A Brief History of the Monsoon

When the *Moonta* dropped anchor in Darwin Harbour in 1869 its crew knew what to expect of the weather. It was February - and so it was 'the Wet'. As George Goyder and his surveyors and sailors 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. Weather measurements and records were not to begin here in Darwin until March 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.

This essay will unpack this history of expectation. After examining British exploration and colonisation of the 'Top End' of Australia, it will look at both indigenous and western ideas of season, and analyse these disparate ways of knowing the natural world. In particular, I argue that a genealogy of the western idea of the monsoon, and a history of its transmission to the colonies, explain Goyder's thinking and, more broadly, illuminate the environmental encounter between European settlers and Australia's north.

At first blush Goyder's certainty about the climate seems unremarkable. Thousands of weather observations had been taken in the broader region since 1824, during the numerous attempts to establish a colony and the laborious explorations in between. Just a year before Goyder arrived, Francis Cadell assumed an intricate understanding of the region's climate. Despite limited experience in the region his reports to the Chief Secretary of South Australia outlined both spatial and temporal dimensions of its atmospheric fluxes. Identifying the 'north-west monsoon' as the major source of the region's rain and fresh water supplies, Cadell was both explicit and

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confident about 'latitudinal monsoon limits of, say, 14 degrees south'.[1] 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'.[2] The north coast had two regular seasons: wet and dry, the dry characterised by lack and absence. In a report on the earlier periods of this expedition Cadell frequently used the term monsoon to indicate a prevailing wind regime.[3] By matching these references to entries in the meteorological register it is clear that Cadell also used 'monsoon' to indicate what came to be known during the twentieth century as the south-east trades.

Throughout the mid 1860s weather and climate along the Top End coast were part of vociferous debate about the best location for what was hoped to become a permanent port, colony and capital. Influenced by Hippocratic notions relating health to fresh winds and illness to damp, hot and stagnant airs, BT Finniss chose Escape Cliffs, where the Adelaide River flows into Adam Bay, as the location for the fourth attempt to colonise Australia's north coast. Hippocratic thinking showed in the South Australian Government's instruction to Finniss, commanding him to give the highest priority to 'salubrity of climate' in selecting a site for the capital.[4] Defending himself against criticism that the location was poor, Finniss extolled its virtues of climate and health. Escape Cliffs' 'superior salubrity' arose, he argued, because:

> It is open to the N. W. monsoon, and to the sea breeze which sets in daily throughout the year almost without

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[1] F Cadell to Chief Secretary of South Australia, 18/2/1868, *Parliamentary Papers, South Australia*, No. 24, 1868, (Adelaide: Government Printer, 1868) p2.
[2] Cadell to Chief Secretary, *PPSA*, No.24, 1868, p2.
[3] Report of Explorations of the Northern Territory by F Cadell, *Parliamentary Papers, South Australia*, No. 178, 1867, (Adelaide: Government Printer, 1867), pp2-5.
[4] Settlement of Northern Territory, *Parliamentary Papers, South Australia*, No. 36, 1864, (Adelaide: Government Printer, 1864), p2.

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.[5]

Convinced of the link between meteorology and malady, Finniss's reports told similar stories, using the same lexicon of monsoons, rainy seasons and dry seasons as Cadell. So did the explorers F Howard and J McKInlay, contemporaries of Finniss and Cadell. Journals of their expeditions show that the major distinction between the two was that Howard referred to the 'dry south-east monsoon', while McKinlay spoke of south east trades.[6] McKinlay also had firm expectations about the timing of weather and the change of seasons. On 30 March he noted :'Very dull, but suppose it won't rain as the dry weather now appears to have set in and nearly time'.[7]Confounded by what he was experiencing McKinlay recorded on 15 May that it 'Looks very much like setting in for rain; it is unaccountable weather for this time of year'.[8]

Earlier sojourners held similar assumptions. 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'.[9]

Two Port Essington observers, however, did not see the local climate as quite so orderly. While correspondence from Port Essington abounds with terms such as monsoon, east monsoon, dry monsoon,

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[5] BT Finniss to H Ayers, 15/4/1865, *Parliamentary Papers, South Australia*, No. 15, 1865, (Adelaide: Government Printer, 1866), p5.
[6] F Howard to Governor in Chief, 9/9,1865, *Parliamentary Papers, South Australia,* No. 84, 1865, (Adelaide: Government Printer, 1866) p5.
[7] J McKinlay's Northern Territory Explorations, 1866, *Parliamentary Papers, South Australia,* No. 82, 1866,(Adelaide: Government Printer, 1866), p8.
[8] J McKinlay, NT Explorations, *PPSA*, No. 82, 1866,p16.
[9] A C Gregory, North Australian Expedition, *Parliamentary Papers, South Australia*, No. 170, 1861 (Adelaide: Government Printer,1861) p8.

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…[10]

Reporting to the Colonial Secretary in Sydney, Captain John McArthur, the Commandant of the settlement, also described how the timing and character of the Wet can vary from one year to another.[11]

One-time resident and champion of the settlement at Port Essington, George Windsor Earl, however, wrote of generally ordered weather and climate. His *Enterprise in Tropical Australia* tells of a relatively benign climate, which compares favourably with those of other tropical places.[12] Sketching the seasons as a regular wet/dry dyad determined by either the westerly monsoon or south-east trade

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[10] *Sydney Morning Herald*, 15/10/1845

[11] Captain John McArthur to Edward Deas Thomson, 23/4/1845, in *Letters from Port Essington* 1838-1845, compiled and edited by J M R Cameron, (Darwin: Historical Society of the Northern Territory, 1999), pp144-148.

[12] George Winsor Earl, *Enterprise in Tropical Australia,* (London: Madden and Malcolm, 1846) p90.

winds, Earl links the arrival and departure of each with the procession of the sun and the two annual equinoxes.[13]

The idea of the region's climate comprising regular 6-month periods of wet and dry was in currency long before Port Essington and its opportunities for detailed observations and records. In 1826, correspondence between Governor Stirling and Governor Darling urged delay in shifting the garrison from Melville Island to Raffles Bay because the 'periodical winds, called the N W Monsoon', causing the 'rainy Season', 'will continue from the present time to the beginning of April'.[14] At the time of this missive, non–Aboriginal habitation 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*. Equipped with thermometers, the colonists measured the intensity of the heat no fewer than 6 times a day between 6am and midnight, subsequently organising these metrics into averages for each of 6 times of day for each calendar month. Health concerns motivated these efforts. Major Campbell outlined a climatic regime of two annual seasons – wet and dry – alternating with orderly and predictable timing as north west monsoons overcame south east monsoons and then, 6 months later, the former were then vanquished by the latter.[15] His arrangement of the meteorological table of temperature measurements, included with his narrative, reinforces this

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[13] G W Earl, *Enterprise in Tropical Australia*, pp86-89.

[14] Captain Stirling to Governor Darling, 8/12/1826, *Historical Records of Australia*, Series I, Volume XII, (Melbourne: Library Committee of the Commonwealth Parliament, 1919), p776.

[15] 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.

sense of temporal regularity. Each calendar month from April to September is categorised as 'south-east monsoon, or Dry Season', the other 6 months the 'North-west monsoon, or Wet Season'.[16] They were not there long enough to detail a seasonal and climatic regime. The correspondence between Darling and Stirling uses the same language, in the same way, years before Major Campbell's *Memoir* was published, so it seems very likely that this conceptualisation of the climate came with the colonisers.

This view is also supported by the fact that the thoughts of 19th Century maritime sojourners in the region such as PP King and Matthew Flinders were organised by periodic monsoons, 'the wet' and 'the dry'. In February 1803, Flinders met the human face of the monsoons along Australia's north coast – Macassan navigators. Monsoons even featured in his conversation with Pobassoo, commander of a fleet of six prows.[17] Although Macassan sailors had been visiting the region for perhaps 200 years, 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.

Seasons, Weather and Time

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.[18] Studying various Top End Aboriginal

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16 Major John Campbell, 'Geographical Memoir',p 152.

17 Matthew Flinders, in Tim Flannery ed., *Terra Australis,* (Melbourne: Text, 2000), p207.

18 Rhys Jones and Betty Meehan, 'Balmarrk Wana: Big Winds of Arnhem Land', in Eric Webb, ed., *Windows on Meteorology*, (Melbourne: CSIRO Publishing, 1997), p14.

communities and linguistic groups during the latter part of the twentieth century anthropologists have described 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 indeterminate period. Given the copious and intricate details inherent in these understandings it seems likely that they took many generations 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,[19] this praxis seems likely to have been 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, anthropologist Deborah Rose explains that this and other important knowledge is passed from generation to generation in songs, stories, myths and life practices.[20] Not only does a development of these climatic ideas long ago seem probable, their transmission through time can be explained.

Indigenous concepts of season and climate are not merely about the dynamics of the atmosphere. They are inherently interconnective,

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[19] Rhys Jones and Betty Meehan, 'Balmarrk Wana', in *Windows on Meteorology*, p15.

[20] Deborah Rose, 'Rhythms, Patterns, Connectivities', in Tim Sherratt, Tom Griffiths and Libby Robin eds., *A Change in the Weather: Climate and Culture in Australia,* (Canberra: national Museum of Australia Press, 2004), p41.

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.[21] 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.[22] 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. 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.[23] 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.[24] 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 the Yolngu of North Eastern Arnhem Land recognise 6

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[21] Jones and Meehan, in *Windows on Meteorology*, p 15., Rose, in *A Change in the Weather*, p39 and Jane Simpson, in*Windows on Meteorology*, pp23-24., all relate this in detail to the communities they have studied.
[22] Deborah Rose in, *A Change in the Weather*, p37.
[23] Janet Simpson, in *Windows on Meteorology*, p25.
[24] Deborah Rose, in *A Change in the Weather*, p39.

seasons,[25] as do the Gundjeihmi of coastal western Arnhem land and at least 2 other indigenous groups of the far north coast.[26]

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 with their meaning 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,[27]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.

In western thinking seasons are structured by time. Seasons also structure time and have done since 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. Despite its poetic form and lyrical style, *Works and Days* is the oldest farmers almanac in existence. Its many instructions indicate and transmit a belief that weather and

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[25] Janet Simpson, in *Windows on Meteorology*, p24

[26] Ben Orlove, 'How People Name Seasons', in Sarah Strauss and Benjamin Orlove, eds., *Weather, Climate, Culture*, (Berg: Oxford, 2003), pp130 – 135.

[27] Ben Orlove, in *Weather, Climate, Culture*, p130.

seasonal changes are so regular as to enable farming to be timetabled by the regular and predictable stars above. Directions are often simple: 'When the Pleaids, Atlas' daughters, start to rise begin your harvest; plough when they go down'.[28] Similarly, lines 598 and 599 declare: 'When great Orion rises, set your slaves to winnowing Demeter's holy grain'; the stanza concludes by urging that 'When the Pleiades and Hyades and Great Orion sink, the time has come to plough; and fittingly, the old year dies'.[29] Hesiod is even more explicit about the regularity of weather. Lines 617-621 communicate this sense of reliability:

> 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.[30]

Another example speaks of a sailing season 50 days after the autumn solstice, a time of gentle breezes followed by '"Notos" awful blasts' and raging seas.[31] While Hesiod identified regular seasons, he did not divide the year into 4 seasons. As Michael Kammen notes, 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 - this period of dormancy was not considered a season. In these pastoral

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[28] Hesiod, *Works and Days*, translated with introduction by Dorothea Walker, (London: Penguin, 1973) p71.
[29] Hesiod, *Works and Days*, p78.
[30] Hesiod, *Works and Days*, p78.
[31] Hesiod, *Works and Days*, p80.

societies, seasons were associated with vegetation, cultivation, agricultural husbandry and the heavens.[32]

Long before the emergence of the four seasons, the Ionian school of natural philosophy had strengthened this sense of order in nature. Spearheaded by Pythagoras, Ionian natural philosophy was the first systematic attempt to understand physical processes without invoking the supernatural. Bolstering 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; a conviction underpinned by Pythagoras' discovery of the numerical relationship underlying musical harmonies.[33]

Since then the idea of an orderly nature has been a powerful strain 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.[34] R G Collingwood's *Idea of Nature* concurs with Glacken's analysis but reveals that the metaphysics of Greek nature are even more powerful. Greek natural philosophy 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.[35]

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[32] Michael Kammen, *A Time to Every Purpose: The Four Seasons in American Culture* (Chapel Hill: University of North Carolina Press, 2004), p39.
[33] Margaret Wertheim, *Pythagoras' Trousers* (London: Fourth Estate, 1997), p31.
[34] Clarence Glacken, *Traces on the Rhodian Shore* (Berkeley, University of California Press, 1967) p15.
[35] R G Collingwood, *Idea of Nature*, (Oxford: Clarendon Press, 1945) p3.

Rome's elites reinforced this idea of an orderly nature. Modelled on *Works and Days* Virgil's *Georgics* certainly conveyed the notion of regular predictable seasons and weather. Two lines (among many) encapsulate this: 'Well for us that we watch the rise and fall of the sky-signs, And the four seasons that divide the year equally'.[36] The seasons had come to be determined by the equinoxes and weather was expected to conform. However, the implementation of the Julian calendar is an even more convincing demonstration of the link between weather, seasons and time in Roman thinking. Occasioned by the belief that seasons and time were out of kilter it demanded major recalibrations to the marking of time.

46BCE was 445 days long. Known as the 'year of confusion' it was the solution to ongoing confusion caused by the calendar and time being so out of synch. In a society with agriculture and maritime trade the calendar alone could not mark when contracts were entered into or when agreements were made. Weather and the seasons marked time; so did the stars, which themselves were associated with expectations about weather. In the ordered Greco-Roman universe, weather and seasons were almost ontologically bound to other profound cultural phenomena such as time and calendars. The Julian calendar was a very stable technology, not being superseded by the Gregorian Calendar until 1582 throughout Catholic Europe and 1752 in Britain. This endurance and the Gregorian calendar being just a minor modification of its predecessor no doubt gave the calendar a natural aura. In the long interim between the two calendars people did not just learn to mark time, they lived it in feasts and religious devotions, all related to seasons determined by celestial dynamics. They did not just think nature's order, they lived it and seasons and weather were bound to this. Following the advent of the

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[36] Virgil, *Georgics.*,in *Ecologues, Georgics*, trans. C Day Lewis, introduction and notes, R O A M Lyne, (Oxford: Oxford University Press, 1999) p59.

printing press widely circulated almanacs explicitly linked time, religion, agriculture, seasons to quite precise points on the yearly calendar, especially the calendar month.[37] An ordered nature was impressed on bodies as well as minds. Disorderly weather was compressed into units of the calendar.

With the unfolding of the scientific revolution calendars acquired an ontological force. The work of Copernicus, Galileo, Brahe and Kepler all bolstered the sense that nature was ordered and predictable. But, it was the work of Newton that to many proved this fact and rendered the cultural phenomenon of time fundamentally natural. 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 and when tested and retested proved reliable. Crucially Newton explicitly predicated his explanation on a particular view of time. Time was 'absolute, true and mathematical time, {which} of itself, and from its own nature, flows equably without relation to anything external'.[38] Indeed, as early twentieth century physicist Werner Heisenberg has said, the system Newton promulgated in *Principia*, contained so many seamlessly interwoven concepts that could be demonstrated experimentally and accorded with experience that it was considered final for nearly two centuries.[39]Even more powerfully, this idea of universal, absolute and independent time accorded with everyday experience. Physicist Paul

[37] Detailed discussions in, Jan Golinski, *British Weather and the Climate of Enlightenment*, (London, University of Chicago Press, 2007) pp91-107, Katherine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology*, (London, University of Chicago Press, 2005), pp 41-82 and Maureen Perkins, *Visions of the Future: Almanacs, Time and Cultural Change, 1775-1870*, (Oxford, Clarendon Press, 1996)

[38] Isaac Newton, *The Mathematical Principles of Natural Philosophy*, trans. A Motte (Berkeley: University of California Press, 1962), p7.

[39] Werner Heisenberg, *Physics and Philosophy*, (London: Harper and Row, 1989) pp 53-54.

Davies observed that Newton's time became the time of physics and science until the 20th century and the understanding of relativity. It 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'.[40] 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. Accordingly, during the modern era, time (through the calendar) has been the external referent generating expectations about weather. Time, and not the atmosphere, has determined what is normal weatherwise. Misunderstood as a marker of an unquestionably natural phenomenon, the calendar, not the natural world, has structured western thinking about weather and climate. For millennia, in western societies, the conviction about a harmonious, ordered and predictable universe, partly based on the seasons, has structured thinking about weather.

Seasons are profoundly cultural phenomena. Potently associated with weather, seasons epitomise the nexus between nature and culture. Despite their intricate detail, sound empirical basis and good fit to the actual environment, Indigenous 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. The virulent prejudices colonists brought and perpetuated, about Aboriginal peoples, is also a major factor. Flinders, King and all who followed merely imposed 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

[40] Paul Davies, *About Time*, (London: Penguin, 1995), p31.

aspect was not recognised. This was an enduring conceptualisation, albeit an imported notion with 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. Seaborn trade and commerce around the Arabian Sea and the shores of the North Indian Ocean were well established more than 4000 years ago.[41] While people in particular locations around the Indian Ocean had long been aware of the seasonal reversal of winds in their locale, it was only 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 are 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 commodities and back again.

Westerners finally encountered the monsoons with Alexander's conquests. Although Nearchus' account of Alexander's nautical

[41] Bruce Warren, 'Ancient and Medieval Records of the Monsoon Winds and Currents of the Indian Ocean', in Jay S Fein and Pamela L Stephens eds., *Monsoons,* (New York: John Wiley and Sons, 1987), pp137-139.
[42] Bruce Warren, in *Monsoons*, p139.
[43] Bruce Warren, in *Monsoons*, p139.

expedition from Mesopotamia to India has been lost, a version of it survives in Arrian's *Indica,* and shows that Arrian and Alexander were aware of the seasonal nature of prevailing winds over India and adjacent waters. 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 with the Indian Ocean shores. Two contemporaneous volumes, both surviving to the present, transmitted this 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]

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

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[44] Bruce Warren, in *Monsoons*, pp140-142.
[45] Pliny the Elder, *Natural History*, Vol 2, Book 6, Chapter 26, translated by H Rackham, (London: William Heinemann, 1969), pp417-419.
[46] Pliny the Elder, *Natural History*, p419.

of prevailing winds, but also identifed 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 were to forget and then rediscover this knowledge before gaining a deeper awareness.

Following the fall of the Roman Empire this knowledge was lost to Europe. Trade networks contracted and disappeared, but Arab knowledge persisted. Examining the ninth century texts of Arab Geographer Ibn Khurradadhbih 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.[48] 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.[49] By the late fifteenth century Arab and Indian sailors certainly understood the vast spatial scales over which these twice-yearly atmospheric reversals operated.

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[47] Unknown, translated and annotated by Wilfred H Schoff, *Periplus of the Erythraean Sea*, (London: Longmans, Green and Co., 1912), p45

[48] Bruce Warren, in *Monsoons*, pp147-148.

[49] Bruce Warren, in *Monsoons*, p147.

Monsoons in the 'Age of Discovery'

It was not Vasco Da Gama but his pilot who identified the direct path from Africa to 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.[50] Prevailing winds and seasons are not explicitly referred to in this work but it is clear from the speedy journey that the voyagers took advantage of a consistent west or southwest monsoon extending most, if not the whole way. 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 vocabulary of nature. It was, however, on the cusp of entering European usage through Portuguese, therefore likely becoming a product of Da Gama's voyage and the encounters he and his men had with people and nature on and around the Indian Ocean.

Moncao is Portuguese for Monsoon. According to the Oxford English Dictionary *moncao* emerged in Portuguese in the sixteenth century and is a literal equivalent to *mawsim*, which by then had acquired the meaning of season in a more meteorological sense.[51] An early use of 'monsoon' (in Tuscan dialect) to denote seasonal 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

[50] Unknown, Translated and edited by E. G. Ravenstein, *A Journal of the First Voyage of Vasco Da Gama,* 1497-1499, (New York: Burt Franklin, 1963), pp45-48.
[51] Oxford English Dictionary, Second Edition, Vol IX, (Oxford: Clarendon Press, 1989), p1036.

Da Gama's return voyage and salient characteristics of the Indian coast and Arabian sea.[52]

The word 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.[53] Even before the six English East India Company 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 advised 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.[54] Evaluating the merits of separating his fleet in a letter written in 1610 to the Company Hugh Frayne explicitly refers to 'the monsoon' and also distinguishes it from the 'winter monsoon'.[55] Moreover, in the same correspondence he makes two explicit references to the regular timing of the monsoons, one identifying a particular date: 15 October, presumably every year. Writing to Henry Middleton, Lawrence Femell and Hugh Frayne affirmed 'there is no going hence to India till the great western monsoon comes,

[52] E G Ravenstein, in *A Journal of the First Voyage of Vasco Da Gama*, p120.
[53] Oxford English Dictionary, p1036.
[54] Frederick Charles Danvers, introduction, *Letters Received by the East India Company from its Servants in the East,* Vol I, 1602-1613, (London, Sampson, Low, Marston & Co., 1896), pp11-14.
[55] *Letters Received by the East India Company*…Vol1, p43.

which will be in May'.[56] The monsoons were also integral to concerns about where fleets should tarry while awaiting changes in the winds.[57]

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'.[58] Volume II contains 52.[59] 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. Although a weather term it was also being used in the original sense of *mawsim*. 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'.[60]

Elsewhere in the tropics, in the 1640s, Abel Tasman already had firm expectations about weather. From Tasman's journal it is clear that he encountered reversing prevailing winds while voyaging in the tropical south-west Pacific and understood them

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[56] *Letters Received by the East India Company*…Vol1, p46.
[57] *Letters Received by the East India Company*…Vol1, p62.
[58] *Letters Received by the East India Company*…Vol1, p356.
[59] William Foster, introduction, *Letters Received by the East India Company from its Servants in the East,* Vol II, 1613-1615, (London: Sampson, Low, and Marston, 1897), p363.
[60] *Letters Received by the East India Company*…Vol II, pp35-36.

in terms of the same concept of monsoons used by EIC mariners and their predecessors on the Indian Ocean.[61]

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.[62] 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. Within this framework any deviations in observed or measured facts were viewed as errors in either observation or nature.[63]

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[61] Two examples: Abel Janszoon Tasman, *Abel Janszoon Tasman's Journal: of his Discovery of Van Diemen's Land and New Zealand, with Documents Relating to his Exploration of Australia in 1644*, (Los Angeles, Kovach, 1965) p 35 & p58, the latter just a few hundred kilometres north of the Northern Territory Coast.
[62] Gisela Kutzbach, 'Concepts of Monsoon Physics in Historical Perspective: The Indian Monsoon', in *Monsoons*, p159.
[63] Mary Poovey, *A History of the Modern Fact: Problems of Knowledge in the Sciences of Wealth and Society*, (Chicago: University of Chicago Press, 1998) p99.

Accordingly, they were to be long disregarded in any further analysis in both theory and in practice as later influential thinkers such as 19th century statistician Adolphe Quatelet reinforced this understanding with even greater vigor. Francis Bacon's innovation, however, was to detail a method of investigation based on experience, systematic observation, measurement and experimentation.

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 that 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.[64] 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.* There it declared an intention 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.[65]

[64] Poovey, *A History of the Modern Fact*, p93.
[65] Royal Society, 'Directions for Sea-Men, Bound for Far Voyages', *Philosophical Transactions,* Vol I, 1665-1666, pp140-141.

This manual instructed sailors to observe compass readings, note 'ebbings and flowings' of seas, rivers and ocean currents, to plot ports and coastlines, take depth soundings of all coasts and ports and keep a register of all weather phenomena, measured and observed, especially changes.[66]

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.[67] Essentially an outline of how winds blow throughout the tropics at particular times of the year, this was a history in the sense of drawing on historical data and extrapolating from it. Rather than discussing specific events or contingencies it is an outline of general principles based on detailed historical records of winds in the past. 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 referring to 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.[68] Speaking of the region between 'Java to the west' and 'New Guinea to the East' he outlined the same periodic reversal of winds.[69] Halley frequently used terms such as monsoons, change of monsoons and trade winds in sketching these flows of air. Just as

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[66] 'Directions for Sea-Men…', pp141-142.
[67] Edmund Halley, '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.
[68] Halley, 'An Historical Account of the Trade Winds , and Monsoons…', pp158-159.
[69] Halley, 'An Historical Account of the Trade Winds, and Monsoons…', p160.

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 a tendency of the atmosphere to establish an 'Aequilibrium'.[70] Grasping that land heats to a greater extent than the oceans, Halley also explained the monsoons as part of a process to establish equilibrium between the air masses above heated landmasses and those above cooler seas.[71] 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, then, were atmospheric clocks. They were understood as periodic, predictable and could be expected with particular movements of the sun. This would become the dominant European idea underlying tropical climates.

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.

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[70] Halley, 'An Historical Account of the Trade Winds, and Monsoons…',p165.
[71] Halley, 'An Historical Account of the Trade Winds, and Monsoons…',pp166-167.

From 1699 it included a second volume including Dampier's now scarcely known *Discourse on Winds.*[72] Based more on personal experiences and observations than Halley's exhaustive data, it nonetheless reinforces what Halley expounded about monsoons and trade winds in the tropics. In general they were seen as regular and as resulting 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 way than by Wet and Dry'.[73]

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

[72] 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).

[73] Dampier, *Dampier's Voyages*,p230.

Gravity, remove it out of its place to succeed into it its self, and make it rise upwards.[74]

With monsoons presenting a different aspect of these solar driven kinetics of thermal equilibrium, they (along with trade winds) are now better explained as regular, periodic seasonal phenomena. 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, 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 from European ports through to India, China and Indonesia they also offered detailed descriptions of ports *en route*, local cultures and of the natural world. Coming at a time when trade, transport and communication hitched a ride on the winds, nautical directories prominently featured weather, climate, ocean currents and tides. *A New Directory for the East Indies(*1791*),* included a very detailed rendering of trade winds and monsoons throughout the tropics over some 40 pages in both its 1774 and 1791 editions.[75] This was a striking work that outlined monsoon and trade wind dynamics in different parts of the Indian Ocean and 'China

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[74] George Hadley, 'Concerning the Cause of the General Trade Winds', *Philosophical Transactions*, Vol 39, (1735-1736), p59.
[75] 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.

Seas', yet reinforced received ideas of the monsoon. Indeed, it extensively quoted from Halley to both describe and explain trade winds and monsoons.[76] Notably, it was 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.[77] Nevertheless, the two seasons, wet and dry, were understood to be regular and opposite, in accordance with earlier notions. This timeliness of weather was reinforced in the piece's discussion of various sailing passages at each month of the year.[78] Undoubtedly useful to merchants and sailors, the calendar month is not, of course, a meteorological unit. Weather merely coincides with calendrical time, and constructing a synthesis of actual events to create a picture of typical weather for a month structurally exaggerates a sense of regularity, distorting 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. 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',[79] were discussed with reference to calendar months throughout this guide. Weather was routinely categorised according to the month in which it occurred and discussed according to what is to

[76] Just two examples: Herbert, Nichelson & Dunn, *A New Directory for the East Indies*,pp27-29 and pp35-36.
[77] Herbert, Nichelson & Dunn, *A New Directory for the East Indies*, p38
[78] For example: *A New Directory for the East Indies*, pp 54-56.
[79] Captain Joseph Huddart, *Oriental Navigator, or New Directions for Sailing to and from the East Indies*, 2nd ed., (London: Robert Laurie and James Whittle, 1797), p3.

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';[80] 'The S. W. monsoon begins to blow on the coast of Africa to the North of The Equator in the first days of March'[81] and 'From Cochin to the south as far as Cape Comorin, this monsoon commences fifteen days sooner than at Bombay'.[82] This directory gives a distinct impression of a clock-work climate ticking in time. And it explicitly extends this dependable periodicity to the atmosphere embracing the Australian shores of the Arafura and Timor Seas.[83] 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.[84] Capper reinforced the received understandings of tropical weather and climate. Indeed, the idea organised the information.

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, reversing every 6 months creating an oscillation that constituted the climate of tropical regions that do not enjoy perennial trade winds. With more information at hand, this opus provided a more sophisticated understanding of monsoons in the southern tropical Indian Ocean. It expounded that:

[80] Huddart, *Oriental Navigator*, p93.
[81] Huddart, *Oriental Navigator*, p125.
[82] Huddart, *Oriental Navigator*, p125.
[83] Huddart, *Oriental Navigator*, p5.
[84] James Capper, *Observations on the Winds and Monsoons*, (London: C Whittingham, 1801).

> 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.[85]

Therefore, ideas about local weather and climate washed up on the shores of Australia's north coast with the colonisers. Indeed the newcomers imported an expectation of climate that had long been imposed on the area by people who had barely tarried there and lived half a world away.

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When the Moonta dropped anchor in Darwin Harbour its crew expected a predictable monsoonal climate. That this idea has endured can in part be explained by the fact that it does account for the most salient features of the climate of the Top End: distinct periods of wet and dry and definite reversal of prevailing winds. A history of Darwin's rainfall, howver, indicates the complexities of local weather, most obviously its variability.[86] Looking at rainfall histories of Januaries, Aprils, Julys and Octobers (see figures 1-4) we see just how significantly volumes vary, from year to year, in each of these months, except July, during the years 1870 – 1916.

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[85] 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,* 3rd ed., (London: Parbury, Allen and Co., 1826) p iii.

[86] All figures subsequently quoted are for Darwin Post Office. Figures prior to 1/1/1908 come from Adelaide Observatory, *Daily Rainfall, Darwin Post Office*, those from 1/1/1908 come from Commonwealth Bureau of Meteorology, *Daily Rainfall, Darwin Post Office*.

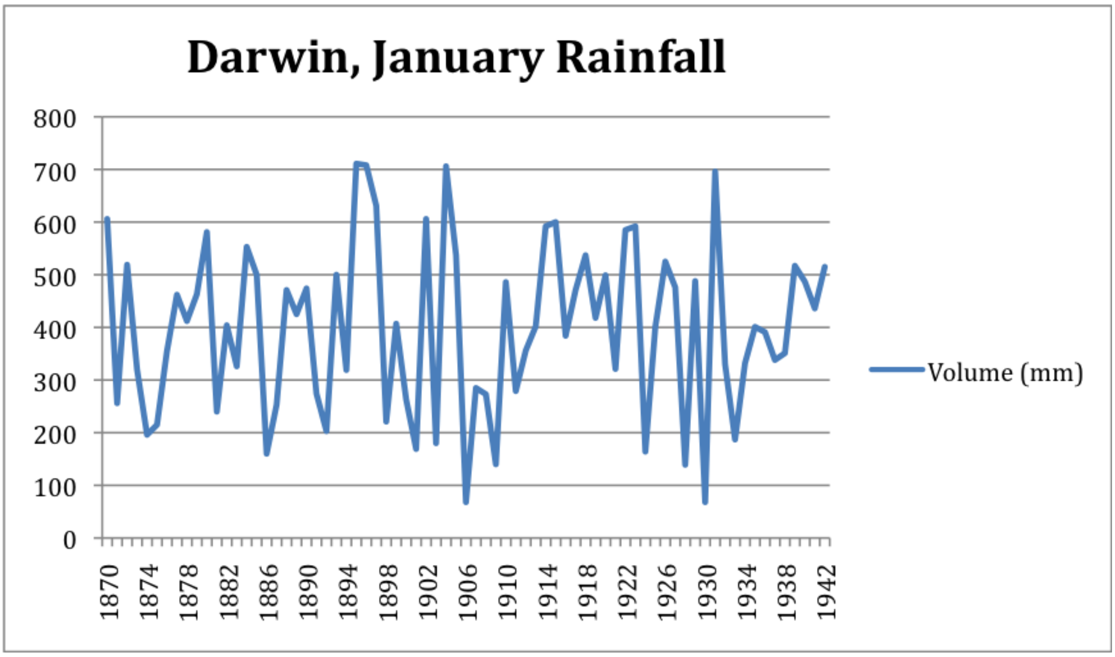

Figure 1: January Rainfall, Darwin, 1870-1942.

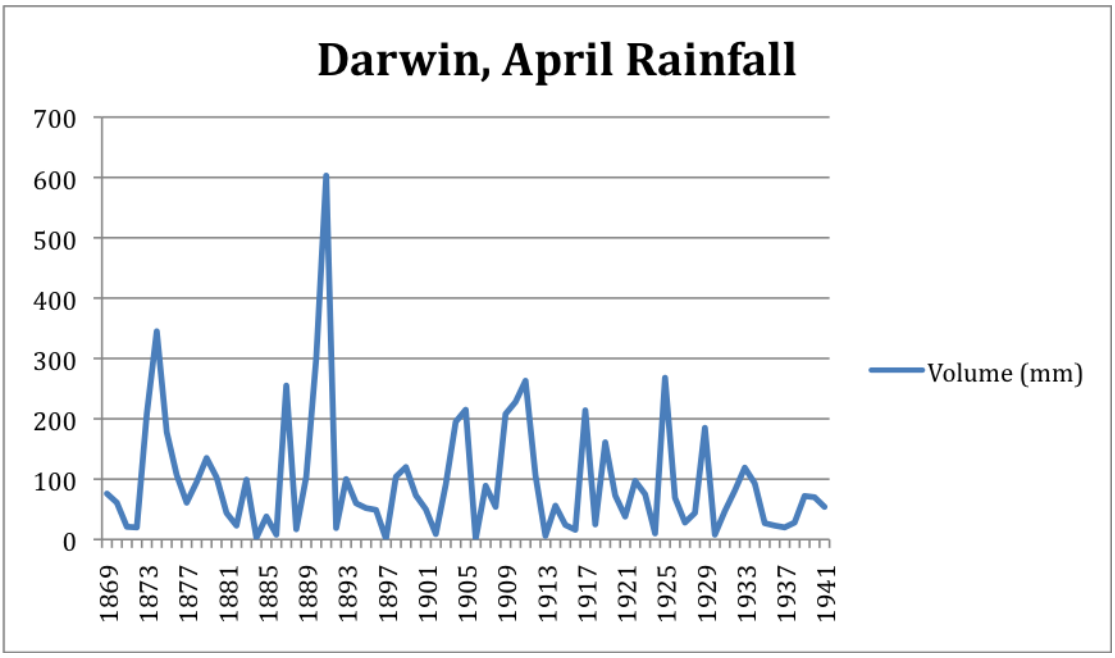

Figure 2: April Rainfall, Darwin, 1869-1941

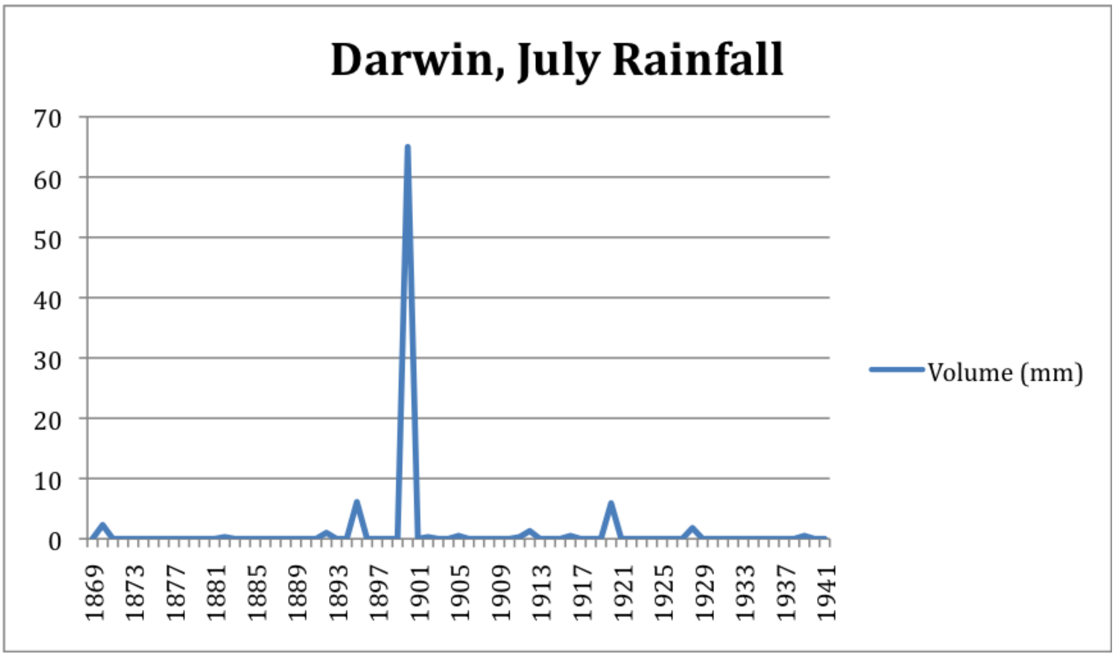

Figure 3: July Rainfall, Darwin, 1869 - 1941

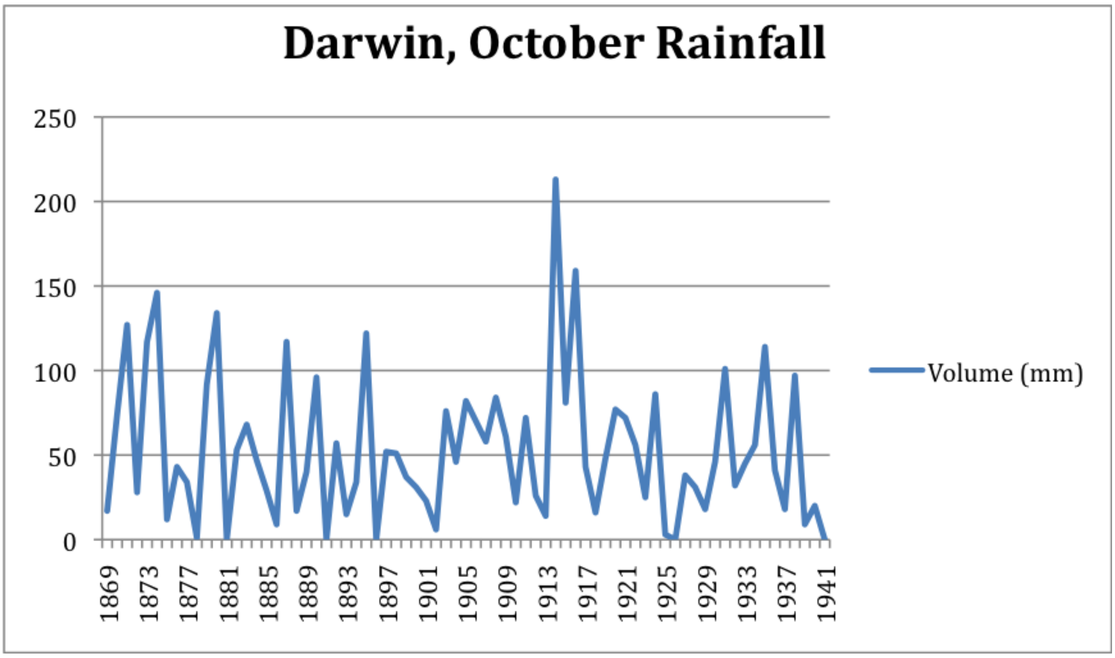

Figure 4: October Rainfall, Darwin 1869-1941

That the months of April and October can be both dry and wet calls into question any idea that either could be considered the same season as January or July, where season is defined by rain or its absence. Indeed these charts suggest that the rain comes and goes at different times each year. Examining when rain has fallen between 1870 and 1942 confirms enormous variability between years in the timing of rain. Twice rain fell each month of the year, and on another 6 occasions it fell 11 months of the year. In 1896 no rain was recorded between24 April and 16 November. In 1925 there was another 6-month period without rain. Indeed that year saw what was arguably the longest 'dry', because rain was light, occasional and sporadic until December. 1926 seems to have had two dries, one from 10 May till 10 September, the other from late September until early November. In all likelihood different humidity levels between each of these periods were not similar enough for them to be regarded as the same season –so it was a year with two distinct kinds of dry season. It seems 1926 was a year with two dry seasons and two obvious kinds of dry season. Periods without rain sandwiched between weeks of soaking wet are not uncommon. As an indication of how variable the timing of rain is, the year of 1911 saw rain on 4 days in March accumulating to 20.5mm and rain on 15 days in April (263.5mm). Missing this inherent variability, the idea of dyadic wet/dry seasons is inadequate for this region. It also misses other vital elements of local weather and climate, most obviously, humidity and storms, which have been incorporated into the more recent seasonal idea of 'the build –up', as well as fog and dew, the less obvious moist phenomena of 'the dry'.

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 through preoccupations with seaborne trade. With maritime transport powered by sails, winds compelled attention. Rains and storms became more important when sailors ventured to wetter climates and when tropical agriculture became economically significant. Important but more complex weather phenomena were disregarded. Tied to trade and commerce, events such as change of monsoons and tropical seasons were explicitly and repeatedly related to calendrical time rather than to more mercurial events in nature. With the advent of nautical directories this relationship 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. Even before development the major cause of monsoons and tropical seasons (differential heating due to the tilting of Earth on its axis) had been identified. With a periodic and predictable cause, they came to be understood as being just as periodic and predictable. Such regularity resonated with the culture of order infusing modern science, government and commerce and flowed from the wellsprings of ancient Greek natural philosophy.

Thus, western thinking about weather was distorted and limited by calendrical time and the compelling ontology supporting it. Structurally blind to climates that varied from one year to the next, like those of Australia, this paradigm distanced us from deep understanding of the peculiarities of local weather and climate. Today's use of 'monsoon trough' rather than the more general idea of monsoon indicates a more subtle understanding of the physical phenomenon. Locating the event more specifically in time and space, it acknowledges local contingencies that shape the development, movement and spatial range of monsoons, as well as more global influences such as the trade winds of both hemispheres. The recent emergence of 'the build-up' as a season also indicates a breaking down of a very old idea about Top End weather and climate. Experience and observation from day to day, even year to year demands it. So does the rainfall variability inscribed in the region's geology, on the vastly larger scale of millennia. Climate and the weather are inextricably linked to our ideas about time. Histories of both must examine not only the physical manifestations of both, but also the cultural influences shaping how these are understood, especially the culture we mistake as nature.

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