffith Taylor’s threshold of human comfort and, more importantly, a very demanding time in which to undertake arduous physical labour. Unsurprisingly, relative humidity levels varied markedly from one April to another.

68 This and all January statistics from Results of Rainfall Observations op. cit., p416.
69 All April statistics from Ibid.
The five highest were all between 60 and 66%; the five lowest in the range from 44% to 40%.

If July in Darwin has been remarkably consistent for rainfall, things are far more complex for heat and humidity. Means for the warmest five 3pm dry bulb temperatures clustered around 31 C; averages for the coolest five were close to 28C. For a month deep in the ‘Dry’ 3pm wet bulb temperatures varied considerably. The warmest five all fell between 22C and 24.5C. The coolest was a comparatively brisk 18.7C and for the next four coolest the means were all below 20C. Of the 35 years of this record only the mean wet bulb temperature was below Griffith Taylor’s threshold on just 19 occasions. Rain might be rare in Darwin during July, but July is not always dry there. Tactile moisture is more frequent than received ideas of season suggest. 3pm relative humidity levels lay this bare: the seven highest were all between 47% and 56%; the five lowest are near 37%, with an absolute range from 36% to 56%. Of particular interest is how heat and humidity levels in July interact. During the other months examined here, when the sun’s rays strike the Top End at angles much closer to the perpendicular, dry bulb temperatures are inverse to relative humidity levels. In other words, the higher the temperature, the lower the relative humidity. In July this is less often the case. Two of the five warmest Julys, in terms of mean 3pm dry bulb temperature, were also two of the most humid, in terms of 3pm relative humidity – 1915 and 1916. The absolute warmest, 1906, coincided with the lowest mean levels of relative humidity. Each of the five coolest Julys also recorded low relative humidity levels, all between 37% and 45%, with four at or below 42%. This indicates that Julys in the Top End can be ‘cool’ and dry, warm and dry or warm and humid. From this we can discern three influences on weather in the region immediately after the winter solstice. ‘Cool’ and dry weather is brought by south-east trades and weather systems, such as strong highs over southern Australia, which have a stronger or longer lasting southerly component, bringing cooler air from places far to south and perhaps for lengthy periods. Warm and dry weather comes to coastal Northern Territory when the south-east trades have more of an easterly component, sending air from warmer latitudes, than southerlies and sou’easterlies which still must travel many hundreds of kilometres before flowing over Darwin. Warm humid weather occurs when trade winds are weak or when weather systems to the north exert more influence than those to the south. This ensemble of systems rarely brings rain to Darwin, but it does bring a variety of weather, lasting for significant

70 All July statistics for Darwin from Ibid., p417.
71 Seven are included here because from highest to lowest the order was 56%, 52%, 50%, 48%, with the next three all at 47%.
periods of time, which is noticeably different experientially. Moreover, this variety happens between the same points on the calendar, during different years. Julys are variable, but in a subtle fashion. It is also the case as far as heat and humidity are concerned. July is very different from April, which some have grouped into the same season, and it is also too different from October, which others have classified as ‘Dry’ to be of the same season.

Even on paper October in Darwin looks trying. Mean dry 3pm bulb temperatures are consistently high: the top five all range from 33.2C to 33.8C; the bottom five from 31.4C to 32.1C.\textsuperscript{72} The mercury in the wet bulb thermometers is similarly extended. The warmest and most moist five means were all close to 26C; the least warm and least wet were around 23.3C. These levels are high and, for most people, oppressive, but to different intensities. Relative humidity levels were close to a mean of 55% for the highest five and between 41 to 44% for the lowest five. Historically Octobers, while unfailingly hot and humid have, nonetheless, varied from each other. In terms of the elements of heat and humidity Octobers are vastly different from Julys. The gulf in mean temperatures, especially 3pm wet bulbs, indicates that these months are consistently of varying quality. This is further underscored by the fact that despite the coolest October being warmer than the hottest July, mean relative humidity levels in October never fall to the lowest levels experienced and calculated for July. The much warmer airs of October are holding much more moisture. Chapter 4 already demonstrated that October and January are not of the same season as far as rain is concerned. Here we see that the same applies for relative humidity.

Even for Darwin the idea of two annual seasons is untenable. Even for a coastal locale, only occasionally affected by arid influences and with heat and humidity frequently shaped by sea breezes and other maritime effects, variations between earth’s revolutions around the sun for the same calendar month are marked. Just like Daly Waters and Katherine, Darwin experiences appreciable variations and variability in heat and humidity. Certain times of year tend to be hotter and more humid than others, but, as with rainfall, this does not play out like clockwork. Although the idea of seasons defined by rainfall and its absence makes sense in a region where rain is a vital element in its agricultural and economic productivity, although it resonated were periods of wet and dry are so stark, excluding heat and humidity is untenable. Heat clearly is not the constant this idea assumes. As far as human experience and questions of development, which putatively hung on human experience, heat is at least as important an element.

\textsuperscript{72} All October statistics for Darwin from Results of Rainfall Observations, op. cit., p417.
Moreover, such questions about development and the ability of particular racial
groups to labour in the tropics involve consideration of humidity, as well as heat.
Once humidity is considered, Darwin and indeed the Top End's seasonal regime
warrants rethinking. If we take Griffith Taylor's comfort threshold of 21.1C as a
measure of high heat and humidity and redefine dry as the absence of both rain and
humidity, as it is often portrayed, an interesting picture emerges. July is the only
calendar month with a mean 3pm wet bulb temperature below this threshold. If
absence of heat and humidity define the dry there appear to have been 3 years
during this period – 1885, 1915 and 1916 – which did not actually experience a dry at
all. At the very least, any periods of 'dry' were too brief to influence statistics
calculated on a monthly scale.

Examining Darwin temperature and humidity on a daily scale is most
illuminating. The pattern of mean 3pm wet bulb temperatures for the months of
May-August reveals that there is a cool dry season, but that it tends to be short and
of variable duration. Rather than look at means, this discussion will focus on more
experiential measures, such as the number of days below the critical point and
periods of consecutive days when the wet bulb temperature was below the limit of
discomfort. This method does have limitations – it gives no indication of the degree
to which observations were above or below the level defining the categorical
boundary, and sequences can be interrupted by just one reading exceeding the
critical limit by a very small magnitude. Such transgressions could also be limited in
time, giving a misleading impression of the weather experienced for most of a given
day and it could only be confined to a small area. In Darwin both could be (and
sometimes were) caused by an early but weak sea-breeze. With these caveats in
mind, however, this approach does give a reasonable approximation of what
people experienced. It also reveals some persistent patterns over the 31 year
period of observations, temporal patterns of temperature and humidity that give
greater insight into the nature and timing of Top End seasons.

Most Julys in Darwin have a distinctively dry feel. Just 9 of the 31 sampled here
experienced 3pm wet bulb temperatures above 21.1C on a majority of days or did
not have a period of 'cool' dry weather of less than 7 days duration.73 Three of these
Julys registered three weeks or more of consecutive 3pm readings below the
threshold. Nothing even remotely similar was observed in any other calendar
month. Afternoon wet bulb temperatures above 23C seem to occur far less
frequently in other months. Also most wet bulb readings in the mid teens or lower

73 All July Data from Adelaide Observatory and Commonwealth Bureau of Meteorology, Darwin Post
were recorded in July. This is not to say that this cooler, drier weather, this realisation of The Dry, as it is conventionally conceived, is confined to July. Seven Junes and seven Augusts during this period had similar profiles to the Julys.\textsuperscript{74} For most of these the cooler, drier weather tended to occur in later June and earlier August, but not always. As far as heat and humidity are concerned both June and August display remarkable variability.\textsuperscript{75} Most days during the first week of June 1889 and most days during the first half of June 1905 recorded 3pm wet bulb temperatures above 27\textdegree C. Extended periods with 3pm wet bulbs around 25\textdegree C occurred every three or so years. Heat and humidity in June is far more common in Darwin than is generally thought. Much the same can be said for August. From these readings humid August afternoons seem to be frequent in Darwin every three or so years and during every other second half of August there. Patterns of heat and humidity do not comply with calendrical time. There is consistency, with some variability, in July, but serious variability in June and August. Rarely does one month experience the same season from one year to the next.

This is not to deny seasonality. In fact the pattern of cool and dry weather indicates a distinct dry season, in every sense of the idea, around the southern hemisphere winter solstice. But it is a season that varies in length. Occasionally, as in 1915 and 1916, it does not arrive at all. Sometimes it is just two or three weeks long but most often it lasts about six-eight weeks, between late June and early August. Clearly there is no undifferentiated 6-month 'Dry', even if we ignore rainfall. There are extended periods most years in and around Darwin, and along the north coast of the Northern Territory, when there is little rain but intense heat and humidity. Often these periods bookend a distinct season of cooler and drier weather. Heat and humidity observations indicate that rather than one Dry, there are a number of dries. Clearly too their timing is far from regular. Concepts of season for this region must incorporate temporal flexibility and allow for its inherent, climatic variability. They must also include the possibility that this variability occasionally means that some seasons do not arrive every year. Comparing Darwin with Katherine and Daly Waters we can also see that Top End seasons vary across space – in the intensity of various elements, in their timing and in their duration.

Ideas of season for the Top End need to accommodate its elemental intricacies. They must incorporate periods that are rainy and humid, without rain

\textsuperscript{74} June Data from ibid., June 1885-June 1916.
\textsuperscript{75} August Data from ibid., August 1885 – August 1916.
yet humid, dry in the sense of being without both rain and humidity and, perhaps, should distinguish between periods when sources of rain vary – when thunderstorms have more influence and when monsoonal troughs and tropical depressions are the more powerful drivers. This is not about classification but about concepts reflecting important aspects of physical reality and human experience of them. An idea of season that focuses just on rain, but not vital elements of human experience such as heat and humidity reinforces the dangerous and mistaken idea that humans stand apart from nature. To better understand the atmosphere and indeed the physical world, the concepts we use must be better attuned to their complexities. I will attempt this with a conceptualisation of Top End seasons set out in the Conclusion of this thesis.

A wealth of climatic data circulated in scientific circles from 1918. It had the means to subvert the conventional understanding of Top End seasons but it did not. As with rain there is the issue of the meaning of means. In meteorology they were understood to point to reality. Measures of spread, frequency and distribution were then trivial, even irrelevant by comparison. Compared to rain, the paucity of temperature data especially beyond Darwin might also reflect the demands the collection of temperature data placed on weather workers. Daily rainfall for each calendar month is summed, then, after figures over a number of decades are collected, means for each calendar month are calculated. Temperature is a different proposition. At the very least readings for 9am, 3pm, often both dry and wet bulb, as well as absolute maximum and minimum temperatures were recorded. Averages for each calendar month for each reading had to be calculated and then, after decades of observations, the averages of these averages had to be calculated. Whether staff at Katherine, Pine Creek, Borroloola, Daly Waters and so forth had the time to undertake these time consuming labours is a serious question. So, it is very likely that material for most of these centres did not circulate during this period. That Griffith Taylor could only use mean maximum temperatures from Daly Waters as the Top End complement to Darwin data in Control of Settlement by Humidity and Temperature suggests that this was the case. However, Darwin data was available, was circulated and indicated that, even in terms of heat and humidity, the far north did not by any means have a clockwork climate.

But scientists, geographers and officials were preoccupied with other issues. These were matters that relied on the use of means and did not demand other forms of analysis. The almost viral issue of whether ‘white man can develop the
tropics' consumed so much time and energy and simply did not lead to more historical investigations of weather and climate. Until now none have been conducted with explicit reference to variation in time and variability. Accordingly the imported understanding of the wet/dry dyad has gone unchallenged, even in the face of embodied experience. Of course, this far from fully accounts for the endurance of this concept. Chapter 7 will illustrate how writers represented Top End weather and climate and the influences they had on understandings of weather and climate in the far north.
"TELLING"
Weather and climate are signatures of Northern Territory writing. Indeed the prominence of weather and climate distinguishes stories about both the ‘Territory’ and Top End from those of other regions of Australia. Descriptions of the wet/dry seasonal cycles of the far north abound in works of History, fiction, biography, travel literature, newspaper reports, as well as scientific and governmental reports. To be sure, the weather and climate are distinctive – though as chapters 4 to 6 demonstrate, in a far more complex manner than they were theorised. There is no doubt too that the interactions between the land, sea and sky in this region bequeath peculiar arrays of circumstances on people who live there – imposing limits and restraints; enabling particular possibilities. Moreover, the notion of a harsh climate and unforgiving environment is an almost worn out trope in narratives about Australia. Nevertheless, the place of weather and climate in stories about the Top End is more than just a variation on a theme because of the significance it is imbued with, the degree to which it infuses NT writing and the attentiveness and richness with which weather and climate are rendered.

In narrative and, perhaps, experience, weather and climate define Australia’s far north. This chapter will examine the significance of weather and climate in ‘Territory’ writing through a reading of some significant works of fiction and non-fiction set in and or written about the Top End between 1880 and 1940. The sample is in no sense representative and makes no claim to be. Much of the non-fiction comes from the local press or memoirs about sojourns in the Top End, as this accounts for much literature written about the region during this period. Owing to its intricacy and distinctive discursive mode the large volume of scientific literature specifically geared at studying weather and climate in the far north will be analysed in Chapter 8. In choosing works I’ve endeavoured to select material so as to include as much of a geographical spread as possible as well as authors with differing intellectual backgrounds, life experience and reasons for being in the Top End. This selection features more prominent and well-known works because this line of enquiry aims to understand how weather and climate has been represented and what understandings about fluxes in the Top End atmosphere are communicated in stories about the region. I have also chosen material that probably shaped thinking within and without the region. Environmental Historian William Cronon urges us to
'tell stories about stories about nature'. The story of this chapter is that stories about the Northern Territory are a major factor in the received, imposed understanding of the far north's weather and climate enduring long after experience and data might have undermined it.

Weather in the Paper

One startling feature of the weather in Darwin's press was its absence. Or, to be more precise, its seasonal absence. The Northern Territory Times (NT Times) and its latter short-term competitor and ultimate successor The Northern Standard did not routinely report the weather during The Dry. The North Australian was published in Darwin between 1883 and 1889. It is not discussed here because its weather coverage is similar to that of the NT Times but much more prosaic. In any case weather during The Dry was only reported on when something unusual happened. Yet, comparing weather records with newspaper reports it is clear that not all dry season rains were reported. Some were, and as I'll later show, in almost all cases their intrinsic strangeness shaped the stories that were written. But sometimes weather reports stopped once the seasons officially changed from Wet to Dry, recommencing when October 1 came around. This is even more remarkable since NT press reports about weather almost exclusively concentrated on rainfall. Reports of temperature, which have been commonplace elsewhere for well over a century, were rare before 1936, when reports of maximum and minimum in tables of enumerated elements became routine.

In weather reports, weather was rain. These reports commonly took a couple of forms: rainfall totals for certain locations over the most recent week and/or a table of annual rainfall recorded at Port Darwin Post Office, sometimes going back decades. In the former case observers at telegraph stations, post offices, police stations, and pastoral and agricultural properties provided data to the press. In contrast to southern papers such as the Sydney Morning Herald, Melbourne Age and Adelaide Advertiser these reports were ad hoc, only including places where rain was recorded rather than the standard list of locations that featured in the weather reports of the southern and indeed, Queensland press. These tables of annual rainfall were perhaps unique.

During the 1890s and early 1900s tables of wet season rains also featured. Idiosyncratically, these defined the Wet Season as the period beginning August 1

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2 One of few examples in nearly 3000 editions of the Northern Territory Times appeared in the edition of 13/8/1914.
and concluding July 31 of the next calendar year. While in one sense incoherent and in direct conflict with the prevailing understanding of the region's climate it implicitly acknowledges that the timing of rains varies from year to year. So, if the conventional definition of 'wet' is used the sometimes significant rains that fall in September, April and, occasionally May, are missed. If a definition encompassed September and April, the not so rare rain of other months would be missed. This way no rain is missed. But, it does hide the fact that some rain does fall in the dry and that this varies from one year to another. I suspect the use of this system reflects a deep belief in natural order and the strong sense of the invariability of tropical climate even as it was demonstrating the opposite. Any argument that this definition was just a thoughtless effort of a newspaper reporter or editor is easily rebutted when we reflect on the difference between annual rainfall defined by the calendar year and a rainfall year from 1/8-31/7. This may seem like sophistry, but this distinction is meaningful as is evident from the frequent notable differences in rainfall volumes between the different 'years' covering the same period of time. For example...They were newcomers, but they understood that with the calendar year changing on January 1 and The Wet, by any definition straddling this constructed divide, rainfall totals for the season are obscured by organising volumes according to calendar year. They grasped the importance of this in a place aspiring to grand agricultural development and where rain or its absence defined both season and climate. Even a unique, if unintelligible, temporality of The Wet offered a more useful way of reporting rain than the calendar year. Coming at a time of heightened criticism from elsewhere in Australia about the lack of development and questions over the Territory's economic viability, this may even reflect efforts to conceal the climate's variability (if indeed variation was read as variability). Regular rainfall would certainly make the region a more attractive option for prospective investors and residents. Nonetheless these 'wet season' tables were secondary in both their appearance and longevity.

The annual and monthly rainfall tables were by far the most significant form of routine weather reporting between 1880 and 1940. Reaching decades into the past they were weather as history. No other Australian paper routinely provided such detailed historical data throughout this period. Reporting long-term decadal averages for annual or monthly rainfall was not uncommon in other Australian papers; such a lengthy tabulation of rainfall data was, however, unique in newspapers and more the kind of material one would read in an almanac of the time. This data was reported in distinct and very prominent tables.
The influence of calendrical time is stark. Rainfall totals were mostly organised by the year and month and not by season. This thesis has already demonstrated that ideas of season in the Top End where distorted by the colonists’ understandings of time and that this imposed conceptualisation of season was blind to variability from one year to another. It has also just discussed one approach to seasonal rainfall reporting defined by unique markings in the Gregorian Calendar, showing that its use outweighs its conceptual incoherence. In this region, with this climate, not organising rainfall data by season nonetheless seems strange. This was a society where the productivity of the land was an important preoccupation. From the 1880s onwards the productivity of the land was important to government and administrators not only to feed the settlements of the far north, but also to help develop its economy and society. Given these circumstances, arranging data into seasons even in the problematic way in which seasons were understood would have made more sense. Arranging the material according to year renders it abstract, and is completely disconnected from the natural world it is trying to understand. Indeed, it has the logic more of economic data, neatly organised into purely social units of time. This becomes even clearer if we compare with a counterfactual but not impossible alternative way of presenting this material: arrangement by ‘wet’ seasons with an extra column noting when each ‘wet’ began and ended.

Instead the seasons are taken as understood. The only indication of seasonality came under most tables with a line that reported rainfall this season, or, sometimes, rainfall since October 1. Nevertheless, these tables are revealing to the attentive reader. From them it is clear just how substantially rain varied from one year to another. They illustrate, without equivocation, the startling differences in the quantities of rain falling on Darwin from year to year over a period of decades, indicating not just how the weather varies, but also the inherent variability of the region’s climate. Accordingly, these bookkeeper-like tables had, by about 1900, the power to subvert the received understanding of the local climate. They could also refute the long-accepted notion that tropical climates were inherently stable, reliable and predictable.

Yet, they had no effect at all. Old understandings obtained. The imported understanding of the wet/dry dyad shaped thinking about local weather and climate. One explanation is that the variations these tables demonstrated were purely quantitative. The timing of the seasons varied as significantly as the volumes of rain each brought. But this is elided in the tables. Either nothing is said about timing or the seasons are defined by the standard calendar dates in supplementary
remarks about the current season. In any case readers would not encounter anything in these tables to disrupt their understanding of local seasons or, indeed, of the local climate. In all likelihood the variations in the data would be interpreted as showing that some wet seasons are wetter than others but that the local climate always oscillated between regular periods of wet and dry. Although the data in these tables show inherent variability in the region’s rainfall it is probable that readers' knowledge of the prevailing European ideas of tropical seasonality prevented even the possibility of reading the data this way. The concept shaped the understanding of data, which, in turn, reinforced the concept. The apparent accord of the concept to lived experience, along with the fallibility of human memory, also, were probable barriers to such an alternative reading of the data. A second explanation for the continuity of these ideas in the face of contradiction is that readers almost certainly regarded such matters as settled and, they probably would not have viewed a body of raw data in a newspaper as authoritative enough to challenge longstanding scientific knowledge. This study coincides with a period in which people, especially literate people, held great faith in science. In fact, they viewed it as essential to propelling the inevitable progress that animated European society. These interlocking faiths posed perhaps insurmountable barriers to questioning received scientific knowledge beyond scientific and intellectual circles. In any case these understandings of weather and climate in Australia’s tropics have never really been vigorously contested by scientists. A third explanation lies in the practices of the NT Times and the Northern Standard. Reiterating an earlier point—these tables rarely featured in ‘dry’ season editions of the newspapers; they were almost exclusively the province of The Wet. It is reasonable that this very stark pattern of publication influenced how this material was read. In fact, it likely reinforced the idea of the Top End’s regular wet/dry seasonal dichotomy. It also gives rise to the curious notion that weather was, effectively, a ‘wet’ season phenomenon.

Press coverage of weather in the Northern Territory was distinguished in other ways. Compared to other parts of Australia it yielded other notable absences. One is the lack of any weather maps. According to David Day the first weather map to appear in an Australian newspaper appeared in the 3 February 1877 edition of the Sydney Morning Herald. Such maps were not possible until telegraphy enabled the speedy communication of simultaneous barometric pressure readings across a large area. The 3/2/1877 synoptic chart, issued to the Sydney Morning Herald by New South Wales’ Government Astronomer H C Russell, only covered the south-

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eastern corner of the continent between Brisbane and Adelaide. This reflects not just the necessity of the telegraph network, which by then extended to Darwin from Adelaide and to North Queensland from Brisbane, but also the need for reliable weather observations across a larger area of the continent. By the 1890s synoptic charts were commonplace in the press of the colonial capitals and the isobars arced across all of Australia except the north-west. Reliable observations, including air pressure measurements, had been made and documented at numerous Northern Territory telegraph stations for nearly two decades. For a long time these were along just the north/south line of the Overland Telegraph, too far from measurements taken either to the east and, especially the west, to be linked with the atmospheric flows over the remainder of the continent.

By the early 1900s, however, the Northern Territory had ceased to be an isolated fragment of data, represented on continent-wide weather maps as a blank. Chapter 8 will examine this as part of a study of mapping in greater detail, but for now it is important to note that the Northern Territory – north, south and central – was an integral part of the weather maps of the southern capital press from about 1900 onwards. Synoptic charts, from H C Russell's of 1877, routinely provided explanations as to how to interpret them and what they are depicting.

Notable Absences

Maps of barometric pressure, did not feature in the Darwin papers before the 1940s. Consequently, weather reporting there had a disconnected quality about it. It seemed to be set apart from everywhere else. The explanation could be as mundane as lack of space – both the NT Times and Northern Standard comprised 4, and occasionally up to 8 broadsheet pages. Covering local news across all of the 'settled' Top End, from as much of the Northern Territory as possible, news from other colonies, and, following Federation, interstate and national news, as well as international news space was at a premium in Darwin's papers. Meteorological authorities certainly provided the information. Even before the Intercolonial Conferences on Meteorology the department in South Australia drew daily synoptic charts. By November 1879, the time of the first conference, South Australia, Victoria, New South Wales and Queensland already exchanged weather telegrams. Each provided the other with data to draw their own synoptic charts. The importance of these charts and an understanding that they were more useful with a larger geographical scope shows in the conference's resolution to 'secure

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5 See Chapter 3.
6 Minutes of the Proceedings of the Intercolonial Meteorological Conference, held at Sydney on the 11th, 13th, 14th November 1879, Parliamentary Papers, Legislative Assembly, NSW, 1879-80, p4.
the co-operation of the Governments of Western Australia, New Zealand and Tasmania7 in this system of weather telegrams. Following the establishment of the Commonwealth Bureau of Meteorology in 1908 daily continent-wide synoptic charts were drawn up and supplied to any newspapers seeking them. Barometric measurements were taken, charts drawn up and they could readily be transmitted, even to 'distant' Darwin.

Lack of space could explain their absence in the Darwin papers. Another possibility might be that synoptic charts, issued daily, were not seen to be of any utility in papers that appeared only once a week. Unless seven charts were published in each edition there would be no continuity from one map to the next. A third reason might also be that dominant ideas about weather and climate maintained that, except for major cyclonic disturbances, the weather really only changed twice a year – with the switch in seasons. Within this logic maps simply made no sense. An important consequence, however, of the absence of maps is that readers of Darwin's papers did not get a sense of the dynamics of the atmosphere around them. While the Top End does not experience the regular, rapid and lasting changes in weather that accompany the passage of cold fronts, so graphically depicted in Australian maps from the 1930s by a line of flying teeth, changes in its weather can, nonetheless, be depicted on synoptic charts. The most spectacular weather changes of the far north – lines of intense, turbulent thunderstorms cannot be charted on maps of the spatial and temporal scale of synoptic charts. But, the conditions that enable them – low pressure, heat troughs, etc, can. Monsoonal fronts can certainly be depicted on a weather map, as can the surges of cool, dry south-easterly winds so distinctive in the far north. In the absence of maps newcomers to the north and residents alike had no way of getting an overview of just how much weather changes within each season, as well as between each season. In the absence of maps there was no representation of the changeability of weather in the far north. Without synoptic charts perhaps the best means of viewing the fluxes, pulses and beats of the atmosphere was unavailable to people in the far north. This lack was a contributing factor to people seeing local weather as essentially unchanging, except at the turn of the seasons; effectively rendering weather synonymous with climate. A second and interrelated distinction of weather reporting in the Top End - the absence of weather forecasts – reinforces this.

7 Ibid.
Forecasts also would have been of limited value in a weekly. Even today forecasts extending have markedly diminished reliability with each additional day.\(^8\) Forecasts for the day of publication and, perhaps the following day, might have had some value, but failure to cover 5-6 days in each week could certainly justify any decision to exclude forecasts in press weather reports. Moreover, as forecasts during most of the period from 1870 -1940 were made from synoptic charts, including maps without forecasts might have seemed unintelligible. But this was a period when both understanding of weather and the practice of meteorology changed markedly.

During the late nineteenth century meteorology was almost a branch of statistics. The crucial task of collating data was recognised and the new technology for transmitting this material was exploited. Although theories for the genesis of storm systems had been advanced, debated, and had withstood decades of experience, these theories left much to be explained and no theories had been advanced to explain the workings of the atmosphere, more broadly, as a physical phenomenon. Instead, as Robert Friedman has noted, meteorologists used statistical patterns to predict the weather.\(^9\) Theories of weather cycles, so distinctive a feature of late nineteenth century meteorology, and perhaps the most plausible hypothesis accounting for atmospheric dynamics, neatly fitted into this statistical paradigm. In fact their demise came about because systematically gathered statistics showed that the hypothetical patterns were not borne out in reality. Deterministic thinking dominated the views natural philosophers held about nature during the nineteenth century. Early in the century French philosopher Laplace argued that since every event has a cause it follows that with complete knowledge of conditions in the present, accurate predictions can be made about the future. Laplace’s call for a rigorous, statistical investigation of meteorology in 1814 and his undertaking of the same over the following decades are a corollary of this world-view. From Katherine Anderson’s account of this it is clear that by the present Laplace did not mean a point in time so much as a period, perhaps decades long, in which statistical patterns can be identified and then applied, by inductive reasoning, to the future.\(^10\) Imbued with this deterministic epistemology other natural philosophers such as John Herschel and William Whewell argued in the 1840s that the study of weather is an inductive process and that prediction entails projecting patterns of the past onto future times.


In 1897 Norwegian physicist Vilhelm Bjerknes began to disrupt this merely statistical approach and the way of knowing encapsulating it. Instead of an undifferentiated ethereal mass, Vilhelm Bjerknes imagined the atmosphere as a heterogeneous fluid with distinct bounded regions of different density and thermal qualities. These differentiations were not just vertical, but also lateral. In effect he conceptualised air masses - an idea essential to modern meteorology. More specifically, he came to see the atmosphere in its three dimensions and conceived of weather as a set of peculiar problems in mechanical physics and applied theories of hydrodynamics and thermodynamics to its manifold manifestations. Viable physical theories about heat, energy, moisture and fluid dynamics were, at last, used to understand the seemingly elusive kinetics of the great aerial ocean. By the 1920s Bjerknes, his son Jacob and their team, known as the Bergen School, had comprehensively explained the workings of extratropical cyclones, or mid-latitude low-pressure systems, and outlined how different bodies of air rapidly displace each other in regions beyond the tropics.

Till then this common experience had defied explanation. This new understanding saw the genesis of the concept of the front - a line delimiting the boundaries between two distinct masses of air. Identifying the location and passage of fronts, particularly cold fronts, has been vital in shipping, aviation, farming and more generally to people as these lines tend to indicate the location and approach of winds squalls and storms. The ability to identify fronts has been indispensable to predicting the weather. Rather than relying on supposed statistical patterns or norms for times of the year, people could see the physical factors shaping what is in the offing weather-wise. Forecasting became more accurate and more authoritative, but helpful as this framework has been, it nonetheless was blind to important mechanisms such as feedback and the specific interactions between land, sea and sky of particular locales. Just as forecasting falls short of expectations now, it did so, throughout the twentieth century. Bjerknes' paradigm did not subvert the determinism of the statistical approach it displaced, nor did it render statistics peripheral to the study of the atmosphere. Old notions of causality underpinned this model and statistics were crucial to understanding what was happening. Rather than applying the statistics to an undifferentiated mass of air at particular points on the calendar, the statistics were applied to contingent, dynamic and bounded bodies in the atmosphere, forever emerging, growing,

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12 Ibid., p58.
transforming, decaying, disappearing and re-emerging. In fact the Bergen School's theories were an important foundation of the first significant work on numerical weather prediction, Lewis Fry Richardson's 1922 opus, *Weather Prediction by Numerical Process*. However, Richardson's vision would remain unrealised until computer technology enabled speedy calculation of the countless enumerations of weather elements produced by observers worldwide.

Nevertheless, forecasts were routinely made by most national weather bureaus by the late nineteenth century. At least six days a week the various colonial observatories provided forecasts to the papers of their respective colony's capital. The Bureau of Meteorology issued daily forecasts to the press from its inception. From a sample of forecasts featured in the *Sydney Morning Herald* and *Adelaide Advertiser* between 1892 and 1942 we can see that forecasts were of a pithy nature, offering vague details for particular regions such as 'warm before late change', 'cool with rain periods', 'humid with late storms' and 'fine with cloudy periods'.

It is untrue to say that this completely passed Darwin by. Long before the creation of the Bureau of Meteorology Darwin's weather station was well integrated in the various networks of observers both across Australia and internationally. Darwin's press did not feature weather forecasts and this systematisation of temperate zone weather seems irrelevant. Nonetheless Darwin's papers did feature articles about the workings of the atmosphere, from time to time. Articles ranged from explanations of weather and weather systems to accounts of colours of the sky and clouds. These features did not, by any means make the *NT Times* or *Northern Standard* unusual. After the *Newcastle Journal* began publishing a weekly essay on the Geography and Natural History of the World in 1739 papers throughout Britain commonly included articles for 'entertainment and instruction'. This practice was clearly exported to colonial Australia and continued decades after Federation. However, much like the absence of weather maps, the absence of weather forecasts gave a false impression of stasis in the skies above the Top End. Without repeated accounts of changes in the weather seeing the need for these forecasts would have been difficult. This striking void in the Darwin papers no doubt reinforced the received understanding of local weather and climate. At a minimum it did nothing to challenge it. Without forecasts weather

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15 Two examples ‘How We are Living under a Mighty Sea of Air’, *NT Times and Gazette*, 14/8/1913 and ‘Ways of Weather’, *NT Times*, 15/11/1929.
in Darwin’s press was history and, primarily, rainfall history. But this history went beyond enumerations of rainfall volumes and the rare reporting of temperatures, as the next section explores.

**Reporting Weather**

Articles in the Darwin papers had an endearing literary grace. Material extended beyond reports of the political, economic and social to include arresting features about nature. Ernestine Hill, in her seminal work *The Territory*, said evocatively of the *NT Times* that:

> It survived for sixty years where all else wilted, a chiaroscuro of history weird as any in the world. When ships were months late it was printed on blue, beige, brown, green, pink, mauve, or jaundice-yellow paper, its tales of Territory life and death to match.17

Just as compelling were its writings on the natural world. The father and son team of C J and Bruce Kirkland wrote vivid descriptive pieces for the *NT Times* for nearly 50 years. Their journals of travels to rivers and islands throughout the Territory are, Ernestine Hill says unflinchingly, ‘well worthy of a place in the annals of exploration’.18 For dramatic flair, vivid imagery and liveliness of language it is hard to go past the narrative nuggets about weather that featured regularly in the pages of both the *NT Times* and the *Northern Standard*. Unique in the capital city press these pieces were also perhaps without peer anywhere in Australia. In essence pithy reports on recent weather events they gave a powerful sense of what weather in Darwin looked, felt and sounded like. It was weather news, even weather history, but embodied and experiential.

These gems were a longstanding feature of the Darwin papers. They first appeared in the 1870s. Visually they were as indistinct as their substance was striking. Usually located among 15 inches of copy broken up into paragraph lengths about almost everything under the sun (including, obviously, the weather!), they were easy to miss. Given their distinctive flair it would not be surprising, however, if some readers actually sought out these pieces in the sections variously titled ‘News and Notes’, ‘Talk of the Town’ and ‘Roundabout’ in which they featured. Like rainfall tables and the numerical reports their appearance was generally seasonal.

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18 Ibid.
However, in common with the press everywhere, the Darwin press relished the unusual and prized the freakish. When strange or out of season weather happened—stories were certainly told. Stories of out of season weather were of two kinds: rain and storms in The Dry and absence of rain or delayed rain in The Wet. Either way, they reinforced the wet/dry dichotomy by framing the weather they so vividly describe as abnormal and counter to expectation.

**Strange Weather**

The Dry of 1900 was very short. The longest period without rain in Darwin was just 81 days, between 4th July and 23rd September. Two and a half inches or 65 millimetres were recorded during the first three days of July. The *NT Times* report on this anomaly contextualised it thus:

> This week witnessed weather the like of which has never previously been seen in the Territory since the beginning of settlement and the keeping of records and it has required no great stretch of imagination to fancy oneself back in the middle of the wet season. The downpour on Sunday and Monday night was particularly heavy, accompanied by a northerly gale. As will be seen from results given elsewhere the downpour has been fairly general and the natural conclusion is that such an unusual occurrence must be the result of a big elemental disturbance somewhere...20

No rain was recorded in Darwin during July 1910, but thunder rumbled in the skies above. Rain did fall elsewhere in the Top End, prompting the *NT Times* to record that:

> Over an inch of rain fell at Umbrawarra on Saturday last. In Darwin we have had nothing but the promise contained in growling thunder and some lightening(sic). The weather is extraordinary for this time of year.21

A dry week in January 1930 occasioned the following report in the *Northern Standard*:

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20 *NT Times and Gazette*, 'News and Notes', 6/7/1900.
21 *NT Times and Gazette*, 'News and Notes', 15/7/1910.
Extraordinary weather conditions are prevailing for the month of January. During the present week practically no rain has fallen nor is there any appearance of rain this day. Actual figures are not available but the total fall for the season to date must be considerably below the average.\textsuperscript{22}

The following piece, from January 1896, exemplifies reporting of late rains:

Weather prophets were wondering what had become of the northwest monsoon, which usually sets in much earlier than this. There has been a noticeable change in the weather here during the past week, the scorching heat having given place to temperate cloudy days accompanied by true wet season rains; and the long expected nor'westers have been renewing old acquaintanceship.\textsuperscript{23}

Hundreds of these reports appeared between 1880 and 1940. Readers would encounter them perhaps once every 2 or 3 months. Of course these reports are not disconnected from reality. Unusual weather is not so unusual. Reports were couched in the language of normality and abnormality: events were 'unusual', 'extraordinary', had not been experienced before, late, early, out of season, absent or contrary to expectations. Framed as exceptional, or, at the very least, odd, these manifold deviations were seen not as a sign that the expectations and the understandings upon which they were based were errant, but that weather in this place was trying and deviant. Where these accounts of unusual weather might have caused people to question their conceptualisation of weather and climate, their nature served to reinforce the received 'wet'/dry dyadic idea of Top End seasons.

Such reports likely acculturated newcomers to the prevailing understanding of local weather and climate. Yet they captured the complexities of Top End weather and climate as an experience beautifully and lyrically. The transition between seasons is not depicted so well anywhere as in the piece from the \textit{NT Times} of 30/4/1909 reporting that the 'Weather in Darwin during the week has been erratic, a queer mixture of dry and wet seasons conditions'.\textsuperscript{24} Lived experience in Darwin and voluminous rainfall, humidity and temperature records reveal that the transition from wet to dry periods and vice-versa usually does not mimic mechanical

\textsuperscript{22} \textit{Northern Standard}, 'Roundabout', 17/1/1930.
\textsuperscript{23} \textit{NT Times and Gazette}, 'News and Notes', 10/1/1896.
\textsuperscript{24} \textit{NT Times and Gazette}, 'News and Notes', 30/4/1909.
processes like flicking a switch. Usually a strong surge of dry south-easterly winds drives a moist air mass hundreds of kilometres north of Australia, inaugurating a lengthy if indeterminate period without rain. Monsoons often arrive quickly ushering in a period of intense and repeated bursts of rain. However, as Chapters 4-6 show it is rare for this to happen without a substantial period of transition. During this period moist and dry air masses wrestle in the great aerial ocean above Australia's far north. So constant are these dynamics that humidity is often an influence near the coast in the dry and The Wet has two forms: rain and humidity. As a realistic depiction this piece has the potential to undermine the wet/dry dichotomy; but this is neutered by this reality being deemed 'queer'. But these pieces did not just identify normality and abnormality nor did they frame reports according to these notions.

Word Pictures

They did nothing less than sketch how weather feels in the far north. These narrative nuggets impressed on the reader the experience of the humidity, thunderstorms and bright sunshine that a person spending extended period in the region inevitably encounters. These descriptions and assessments of the normality or otherwise of weather would certainly help newcomers learn to inhabit this particular place. Strikingly vivid, their grace and lyricism are exemplified by the following report of 18 February 1910:

Heavy storms, mostly from the eastward, with Turkish bath temperature between the downpours and an entire absence of nor-west gales, have been the distinguishing attributes of weather in Darwin throughout the week.25

Storms were a favourite of the Darwin press. Given both their high frequency in the far north and their compelling nature this is unsurprising. More surprising is that the reports were often equal to the phenomena they were detailing. A far from isolated example comes from a February 1892 edition of *NT Times*, which reported that:

A terrific storm of rain, thunder and lightning visited Palmerston on Tuesday night...The lightning played around in a manner that would have been fantastically beautiful but for it being so

25 *NT Times and Gazette*, 'News and Notes', 18/2/1910.
dangerously close. For three hours or so it enveloped the town in 
an unbroken blaze of light, waving and darting in all directions, 
while the thunder crashed down sometimes as if it had a contract 
to rattle us out of existence.\textsuperscript{26}

Another report from four years earlier began:

On Sunday night one of the severest thunderstorms we have 
experienced for years passed over the town and district. Soon 
after midnight the thunder and lightning were almost incessant, 
flash and report being almost simultaneous, indicating the 
proximity to the atmospheric disturbance. Torrents of rain fell at 
the same time, keeping up a continuous din that almost banished 
sleep from the township while it lasted.\textsuperscript{27}

These reports were commonly as instructive as they were gripping. As well as 
painting vivid picture these narratives included sequences of wind shifts such as:

The strong north-westerly winds experienced for several days 
previously developed into something approaching a veritable 
storm on Saturday night last, the forces of wind during some of the 
heavy rain squalls approaching the cyclonic. There was a fall on 
Sunday afternoon but on Saturday night wind and rain were 
furious. At midday on Monday the wind shifted around into the NW 
from which we shall probably have a succession of heavy squalls.\textsuperscript{28}

Far from providing unnecessary details this information about wind directions 
educates readers about wind and rainfall when a monsoonal trough prevails over 
the region: rain, storms and squalls strike Darwin from over the waters to its west 
and north-west. The frequent telling of such stories with these directions informed 
readers of this phenomenon. It also accurately represents such monsoonal rains as 
intense, squally and repeated. This is the closest the Darwin press came to 
forecasting weather and lines such as the concluding sentence were far from 
uncommon. To underscore the importance of what may seem to be fairly banal 
detail it is important to recall that this differs from the dominating idea of the wet as 
being months of steady rain.

\textsuperscript{26} NT Times and Gazette, 'Notes of the Week', 5/2/1892.
\textsuperscript{27} NT Times, 11/1/1888.
\textsuperscript{28} NT Times and Gazette, 'News and Notes', 8/1/1914.
It is also crucial to be aware that this contrasts with the other major source of rain in the Top End, the vivid storms of earlier reports. Two among many reports distinguishing between kinds of rain and their origins noted:

Palmerston was visited with a fair-sized blow on Sunday night, about 11:30pm. It had been working up from the east for some hours and when it did finally come there was no mistake about it. The thunder and lightning were almost continuous, the latter at times very vivid.29

And:

A heavy thunderstorm broke over the town about 4:30pm on Wednesday, coming from the southward. Within a few minutes all dry season indications were literally swamped for the time being and gushing waterspouts and flooded watertables were everywhere in evidence.30

When monsoonal troughs are not directing a strong and deep westerly or northwesterly flow over the Top End, and when heat and humidity abound, storms generally roll into to Darwin from the quarter of sky between the east and south. Of course, understanding of the workings of monsoonal troughs is very recent. This certainly eluded the residents of Australia’s far north during the period of this study. Nevertheless, these stories about rains and their different sources shows that newcomers and residents of the north could distinguish between those that came with larger systems such as monsoons and those produced by local factors. They certainly noticed that rains came with strong, consistent north-westerly blows in storms or squally showers that swept in from the sea again and again. People also noticed that when the heat was intense, the air seemed to sweat and winds either did not blow strongly from the west or northwest, or if winds from these quarters were local seabreezes and not vigorous flows from afar, thunderstorms often rolled in from the land to the east and south. When they develop, these storms, generated by a baking of the land, tend to either strike a locale once an afternoon or evening, or, hit with much larger time intervals between them than is the case with monsoonal storms. At least some people in the Top End, including writers for the papers, observed closely enough to identify these patterns and associations.

29 *NT Times and Gazette*, 'News and Notes', 7/2/1900.
30 *NT Times and Gazette*, 'News and Notes', 8/4/1904.
In grasping these patterns they could perhaps forecast what was coming in the immediate hours weatherwise. Writing stories that conveyed these associations they enabled any reader of perhaps only 6-12 months standing to identify prevailing weather patterns and associations and do the same. Just as reports of cyclones educated people so did these regular and often arresting stories on weather. These narrative nuggets were not just an interesting read, they immersed their readers in the great aerial ocean embracing them. Commonly these stories also taught readers just how marked differences in weather across small distances are in this region. One piece from 1900 is most revealing:

A heavy shower fell at 2 and a half mile on Saturday afternoon, but Palmerston proper only had a light fall. It is a noticeable fact and has been remarked upon for years, that the 2 and a half mile locality is blessed with more showers and heavier ones than in Palmerston. The erection of a rain gauge at our only suburb would be a good idea for testing the difference –alleged – in the rainfall during the year.\(^{31}\)

Colonial Darwin seemingly had a scientific cast of mind. At the very least this was an important subculture. This is science in action: an observation prompts a hypothesis that urges testing. This was not a specialised journal. It was a newspaper, which likely reflected something of the mentality of its readers. Its readers were newcomers, intent on understanding, controlling and exploiting a compelling and at times confounding natural environment.

Moreover noting this spatial difference was perspicacious. With a multitude of rain gauges across Darwin and the Top End, some merely a kilometre or two apart, the difference in the rain any particular event brings to different locations is stark.\(^{32}\) Torrential rainfall is sometimes remarkably localised. While there is no evidence to support the suggestion in this article, longer-term records show trends operating over the region, indicating subtle climatic spatial distinctions even across Darwin and its immediate hinterland. During periods when more rain typically comes in from the Arafura Sea volumes at Middle Point more than 50 kilometres east of Darwin are about 70-75% of those recorded in Darwin. During periods when most rain comes from storms sweeping in from the east and south – what we now know as

\(^{31}\) *NT Times and Gazette ‘News and Notes’, 23/11/1900.*

\(^{32}\) Evident in any week of Northern Territory Daily Rainfall Bulletins during the ‘wet’ seasons, available online through the Bureau of Meteorology.
the build-up – measured volumes of rain are in excess of 90% of those recorded at Darwin. An attentive reader learned much about the local environment and the community's relationship to nature just from reading the paper.

Newcomers loved rain. Metres of print concentrated on the arrival of rain. This was not just about expectation, when it should arrive and when it should disappear. Timing was important and ideas of normality and strangeness were usually reinforced in these pieces. But it is worthwhile noting how the press depicted indications of rain, untimely absence of rain and conditions that usually prevailed. Particular interest was shown around the first rains of the season, pieces about which featured every year. This story from the *Northern Standard* of 1929 tells of a very regular regime of wet and dry:

> The first rain for the season fell last night, commencing shortly before two o'clock and continued for some time, a fall of 58 points being registered at the Post Office. The fall has replenished the supply in most of the rain water tanks. The rain is just two days later than last year when the first fall of the season took place on 29th September.  

Although first rains were almost always reported it is unfortunate that such explicit comparisons of timing from year to year were not. In this case the weather was running to time. Such virtual mechanical precision no doubt prompted the comparison but comparisons between larger numbers of years or even each year and the one preceding it would have shown the remarkable variability in the timing of 'Wet Season' rains. For example, the first rains of the 1927 season also fell on 29/9, but came on 11/9 in 1926 and 20/10 in 1925 and as late as 16/11 in 1896. Nevertheless, highlighting correspondence in timing no doubt reinforced the idea of an orderly wet/dry climatic dyad. Interest in the first rains was so intense that the papers usually even reported early signs of the first rains. Pieces such as these were typical:

> The first rumbling thunder heralding the approach of the coming wet season was heard on Monday afternoon, coming from some black looking clouds banked along the horizon and with the fall of

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33 Bureau of Meteorology, *Climate Data Online*, Monthly Climate Statistics, Station 014015, Darwin Airport, and Station 014090, Middle Point Rangers. Darwin PO not used because records do not coincide with those at Middle Point for a sufficient period to enable comparisons such as this one.  
34 *Northern Standard*, 'Roundabout', 1/10/1929.
night the frequent reflection of distant lightening (sic) to the eastward betokened a storm inland...\textsuperscript{35}

And:

The weather just now, both in town and country, is becoming oppressively hot, as it always does at this time of the year; but there is a feeling of moisture in the atmosphere, which may be taken to mean that rain is close handy (sic). October, November and December are the worst trial of the whole year.\textsuperscript{36}

People saw, heard and felt the elements leading up to the first rains. Narratives like these informed new arrivals of the signs. Increasing the suspense, however, was the fact that nobody, not even the longest-term resident, could tell when rain would fall on the dusty, barren streets and fields and relieve, albeit briefly, the stifling heat and humidity.

Humidity was another staple. In the Top End humidity is palpable during the ‘build-up’, between monsoonal bursts during The Wet proper, or between what today are known as active monsoon periods, and when moisture lingers long after The Dry is expected to have set in. Examples of each abound. These stories are almost inevitably told in the vocabulary of hardship, with terms such as ‘trying’, ‘oppressive’ and ‘muggy’ almost a guarantee. But the most interesting narrative on humidity goes further:

Weather conditions during the last couple of days following a heavy fall over the town on Sunday night have been hot and trying with every indication of more rain. This morning the weather was oppressive and trying and new arrivals are feeling the trying conditions very much.\textsuperscript{37}

On the surface this states the obvious: people unaccustomed to such energy sapping heat and humidity would be uncomfortable. But I suspect this is really saying something else. Implicit in this narrative is that longer-term residents were not as harassed by the weather, they had adapted. A defensible reading would be that newcomers literally season over a number of years and that this seasoning or adaptation defines a genuine person of this place. As early as the 1880s these stories convey a sense of the far north as a community and therefore an inhabited

\textsuperscript{35} NT Times and Gazette, 'News and Notes', 2/10/1908.
\textsuperscript{36} NT Times and Gazette, 'News and Notes', 16/10/1896.
\textsuperscript{37} Northern Standard, 'Roundabout', 22/10/1935.
and settled place. So many of these weather narratives focus on the embodied experiences of people, sights, sounds, feelings. Moreover, these are often sensations and events many, most, occasionally even all the population experiences in common. Yet this goes even further. Reports on unscheduled or extreme weather often also refer to the memories of long-term residents. As early as January 1880 one story about tempestuous weather stated that:

Ever since New Years Day we have had a succession of wet and stormy weather, such as has not been experienced by the oldest inhabitant. On Tuesday about noon, half of the house occupied by Mr Arnold was blown over and the remainder rendered uninhabitable for a time. During the night and morning of the following day sundry roofs and verandas were blown down. The weather was so boisterous that very few obtained any rest, being hourly expecting some catastrophe to happen.38

The story was not confined to the elements or the material damage caused. Like much Darwin press reporting of weather it went so much further: to human memory to gauge its severity, to the common experience of noise and anxiety intruding on sleep. It was not unusual for narratives to provide statistics from the Observatory or weather bureau to make their point, but stories referring to the recollections of 'old timers' or 'old hands accustomed to the storms of the tropics' to the same end were not rare either.39

Interactions between land, sea and sky were also a salient feature of these remarks. Reports on winds often refer to the wild swells these would whip up on Darwin Harbour or the waters off the north coast. One piece among a number that encapsulates the forceful gusts of the south easterly trade winds that periodically surge over the Top End during The Dry reports that:

Strong SE winds set in again on Tuesday morning covering the harbour with sparkling foam caps and setting quite a heavy sea breaking against all of the eastern facing foreshores.40

Vivid and strikingly authentic as this imagery is, reports of the effects of rain or its absence on the land are far more prominent. Although unsurprising for a

38 NT Times and Gazette, 'News and Notes', 17/1/1880.
39 Quote from NT Times and Gazette, 24/2/1893.
40 NT Times and Gazette, 'News and Notes', 5/6/1908.
community so interested in exploiting the land the pictures these stories create command our attention.

A wonderful visual delight residents of the Top End enjoy every year is the luxuriant springing up of grasses from desiccated, fallow grounds after the first substantial rains. Sometimes, when rain comes, goes and then returns after a baking absence this happens twice or even three times in a year. As I discuss below, this is such a distinctive and compelling phenomenon that it has featured in much writing about the Northern Territory: fiction and non-fiction, by resident and visitor alike. Some narrative nuggets in the Darwin press are as literary as those in more acclaimed works. Just one of many stories tells us that:

The rain which fell on Wednesday morning of last week (and subsequent showers) has given a wonderful spring to the grass around Darwin, and horses and other livestock once more think life is worth living. Within three days of the first rainfall tufts of grass were to be found in some of the more fertile burnt patches of bush fully three inches long.\(^\text{41}\)

Conversely, in the far north, when the lands dry, where there's grass there's usually fire. Darwin's press captured this compelling face of the seasonal cycle as this pithy piece from Grove Hill, in the hinterland demonstrates:

All the country round here is bushfires. Strong south-east winds have been blowing, which generally means no wet.\(^\text{42}\)

Weather in Darwin's papers was about interactions between land, sea and sky and how people experienced them. What it lacked in forecasts and material enabling predictions, what it was missing in terms of integrating the atmosphere of Australia's far north to the rest of the continent or region, it made up for in the intricacies it portrayed in local weather. Elsewhere weather was somewhat cut off from the rest of nature and abstracted in enumerations. Useful and effective as this was it nonetheless rendered the atmosphere into something of a fragment. In Darwin's press weather was placed in its natural and cultural contexts. Reports told of what weather did to fields, rivers, streams, roads, homes, public buildings, towns, boats, to the waters of the Arafura. As this chapter has shown it did this while telling how the weather felt, looked and sounded to those who experienced it. Detailed

\(^{41}\) NT Times and Gazette, 'News and Notes', 28/9/1916.  
\(^{42}\) NT Times and Gazette, 'Notes of the Week', 15/4/1892.
enough to evoke vivid imagery and palpable sensations in readers many decades after the events and even further removed by degrees of longitude the influence of these reports on contemporaneous readers in the Top End demand our attention. So much of what was reported were events common to much if not all of the community. While storms and rain showers might be localised their signs can be perceived over much greater distances. As a simple matter of fact storms and showers are often not so isolated in this region, but come in widespread bands. Even distant fires are indicated by towering columns of smoke and the humidity leading up to The Wet and during dry spells within it spreads across all of the northern half of the Northern Territory. Common to all in the region these distinctive and memorable events were communal and reporting on them likely reinforced this sense.

In his study of news reporting, historian Mitchell Stephens noted that cohesive societies are created, in part, through a stream of sentiments, perceptions and understandings from a shared perspective and that news provides this necessary set of shared thoughts.43 Benedict Anderson’s seminal work on nationalism, *Imagined Communities*, argues persuasively that writing, including the press, has been integral to the cognitive formation of national communities, with a shared social consciousness, among populations who could never actually get to know more than an infinitesimal proportion of people who are part of their imagined community.44 There’s no reason to assume that this could not happen on a smaller demographic scale. Indeed, through the Darwin press, weather and climate may have become a means by which people of the Top End imagined their community.

Press interest in weather is easy to understand. Weather was part of their brief. More particularly, the weather newcomers encountered in Australia’s far north would have been truly remarkable. Its intensity, the larger than life quality of storms, the overwhelming nature of heat and rain, the refreshing respite offered by the dry-breezy sunshine of midyear often were worthy of stories. The contrast to what many newcomers would have known made the weather even more newsworthy. Interest demanded reporting and reporting was a means of recording. Recording enabled strangers to this region to come to terms with its dramatic natural environment. Gaining such understanding was part of the colonial project: newcomers had imported a concept of climate but they still needed to grapple with the weather. Understanding weather was integral to coming to terms with the place and becoming a resident, denizen and ultimately citizen. The colourful and lyrical stories

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of weather in the Darwin papers helped newcomers learn about the vicissitudes of weather in the Top End, as well as how to understand them. They therefore helped residents and new arrivals alike inhabit as well as exploit it. A crucial, if perhaps unintended, consequence was that these documented weather events, in their spectacle, severity, timeliness, irregularity, oppressiveness, soothing balm or sheer abnormality became, before long, events about which newcomers shared a common awareness. Something talked about; something about which to talk about. Weather is a common experience to all in any particular locale.

Here, however, a discursive awareness of this common experience was created through repeated storytelling about weather. The stories gave readers a strong sense of the place and of the difficulties, spectacles and enchantments integral to making a life there. The stories highlighted what putatively distinguished the Top End from other places. Persistent heat, long bouts of oppressive humidity, a predictable annual cycle of precise 6 month periods of wet and dry, brought about by a complete reversal in prevailing winds and countless weather events that confound this entrenched, pervasive understanding. This became an important part of local community awareness, a common understanding about not just the place, but what it means to live there. One indication of this is that reports, as some cited in this chapter show, refer to embodied experience, the common, embodied experience of all who went through particular events. The repeated explicit highlighting of whether weather is normal or strange, whether it is timely or not, also gives newcomers a sense of what they should expect, as well as reinforcing, hundreds of times, the received understanding of weather and climate. While it heightens the drama, it is also very instructive. A third strand of evidence comes from distinctions made in some of these pieces between how longer-term residents and recent arrivals experienced the weather. Although mere assertions they read as saying that newcomers adapt, in time.

Given that the readership of the paper can be clearly discerned from its content as white, this is also the press offering its own rebuttal to the contentious notion examined in Chapter 5 that white men could not develop the tropics. In other words, it is the papers arguing the viability of their own imagined community of a white tropical Australia. The distinction between comfortable residents and distressed new arrivals also implies who belongs: only those who have adjusted and who feel perfectly at home in the local climate. The true ‘Top Ender’, was the person who had lived there long enough to deal with whatever the skies threw at them and had been there long enough to remember weather in the past. In a community with such a large transient population this way of determining who belonged to the
community, real and imagined, resonated. Newspaper weather reports were about identity as well as the weather. In the Australian state/colonial capital press this makes weather reporting in Darwin unique.

Acclimatisation and climate were intimately bound to identity. It is unsurprising therefore that the imported idea of climate prevailed throughout this period. This is yet another reason why the notion of the wet/dry dyad was not questioned in the contradictory face of reality. However, if newspapers informed Top End residents about their weather and climate and helped create a distinctive social consciousness among them, books about the Top End portrayed its weather and climate to the rest of Australia and beyond.

**Top End Literature**

Climate is a character in many works about the Top End. This applies to fiction, as well as non-fiction. Weather too is an actor in ‘Territory’ literature but it often plays a notably different role to the one it plays in writing from other places. In western literature weather is deeply symbolic: it literally provides the atmospherics but usually means other things. Depending on the context rain portends cleansing and new life or inundation, sadness misery; sun can energise, it can burn and disorientate; storms are often associated with catharsis and resolution. In ‘Territory’ writing the weather is itself the spectacle. Readers have no doubt linked the weather they have read about to compelling human issues but weather in writing from the north does two things that mark it out from writing elsewhere. The weather does not just set the scene, it highlights what makes the region so distinctive. It also symbolises the sheer elemental force of this wild part of Australia and, therefore the battle people face, in both life and literature, in attempting to subdue the place to their own ends. Paradoxically climate plays the same role. Climate is a might against which human characters struggle, a force that often overcomes them in literature. This is paradoxical because the climate in all writing about the far north during the period 1870-1942 is the orderly, predictable annual switching between wet and dry imported by the colonists. Of all ideas about terrestrial climate this is the tamest. Theoretically, at least, it points to a much more predictable weather regime than could ever be expected in the temperate regions from which the newcomers, and human characters have come. Yet, this paradox is overcome because the climate is presented as part of the strangeness of the Top End. Xavier Herbert ends the opening paragraph of his sprawling, magisterial 1938 novel *Capricornia* speaking of the:
violence of the climate, which was not to be withstood even by men so well equipped with lethal weapons and belief in the decency of their purpose as Anglo-Saxon builders of Empire.\textsuperscript{45}

Climate is among the first enduring characters Herbert introduces. In a lyrical historical sketch of early failed attempts to colonise the region Herbert outlines the climate and its malevolence, providing both a scene and actor for the next 575 pages of drama. His description is worth quoting in detail:

When New Westminster was for the third time swept into the Silver Sea by the floods of the generous Wet Season, the pioneers abandoned the site to the crocodiles and jabiroos and devil-crabs and went in search of a better. Next they founded the settlement of Princetown, on the mouth of what came to be called the Caroline River. In Wet Season the river drove them into barren hills in which it was impossible to live during the harsh Dry Season through lack of water. Later the settlements of Britannia and Port Leroy were founded. All were eventually swept into the Silver Sea. During Wet Season, which normally lasted for five months, beginning in November and slowly developing till the Summer Solstice, from when it raged till the equinox...as the first settlers saw it, the whole vast territory never seemed to be anything for long but either a swamp during Wet Season or a hard-baked desert during the Dry. During the seven months of a normal Dry Season never did a drop of rain fall and rarely did a cloud appear. Fierce suns and harsh hot winds soon dried up the lavished moisture.\textsuperscript{46}

Although Herbert’s wet/dry dyad differs from official definitions it still reinforces the notion of the two regular seasons of the colonisers. Indeed the wet and dry are writ large on the landscape as well as in the skies. The climate might be orderly and predictable but it is predictably harsh and hostile to the plans of men and empire. The climate was forbidding in the forms of inundating rains and desiccating sun. It had vanquished permanent settlement again and again. Now that a colony had finally taken root it threatened to overwhelm the specks of commerce, bureaucracy, culture and sociality scattered throughout the far north.

\textsuperscript{46} Ibid., p2.
Climate is a marker of oddity and difference and menace. The fact that it features in so many works suggests that it was an effective means for authors to evoke in their readers this stark sense of strangeness. Through this discursive practice climate came to distinguish the Top End, to mark it as a place, in the imaginations of people in other places. The virtual ubiquity of climate in Northern Territory writing also indicates the impact weather and climate had on the authors and, one suspects on most who ever spent time there.

Writing from other parts of Australia tends to mention climate when highlighting differences with Britain.\textsuperscript{47} Even so, this is often done by commenting on salient weather events or through remarks about intense heat and drought. What is particularly remarkable about Top End literature is that the climate, as it is conceptualised, is almost a standard feature of almost all works. Climate not only distinguishes north Australia from Britain, but also from the settled and temperate south. Since climate accounts for patterns of movement and activity across the far north it is at a minimum a vital part of the backdrop demanding explanation. Through this repetition from publication to publication the wet/dry dichotomy becomes something of a literary trope. It locates the drama captured by an author infusing readers with a sense of the place and creating an identity for Northern Australia among those who might never experience it. More prosaically, it transmits the imported understanding of climate to a much wider population, giving this notion greater currency and authority.

**Encounters and Visitations**

Wet and Dry abound in Top End literature. To be sure their depiction is not as poetic, nor is their role as dramatic as in *Capricornia* but they are important in setting the Top End scene. After sixteen years as a customs officer Alfred Searcy wrote an arresting account of his encounters around the Northern Territory coast and in the hinterlands of the Top End. Encumbered by the dehumanising prejudices European invaders projected onto the long-term residents and custodians of the region, who are conscripted to help define the wildness of the Top End, *In Australian Tropics* is nonetheless an engaging study of late nineteenth century north Australia. We meet strangers in a land teeming with mosquitoes, ants, termites and crocodiles, and on seas in which crocodiles and sharks cohabit with enigmatic dugong. We meet Macassan sojourners and remnants of earlier attempts to colonise the north coast. We learn of the Herculean labours of settling a foreign place. In just the third paragraph of his opus, Searcy introduces the climate:

\textsuperscript{47} For example Watkin Tench
The wet season begins about the end of October, and lasts approximately five months. The rainfall during January and February is very heavy...dry heat prevails during the south-east monsoon, but it is not extremely hot except just prior to the setting in of the rainy season, and up to the end of December, when the north-west monsoon as a rule sets in strongly. 48

Thereafter terms such as wet/rainy season and dry season appear frequently, setting a scene or giving an event both timing and atmosphere. Typical of associations with the wet are lines like 'it being the wet season, we were worried by innumerable crawling things'. 49 Weather and climate are a crucial part of the encounter in the Top End, experientially and discursively. As well as helping us feel the exhaustion of enduring intense heat and humidity and the formidable power of tropical nature Searcy enchants with his tales of tropical weather. Enticing and exciting the reader he tells us that:

Of all sights in the tropics, I think the lightning which accompanies a thunderstorm is the grandest and most awe-inspiring. What wonderful storms we used to experience in Darwin, especially at the break of the monsoon, and how I used to delight in them! Many hours I have spent in a long chair in the verandah (sic) watching a storm, the flashes being so vivid at times that you could see trees miles away standing out distinctly against the sky. I well remember one storm in particular, which lasted for many hours, during which time the thunder never ceased for a moment, crashing near you, and then dying away in the distance; then, before the deep growling mutter ceased, crash again and so it went on. The lightning was simply terrible. Right through the wet season lightning was always about. It was playful at times and did some damage. 50

In fewer than 150 words he leaves an indelible impression on the reader. Weather in the Top End is larger than life. Recounting a storm that struck Darwin in February 1893, which was reported in detail in the 24/2 edition of the NT Times and Gazette, Alfred Searcy continues:

49 Ibid., p129.
50 Ibid., pp118-119.
We had a very strange instance of its playfulness. In front of the Wesleyan Church there stood a trunk of a dead tree upon which the bell was fixed. It was about fifteen feet high, and nearly two feet in diameter. One evening during a bad storm a fearful flash of lightning seemed to strike the whole town. But it didn’t, it just fetched the church. The old tree was sent to smithereens, but the bell was left intact. The lightning having finished with the tree ran along the galvanised fence, burst open the gate and passed through the door of the parsonage, which it filled with sulphurous fumes.51

Weather was not just a spectacle, it was a ‘sulphurous’ visitation. After noting that the ‘lightning and thunder were certainly prominent enough to make even the stoutest heart quake’ the NT Times article concluded its report stating that ‘the storm on the whole was a trite illustration of Byron’s ‘hell broke loose’.52 Nature in the Top End was rendered and recorded as awe-inspiring, overwhelming, and otherworldly.

Metamorphoses

At the very least, northern nature was odd. Ranger, drover, sailor, fisherman and writer, Bill Harney wrote several books that at times sing of Top End society and nature in the early-mid twentieth century. More humane in its treatment of Aborigines, North of 23 Degrees still captures the brutalities and broils of the cultural and natural environs of the Northern Territory.53 Like other writers Harney speaks in terms of the wet and the dry. These concepts determine readers’ understanding of local weather and climate. But Harney’s rendition of weather and climate is through the ways they transform the environment:

Nature is strange in this northern land. In the wet season the grass grows high and everywhere there is plenty; then comes the time of dry weather and smoke rises everywhere from the fires that burn out the countryside. Up grows the grasses again in places, yet towards October, the trees shed their leaves and

51 Ibid., p119.
52 NT Times and Gazette, 24/2/1893.
everywhere is bare ground. After a while we see the green shoots sprouting out of the ground and the trees taking on new leaves. Then flowers come out, but we have no rain. It is as though nature were at war with the elements, defying the dry time and offering a challenge to the Rain Gods so that she, old, 'mother earth', may still bring up moisture from below to nurse her seedlings so that they may be strong enough to defy the full blast of the thunderstorms or the swish of the monsoon.54

Wet and dry are read from the land. The seasons as lush verdure; smoke and fire. And there is an in-between period, when the land adjusts from parching dry to inundation. This alludes to something other than the received dichotomy but where he mentions seasons Bill Harney speaks of The Wet and Dry. But his attention to the annual cycle of colours in the land, driven by the seasons is well worth retrieving. Speaking of the countryside near Borroloola he tells of how the land does not conform to the wet/dry dyad:

Here and there ti-tree scrubs were dotted about. The grass was the usual coastal grass, shooting up in the early storms, dark and green, full of the natural juices that fatten up the herd, then growing longer and higher and higher, on the river flats until it was over the horses heads. Next the seeds come and then, its cycle complete, it bows its head and with the final storms—'knock 'em down' they call them—it bends to the ground. The green becomes paler, then a yellow tint shows; getting darker, its slowly dies; its juices gone, it is useless. A match thrown down, or friction causes a spark and the country is in flames—the early burn. Everywhere the landscape is black, until a few days go by and the green tinge comes again. This lasts a few months, then dies away. The cattle now look for the 'top feed', the edible bushes which keep them going till the wet returns.55

Metamorphosis on the land is just as integral to experiencing Top End nature as the fluxes in the skies.

Norwegian Zoologist Knut Dahl explored this region, along with the Kimberley, in 1895 to study its flora and fauna. Originally published in Norwegian, Dahl's

55 Ibid., p99.
chronicle of his travels was not translated into English until 1926. *In Savage Australia* is a story of 'civilised' man against wild, perhaps untameable, elements. When it speaks of weather and climate it uses the received vocabulary and concepts. Nonetheless this work devotes an entire chapter to the 'rainy season'. The concluding paragraph vividly describes the change of season as it transforms the land:

> The enormous forces of life and growth which the rainy season had stimulated had now long reached the culminating point...only occasional rain fell now and the long grass dried up day after day, collapsed and broke. The vivid green of the forests faded, and mounting a hill to obtain a view of the illimitable forests we could see the smoke of distant grass fires rising towards the sky. This was the first sure sign that the summer of the tropics was past. Very soon tongues of fire would sweep the land, leaving the earth black and bare.\(^5^6\)

Here 'wet' and 'dry' are painted green and black. Indeed they are similarly rendered on the landscapes of far Northern Australia. Rain falls and grasses rise during one, grasses fall and smoke rises during the other. This is not unique to Dahl and Harney; their accounts are merely the most memorable and delightful. However, these compelling extremes in both literature and experience might in fact have reinforced the wet/dry dichotomy in peoples' minds. The in-between times rendered by Dahl and Harney (and others) are analogous to the periods between seasons when weather from both prevails. Changes in the land, like changes in the sky, seem not to be read as indicators of more complex and nuanced processes that warrant reappraisal of the central idea that organises them. Instead the in-between phenomena are read as part of a linear movement towards the culmination of one of two opposites. If transformations in the land are read this way, this would reinforce the imported understanding and be seen as another sign of it.

Like all literary sojourners in the Top End, Dahl speaks vividly of the storms. Sketching their development is almost a trope in writing about the far north. Nevertheless, Dahl's account leaves a vivid impression:

> A small cloud would appear on the horizon, growing rapidly larger and larger. And almost before one had realised its threatening aspect lightning and thunder would burst out. Then

followed the rain, which was whipped along by the wind with a
force that threatened to pull the house down over our heads.
Then suddenly the tempest would subside.\(^{57}\)

Dahl also observed that these storms were both localised and that they raged ‘with
the fierceness of a cyclone’, at times completely mowing down large tracts of forest:
trees, not just grass.\(^{58}\)

The oldest surviving memoir of life in the Top End features a similar account of
the storms. Written by Harriet Daly, daughter of the Northern Territory’s first
Government Resident, Bloomfield Douglas, the memoir records her experiences and
perceptions of her life in Darwin from 1870 till the late 1880s. *Digging, Squatting and
Pioneering Life* devotes perhaps a thousand words to weather and climate. It defines
the seasons as Wet and Dry, albeit with the wet from October till April and the Dry
from May to September, departing in content, if not structure from the imported
understanding. Harriet Daly is, however, explicit that the switch is brought about by
the regular, timely change of monsoons.\(^{59}\) ‘The wet season’, she says, ‘is a most
destructive one in every sense of the word’, when everything receives a ‘coating of
mould’ and when ‘paper and envelopes become as porous as blotting paper’.\(^{60}\) The
Wet has a palpable presence even away from the rain. But it is the storms that she
portrays as emblematic of the wet and its potential destructiveness. From Daly, we
can see how received ideas about the wet were transmitted to people in Darwin and
way beyond. According to Harriet Daly:

\[\text{Every day we had a thunderstorm about the same time... To watch the}
\text{clouds gathering over the opposite shore was really a grand}
\text{and imposing spectacle. The sky became almost black and lurid}
\text{flashes of lightning, miles and miles away played incessantly in}
\text{the heavens. Gradually the storm approached, rising like an inky}
\text{arch sweeping across the harbour, and as it touched the water}
\text{cut it up into wreaths of foam.}\]

The similarity to Knut Dahl’s report on storms is clear. While it is by no means
unlikely that Dahl would have read Daly, the similarity could also reflect the
spectacle of storm formation in the region. Clouds appear from nowhere, they tower,

\(^{57}\) Ibid., p159.
\(^{58}\) Ibid., pp159-160.
\(^{59}\) Harriet Daly, *Digging, Squatting and Pioneering Life in the Northern Territory of South Australia*,
(London: Sampson Low, Marston, Searl and Rivington, 1887), p117.
\(^{60}\) Ibid.
\(^{61}\) Ibid., p118.
build, tower and engulf. A compelling sight, I suspect the genesis of storms has become something of a trope because it is so remarkable and memorable to experience and relate. To newcomers, accustomed to very different weather, it likely became an early marker of place - a marker that resonated with each new resident, sojourner and visitor. Daly’s narrative portrays an atmosphere that is both wild and orderly. The storms only happen at certain times of the year. During these months they happen every day and they happen at the same time of day. Powerful as they are, storms are predictable on the time scales of months, days and hours. This notion of such harmonious, regular skies has been a persistent idea and can still be heard in Darwin today. Perusal of any records from period late or early in the calendar year refutes this idea. Nevertheless it did add temporal dimensions to the imported understanding of weather and climate -extra dimensions that emerged through experience and the authority this gives. Moreover, it gave readers an impression of a climate with far greater predictability than most others, giving a sense of awe with definite limits to any wildness. Elemental force can be destructive but when it can be predicted it can be protected against and adapted to.

Regularity on the scale of seasons infused other works about the far north. Most pieces of writing reflected the wet/dry dichotomy in distinctive ways. In her ‘Introductory’ to Untamed Territory, Elsie Masson’s refracts the two switching seasons through the reversal of winds that brought Macassar fishermen to the northern coast and then swept them back to the Celebes.62 Her explicit and detailed description of the climate is geared to the experience of the newcomer. First she advises newcomers not to start their journey (from the south) to the Northern Territory till April, ‘when the hot wet months are past and the dry rainless season which lasts until October is begun’.63 Masson asserts that the ‘newcomer’s first experience of the climate of Darwin is in the dry season’ when ‘every day is bright and cloudless, with a fresh wind blowing over the blue harbour’. In the dry roads are ‘thick with red dust and the ‘grass in the bush is long and yellow’.64 While acknowledging just two seasons Elsie Masson nonetheless observes what has been known in recent decades as the ‘Build Up’:

With the beginning of September comes a change. The days and nights grow steadily hotter. Yellow clouds lower on the horizon, the sea is a sullen greenish tint, the air heavy with a sense of something coming. Gusts of wind sweep up, whirling leaves and

64 Ibid., p39.
dust before them; thunder grumbles in the distance. Everything seems to be working up to a climax and still that climax will not come.  

These vivid images capture the mood and feeling of the in-between time after The Dry and before The Wet. But its advent is certainly not as timely as depicted. And while the much-anticipated climax to the building heat and humidity can long elude the people who endure it, the build-up is not as linear in its progression as this piece indicates. Nor does the ‘dreaded wet’ begin as Masson’s narrative continued, when the first ‘storm of rain rushes across the harbour’. Storms mostly arrive before The Wet does. Nevertheless, Elsie Masson may have been one of the first writers to record an enduring truth—that ‘old Territorians prefer the wet season’. She returns to the seasonal switch at various times in her book noting the surprising cold that people can feel during the dry and how the land teems with snakes and creepy crawlies during The Wet.

*North of the Never Never* is a memoir of a man who volunteered at the mission on Bathurst Island. Its narrative trajectory is of a man leaving ‘civilisation’ for the ‘wilds’ then returning to ‘civilisation’ enriched. Patrick H Ritchie leaves us in no doubt: the title of chapter 1 is ‘An SOS’, the penultimate chapter is called ‘Untamed’, the last ‘My return to civilisation’. In rendering his physical and spiritual journey Ritchie paints an arresting portrait of the Tiwi Islands, its peoples and environment. His account uses and transmits the imported understanding of The Wet and ‘Dry’ but his gaze is attentive, speaking of the counterintuitive such as dry season dews ‘so abundant as to supply the want of rain’. Like all others he speaks of regular seasons in calendrical time: the wet ‘coming on’ in October, after which, ‘for six months of the year the season is continually showery’ followed by a time when ‘for six months of the year, it is extremely dry, except for an occasional tropical storm’. Storms do form over the Tiwi Islands sooner after the receding of dry south-easterly airmasses than they do over mainland Top End. Nevertheless, ‘Dry Season’ storms are not so uncommon in the far north as to be unworthy of comment, yet Ritchie is a rare writer in not being mute about them. His account of wet season environs comes with a rich soundtrack: after the first rains ‘the big green and grey frogs commenced their monotonous croaking, and made such a noise that you could hardly hear

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66 Ibid., p40.
67 Ibid.
69 Ibid., p96.
yourself speak'.70 Every night ‘continuous but distant sheets of light flashed behind
great banks of cloud’; throughout the night thunder clangs ‘at an even tempo for a
time, then the note is changed...followed by the wild scream of the wind as it tears
through the plantation’.71 Ritchie’s sensuous narrative extends from sight and sound
to touch including the stings and itches of bloodthirsty sandflies and mosquitoes.

Insects are actors in Top End memoirs. Recounting a prolonged excursion
along the coast and rivers of the far north Charles Barrett recalls of sandflies that
‘During the Wet they swarm indoors and out; while battalions of mosquitoes are
their allies in bringing misery to mankind in North Australia’.72 To this Fellow of the
Royal Zoological Society man and nature were clearly at war in the ‘untamed’ north.
Barrett speaks of The Wet and The Dry throughout even explicitly comparing the two
seasons of the north to the four seasons of the south to contrast nature in both.73
White Ants were a major northern curse in Jesse Litchfield’s memoir and experience:
‘they ate everything!’ No remedy was permanently effective and ‘if the ants want to
eat down your house, they will do so – sooner or later!’.74 As with sandflies and
mosquitoes they ‘swarmed’ in ‘countless’ numbers during the wet season.75
Litchfield introduces readers to Top End seasons just a few pages into her story. It is
the ubiquitous ‘wet and ‘dry’ but she relates it to how the seasons dramatically
affect travel across the region. A two-month journey in the dry season can take six
during the wet.76 Jesse Litchfield also tells us how locals spoke of the seasons:

No one ever speaks of the wet season or of the dry season up
here; it is always ‘the wet’ or ‘the dry’.77

It was, resolutely, ‘wet’ and ‘dry’ to the resident newcomers –indicated even by the
insects that harassed them. Even the most astute non-Aboriginal observers
perceived only two seasons. Despite observations on the land as well as in the skies
that spoke to other, more nuanced understandings this was how patterns and
sequences were understood.

Timing was an issue; the dichotomy was not. Nor was the belief that change of
season did not vary from year to year. Where most other writers defined the wet as

70 Ibid., p119.
71 Ibid.
73 Ibid., pp54-55.
74 J S Litchfield, Far North Memories, (Sydney: Angus and Robertson, 1930), p41.
75 Ibid., p42.
76 Ibid., p7
77 Ibid., pp63-64.
either October to March or October to April explorer and writer C Price Conigrave identified The Wet as the four months from December to March. The rest was the dry – only the two seasons. But, ‘the sweep and howl of the nor’wester when the monsoon roars across the Arafura Sea’ comes and goes at the same time each year. Conigrave gives a pithy and vivid account of the time between when the first rains fall and the coming of the first monsoonal trough. With the first light rains, about late September:

the local world changes with dramatic suddenness. From a parched dry land, over which no rain has given its blessing for seven or eight long dreary months, there springs a wonderful tinge of green. ‘The grass has started’, someone will exclaim delightedly as the annual miracle of Nature takes place once more. And with the advent of the grass, the atmosphere becomes increasingly humid and uncomfortable. In October and November, thunderstorms that in Darwin rarely culminate in rain, growl on the horizon.

While a check of records shows that Conigrave was using a little poetic license when referring to 7 or 8 months without rain, we know from other writers and indeed the Darwin press that the first rains and the new grasses represent a significant turning of the seasons. It is worth reflecting on the fact that what Conigrave describes here is tantamount to a season: patterns in the atmosphere bring distinctive weather, in this case storms; the rain is different from the monsoonal ‘wet’ and there are distinct signs in the land, indeed the most salient and celebrated changes in the land. Of course, in later decades this came to be known as a particular season – the ‘Build-Up’. Like other authors C Price Conigrave incorporated this into the two season imported understanding. He also defined changes according to calendrical time, perpetuating an erroneous sense of a climate lacking variability. Subsuming the time between the first rains and the intense rains into The Wet, as most authors do, does make sense. With the new grasses springing up and flora bursting into life with changes in the weather this is intelligible as part of a culminating process, even if it could also be understood as a distinct season. Conigrave defining it as part of The Dry is harder to understand. It makes sense if we define The Wet only as a sustained period of frequent rain and The Dry as the rest of the year. Nevertheless, what we now know as the ‘build-up’ and its unnamed doppleganger between The Wet and The Dry seem too distinctive from the rest of The Dry to constitute the same season.

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79 Ibid.
80 Ibid.
What it does show is that the criteria for defining the seasons of the Top End may not have been accessible to a visitor such as Conigrave, even one so well informed. It might also point to this received idea of seasons being transmitted and understood by convention without its bases in the physical world being fully understood more generally.

**Wrestling Seasons**

‘Man’ fights the elements in Top End literature. In her autobiographical novel, *We of the Never Never*, Jeannie Gunn, however, captures the elements in battle with each other. Though a work of fiction it captures her experience of life on Elsey cattle station near Mataranka in 1902. Wonderfully attentive to the world she was in Jeannie Gunn offers rich and memorable descriptions of the sights, sounds and feel of nature in the Top End, as well as the newcomers struggling to exploit it. She introduces us to the two seasons on page three and the terms ‘wet’ and ‘dry abound throughout. Uniquely, she depicts the turn of the seasons as a contest:

> we realised that November was with us, and that the dry was preparing for its final fling – ‘just showing what it could do when it tried’. With the south-east trades to back it up it was fighting desperately against the steadily advancing north-west monsoon, drying up, as it fought, every drop of moisture left from the last Wet.81

Her portrait of how this looks and feels is arresting:

> Half of the heavens seemed part of the Dry, and half part of the Wet; dusty blue to the south-east, and dark banks of clouds to the north-west, with a fierce beating sun at the zenith. Already the air was oppressive with electric disturbances.82

Rarely does material speak for itself so eloquently. Over the next ten pages this elemental clash does not merely set the scene but is part of the drama for her other characters. The heat and humidity overpower human and non human nature, staff from telegraph stations closer to the coast taunt those further inland after rains bring relief to the coast and its immediate hinterland. Most memorable of all the images comes from a salutary bush tale about how fleeting the first rains can be.

82Ibid.
Station hand Dan tells a traveller about the gent who when the first drops fell 'got himself nicely soaped'; by which time the shower had passed and 'there wasn't another drop of rain for a fortnight, which wasn't too pleasant for the prickly heat.'\(^83\)

Shortly after this story is told the Wet conquers at last:

> Just before sundown we felt that first breath of victory from the monsoon – just a few cool, gusty puffs of wind, that was all and we ran out to enjoy them, only to scurry back into our shelter, for our first shower was with us. In pelting fury it rushed in upon us out of the north-west, and rushing upon us, swept over us and away from us into the south-east, leaping from horizon to horizon in the triumph of victory.\(^84\)

The coming of rain is theatre in the Top End. It is part of the struggle seasons and elements seem to wage against one another. That such rich renderings are drawn in writing about the region is unsurprising. That there are two protagonists – 'wet' and 'dry' - gives this battle focus and potency. Like any conflict between the two poles of a dichotomy victory seems total but is only temporary. But the two opposing forces, while inanimate, are memorable characters. That 'wet and 'dry' are so strongly associated with the climate of the Top End is almost unremarkable when atmospheric fluxes are represented with such arresting drama.

**More Prosaically**

The far north commanded the attention of officials and scientists. Concern about its potential for development, vulnerability to invasion and suitability for permanent 'white' settlement drove this, as Chapter 6 discusses. The received wet/dry dichotomy defined the climate of the far north in official government reports, almanacs and guidebooks on the Northern Territory, as the three examples below exemplify. Needless to say these accounts were far less memorable than those from Xavier Herbert, Bill Harney and Jeannie Gunn, but they were authoritative and reinforced the framework expressed in other, more literary stories. Having said that, W J Sowden's report of the South Australian Parliamentary Party's study tour of the Northern Territory, *The Northern Territory as it Is*, is particularly vivid and lyrical. Touring the far north during February and March 1882 the party witnessed torrential and flooding rains. Among acute observations about the natural environment, Darwin's botanical gardens, agriculture and mining in the hinterland, and social life

\(^83\) Ibid., p207.
\(^84\) Ibid., p208.
Sowden says of the climate that ‘the year has two seasons – the dry and the wet – from May to September and from October to April, respectively’.85 Later he notes that people dress for the climate: civil servants often wearing little more than singlet and trousers or, on formal occasions, serge or tweed when it is cool, white suits when it is hot.86 The *Northern Territory Times* published an almanac about the Northern Territory between 1885 and 1898. In its introduction the climate is also defined as wet from October to April and dry for the rest of the year.87 Adelaide based geologist William Howchin outlined identical seasons and timing for the far north in his *Geography of South Australia*.88

Through stories we make sense of our experiences. Through stories we grapple with human and non-human nature. Philosopher and ecologist David Abram even contends that imagination is not a distinct cognitive faculty but the means by which the senses go beyond what is immediately given in order for us to understand hidden or invisible aspects of the sensible.89 Narrative and story might be fundamentally embedded in basic human perception. In any case story is integral to human experience. And culture, especially understandings of nature and place, moulds the narratives we shape from these perceptions. Stories shape stories.

In Top End stories the seasons were two and they were timely. This recognisably tropical pattern marked the place itself. Vivid renderings of the weather in its drama and of the climate in its dyadic extremes sketched a region in stark contrast to Australia’s more ‘settled’ south with its familiar, temperate four seasons. These stories also tell us what people noticed and how they made sense of their experiences. They also dazzle in relating the awesome spectacle of Top End weather. Embodied and sensuous, many of these accounts tell the engaged reader what the Top End looks, sounds and feels like. Just as importantly, these stories and the images they conjure are, for the most part, especially memorable. They tell readers of the complexities deciphered by seasoned residents and give longer-term white newcomers a privileged place in comparison to the many sojourners who came and went. While telling of the intensity, oppressiveness and even danger of the

86 Ibid., p147.
region's weather these stories also reassure that adaptation is possible. In this Top End stories are another strand of frontier/colonial writing.

Colonising is conquering. Adaptation signifies that newcomers have made a new home and that the elements they had to struggle against have been vanquished. Adaptation represents a victory of civilisation over wilderness. As historian Roderick Nash demonstrates, the struggle between civilisation and wilderness – the fight to domesticate, tame, exploit and inhabit wild places – is among the most enduring concepts about the natural world in western thought.90 When Europeans forced this frontier across North America the trope of an epic struggle of ordinary people against a formidable landscape emerged in late nineteenth century writing about US history and development. Popularised by Frederick Jackson Turner, this plot line drove the narratives of many works of US history during the late nineteenth and early twentieth centuries, according to William Cronon. Struggle against land and nature was integral to these stories. In her enlightening study of Northern Territory writing and of the Northern Territory as metaphor in Australian writing, Darwin historian Mickey Dewar observes that 'the outback is the frontier of white Australian imagination' and that the Northern Territory, including the Top End, is the locus for this frontier (still!).91 That the far north was seen as a frontier between 1870 and 1940 is certainly clear from the material discussed here. According to Mickey Dewar, in all writing about 'The Territory' land was a major preoccupation, especially as a 'wilderness which needed to be conquered or subdued'.92 From my reading, it was not just the land which had to be fought in this place, but also the weather and climate. Weather and climate were part of its wildness. They were not mere scenery; they acted against man. Seasons fought each other on this distinctive frontier. This was not a desert to be turned into pasture or gardens but a place that turned itself from pasture to desert and back again during the time it takes the earth to orbit the sun. Extremes of deluge and drought were commonplace in any given year. Adapting to such abundance and absence was integral to the struggle. In broad terms these extremes resonated with received ideas of wet and dry. While Top End writing offers abundant stories of nature's failure to comply with human concepts it also offers important clues as to why the imported understanding endured. Firstly, on a discursive level, the seasons were outlined in every book and in much newspaper coverage, one way or another. Apart from the fact that this repeated the concept, it also organised how readers interpreted stories about weather and climate. The wet/dry dyad operated as a

91 Mickey Dewar, In Search of the Never Never, (Darwin: Northern Territory University Press, 1997), xi.
92 Ibid., pp1-2.
meta-narrative that conceptually arranged stories about weather into a particular thoughtprint, time and time again. It also distinguished the local climate from others in Australia and gave a sense of order in chaos and wildness. The latter could fulfil two ends: indicating that the struggle against the elements was not futile and that those who waged it were genuinely heroic and robust. In telling detailed stories about nature in Australia’s far north these works give readers a sense of what the place is like to experience. Integral to this experience are not only periods of intense rain and its prolonged absence but also vivid analogues in the land. Each year season-like contrasts between flood and withering desiccation, between spurtling grasses and crackling fires, between the colours of green and black are etched into people’s memories of being in the Top End. Even though these periods do not correspond to The Wet and The Dry and even though they do not happen at the same time each calendar year they nevertheless resonate with the binary idea of two seasons of opposite kinds of weather. Their compelling vivacity almost certainly registers with more potency than much less immediate even relatively abstract experiences such as rains coming and going at different times during different years. This is true whether one’s encounter is through reading or embodied experience. In both life and literature these cognates of the wet and dry dichotomy likely enabled the perpetuation of this imported understanding. The story about non-scientific stories about weather in boreal Northern Territory is that they depicted its intricacies, spectacle and destructiveness but transmitted the received ideas about season and climate to readers near and afar. Chapter 8 will examine the vision refracted by scientific approaches to the great aerial ocean engulfing Australia’s far north through one of its distinctive modes of storytelling—maps.
CHAPTER EIGHT

SEEING WEATHER

Scientific works visualised, projected and mapped the weather. In contrast to the weather of newspapers and the weather of literature, which included the auditory, and the tactile, as well as the visual; the weather of science was visual. It was visual in content and it was visual in its representation. In a sense this is not surprising: nineteenth century British meteorology was similarly sight based. Much effort was expended on describing the appearance of the sky and reading its signs. The seemingly impossible had been achieved when Luke Howard conceived of a viable system for classifying the ever-ephemeral clouds. Before long these categorisations, demanding attentive and searching gazing at the faces of the sky, were routine features of official weather observations. But, as Katherine Anderson has shown, the visual in nineteenth century natural philosophy and, particularly, in Victorian meteorology went far beyond classifying clouds. There were the scrolling graphs produced by self-recording instruments, the manifold clouds reproduced by mechanical photography and the likes of Charles Piazzi Smyth. There were the cloud atlases borne of this photography, the plethora of maps produced daily by official weather bureaux, mariners and, later, newspapers and the controversial drum and cone semaphore signals planted on headlands to warn sailors of a forecast storm.¹ In Victorian Britain scientists, mariners, farmers and all who were interested read the skies and the panoply of representations about them. Indeed there and then the broader visual culture generated by the art of Turner and Constable and the aesthetic philosophies of Ruskin arguably enriched meteorology's culture of seeing.² Such dynamics seem not to have been operating in Northern Australia. However, the British colonisers certainly brought aspects of this aesthetically enriched visual culture to Australia. Its two major manifestations were in the observation of clouds and in mapping. After sketching a genealogy of the ideas about clouds and their place in weather observation in both the Top End and Australia more generally, I will examine the story maps have told about the weather and climate of Australia's far north. It is a story that, despite its sophistication and grounding in local observation, reinforces the received understanding of Top End weather and climate.

² Ibid., pp310-317.
A Prehistory of Clouds

Clouds have intrigued and perplexed people for millennia. Texts scratched into clay by Ancient Egyptians, Chaldeans and Babylonians up to four thousand years ago tell of this fascination. Prophecies based on signs from the clouds represent early efforts at weather forecasting.\(^3\) Around 600 BCE Thales of Miletus conceived of a world and cosmos based upon water. In this imagining the atmosphere and clouds were, accurately, seen as kinds of water. As Richard Hamblyn has noted, while Thales almost certainly did not understand the intricacies of condensation he nonetheless made the first decisive step in western thought towards building a 'meteorological imagination'.\(^4\) Follower of Thales, Anaximander (circa 610-574BCE), soon averred that lightning was caused by friction in the clouds and, according to H Howard Frisinger was first to describe wind as a 'flow of air',\(^5\) though it must be said that his ideas of air masses and air movements due to forces such as convection were not widely accepted. As well as conceiving of an atomistic cosmos Democritus (circa 460 – 370 BCE) theorised that clouds are formed from the vapour produced by melting snow, which aloft, are carried by winds and the water eventually returns to earth as rain, completing the water cycle.

But it was Aristotle’s theories about cloud formation that would dominate classical thinking and, in an amalgam with Christian scholasticism, shape Western thinking about clouds till the seventeenth century. The conviction of an orderly nature reached a crescendo and found a virtually unassailable champion in the works and cosmology of Aristotle, and clouds were integral to this. If something so fleeting, so amorphous and so singular can be explained; if an underlying order can be found beneath such apparent manifest chaos, then order and harmony infuse the cosmos. Aristotle explained clouds as resulting from the mixing of heat and wet elements in the atmosphere coming from exhalations from deep within the earth. He also conceived of stratified skies in which clouds could only form at a particular level, above which they would be burned away by the sun.\(^6\) Indeed the ever-changing nature of clouds was the grist for Aristotle’s theory that the sublunary levels of the skies are in constant flux while above them stars moved in circles but nothing essentially changed. Just over 2000 years ago Seneca rightly saw clouds as the locus of thunder and lightning. Lucretius celebrated how atoms band together

\(^4\) Ibid., p22.
to form clouds, which build in size and fuse with larger, even enveloping clouds till they burst into rain, which washes the clouds away.7

But differentiation of clouds and understanding of the different processes of formation for each kind were far off. In the late 1630s Rene Descartes’ Cartesian rationalism began to prise western cosmology from the grip of Christian Scholasticism. Like Aristotle, Descartes saw clouds as the ultimate test for his approach to both nature and knowledge. Descartes was doing nothing less than testing a new method for knowing, based on deductive reasoning. In stark contrast to the inductive approach being championed by Francis Bacon and many other natural philosophers, Descartes’ approach nonetheless enabled him to elucidate important characteristics of clouds and their formation. Descartes reasoned that clouds were formed by water droplets or small pieces of ice formed by rising vapours produced by moisture on the ground, not mixed airs produced by exhalations from within the earth. Rain falls when the droplets get too heavy; snow and hail when the air is too cool for water in liquid form.8 But with the invention and development of instruments such as telescopes, microscopes, barometers and thermometers the study of nature, including skies and clouds was taking a turn for the visual, the numerical and the ever more precise. Demand arose not just to understand clouds and their genesis but also the nature and origin of the different structures of cloud.

Classifying Clouds

Efforts to classify clouds date to the 1660s. With visual and metric instrumentation better distinctions between kinds of phenomena could be identified, compelling attention to projects of classification. By far the best known of these early modern endeavours to classify is Linnaeus’ system of taxonomy circulated in his Systema Naturae, first published in 1735. Linnaeus’ schema sought to classify any organism into a genus and a species, giving every living thing a category based on two Latin names. Critics such as Comte de Buffon reasonably objected that this approach did not account for organic change and mutability, and nor for the interconnections among terrestrial life. Despite its fragmented abstraction Linnaean taxonomy prevailed, perhaps because it has great organisational power and because it resonated with the deeper ethos of order that characterises western modernity.

Robert Hooke’s attempt to classify clouds has been largely forgotten. Originally published in Thomas Sprat’s *History of the Royal Society of London* in 1667 cloud classification was an element of Hooke’s Method for Making a History of the Weather. Accordingly it was an important component of early English attempts to order the skies. Hooke’s method demands studious watching, observing, measuring, recording and describing. As discussed in Ch 1 observers (usually mariners, farmers or explorers), were instructed to note wind strength and direction, to measure ‘the degrees of heat and cold in the air’, to assess ‘the degrees of Dryness and Moisture in the air’ and to study the tides, thunder, lightning and their effects, as well as the air pressure. Of all elements Hooke devoted most space to ‘the constitution and face of the sky’, something ‘best done by the eye’. Hooke’s instructions are clearly an effort at more than description. Geared at associations with other elements and interconnections among components of weather they are worth quoting in full:

Here should be observed, whether the sky be clear or clouded; and if clouded, after what manner; whether with high exhalations or great white Clouds, or dark thick ones. Whether those clouds afford Fogs, or Mists, or Sleet, or Rain, or snow, etc. Whether the underside of those clouds be flat or waved or irregular, as I have often seen before thunder. Which way they drive, whether all one way, or some one way, some another; and whether any of these be the same as the Wind that blows below; the colour and face of the Sky at the rising and setting of the Sun and Moon; what haloes or Rings may happen to encompass those Luminaries, their bigness, form and number.

These are the instructions of the attentive observer. Already Hooke knows that air flows in different directions at different heights and suspects that more detail about this will enable greater understanding of atmospheric dynamics. The visual spirit of natural philosophy is evident in the quality of observation underpinning these instructions and the discipline they transmit. There is a clear effort to link clouds of certain appearance with certain kinds of weather. Hooke himself explicitly indicates elsewhere in this opus that the format and notation of records use those common in English almanacs. But it is also clear that some of these instructions – such as

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10 Ibid., p174.
11 Ibid., p174.
12 Ibid., p176.
appearance of the sky at sunrise and sunset - derive from folk notions expounded in English almanacs.

Later Hooke outlines specific distinctions between clouds. Aware that the many faces of the sky 'want proper names', he suggests a set of categorical names that observers can agree upon. His long forgotten schema warrants detailed recalling:

...let Cleer[sic] signify a very cleer Sky without any clouds or exhalations: Checker'd a cleer sky with many great white round clouds, such as are very usual in Summer. Hazy, a sky that looks whitish, by reason of the thickness of the higher parts of the air...Thick, a sky more whitened by a greater company of vapours...Overcast, when the Vapours so whiten and thicken the Air, that the sun cannot break through...Let Hairy signify a sky that has many small, thin and high Exhalations, which resemble locks of hair...whose varieties may be expressed by straight or curv'd...Let Water'd signify a sky that has many high, thin and small Clouds...Let a sky be called Waved, when those clouds appear much bigger and lower...Cloudy when the Sky has many thick dark clouds. Lowring, when the sky is not very much overcast, but hath also underneath many thick dark clouds which threaten rain. The signification of gloomy, foggy, misty, sleetting, driving, rainy, snowy, reaches or racks variable etc, are well known.13

The poetics of these classifications make contemporary meteorological descriptions look very banal indeed. They also attest to the importance of visual imagery in studying the sky. Attentive observation begets vivid visual images that beget more acute observations...They show that certain appearances of the skies are associated with particular seasons and times of the year. They show that certain cloud formations are causally identified with rain. More fundamentally, they show an understanding of the markedly different kinds of cloud structures and that these portent different kinds of weather. Richard Hamblyn comments that Hooke's classifications, while memorable, were perhaps too amorphous and unsystematic to offer the precision such a system needed to endure. Without precision it lacked explanatory power and fell by the wayside. Hooke himself moved on from weather and nephrology quickly and his system lacked other promoters.14 But it is also

13 Ibid., pp177-178.
14 Richard Hamblyn, op. cit., p98.
evident that Hooke’s system was also encumbered by its fidelity to Aristotelian exhalations rather than emerging empirically based notions developed by Halley. An Aristotelian framework in an era where enquiry was increasingly spurred by both Baconian and Cartesian ideas about the acquisition of knowledge was always likely to be problematic and seen as outmoded. No matter how graceful, poetic, or in tune with the visual zeitgeist it may have been.

Others tried to classify the clouds. Except for the Societas Meteorologica Palatina they all failed. Circa 1780, under the patronage of Prince-Elector Karl Theodor at Mannheim, the Societas was founded to understand and forecast weather through the collection of detailed and geographically extensive data. The network established by the Societas spread from Siberia to Europe to Greenland and eastern North America. Cloud classification was an important part of its remit and the society developed a system of clouds and notations for each. However, this system was less useful than Hooke’s. Clouds were categorised as ‘White clouds’, ‘Grey clouds’, ‘Dark clouds’, ‘Orange-yellow clouds’, ‘Red clouds’, ‘Thin clouds’, ‘Thick clouds’, ‘Streak-like clouds’, ‘Rock-like clouds’, ‘Disc-shaped clouds of milky appearance’, ‘Layered clouds’ and ‘Gathering clouds’.\(^{15}\) Although each category was defined this system lacked the evocative elegance of Hooke’s system and the way it attempted to link observed phenomena to physical causes. These efforts to grasp the workings of the atmosphere were trampled underfoot by the French Revolutionary Army, which invaded Mannheim in 1795. Unlike Lavoisier, members of the Societas Meteorologica Palatina did get away with their heads.

In 1799 Jean-Baptist Lamarck published his first study of weather. Another volume shortly followed and a third, published in 1802, offered what Lamarck hoped would be a workable taxonomy of cloud types. At the core of this system was the insight that clouds assume certain structures contingent upon particular atmospheric phenomena but Lamarck did not elucidate any specific links between cloud type and particular dynamics in the atmosphere. The same insight was the basis of the enduring scheme developed by his contemporary, Luke Howard. Regrettably for Lamarck being bested in cloud taxonomy would prove a rehearsal for his later fate in evolutionary theory. Lamarck initially proposed 5 cloud families, but as Richard Hamblyn observes, like the systems of Hooke and the Societas Meteorologica Palatina these were essentially descriptive and explained little.\(^{16}\) Lamarck’s genuine innovation was to distinguish cloud types by altitude. However, at the same time Luke Howard proposed a system that both chimed to the era’s

\(^{15}\) Quoted by Richard Hamblyn, ibid., p99.

\(^{16}\) Op. Cit., pp103-104.
desire to completely order nature and offered a foundation for understanding the
genesis, life and deliquescence of clouds.

When Luke Howard began to read his paper to London’s Askesian Society in
December 1802 he could not have anticipated its reception. A chemist and small-
businessman with abiding passions in weather and science, Howard forever
changed our understanding of the skies. His system was decidedly Linnean with
Latin terms identifying primary and secondary features of clouds and grouping
clouds into recognisable families. This use of Latin immediately gave it currency
across all of Europe. Latin also gave it authority: after Linnaeus Latin was the
language of science and would be till the twentieth century. Scarcely 100 words into
his paper Luke Howard made the commanding assertion that clouds:

are subject to certain distinct modifications, produced by the
general causes which effect all the variations in the atmosphere:
they are commonly as good visible indications of the operations of
these causes as is the countenance of the state of a person’s mind
or body.\(^\text{17}\)

This was not an exercise in mere description or categorisation. Understanding the
vagaries of clouds could help unlock the mysteries of the atmosphere, Howard
claimed. After imploring all who seek to understand weather to watch the skies and
not just the indications of instruments, he explicitly defines terms such as
modification – structure – and then proceeds to outline his system. Clouds have:

Three simple and distinct modifications, in any one of which the
aggregate of minute drops called a cloud may be formed, increase
to its greatest extent, and finally decrease and disappear
But the same Aggregate which has been formed in one
modification, upon a change in the attendant circumstances may
pass into another:
Or it may continue for some time in an intermediate state,
partaking of the characters of two modifications.\(^\text{18}\)

Or the cloud could disappear or return to its original form. Clouds of different
‘Modifications’ can unite retaining characteristics of each kind. With the observed

1865), p1.
\(^{18}\) Ibid., p3.
rationale for his system outlined Howard sets out his taxonomy. Clouds have 3 basic forms *cirrus*, *cumulus* and *stratus*. Cirrus look like tendrils, cumulus recall heaps and stratus are like horizontal layers. *Cirro-cumulus* and *Cirro-stratus* were the two intermediate ‘modifications’ identified by Howard while *Cumulo-stratus* and *Cumulo-Cirro-Stratus* or *Nimbus* were the two ‘compound modifications’.\(^9\) Howard provides detailed explanations of each in terms of what weather each is associated in particular circumstances, what weather each may follow or portend. Howard did not comprehensively explain the formation of clouds. Indeed aspects of his accounts relating to droplets and electrical charge, such as his claim that cumulus clouds do not produce rain because droplets in cumulus clouds repel each other are simply wrong.\(^20\) However Howard gets other fundamentals right: that cumulus only form during the day because they are the result of hot air rising from surfaces heated by sun rays.\(^21\) But in getting some fundamentals right and in linking particular cloud structures to particular atmospheric events (even erroneously) he provided the first viable platform for this kind of investigation.

In addition Howard devised an efficient system of symbols for each cloud type, for use in Journals and Meteorological registers. Indicating just how intense the culture of seeing was to nineteenth century study of the weather Howard made an intriguing note in the third edition of this work. Unlike earlier editions he consciously chose not to include a set of plates capturing each cloud type. Instead he declared that ‘the real student will acquire his knowledge in a more solid manner, by the observation of nature, without the aid of drawings...[because] the more superficial are liable to be led into error by them’.\(^22\)

Observers attentively watched the skies. Many, despite Howard’s misgivings, used visual aids. In subsequent decades weather watchers modified Howard’s system but they did not fundamentally change it. Nor did they alter its logic. They merely added and subtracted and, ultimately, changed the fundamental categories. But these categories remain, to this day, based on cloud structure and relate to particular kinds of current in the great aerial ocean. In 1840 German weatherman and physicist Ludwig Kaemtz added *Strato-cumulus* and in 1855 French observatory director Emilien Renou added *Alto-cumulus* and *Alto-stratus* to the taxonomy.\(^23\) By 1887 Professor Hildebrandsson of the University Observatory of Uppsala and Ralph Abercromby of the Royal Meteorological Society had, with the aid of Abercromby's

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\(^9\) Ibid., pp3-4.
\(^20\) Ibid., p29.
\(^21\) Ibid.
\(^22\) Ibid., pp14-15.
\(^23\) Richard Hamblyn, op. cit., p234.
arresting photography, devised a system of ten proposed cloud types based on Howard’s fundamental categories.²⁴

1896 was the International Year of Clouds. The first International Cloud Atlas is one of its lasting legacies. After much deliberation, the system of cloud classification almost identical to that in use today had been authorised by meteorologists. There is something of Lamarck in it with clouds since being classified according to height. Ten classifications of cloud are still identified but nimbus clouds are no longer officially recognised while the more precise nimbostratus have been since 1930.

Clouds in the ‘Antipodes’

Observers in the north were using Howard’s taxonomy before Darwin was settled. Australia and its Northern Territory were perceived as remote but they were not removed from these developments and practices. Weather watching in Darwin and the Top End was every bit as visual as the term implies. Today many images generated by science come from a vantage point far above the clouds. Satellite technology has enabled examination of flows of air from above and clouds are still crucial to elucidating these. Systematic satellite snapshots, time lapse imagery and computer modelling all capture clouds and their movement. During times before satellite technology people had to discern movements in the upper layers and in the atmosphere more generally from the clouds, but then from the seabed of the great aerial ocean. Clouds were understood as signs and as portents, even if quite poorly. Regardless of how well their relation to other weather phenomena were understood, recording the clouds was routine in the Top End, even before the roots of permanent European settlement took hold.

A dusty volume survives to this day with detailed observations from the stillborn settlement of Escape Cliffs (also known as Adam Bay). It bears the unmistakable stamp of empire: ruled columns and lines, organised by the calendar month, measurements of air pressure, dry and wet bulb temperature, wind direction with category of force recorded, maximum and minimum temperatures in the shade were recorded for ‘night’ and ‘day’, rainfall figures were arranged into ‘night’, ‘day’ as well as ‘24 hour’, and two columns were given for clouds, one for type, the other for ‘amount’.²⁵ Data are recorded regularly throughout the day, in a most elegant

²⁵ Results of Meteorological Observations Palmerston (Adams Bay), Month of February 1865 – Month of July 1866, NAA Darwin., NTAC 1976/106 VOLUME.
hand — initially at 3 hour intervals between 6am and 6pm, later at just 9am and 3pm — with all quantities used to calculate averages, recorded beneath the relevant column. Another page records means for each measured phenomenon for each time 6am, 9am noon, 3pm and 6pm each calendar month.\textsuperscript{26}

Clouds hung heavily over Adam Bay during the ‘settlement’s’ early days. It is worth noting that the cloud observations for the first week of February 1865 are consistent with what is commonly seen in the region during what are now known as monsoonal breaks during ‘The Wet’. Thick skies during the morning, partly cloudy during the middle of the day with sometimes lengthy breaks of sunshine and building clouds in the afternoon with both distant and proximate lightning, thunder and showers. Cloud types were generally noted according to code. Entries for February 2, 1865 give something of the flavour: 6am, ‘CiCu, Nimb’; 9am, ‘CiCu, Ci, St’; noon, ‘CiCu, CiSt’; 3pm, ‘CiCu, Cu, Nb’; 6pm, ‘CiCu, CuSt’.\textsuperscript{27} Cirrocumulus throughout the day with the now defunct nimb at 6am, with cirrus and strat at 9am, cirrostratus at noon, cumulus and nimb and cumulostratus early evening. We cannot read from these observations exactly how this was understood. But we can certainly see, especially from looking in detail at the data taken over this seventeen month period at Adam Bay, that these observations captured the often turbulent and brothy nature of the skies above Australia’s far north. Skies were certainly observed both at Adam Bay and later at Darwin and other Top End stations attentively enough to dispel the notion that tropical weather is essentially unchanging for six months, before flipping for another six and switching back again. Just as rainfall patterns and humidity subverted the imported understanding of climate and clarified exactly how newcomers defined seasons, so clouds help us understand how certain weather elements were privileged over others in the endeavour to understand local weather and climate.

Observations from May and July of 1865 and 1866 illustrate this. Each of these months show that, despite all being in the same ‘season’, the weather is visibly different from one day to the next. Some days cirrocumulus clouds dominate, on others it is clear, other days feature isolated heaps of cumulus, others again wisps of cirrus, on a few days stratatus clouds of varying thickness were recorded.\textsuperscript{28} It is worth pondering that in a visual culture such obvious visual phenomena did not lead to a shift in ideas about climate and seasons, or, at least, a questioning of the idea of two kinds of constant tropical weather. That this did not happen points to the

\textsuperscript{26} Hourly Means, NAA Darwin, NTAC 1976/106 VOLUME.
\textsuperscript{27} Month of February 1865, ibid.
\textsuperscript{28} Month of May, 1865, 1866; Month of July, 1865, 1866, ibid.
importance, the sheer dominance, of rain in notions of weather and climate in settler societies desirous of exploiting new tracts of land. Such societies did not study weather completely and in a disinterested fashion, but, understandably, with an eye to the factors perceived as most related to prospective success of colonies with a substantial agricultural base. Clouds were studied but given less weight than related phenomena such as rain. The data I have studied from Adam Bay and early Darwin are not substantial enough to draw any real conclusions about weather patterns. Intuitively I suspect that the elusive, highly variable nature of clouds and the differing acuity of observers and quality of observations over much longer periods of time would make many inferences about patterns questionable. Nevertheless, this cloud data indicates that there were reasons to doubt the idea of ‘The Dry’, incorporating May and July even before Darwin was founded. I have chosen to ‘interrogate’ the dry because average rainfall figures suggest a uniformity during this time of the year that they do not indicate for any calendar months of the official ‘wet’. Put simply, the figures most circulated indicate that ‘The Dry’ is almost constantly so, while different periods of ‘The Wet’ are wet to varying degrees. Cloud observations show that air flows over the Top End can be different enough in May and July to at least question whether these are part of the same season. Most evidently no nimbus clouds were observed during either July but they were recorded during both Mays. July days on which either clear weather or skies with only cirrus clouds were noted at 3pm were between double and triple those of the Mays. Complex cloud assemblages were more frequent during the Mays than the Julys. Not once were three different cloud types recorded on any July day at 3pm; this happened on four occasions during May 1865 and twice during May 1866. The skies were watched, but perhaps not as closely as Howard and, later, Abercromby urged.

This is not to suggest that observers in the Northern Territory were lethargic, inattentive or simply followed established procedures. Following the International Meteorological Conference of 1896 P Barrachi, Government Astronomy of Victoria, sent a copy of the updated cloud classification system to Charles Todd at Adelaide Observatory for distribution throughout its network and for cloud observations to be gathered for a study Barrachi was soon to coordinate.29 Barrachi’s descriptions were particular vivid: cirrostratus were described as a ‘thin whitish sheet’; cumulus as ‘wool-pack clouds’ and cumulonimbus as ‘rising in the form of mountains, turrets or anvils’.30 Instructions for observers were precise and to be taken at specific times. Cloud thickness and motion were to be recorded. Motion meant both direction of travel and apparent speed, for which a scale was circulated. The scale of 0 to 4 (no

29 P Baracchi, ‘Clouds’, State Records, South Australia (SRSA), GRG 31/2, No. 5513, 1896.
30 Ibid.
motion to very rapid) classified how fast a cloud moved 'through a distance subtending an angle of 15 degrees at the eye of the observer'.

On the ground observers in the Top End routinely reported hazes and glows in the sky to authorities in Adelaide. One particular incident in late 1902 indicates the assiduousness of their observing. When thick bluish smoke enveloped Darwin observations throughout the 'Territory' were examined. Smoke was reported at every station from Port Darwin to Powell's Creek but no bushfires were reported. J A G Little telegraphed Charles Todd to investigate whether the smoke was observed at Thursday Island. Captains of in-coming shipping were quizzed and log books examined. Captain Dabelle of the Guthrie reported that his voyage from China had been hampered and delayed by smoke the whole way from the Philippines to Australia. A report from Captain Lindburgh of China Navigation Company Limited's S S Tsinan corroborated this, but was more specific: en route to Hong Kong the smoke was observed from 'Lat 8.16S Long 129.9E and Lat 6.34N and Long 122.22E'; returning to Darwin it was encountered from Lat 1.12N Long 125.27E all the way to port. Mr Christie, keeper of Point Charles Lighthouse, not only provided a detailed description of this event but also took a sample of the dust from a window pane. He forwarded this to Mr Little in Darwin who forwarded it to Todd in Adelaide who sent it to Professor Rennie, chemist and metallurgist at Adelaide University, for analysis. The cause was a volcanic eruption in Sumatra and observers in the far north left no stone unturned to explain what they saw, smelt and at times probably coughed up.

At an institutional and national level clouds still attracted the attention of meteorologists. When the Commonwealth Bureau of Meteorology (BOM) began operating in 1908 workers continued to study clouds, hoping that they might yield some of the sky's mysteries. With a national bureau information and theories circulated even more widely than before. The bureau's Bulletin was a significant contributor to this and to transmitting scientific material about weather and climate in Australia, including its far north. Clouds were certainly a feature of this national discourse: Bulletin 12 was entirely devoted to bureau meteorologist E T Quayle's ideas about representing cloud types in daily reports and in the 1920s the Australasian Association for the Advancement of Science published a detailed paper from Captain Kidson of BOM about cloud height and classification reaching back 25 years to Barrachi's early work. By then clouds had long ceased to be the primary means by which scientists saw weather. Early twentieth century institutional and

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31 Ibid.
32 The following sequences comes from the telegrams and memoranda comprising, 'Pt Darwin, Thick smoky haze- reporting', SRSA, GRG 31 SERIES 2, No. 11138, 1902.
33 Ibid.
scientific discourse about weather had become distinctive: it told its stories in maps. Moreover, these visual stories spoke of various climatic elements by means of statistical abstraction and, perhaps, shaped ideas about weather and climate, including in the Top End, even more than the enormous volumes of literature and reporting discussed in Chapter 7.

Mapping the Skies

The herculean efforts of Alexander von Humboldt and his companion Aime Bonpland inaugurated a profound shift in ideas about climate and space. From Eratosthenes, through thinkers such as Ptolemy, the notion of climate zones due to klimata—the inclination of sunlight as it radiates down to the surface of the earth—and in part defined by the 'sun's' turning (tropos) about 23 degrees north and south of the equator prevailed until well into the nineteenth century. The astronomical phenomena that set the temporal limits for seasons also set the spatial limit for the tropical climate zones of the earth. The boundaries of each zone—whether seven, six or five in number—girded the globe. By this rationale all places with the same latitude experienced the same climate. As those who held this view increasingly encountered other places and other climates this idea became increasingly dubious. Nevertheless, it took a student of nature who could see the interconnections among the dazzling array of lifeforms and physical phenomena that make up non-human nature to grasp the intricacies of climate and imagine other ways of understanding its spatial aspects. Even before setting out on his five year expedition of tropical Central and South America in 1799, Humboldt had intuited important relationships between climate and vegetation. In 1793 he published a work urging botanists to transcend classification and superficial appearances and to study plants in context with all other elements of the physical environment, as well as their influence on humanity.34 But as he published his voluminous accounts of his observations, as these came to be translated from French into English and German, the ideas honed by his embodied experiences, and astute reflections spread throughout the community of European natural philosophers. A nuanced and holistic understanding of climate displaced the old astronomical one.

Humboldt’s explorations and observations compelled this. The idea that climate is largely determined by the inclination of the sun simply buckled under the weight of Humboldt’s examples to the contrary. Over his exhaustive wanderings

with Bonpland through ‘Equinoctal’ America he took remarkably detailed descriptions of the environments he encountered.\textsuperscript{35} How they looked, how they felt, how they sounded, how different elements were linked. Intricate descriptions of plants, rocks and landforms were complemented by assiduous recording of temperatures. Alexander von Humboldt read the error of the idea of climate as \textit{klimata} in the plants. Understanding that there are critical temperatures above and or below which certain plants cannot grow Humboldt saw that altitude, topography and location are at least as influential as latitude in determining a climate. By 1800 European experience of icy winters in the north-east of the United States, much colder and harsher than those places further from the equator such as Britain, had undermined the classical idea of climate. Humboldt, however offered an empirical means to grapple with this. His explanation of the difference in climate between two nearby settlements encapsulates his approach:

The climatic difference between the two neighbouring towns is due less to the height of one of them than to local weather conditions. Among these causes are the proximity of the jungle, the frequency of rivers falling down narrow valleys, the amount of rain and those thick fogs that block out sunlight. The cool climate surprises us all the more because...very great heat is felt though the height between 200 and 480 toises above sea-level. In plains, as well as on mountains, isothermal lines are not constantly parallel to the equator or the surface of the earth.\textsuperscript{36}

After this vivid illustration of interconnectedness Humboldt makes a portentous declaration:

Meteorology’s great problem will be to determine the direction of these lines and the variations due to local causes, and to discover the constant laws in the distribution of heat.\textsuperscript{37}

Groundbreaking as his thinking about spatial aspects of climate was, Humboldt was captive to received ideas in thinking about climate and time. Weather and seasons were related to the calendar month indicating invariability from year to year whether this was warranted or not. This by no means undermines

\textsuperscript{35} Evident even in abridged versions of Von Humboldt’s \textit{Personal Narrative of a Journey to the Equinoctal Regions of the New Continent}, such as that abridged and translated by Jason Wilson, (London: Penguin, 1995).
\textsuperscript{37} Ibid, p88.
his spatial claims and other intellectual innovations but is an example of how profoundly influential and pervasive the notion of invariable climates on short timescales has been in western natural philosophy. Nevertheless, Humboldt anticipated the kind of work that would occupy scientists and geographers in Australia, such as that examined in Chapter 6 as well as later in this chapter. More broadly, his work created a conceptual space in which climate globally could be studied with more intricacy and detail. Between 1845 and 1858 Humboldt published his four-volume *magnum opus*, *Cosmos*. *Cosmos* transmitted Humboldt's most refined thoughts about the study of nature to the western scientific world. Over more than 20 pages of volume 1 he ruminates on meteorology and climatology.38 After outlining how weather and climate interact with other physical elements such as topography and vegetation, he speaks of how the enigma of climate can only be explained by the collation of empirical, numerical data and the mapping of isothermal lines based on these figures. Climatic relations could not be elucidated until they were based on 'the numerical data of mean annual temperature'.39 Understanding that interactions between weather and plant life occur on scales less than that of the year, Humboldt also conceived the notion of *isochimenal* (lines of equal mean winter temperature) and *isothermal* (lines of equal mean summer temperature).40 Mapping average quantities of various, measured, weather elements — temperature, humidity, pressure, rainfall — on annual, seasonal or even monthly time scales subsequently became the principal method for understanding climate.

But different theorists applied different means to very different ends. According to West Australian geographer Joseph Gentilli, Austrian Geographer Alexander Georg Supan compiled the first modern map of climatic zones, classified according to average annual temperature and the mean temperature of the warmest month.41 First circulated in 1879 the zonal definitions coincided with polar and tropical limits, as well as the limits of tropical vegetation. Nevertheless, in 1884, Supan replaced the received handful of climate zones striped across the globe with a mosaic of 35 distinct climatic regions. Included in this was province number 16: ‘Indo-Australian Monsoon’, encompassing the northern third of the Northern Territory, Cape York Peninsula and the far north of what we now know as the

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39 Ibid., p325.
40 Ibid., p330.
Kimberley, early recognition that Australia's tropics were not a climatic unity. More significantly, this new paradigm undermined one of the conceptual supports of the wet/dry climatic dichotomy. Halley and followers imposed this idea on the Top End based on empirical observations. However, notions of climate as klimata and of latitude determining climate also conceptually supported the idea of the wet/dry dyad. Curiously what replaced the old framework was a region-specific category that by definition reinforced the imported understanding. Moreover, this happened long before the region's climate could be discerned through local observation and experience.

Flawed by its specificity and inability to relate geographically distant regions of similar climate, Supan's system was supplanted by other models that better accounted for relationships between temperature, moisture and plant growth. In 1884 St Petersburg trained German botanist Wladimir Koppen proposed a classification system incorporating the length of time (in calendar months) mean temperatures fell below critical levels for vegetation growth. A much more detailed system Koppen published in 1900 linked critical levels of heat and moisture and their average annual duration to a five part division of vegetation based on critical limits of temperature and moisture formulated by botanists over the previous 25 years. Modified on numerous occasions, such as 1918 and 1936 as Koppen identified important elements such as divisions between moist and arid climates, the temporal distribution of rain and the timing of dry seasons, Koppen's system was perhaps the most enduring and influential throughout the twentieth century. This was not for a lack of schema. In the 1890s Hult devised a system based on three divisions of annual mean temperatures, which were then broken down into further groups based on seasonal profiles or precipitation, temperature and winds, yielding 103 climatic districts. In 1905 Herbertson developed a scheme based on temporal profiles of heat and rain. In 1912 he elaborated the thermal categories to encompass 10 thermal regions distinguished by the timing and duration of heat and cold throughout the year. In the 1910s Martin Vahl outlined a taxonomy based on critical limits of plant growth and average temperatures of both the warmest and coolest months. But it was Warren Thornthwaite's modification of Koppen's system that would offer the greatest challenge to Koppen. In 1931 Thornthwaite critiqued Koppen's climatic classification of North America. Doing this he introduced the idea of precipitation effectiveness – effectively how little or much precipitation is depleted by the heat and or aridity of a region. Unlike other climatic formulations

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43 Ibid., pp469-472.
44 The following schema are detailed in Gentilli and Ward, op. cit.
this was calculated on a monthly basis, though like others it relied on mean values of relevant elements.

This by no means exhausts the range of global climatic systems developed between 1870 and 1940. As is clear from their timing most, perhaps even all are encumbered by not being based on sufficiently substantial systematic observations in regions that were relatively late to be engulfed by expanding Europe and neo-Europes. The scramble for Africa and the scramble for Antarctica were accompanied by a somewhat premature scramble for the skies. The European imperial drive to annex, classify, order and control was truly three-dimensional. Nevertheless, as well as indicating how complicated and problematic climate classification is, this survey also gives something of the flavour of the conceptual contexts in which Australian scientists and geographers laboured to answer various climate related questions about their own continent. The overthrowing of 'classical' ideas of climate led to new ways of understanding that were imposed upon, imported into and, consequently, widely practised in Australia.

**Mapping and Stories**

These new ways told stories through maps. Mostly these are stories of climate based on calculations of means from the numbers and tables that told the stories of Chapters 3-6. These are stories that locate the Top End in relation to the remainder of the continent of Australia. Indeed, given the tendency of official weather bureau maps to include neighbouring islands such as New Zealand's big two, New Guinea, Timor and sometimes Flores, Lombok and eastern Java, maps gave the Top End a place within Australasia. Maps of Northern Territory weather and climate were not constructed locally: initially weather maps were drawn by the colonial observatories in Adelaide, Sydney, Melbourne, Brisbane and Perth. As noted in Chapter 7, from the 1880s they were supplied to colonial newspapers and published routinely in weather reports, but not in Darwin. Reading maps of barometric pressures appearing in both the *Adelaide Advertiser* and the *Sydney Morning Herald* between 1892 and 1942 it is clear that changes in airflow across the Top End seem to be purely seasonal and not something that occurs on the time scale of the day or week.45 Daily weather maps reinforce the imported understanding to southern readers practically every day. During the early part of this period few isobars ran across the central and western parts of Australia's north coast. While this certainly gave the impression of effete doldrum-like winds in this part of Australia's tropics

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day after day, this was of a consequence of there being few observational posts in this region and on the seas to its immediate north. Consultation of daily weather charts from Melbourne Observatory and, later, the Bureau of Meteorology confirm that the visual depictions of air pressure over the far north and north-west were something of an artefact of the large regions either without observations or without stations that reported frequently enough for inclusion in daily weather charts. They also reflected the peculiarly linear pattern of stations in the Northern Territory. Crucially, observations both on the adjacent waters and at higher altitudes were not taken in sufficient numbers at requisite regularities for inclusion in daily synoptic charts. The most salient illustration of these gaps is that neither the 1897, nor 1937 cyclones appeared on either the daily newspaper weather charts of the *Advertiser* or *Herald*, or the official daily barometric charts of the Bureau of Meteorology or its predecessor. Accordingly, these maps illustrated a misleading picture of stability in the atmosphere enveloping the Top End. And it was, during this era, structurally impossible to graphically depict and hence see the contingent, spatially confined, trough-like nature of monsoonal systems over northern Australia. Weather maps in fact helped perpetuate the oceanic sense of monsoon and thus the imported understanding of seasons prevailed for so long.

The network was geographically extensive enough to enable weathermen to retrospectively reconstruct weather events. Like the Societas Palatinas, William Brandis and US weathermen such as William Redfield and Frank Bigelow, and students of Australian weather such as Charles Todd, mapped weather across the continent in order to identify patterns. Integral to a review of Meteorological work in Australia presented to the fifth meeting of Australasian Association for the Advancement of Science (AAAS) in 1893, Charles Todd presented a number of maps to illustrate typical kinds of weather in Australia. Reminiscent of Luke Howard he identified a small number (in this case seven) of 'frequently recurring' 'well marked types', classified into particular types, illustrated visually. Specifically, each type was illustrated by a synoptic chart for a particular day and drawn by his own Adelaide Observatory. Unsurprisingly, given the period, these extracts of the typical tell the same story of weather in Australia's far north as press and bureau maps. The first weather map to demonstrate disturbance in the tropics accompanied a Bureau of Meteorology study on Australian and South Pacific

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46 January 1897 and March 1937, NAA, Melbourne, MP 149/1 WHOLE SERIES.
47 For a detailed account see Chapters 1 and 2, Mark Monmonier, *Air Apparent*, (Chicago: University of Chicago Press, 1999).
49 See plates in ibid. between pages 260 and 261.
'Hurricanes', published in 1925. Principally authored by US meteorologist and geographer Stephen S Visher, this study and maps show the swathes cut across Australia, especially the north, by 'hurricanes and related tropical storms'. But these maps show disruption of tropical 'torpor' by extreme events, not day-to-day weather. In any case maps narrate even more compelling stories about climate in Australia than they do about weather.

**Mapping Climate**

Climate intensely preoccupied government. The major published studies of climate were all initiatives of government organisations such as the Bureau of Meteorology, government departments, or groups such as the Advisory Council of Science and Industry. Accordingly these studies give a sense of how scientists, geographers and officials thought about and narrated climate in Australia. Maps were integral to both these studies and to what they said about climate in Australia and the Top End. Climate maps concentrated on temperature and rainfall. This discussion focuses on rainfall for two reasons. The climate of the region and indeed, its seasonal regime, has been defined in terms of rainfall. While, as Chapter 6 has shown, the extent to which high temperatures have been regarded as a constant in the Top End is not quite warranted by the historical record, heat has, nonetheless, been regarded as a constant in climatic studies of the far north. The treatment of rain affords more insight into the study of climate more generally. A number of maps drawn mostly by the Bureau of Meteorology or by federal government departments are of particular significance because they appear and reappear, albeit in revised form, in official publications. The remainder of this chapter will analyse these illustrations.

Unsurprisingly, maps of average annual rainfall featured prominently. Early publications used data based on the period 1897-1906 and so were not based on a particularly sound foundation, but as time passed and more data was gathered the maps came to capture climate over a longer period. *Bulletin No.1* of the Bureau of Meteorology exemplifies this. Reprinted from the *Official Yearbook of the Commonwealth of Australia, Bulletin No. 1 – The Climate and Meteorology of Australia –* was published in 1908, with the inauguration of the bureau. Map 1 (overleaf) appeared in the very first *Bulletin*. *Bulletin No.9*, issued in 1914, bore the

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51 For maps see ibid.
same title and was a modified version of *Bulletin No. 1*, extracted from the *Federal Handbook on Australia*. These all used the bureau’s map of average annual rainfall to 1906. This map was also the most prominent feature of *Bulletin No. 2*. Later editions of *Bulletin No. 1* such as the 1933 and 1936 revisions used the bureau’s map of 1924.\(^{54}\) Despite the differing data sets the 1906 and 1924 maps had the same rationale and drew on the same methods. Accordingly, the following criticisms apply to both.

The 1906 map does tell an important story. Clearly the northern half of the Top End is among the wetter parts of the continent. We also learn that rainfall tapers off moving inland from the north coast, though it is voluminous within 300 kilometres of the coastline. The 1924 map shows a similar pattern, identifying two extra rainfall bands in the deep blue of the 1906 map. But such linearity is misleading. At the time mean values were seen to indicate truth and they were not commonly interpreted in conjunction with measures of variation. Some years annual rainfall has declined spatially in the manner depicted here. In others more rain has fallen inland, the pattern has not been so linear or the drop off has not been anywhere near as constant. Moreover, historical differences in the far north problematise any notion that the northern Top End could be regarded as all falling within the same rainfall zone. Any sense of orderly decline going inland is also difficult to sustain. For example, in 1898 more rain fell in Katherine, approximately 250 kilometres inland than in Darwin and more rain fell in Pine Creek, approximately 200 kilometres inland than in Katherine.\(^{55}\) In 1895 900 fewer millimetres (mm) of rain fell in Pine Creek than was recorded in Darwin, yet slightly more rain fell in Katherine than in Pine Creek. A similar pattern, though with a smaller difference between Darwin and Katherine, occurred in 1907. In 1912 there was a 500mm difference in total rainfall for Pine Creek and Katherine, in 1924 and 1925 the difference was in the vicinity of 400mm. In 1930 and 1937 rain volumes were similar across all centres with less than 250mm (or 10 inches) or an isohyet’s difference in totals between all three locations. Weather is always more disorderly and variable than climate but comparisons of historical rainfall data across the Top End point to a climate more variable than indicated by charts such as this.

Official bureau maps were quite sophisticated. They were not merely derived from basic quantities such as annual means but also looked at rainfall distribution within the calendar year. Map 2, overleaf, featured prominently in the 1912 Revision

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\(^{55}\) This and all following rainfall figures come from Bureau of Meteorology, *Climate Data Online*. 
of Bulletin No. 1, as well as Bulletin No. 4, Monthly Distribution of Australian Rainfall, and Bulletin No. 9. Rather than display monthly averages these maps showed the proportion of annual rainfall falling in each calendar month, in particular locations. While this does enable viewers to identify particular wet and dry periods in specific locations it is blind to inter-annual variability in rainfall. The dotted lines running roughly south-east to north-west across the continent indicating the limits of summer and winter rainfall strengthen this idea of a climate without inherent variability. For the Top End it shows extremes of wet and dry for particular times of the year, a partial ecological truth of this region, and is a reinforcement of the imported understanding. However, as this thesis has shown this is only one aspect of climate in Australia's far north.

It is not that scientists in Australia had no regard for weather and climate across time. Indeed they studied both on a variety of time scales, in a number of ways. Map 3, overleaf, is a map of the wettest calendar month across Australia. The floods of green, blue and pink tell us that large parts of Australia are wettest in the months of January, February or June. Certainly useful in identifying general patterns in the movement of rainfall across Australia it is similarly encumbered by the same flaw as the other maps. Regardless of the stories told, these maps all draw upon the same abstraction: average quantities as approximations of realities. And there are the problems discussed throughout this thesis of compartmentalising physical phenomena into calendar months. The old, unintelligible notion of 'January weather' or 'January rain', especially applied to the far north, first identified in seventeenth century English almanacs, is replicated here. Temporal order is imposed and misconceptions are, unwittingly, perpetuated.

Timing in fact was vital. In a society with such a strong economic and developmental emphasis on agriculture it is unsurprising that the bureau and government departments drew up rainfall maps for the wheat-growing season. To best exploit the land, the newcomers had to know what to do, where to do it and when to do it. But there was a broader preoccupation with timing weather for its own sake and defining climates accordingly. Map 4 (the page following map 3) illustrates this, literally. A version of this map was drawn up used by the Ministry of National Development and is preserved in the National Library of Australia's map collection.

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58 For example, NLA Maps, Map Showing Average Rainfall for Wheat Growing Period, G8960.C883.
59 NLA Maps, Duration of Wet Seasons, G8960.C883.
But this map, *Duration of Wet Seasons*, circulated widely. At a minimum it appeared in *Bulletins* No.22 and No.23 in 1938 and, even more significantly, in Griffith Taylor's major work *The Australian Environment (Especially as Controlled by Rainfall)*, published in 1918. This copy comes from *Bulletin* No. 23, *Australian Rainfall In District Averages*. Here every portion of the continent, and the surrounding seas, are categorised according to when most rain falls and the period when hurricanes, cyclones and storms occur or are most common. Natural phenomena are classified according to the calendar month. Of course the notion of an October to April wet season conforms to and reinforces the imported wet/dry dyad. From this map we can see that this is also how meteorologists and geographers thought of and spoke about the climate of the far north. Indeed their way of seeing climate in Australia, continent wide, especially in relation to time, did not brook even the possibility of inherent variability. This is a picture of an ordered climate, a regular, predictable climate, a climate understood across a continent and, perhaps a climate under control. Rain falls over the Top End from October to April; by the 1930s historical records showed that this was unusual, with the 'season' being shorter and interrupted and the 'season' many years being shorter inland than it is on the coast. A more accurate map, at least for the Top End, would define October to April as the period during which mostly wet seasons occur. It would distinguish median 'season' lengths in Darwin from those in Katherine and Daly Waters and, it would endeavour to distinguish convective, stormy wet, from monsoonal wet, indicating that there are a variety of wet seasons most years in this region. But criticising scientists and officials for not doing this is to risk anachronism. During this time means were still seen as an enumerated measure of reality. This is clear from *Bulletin* No. 23, which accompanied this map with long tables of monthly rainfall totals and averages. Although the raw totals tell more complex stories of variation, hinting variability, the organised, ordered and privileged averages reinforced the narrative of this map time and time again. This was also the case with other publications, such as *Bulletin No.9*, which included an exhaustive list of the most intense rainfall events, the date on which they occurred, and the volumes recorded, for hundreds of locations across Australia. As extremes they seemed to be exceptions proving the rule encapsulated in the tables of annual and monthly means.

Nevertheless, Australian scientific enquiries into climate were remarkably sophisticated. We have already seen how they looked at climate across a variety of time scales, whether annual, monthly or seasonal, and indeed the latter in various guises. The Bureau of Meteorology did not just look at phenomena such as rain from

60 Commonwealth Bureau of Meteorology, *Australian Rainfall in District Averages, Bulletin* No 23.
MAP No. I. DURATION OF WET SEASONS, AUSTRALIA

Map 4
Duration of Wet Seasons
(1938)
the perspective of quantities, but also when it fell and how often it fell. Griffith Taylor's *Australian Environment* was both the most important and the most intricate study of Australian climate published in the first half of the twentieth century. Integrated consideration of vegetation, topography and climate, on both continental and regional scales, form this thorough analysis. Using the climatological template of Supan, Griffith Taylor identifies 15 distinct climatic, even ecological regions, defined by rainfall regime. *Darwinia*, $K_1$, in this taxonomic shorthand, effectively encompasses the entire Top End of this thesis and a little more. This work, as discussed above, does perpetuate the mistaken notion of unvarying periods, defined by calendar months, in which kinds of weather, such as rain, regularly occur, year, after year. Griffith Taylor does this on a continental scale in his inclusion of the *Duration of Wet Seasons* map to substantiate his discussion that all parts of Australia have marked wet seasons. In relation to the Top End he does this by giving his discussion of seasons over to the eloquent but erroneous words of J A G Little quoted briefly in Chapter 1 and in detail in Chapter 3. To convey their force and influence I quote it again, in even greater detail:

The different changes in season are so uniform and regular that they may be predicted almost to a day. Signs of the approach of the wet season appear immediately after the sun has crossed the equator during the spring equinox, in September, when the strong E.S.E monsoon – which has been blowing continually throughout the dry –ceases and is succeeded by calms...thunderclouds gather over the land, increasing in size and density by the day, until they burst into terrific thunderstorms, accompanied by hurricane squalls of wind and rain. These, squalls, at first take place every four or five days, gradually increasing in numbers until the end of November, when they occur almost daily...

During December the N.W. monsoon gradually gains the ascendancy, with an occasional break of calm weather

The N.W monsoon is accompanied by rain almost daily, and increases in force until late January or beginning in February, when it is blowing in full heart and penetrates with its copious and fertilising showers into the very centre of Australia...

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61 As well as average volumes the Bureau also drew maps such as that illustrating Average Number of Annual Raindays, NLA Maps, G8960. C883.
62 Griffith Taylor, *Australian Environment (Especially as Controlled by Rainfall)*, Published under Authority of the Executive Committee of the Advisory Council of Science and Industry and H A Hunt, Commonwealth Meteorologist, (Melbourne: H J Green, 1918), p33 and pp67-78.
63 Ibid., p22.
On the approach of the autumn equinox the N.W monsoon gradually dies away and is succeeded by the calms, variable winds, thunderstorms and oppressive weather until the end of April, when cooler weather is felt; the S.E monsoon sets in, and the dry season may be said to have fairly commenced.64

The clockwork climate is encapsulated and authoritatively transmitted, in a most poetic rendering, in perhaps the most important scientific studies of Australian climate of the period. Indeed Griffith Taylor's quoting of Little is almost triple the length of what I've used. As well as the orderly, gradual and scheduled turns, and linear increases and decreases Griffith Taylor includes arresting and memorable images of 'fertilising showers' and scudding 'banks of nimbus'.65 If The Australian Environment portrays a clock-work Top End climate its, nevertheless, also transcends the received idea of weather and climate by presenting, for the first time in a scientific work, its complexity, variety and, indeed variability.

Maps are instrumental in this innovation. Much in the manner of Todd's AAAS paper, Griffith Taylor speaks in detail about typical kinds of weather. In a lengthy piece titled 'Character of rainfall', the varieties of rain common to Darwinia are first tabulated according to their occurrence and then the synoptic charts exemplifying each of these five types sketch the weather systems that precipitate them. Five kinds of rain are identified those due to: western lows, central lows, eastern lows, trough and indefinite.66 Their occurrence in each calendar month of 1910-1914 is tabulated, offering a strong rebuttal of Little's rendering of wet and dry and of the received dichotomy. Yet, Griffith Taylor's discussion on the following page, speaks of average occurrences for each calendar month, reinforcing the mistaken ideas of linear increase to times maximum, gradual linear decrease to scheduled minimum with flipping points between 'wet' and 'dry' on the way.67 Using eight genuine synoptic charts of particular days exemplifying typical kinds of rain in the Top End this treatment shows that rains have many causes and appear in a variety of forms. But these valuable and original insights, framed as they are, do not call into question but rather reinforce the idea of the region's clockwork climatic dyad.

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64 J A G Little, quoted in Griffith Taylor, ibid., p70.
65 Ibid.
66 Griffith Taylor, ibid., p75.
67 Ibid., p76.
Nevertheless, *The Australian Environment* is among the earliest works to map rainfall variability. Map 5, overleaf, features prominently in Griffith Taylor’s opus and is particularly revealing.\(^{68}\)

This map represents an important conceptual breakthrough. The isopleths join places of equal rainfall variability, variability defined as the average of departures from the means during the period 1891-1910. Looking at and measuring deviations was rare at this time. Although statistical entities such as standard deviations, mean deviations, mean differences and interquartile ranges were formulated by theorists such as Bernoulli, Laplace, Gauss and Quetelet in the eighteenth and early nineteenth centuries they had largely been applied first to astronomical observations and later to biometric measurements.\(^{69}\) Such methods of measuring dispersion were not part of the analytical ensemble used by authors of publications in the bureau’s *Bulletins* and so were not part of how weather and climate in pre 1940s Australia were narrated to the wider public, or, perhaps, even, most of the scientific and official community. Griffith Taylor’s remit was the continent as a whole, so there is no specific discussion about the Top End. But important things, nonetheless, can be read from this map. The first is that the supposedly reliable and predictable tropics, at least in Australia, yield rain that is more variable in quantity than that of ‘variable’ and temperate south-west Western Australia, southern Victoria and Tasmania. We can also read that the base of the Top End has a measured variability of nearly 30% and so has unreliable and unpredictable rain. Evidently rainfall variability is portrayed here as increasing sharply not far into the Top End hinterland, undercutting the stories told by maps of mean annual rainfall. Such substantial variability, albeit in relation to volumes, at least logically, calls into question the stories of unchanging seasonal periods too. However, these matters were not taken up, either by Griffith Taylor or by other geographers and scientists of the first half of the twentieth century.

Maps and science told the same story as the colonists, importing their understanding, but with countless numbers and substantial authority. From a distance they were also telling the stories that many who had actually lived the arresting and memorable atmospherics of the Top End were telling. This was not intellectual diffidence. This was not lazy group-think. In part it is a reflection of the

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\(^{68}\) Ibid., p21.
peripheral nature of this region in Australian life. It was just one of many regions that limited numbers of scientists and officials sought to understand, order and exploit. Significant resources were put into studying and exploiting the north of the Northern Territory and there was only so much reviewing of work that could be done and a limited number of people to undertake it. Another factor is that the stories of science were seductively congruent with the work of earlier, esteemed authorities and congruent with the impressions and experiences of other attentive people. If something seems right there is no compulsion to review it. The nature of early twentieth century meteorology and climatology in Australia is also important. They were thorough, assiduous and meticulous. But they were developing and even emerging disciplines. They had not evolved to the point of drawing on more sophisticated techniques of statistics to see more subtle aspects of Australia’s and, particularly, the Top End’s weather and climate. Even more importantly, this may reflect the fact that students of weather and climate had simply not been here long enough to recognise these intricacies. Indeed newcomers to both the north and to the continent as a whole had almost certainly not been here long enough to recognise that European ways of seeing were blind to some facets of Australia’s environment, such as its inherent climatic variability.
CONCLUSION

Atmospheric history undermines the newcomers' key concepts. Received understandings of weather and climate for the Top End are not reflected by a detailed historical study of atmospheric fluxes. Scientists extrapolate patterns from 30 or more years of weather history. From this history we can conclude the following. Rain is too varied in timing and quantity. Some years are stormier than others. Some years the monsoons are more vigorous and act for longer. Other years they are less significant. Regional wind patterns are not as regular as the dominant ideas of weather and climate would suggest. Heat, seen as perennial by mean monthly temperatures and conceptually, is in fact far more variable when examined on the timescales of the month and the day. Indeed studies incorporating smaller slices of time such as the hour and analysis on larger scales such as the decade and the century would unravel even more complex patterns, not just of heat, but also of all weather elements and weather and climate more generally. Human response to heat is most meaningful in terms of the combination of heat with humidity. Humidity, like rain, undermines the received Wet/Dry dyad that have defined climate and season here and ordered weather.

In the late twentieth century the inadequacy of this framework came to be recognised with the emergence of a third western Top End season: the build up. But formally two seasons are frequently recognised - the seasons of this history. This history shows that when patterns of weather elements are analysed in terms of intensity and timing more complex and intricate patterns emerge.

Particularly intriguing is how a concept could endure in the face of repeated contradictory experience. How this happened reveals much about how modernity has interacted with nature. It is also very telling about how people know things and how we order experience. Weather was studied here long before a permanent colony was established. The region was part of a quality-controlled network, linked to other observatories across Australia and across the world. Those who oversaw meteorology in the Top End such as J A G Little and Charles Todd were both indefatigable and diligent. The tens of thousands of pieces of data that underpin this study attest this energy and attentiveness. Many in the Top End were seasoned weather-watchers. Mariners and workers in the pearling industry were numerous, especially in Darwin. The weather was key not just to farmers and labourers on the land but also to any who needed to travel, those involved in alluvial mining, construction and mail delivery. Rain could strand the inattentive for potentially threatening periods of time. Relating to this there is the attentive weather
reporting in the Darwin press. How much this responded to real or perceived demand and how much it fostered interest in the skies is impossible to say. But given the dramatic and arresting nature of the reporting, its practical and informative bent, its frequency and longevity in Darwin's newspapers we have ample reason to believe that interest in weather was part of newcomer Top End culture. This was a community that paid close attention to the great aerial ocean in which it was immersed. Other writing from the region gives the same impression: the weather and its effects on the broader ecology were so striking as to be integral to experience of the region.

Yet, they got it wrong? The gulf between conceptual understanding and historical experience makes sense when we recognise that the received, imported understanding does capture a vital aspect of Top End weather and climate: each year brings periods of voluminous rain and extended times without any rain. With each revolution of Earth around the Sun, with each complete cycle of Earth's tilting on its axis come pronounced periods of wet and pronounced periods of dry. Much of the time the most marked period of rain is from around the southern summer solstice to around two months afterward. Rain is uncommon from a month before the winter solstice to about six to eight weeks afterward. There is a stark pattern. But the pattern is nowhere near as regular and predictable as has been assumed and maintained. The attentive, diligent newcomers to the north did not so much get it wrong as miss other important dimensions of weather and climate there. They missed the inherent variability that Europeans across Australia have taken a long time to recognise.

Of course the Wet/Dry dichotomy had a good pedigree. It came with confident and competent men of the sea. They got it from other able mariners, who ultimately got it from none other than Edmund Halley. By the time it was brought ashore in northern Australia it had been tried and tested over nearly two centuries. It was not merely knowledge or theory that had been handed down through generations. This was knowledge mariners had used repeatedly during this time, mostly to their advantage. Of course it was knowledge produced for that very purpose but understood as about atmospheric dynamics generally and as disinterested and scientific. Halley himself based his outline of winds and monsoons and countless records from English East India Company ships. These records may no longer exist but it would be fascinating to review the material Halley used in his influential study. Moreover, the imported understanding contained the same powerful assumptions as other western ideas about nature: it is regular, periodic and can be shown to be so in relation to the naturalised external referent of time. Time's
history and the culture infusing the calendar had long been forgotten. The Wet/Dry dyad made sense in terms of how season, climate and indeed nature were understood.

Officials and weathermen transmitted this idea to the newcomer population throughout the Top End. By the time this region was permanently colonised enumeration was integral to European imperial and governmental control. In the nineteenth century measuring, recording, gathering statistics and using these to generate knowledge was routine. This was the case with social and economic phenomena. It was the case with natural phenomena. In the data that was presented, the manner in which it was presented, conclusions drawn from and sometimes in spite of the data and detailed outlines of weather and climate the inadequate imported understanding was repeatedly reinforced. Authoritative figures such as Little, the Government Residents, authors of the almanac all transmitted it. In the various means outlined it circulated in Government Residents’ and Administrators’ reports, Parliamentary Papers, Almanacs and Statistical Guides, Official weather reports and governmental studies on the Northern Territory. As we have seen while statistics had developed a variety of techniques and had long identified Gaussian dispersion by 1870 the study of weather in the Northern Territory organised data such as rainfall totals and temperatures into monthly means. This was consistent with practice across Australia prior to the 1930s. Only the occasional study of correlations was employed in some meteorological studies then. Means were the focus because endeavours to understand weather and climate were guided by an epistemology that saw averages as the way of both approximating physical reality and that focussed on identifying regularities in time. In an almost neo-Platonic vein deviations from the mean were not seen as ‘normal’ elements of the climate but as anomalies brought about by some causal atmospheric departure from the norm. Such data gathering and statistical computation was not merely habitual practice but vital elements in an elaborate way of knowing. Statistical techniques looking at dispersion and simple frequencies of what happened and when it happened were not seen to address the questions that scientists and officials were interested in. Officials and mariners and other authorities conceived of Top End weather and climate in the same way. Numbers supported them. Innovative scientific study by people no less distinguished than Griffith Taylor and by federal institutions confirmed the regularity of the Top End’s climate.

These ideas circulated often and widely. Most curious of all was the treatment in newspapers and in Northern Territory literature. The pattern of
newspaper reporting, that is to say, the tendency to only publish rainfall tables during ‘The Wet’ certainly, if implicitly, reinforced the imported understanding and the misleading sense of atmospheric regularity inherent in it. The practice of publishing weather stories during the official Wet did the same. So did the publishing of stories about aberrant weather during ‘The Dry’. As we have seen, however, weather coverage in the Darwin press was remarkably and distinctively attentive. Indeed the papers included much material that conflicted with the prevailing idea of weather and climate. But departures from the norm were not read as signs to question dominant ideas of local weather and climate. They were seen as deviations and part of the wildness of the place. A concept of climate that accommodated variability from year to year was not available to them. Moreover the reporting and the structure of its time worked against the mergence of such an idea. It was not just official and scientific voices that defined climate according to the Wet/Dry dyad.

Top End literature paints vivid, evocative pictures of the local environment. Portrayals of the atmosphere are rich, insightful and faithful to the complexities. They offer a remarkable experiential complement to the abstract, disembodied knowledge of science and government. Crucially, they illustrate many instances of how the atmosphere subverts the newcomers’ understandings of it. In this literature, and indeed newspaper reports, we get a sense of the remarkable transformations, particularly on the land. Wet and Dry have salient analogues on the land: falling rain and towering smoke; green and black; flood and fire. Discursively this works to buttress the atmospheric dichotomy. But it probably also points to a perceptual/experiential reason for the endurance of this erroneous or at least deficient understanding. Experientially, wet and dry are associated with other salient and memorable events, visages, sights, sounds and smells. In transcending the purely cognitive, this constellation of associations may well have given the imported understanding even more force. In addition of course, works of literature, regardless of the background and experience of the author, outlined the dominant understanding of the region’s weather and climate. Accordingly they provided a framework within which all weather and hence climate was to be understood.

Clearly the erroneous can make sense. An idea, such as this, which neglects a vital dimension of the phenomena it tries to explain, can still be very useful. This is something we must always heed, when studying weather, climate or nature. Questions we ask always cast blind spots over what we endeavour to elucidate. For much of the period of this study newcomers simply had not been in the Top End long enough to grasp the intricacies of its weather and climate and critique their
understanding of it. They were diligent, meticulous and attentive. But this history has also shown that the ideas they thought with could not see what needed to be seen. Perhaps this is true for contemporary Australians concerning many aspects of this old continent's environment. Or, perhaps, old, often imported and seriously inadequate concepts still abound.

Concepts are always approximate. Concepts will always oversimplify or miss important complexities. However, some concepts are better than others and there are better conceptualisations of Top End climate than the Wet/Dry binary. From this history we can see that until significant climate change affects the Top End this region experiences distinct periods when certain kinds of weather prevail most years. Extrapolating from the data for Darwin we can outline the following regime of annual seasons for Darwin and immediate hinterland. This is very similar to seasonal cycles discerned by the Yolngu, Larrakia and other Top End Aboriginal groups and circulated by Stephen Davis in particular. But it is also mindful of warnings by Deborah Rose and Jane Simpson not to impose inflexible western ideas of calendrical time on to concepts of great conceptual fluidity. Not wishing to appropriate from the Larrakia it does not borrow exclusively Aboriginal terms. But it also uses English terms to emphasise that it is derived from a western epistemology. Based on this history, this is what a better schema of Darwin's seasons might comprise:

**DRY:** Starting from around the winter solstice there is a distinct period when rain is rare, day-time humidity is low. Skies are usually clear apart from processions of cirrus clouds at high altitudes. South-East trades prevail, nights are commonly calm and moist bringing dew and, sometimes, fog. This pattern can prevail from late May through to early September, is most common from mid June to mid August and sometimes shrinks to several weeks, usually incorporating most of July.

**BUILD-UP:** This is a period in which humidity builds and heat increases. Clouds become more common, particularly cumulus and cumulonimbus. SE trade winds become less dominant, though not necessarily in a linear fashion. Nights are also consistently warmer. Rain might fall but is not frequent or long lasting. Often prevailing from mid August to late October it sometimes emerges earlier and it can run into November.

**STORMY WET:** Thunderstorms become frequent, cells of cumulonimbus pile up in the skies. Heat and humidity peak. Showers
can be frequent but rain lasting more than a couple of hours is uncommon. With the SE trades largely gone and the monsoons yet to arrive no wind predominates and conditions are often calm.

**MONSOONAL WET:** When monsoonal troughs and the movement of the Intertropical Convergence Zone (ITCZ) shift south over North Australia rain falls often and it falls for long periods of time. Rain can last for hours, it can be in series of frequent, repeated torrential downpours. During monsoons rain comes in from the seas to the west and northwest. Contrary to the cliché it does not usually rain every day but this is the only season when it can rain on the scale of weeks. Skies are often overcast when it is not wet. But periods with sun, when rain comes more in the form of convective storms from the east and south are also normal. Short monsoon wets usually coincide with January and February. Long seasons start in early December and conclude in late March. Intermediate seasons last for a chunk of time in between that almost always overlaps with January and February.

**KNOCK ‘EM DOWN’ WET:** Most years there is a period between the subsiding of the monsoons and the end of frequent rains when storms, intense heat and stifling humidity prevail. It is much like the Stormy Wet but it is salient in that the rains knock down grasses and plants that spring up during the wet seasons. Storms are frequent, often intense. With the subsiding of the monsoons, they usually come in from the east and south. Heat increases appreciably and humidity is palpable. This pattern prevails for as little as six weeks and as many as ten, at some stage between late February and early May.

**DRYING:** South-east Trades reappear and become more influential. Rain is rare, skies are clearer than the preceding four seasons. Heat becomes less intense. Humidity can still be high but drops. This is not linear and progressive but the latter period is almost always cooler and drier than the beginning. This season can start in April and extend till June. Commonly it is a six or so week period straddling May and early June. It can end abruptly with the arrival of vigorous, persistent SE trades, which often usher in the Dry and start the cycle over.

Except that this is not a cycle that repeats itself exactly. Some years seasons don’t come. So we cannot say that Darwin always has six seasons a year, but that it

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1 Although this sounds Aboriginal and might have originated in Aboriginal English this term was commonly used by newcomers and featured in newspaper reports and other NT writing. I thank lifelong Darwin resident and Meteorologist Colin Beard for informing me of its widespread use among Europeans in the Top End at the 2007 Darwin History Colloquium.
usually has six seasons and sometimes five, but not always the same five. These seasons appear in particular sequences but the timing occurs not at points in the calendar but within temporal ranges. Moreover seasons are not of equal duration either within a year or between years. Anthropogenic climate change might change crucial patterns and hence seasonal regimes – it is crucial that we understand these patterns historically so that we can understand which might be happening in the future. While this is a history of Top End weather and climate, the available data have been insufficient to sketch seasonal outlines for other parts of the region. Given that Aboriginal ideas of season focus so intently on prevailing weather elements it is unsurprising that this outline should bear such a strong resemblance to them. I will heed Aboriginal understandings of how weather and climate vary across the Top End and reiterate that what I've outlined applies only to Darwin and surrounds.

Yet this is enough to demonstrate that we must not take concepts like climate, season and time for granted. We need to understand their history and how they have shaped inquiries that have produced our knowledge. Just like monsoons, and climate and time, seasons are not what Europeans and neo-Europeans think they are. In northern Australia they are not regular and predictable. They do not necessarily mark time. Not every season even occurs every year. Perhaps this is also true, elsewhere in the tropics. Historical study of weather might even identify the irregularity and variability of seasons in temperate climates.

Perhaps this atmospheric history has shown something deeper. From it we see that westerners have projected assumptions of regularity onto complex phenomena. The assumption that nature is ordered is crucial to its elucidation. But we must be mindful that this is an assumption so that this does not distort our undertakings. Assuming is one thing, projecting is another. What we have also seen is how complicated phenomena such as weather and climate are to understand. If we understand better how concepts, knowledge and questions have been formed we might better be able to identify things they might not identify, at least in their present form. In northern Australia this matters not just because of the impending and perhaps accumulating vicissitudes of global warming. Prevailing understandings of weather and climate have kept us from grasping important aspects of the region’s climate. Now, in late 2011 corporate and political elites from the south, east and west of Australia, along with counterparts in the north, energetically propose a massive imposition of industrial agriculture. How much damage – environmental, social and economic – might be inflicted if this is done
with an erroneous notion of the region's weather and climates? Ignorance is no longer reasonable.
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