Australia; summer 2019/2020

Extreme bushfires with widespread thick smoke, plus damaging floods and heavy hail.

Dennis Nicholls; Shuttleworth, year of 1962

Australia has experienced quite rapid warming of1.4 °C over 110 years, and this has had a drastic effect on Australian bushfires. This piece highlights the changing bushfire conditions within Australia (changes currently denied by the current Australian Government!) plus a few related topics, including something of the wider effects of human induced climate change on the wider region of Oceania. A **Royal Commission into National Natural Disaster Arrangements** of this past summer is currently under way – the findings are due to be released sometime prior to the coming bushfire season. This past summer of extreme bushfires is referred to as Australia's **Black Summer** (there are some competing descriptions) but due to the arrival of the covid-19 emergency public information on the 'catastrophic' bushfires, and public interest in them, tended to dry up; so the term 'Black Summer' has hardly been used. The suffering of those damaged by the fires certainly continues, but coverage of the catastrophic summer has been far less than would have been the case without the arrival of the virus! My comments below are mainly based on published material gathered in the months since the extreme bushfires ended – and they *were* 'extreme' bushfires, as backed by recent, and ongoing, international research. – DN



'The fires were a stark example of our changing climate.': **Fighting Bushfires with Science;** Science Week, Aug 2020, Canberra.
'In a crisis, creativity is required to solve problems. As bushfires blazed across vast areas of Australia in the devastating summer of 2019–20, scientists from diverse fields came together to find solutions.'

……..

Overview

"The bushfires that engulfed parts of Australia this year were nothing short of apocalyptic": New Scientist 25 July 2020. There were many warnings within Aus that damage from human induced climate change would become noticeable in Australia by 2020. In 2008 a Climate Change Review predicted that the "Fire seasons will start earlier, end later and be more intense (this) should be directly observable by 2020". In 2009 a consortium led by the CSIRO (the Australian government science body) reported that "by 2020 extreme fire danger days in south eastern Australia may occur 5 to 65 per cent more often than at present". Late 2019 to February 2020 saw the substance of these warnings become reality.

In Canberra (Australian Capital Territory) the first 'extreme' bushfire occurred in 2003, when fire conditions generated cyclonic winds of around 250 kph ('a first' as CSIRO researchers remarked!) which felled pine trees in a plantation adjacent to the western suburbs of the city. See **Pyroconvection** below. That bushfire had been burning for some ten days in the native forests beyond the Brindabella Range on the western fringe of the ACT (with peaks up to 2,000 m, about twice as high as Snowdon) then with almost gale force winds the fire topped a high ridge (1,400 m) crossed the river at its base (where the bushfire fighting teams were attempting to stop it crossing the river) and raced through open country and pine forests directly into the western suburbs (beating the bushfire vehicles racing back to the city) to destroy over 500 homes in short order. The era of extreme, pyroCb cloud creating, bushfire storms had become noticeable; and such summer fire storms are now here to stay while the rapid warming of the Australian climate continues.

Come late 2019, the early severe bushfires in Queensland provided a strong warning that the coming bushfire season was going to be catastrophic down the eastern side of Australia. Rural fire chiefs from all states and territories met together in Tasmania to discuss more innovative approaches to the catastrophic fire season ahead; it was realised that three very dry years and now the hottest year on record the conditions were going to test all fire services; the NSW fire chief declared that early evacuation of residents in the path of extreme bushfires was going to be a main initiative in the face of such fires. By the end of the first week of November 2019 nearly 100 bushfires were burning out of control across NSW, with some 17 of them considered life threatening emergencies. At one point a series of bushfire fronts in NSW was estimated to be 6,000 kilometres long. Many of the bushfires arriving were reported as behaving in unusual ways, with many being hotter than previously experienced by long term firefighters. This heralded a "more intense" bushfire season in NSW. An extreme bushfire was also raging on Kangaroo Island in South Australia. These earlier than expected, and catastrophic, bushfires fulfilled the 2008 prediction of being "directly observable by 2020" – but arriving some months earlier than the prediction. These early fires triggered an immediate response from the ever ready volunteer bushfire fighting units. Widespread extreme bushfires raging across south and south east Australia added a mass of thick smoke over very wide areas, and the number of extreme bushfire days were certainly greater in number than in past years – fulfilling the 2009 prediction.

Sadly, the widespread thick bushfire smoke hit urbanised areas and brought about many more deaths than those occurring directly from the advance of the extreme bushfires. Many citizens vulnerable to such thick pollution – Canberra's smoke and dust storm air pollution exceeded that of Delhi for a number of days last summer! – and those who didn't directly die from the polluted air, are suffering ongoing conditions which may shorten their lifespan.

Volunteer teams of firefighters, with their fire trucks and aided by small water bombing helicopter support, are the main defence against bushfires across the southern states and territories of Australian. Only a few large fixed wing aerial water bombers, plus a small number of larger, specifically designed, helicopters, are hired from abroad each season to aid in fighting bushfires. But the lands they are hired from are tending to require their firefighting aircraft for longer periods each year. The approach to bushfires here is different to that of North America, where large numbers of fixed wing aircraft are used to bomb large forest fires.

There was substantial interest around 2016 in increasing aerial firefighting resources within Australia. In May of that year the National Aerial Firefighting Centre told an Australian senate inquiry that there is an "increased demand for aerial firefighting resources" and a "large national fixed wing tanker capability" was required in the near future. This was accepted and backed by the senate inquiry, but later rejected by the federal government

An unusual sighting over an Australia bushfire!! **Ex Australian fire chiefs request this size aircraft (shown dropping fire retardant).**

In 2020 fighting bushfires is still mainly based on volunteer firefighters on the ground; equipment by government and funded by donations gathered in their local communities. Volunteers who have to forego home, work, and business commitments for increasingly longer periods each fire season. The bushfires this past summer meant emergency periods averaging six weeks for all fire zones. The time commitments and extreme danger are increasing each year. Where pressed the volunteer units concentrate on saving lives by

encouraging early evacuation of endangered areas – particularly with the arrival of more intense 'extreme' bushfires – rather than, on many occasions, continuing attempts to save homes and businesses, including farm infrastructure and livestock.

A large tanker helicopter dropping water over a bushfire.

Smaller helicopters, with buckets, in action over a bushfire, 2020

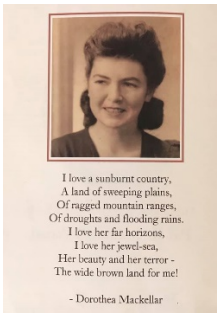
The policy of early evacuation of properties, assisted by broadcast warnings (mainly by ABC local radio) and various help lines, is saving more lives. This year's national toll of 33 lives lost (including, sadly, firefighting volunteers and aircrew) is very light compared with large bushfire events of the past. Without a major increase in 'fixed wing tanker capacity' the larger bushfires will remain 'uncontained' until local weather conditions change and reduces their impact or they eventually run out of fuel. With the Australian climate rapidly warming and becoming much drier in the south large uncontained bushfires will range widely for longer periods. The large and prolonged fire related emergencies of this past fire season, and the costly losses incurred, made a strong impact on the nation – until the urgent COVID-19 related emergency arrived just as the summer bushfire emergencies came to an end. What eventuates post COVID-19 - and the accompanying global financial downturn - is up for discussion with many views being expressed, but the next fire season will arrive before the pandemic passes.

Can this type of construction continue among eucalypts – or in rainforest, and in particular within dry forest areas? Image of a lodge in a Queensland national park, where the bush may be damper!

[As I complete this article similar 'wild fires' are occurring in California; where even their large fleet of fixed wing areal water bombers is having little affect.]

A prolonged period of dryness is passing, as 2020 progresses, and drought conditions are easing in many areas as near average rainfall returns - though some pockets of drought remain in rural areas. The Australian Bureau of Meteorology (BoM) current 'three month outlook' forecasts a La Nina in the Pacific which together with suitable conditions also occurring in the Indian Ocean, so this coming summer may be a wet one with less prospect of extreme bushfires happening over large areas of country. Canberra, where I live, has a number of reservoirs slowly filling; taking the city's water supply above the halfway mark; with the main city reservoir now overflowing (October 2020). Some parts of rural Australia (particularly in western parts of Victoria where troubling dust storms originate) remain in drought, with many farmers and graziers waiting anxiously for "good" rain. A major river, which hasn't flowed since 2016, the Darling River (part of the Murray/Darling system; which takes up some 25% of mainland Australia; and includes the ACT) is flowing again and many lakes, floodplains and reservoirs are filling; this will kick start normal farm production within the large Murray/Darling catchment; including large areas reliant on irrigation (which includes irrigation of non food crops such as cotton; but why cotton not hemp which requires half the water?). Heavy rainfall in some areas has relieved much prolonged local rural and urban reliance on carted drinking water; including bottled drinking water – for periods stretching

into years! Threats of flooding across most areas will recede as the tropical cyclone season has ended. If the oceans surrounding Australia return to conditions producing well above long term average rainfall, then many parts are bound suffer dangerous flooding. 'The Land of droughts and flooding rains' of Dorothea Mackellar's poem of 1904, 'My Country' (written when she was 19) will once again prove true; over a hundred years of warming later, but this time perhaps with a vengeance.



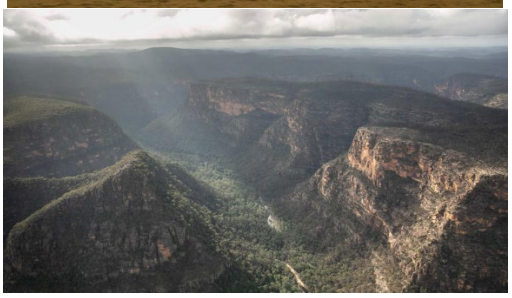
The 19 year old Australian poet; born 1885.
Women of NSW had the vote from 1902, which allowed Dorothea to become active.
Lady Denman, who laid the foundation stone for Canberra on 'Capitol Hill' in 1913, also became active.
In the UK Suffragette movement which she was head of for some 40 years after returning to the UK.

People of subsistence societies live in kin based institutions, within clans and other groupings, and these kin based organisations provide members with protection, insurance and security (more thorough than we experience) caring for sick, injured and less endowed members as well as the elderly. These intensive kinship networks nurture a non WEIRD psychology (a 'non western' psychology) creating a more collectivist mindset with greater conformity, obedience to authority, nepotism and in group loyalty: a loose quote from research comparing western psychology with mainly subsistence groups at the University of Harvard, in 2020; hence the term Weird psychology as the west has, socially, evolved away from most of the world and reached an industrial revolution, and wealth, earlier than other social groupings. When this is applied to fieldworkers owing allegiance to their own clan but engaged in rural development in PNG, it's easy to see that other difficulties arise particularly in a reluctance to establish a working relationship with Big Man networks within clan systems which are strange to them as they come from other parts. Working with Big Man networks which include their own clan leaders may be even more of a challenge. Yet these challenges have to be overcome by any rural development field service before any development projects reach permanent success. Without this working link with subsistence group leaders, many fully funded projects intended to address the difficulties arising from a fast changing climate will not fulfil their aim.

The Battle for Sydney

The Gospers Mountain fire, to the north west of Sydney, was "the biggest bushfire from a single ignition point in Australian history". The 'single ignition point', a tree strike, was in a remote spot, accessible only by helicopter. The fire burnt for 79 days and remains seared in the minds of those who feared and fought it - over a million hectares burned. "It's a huge area we had to deal with" Rural Fire Service Superintendent Hodges said. The landscape was extraordinarily dry; possibly the driest on record. Authorities abandoned the possibility the fire could be snuffed out and braced themselves for the possibility of a "campaign fire"; a blaze which can't be extinguished and presents a constant threat. By December 5, alarm bells were ringing. What became known as a "mega blaze": was a combination of six fires. Thousands of firefighters were now in the field, as strike teams from interstate and overseas joined the battle. "The first thing you experience is the ember attack. It's like a snowstorm but embers, and the colour of the sky turns to orange, then dark. It's like sitting in front of an

oven" a firefighter said. "We couldn't control the fire the way we had in the past" said Superintendent Hodges. On November 12, a "catastrophic" fire warning was issued for Greater Sydney and other parts of the state. It was the first time the new rating had been used. The fire developed its own weather; that happens when the superheated air rising in the smoke plume rapidly expands and cools, eventually generating its own thunderstorm. The phenomenon is called a "pyro" cloud. If the fire had broken through, it would have triggered one of Australia's biggest peacetime evacuations. Superintendent Hodges, who has been involved in bushfire fighting for over 30 years, said she had "never seen flames move so fast. That's when I got an indication that this fire wasn't normal". Meteorological data shows there were 19,016 lightning strikes in the area; during just two days in November (2019) lightening sparked several new blazes beyond the containment line. Flooding, from heavy rain, eventually extinguished the blaze on February 10; Day 79. Every professional interviewed for this story fears more extreme weather events will drive similar infernos in future**:** *Anatomy of a 'mega blaze'*, *Australia's largest ever bushfire…*; ABC TV; a documentary aired in July 2020. [For "pyro" cloud see below under Pyroconvection.]



Smoke from the mega-blaze blanketed the Harbour City for much of the summer. Wollemi National Park north of Sydney; the steep gorges were no barrier to the "mega blaze".

A Royal Commission into National Natural Disaster Arrangements

This Royal Commission commenced in April; with the findings expected to be released to the public much later in 2020.

An initial revelation of the Royal Commission is that in addition to the 33 bushfire deaths there were 445 indirect deaths from bushfire smoke inhalation. [This almost competes with the level of death rate of covid-19 in Australia by mid 2020.] Over 7 million Australians were directly affected by last summer's bushfires, but many others were affected indirectly– by dangerously thick bushfire smoke, socially and economically - leading to over a third of the population being affected. Although the arrival of the COVID-19 emergency overshadowed the bushfire emergencies, the Royal Commission and other enquiries will refocus the population back onto the devastating bushfire emergency and its link to rapid warming; on land and in the surrounding seas; but not until the nation once again faces dangerous bushfires. The Royal Commission began with an understanding that accelerating warming was a major factor in the extreme nature of the bushfires of last summer. This 'understanding' prompts the question of are the politicians listening?'. Whether they are or not, they find it necessary to continue to subsidise the fossil fuel industries; the industries which drive the fast changing climate and bring about the extreme bushfires which the Royal Commission and other enquiries are attempting to come to grips with – a very odd, and very concerning, state of affairs.

NSW has its own enquiry, the **NSW Bushfire Enquiry**: At stake is identifying whether more could have been done to save and so to reduce last season's death toll of 25 people - some of them perishing as they battled blazes - and the loss of 2,500 homes in NSW.: The Sydney Morning Herald, July 18-19 2020. The NSW Rural Fire Service is training 8,000 new volunteer recruits to add to the existing 72,000; but there seems to be no aim to increase the aerial firefighting force. Could anything have been done to save the lives lost in last summer's bushfires? Yes, by the nation leading the way internationally by drastically reducing its (currently expanding) exports of coal and gas. Oil production is also still in the 'wings', but socially inspired objection to any commencement of drilling wells off the coast in the environmentally rich Australian Bight; with its recovering populations of whales after the excesses of the nineteenth century. This in itself brings the level of social nous of our politicians into question.

Quarterly Essay; Professor Judith Brett; mid 2020

So let me take you back to early January … fire fronts were roaring through south eastern Australia … around New Year, 4000 people were trapped on the beach at Mallacoota, waiting for the navy to … start an evacuation (off the beach) … car convoys were leaving … the other holiday towns on the NSW south coast … authorities were warning of worst to come … the day after New Year (PM, Morrison) battered away any suggestion that the catastrophic fires might push (the government to) reduce emissions … with arguments which were all too familiar. Everything about (the PMs) response to the fires was wrong …flying off (to a family holiday in Hawaii) when the fires were already raging … the smoke was so thick in Sydney the tourists couldn't see the Bridge from the Opera House … mounting outrage forced him to cut his holiday short … Visiting the fire ravaged village of Cobargo … he was heckled … people refused to shake his hand … the whole nation watched … they wanted him to talk climate change, to admit that the ferocity and extent of the fires were what scientists had been predicting as the climate warmed. … the former NSW Fire and Rescue Commissioner, described the fires as "unprecedented" … he and eight other former fire and emergency chiefs had called for an emergency summit to be convened on how the country should prepare for bushfires in a changed climate. Back in April (2019) they had tried to warn the (PM) that fire behaviour was changing in Australia … but … "We weren't listened to" (they said). … Scientists had been warning of fires like these (since the) Climate Change Review of 2008. Human induced Climate change deniers are one thing: But just as important are **climate change minimisers** … who admit the world is warming but say we have plenty of time … who worry about economic disruption of acting too fast … I am an historian, so I look for explanations not just perfidies of the present … This essay is about the history of Australia as a commodity exporting nation and its consequences. The essay being entitled: '*The Coal Curse'*. The title of the professor's essay refers to the ongoing, and increasing, exporting of fossil fuels by Australia:

- **Australia's exported emissions have increased 4.4% between 2018 and 2019.**
- **In 2019, the emissions from Australian fossil fuel exports were 1.4 times greater than Germany's domestic emissions.**
- **In 2019 Australia's exported emissions were 1.4 times greater than all the CO_2 emissions produced by the 2019/2020 summer bushfires.**
- **Every Australian is paying $1,832 per year for fossil fuel subsidies, compared to the one-off payment of around $78 for bushfire relief.**

'Australia: an emissions super-power', July 9, 2020; Analysis & Policy Observatory (APO) University of NSW.

Part of the 'consequences' of Australia's long term tie to fossil fuel exports is well illustrated by our current Prime Minister, Scott Morrison, who, in a previous role as a minister on the

front bench, handed around a lump of (varnished) coal behind the then Prime Minister and suggesting, through the Speaker, that there's nothing to be feared from coal!

Coal promotion

Morrison hands a lump of varnished coal around to the front bench.
"Nothing to fear"; Australian parliament, 2017.
['Hallelujah', our current PM is a strong member of one of those very large American chapels; he must be telling the truth!!!]
[Sadly, no; he's just being a (much misguided) politician!]

Such lack of social nous is not, of course, confined to one leader or one party; nor to any one nation. *World leaders can't be that lacking in social nous?* it may be asked. But how else would a fossil fuel driven fast changing climate come about when far less damaging (green) energy has been available for generations; and with an efficiency increasing with such rapidity that it has become obvious to all!

The lack of social nous in our Prime Minister was again on display when he forced an unwilling victim of the Cobargo bushfire to shake hands with him when she was so obviously upset by his very presence! I have witnessed greater social nous within clan communities in third world lands. The professor is wise to concentrate on the long term 'consequences' of mass fossil fuel exports by Australia and not on the 'perfidies' of the present.

Part of the main street of the village of Cobargo.
On the morning of the 31st of December 2019.
And a bushfire victim refusing to shake the hand of the Prime Minister.
The PM, rudely, lifted her limp hand in an imitational handshake for the cameras of the press.
[Always the much misguided politician!]

The main street of the village of Cobargo, mentioned above, was devastated by an out-of-control bushfire at New Year 2019, Volunteer firefighters and the local residents were unable to defend the historic village, as airborne burning embers rapidly set light to many homes and other buildings along the main street. The photo picked up an image of a resident refusing to shake hands with the PM; he then lifted her unwilling hand; not an image any political leader would wish to see published, but it does highlight a determined lack of social nous by a PM. The township and its residents continue to suffer the after affects that extreme bushfire – the PM with his family being away on holiday in Hawaii as extreme bushfires raged at home; he was forced to break his family holiday and return to a fire ravaged nation caused by his 'nothing to fear' coal.

The community of Cobargo has gathered the strength to create support for those severely affected by that very damaging bushfire. Many households and farm families, having experienced a number of less damaging bushfires over time, had become quite confident that they had insured all that required insuring; but the strength of an extreme bushfire had seen the destruction of far more than had been covered. Without community support many would be living in far from desirable circumstances.

In Mallacoota, where 'First Nation" people had planted a large area of subsistence food plants, which were consequently destroyed by the extreme bushfire, the community has formed a self help body of their own to assist those most damaged by the fires of New Year's Eve. If such efficient social action can be brought about in one of the broken clans of First Nation people in eastern Australasia, I'm sure there's a wealth of social nous in small

communities across the whole of Oceania; a region which includes Australasia. A ‘wealth’ worth tapping through a dedicated network of the interested. Politicians have the Pacific Island Forum; small communities require a ‘secretariat’ the equal of the ‘forum’. Particularly as China is taking an increasing interest in Oceania; with ‘aid’ money to spare, but with strings attached!

A Dunkirk style beach rescue of stranded residents at Mallacoota – while the New Year’s Eve extreme bushfire rages above the beach.

Increasing heat and dryness in the Great South Land

The driver of extreme bushfire conditions, in the southern parts of Australia, is the rapid increase in ambient temperature coupled with increasing dryness.

2019 was a record breaking extremely hot and dry year for Aus. The Australian Bureau of Meteorology records show that rainfall for the year was 40% below the long term average and: ‘2019 was Australia's warmest year on record … Mean maximum temperatures were at 2.09 °C above average, well above the previous record, which was +1.59 °C in 2013. …. Australia's climate has warmed by around **1.4 °C since 1910**, well above the global average:

> The average global temperature on Earth has increased by a little more than 1° Celsius since 1880; NASA’s Goddard Institute for Space Studies (GISS),

Fire danger seasons in Australia:

Large bushfires started earlier than expected in 2019.
This too had be been forecast by climate researchers.

Since the 1980s the intensity of bushfires in Australia have been observed to be increasing

Pyrocumolonimbus (pyroCb) clouds, tropopause piercing clouds which form above very intense bushfires and produce dry lightning, have, within Australia, been increasing in number since the 1980s; when satellite images became more widely available.

> [So, it has been known for more than half a century that ‘extreme’ bushfires would become an increasing menace in the southern parts of Australia, in both town & country!]

They pose a greater threat to firefighting units: PyroCb storms are feared by firefighters for the violent and unpredictable conditions they create on the ground. PyroCbs are able to generate their own lightning strikes, mass downdrafts of air, gusty winds and even hail

blackened with soot. The plumes generated from pyroCbs can influence the atmosphere at heights of up to 15km. Embers still hot enough to start new fires can be shot out of a pyroCb at distances of 30km from the main fire…. The advice given to firefighters in NSW before and during a pyroCb event is to "make sure they have a safe refuge" … "It instils fear – the thought of a fire creating a thunderstorm that's throwing embers and lightening in front of it. It creates a dangerous situation and we take them very seriously." … The NSW Rural Fire Service was using weather balloons to take atmospheric measurements during times it is feared that pyroCBs could form. New communications material for firefighters has also been produced … one warning sign was a smoke column that rises to about 5km and forms a white top as moisture turns to ice. If the column continues to rise, a warning is sent to firefighters and communities on the ground. As well as creating dangerous weather conditions, … pyroCBs prevent the fire service from using aircraft either to take measurements, or to drop water or fire retardant. The Guardian, *Scientists fear surge in supersized bushfires that create their own violent thunderstorms*, 20 December 2019.

Very high pyroCb clouds with white tops were very noticeable, and were clearly to be seen, some distance away to the east from Canberra early in the local bushfire season.

They looked odd and out of place; but they were real and an indication of dangerous bushfire conditions forming just inland from the east coast.

It has been mentioned of late that drone water bombers may be used in extreme bushfire conditions (sometime in the future!). Others, with interest in satellites, forecast that the hotspots within extreme bushfires will become clearly visible from very high above through the thick murk of the fires. Putting the two together, there seems *some* promise of forestalling pyroCb storm formation.

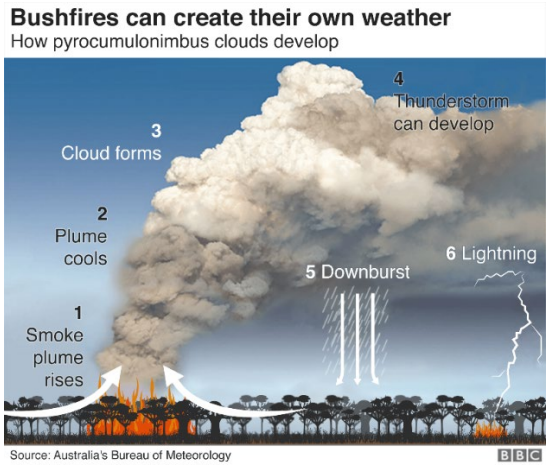
Pyroconvection (PyroCb) extreme bushfire events; the science progresses

The appearance and a number of pyroconvection (pyroCb) clouds per annum is the best existing measure of the number of extreme bushfires occurring in Australia. As these are occurring at an increasing rate, and as they are forecast to bring ever more dangerous bushfire conditions to the southern parts of Australia, they require a fuller explanation:-

A more formal description of pyrocumulonimbus (pyroCb): Extreme fires have substantial adverse effects on society and natural ecosystems. Such events can be associated with intense coupling of fire behaviour with the atmosphere, resulting in extreme fire characteristics such as pyrocumulonimbus cloud (pyroCb) development. … PyroCbs lead to highly erratic fire behaviour because of strong updrafts and downdrafts, the possibility of associated whirlwinds and tornadoes, and rapid fire growth due to heightened ember generation, long-range spotting and cloud to ground lightning strikes … Specifically, downdrafts can cause erratic fire spread, driven by sudden wind gusts impacting the surface in multiple directions, endangering firefighters near the pyroCb … and frustrating accurate prediction of fire behaviour. Local surface processes can amplify fire behaviour, for instance, eddies in steep lee-facing slopes can cause lateral fire spread and mass spotting in downwind areas, a process known as fire channelling or vorticity-driven lateral spread (Sharples et al., 2019). Anthropogenic climate change is increasing the occurrence of dangerous fire weather conditions globally … leading to energetically intense wildland fires. … increased risk of extreme fire events … in most locations. *Evolution of an extreme Pyrocumulonimbus-driven wildfire event in Tasmania*, Australia.

The term 'extreme bushfire' is now widely used by fire authorities (but not by the federal government!). Emeritus professor Sharples, from the University of NSW, in a recent talk on bushfires at the national botanic gardens in Canberra, defined an **'extreme bushfire'** as a combination of fire conditions on the ground and atmospheric conditions above. Further description of an extreme bushfire matches reports of fire front conditions by fire authorities and by the public experiencing the frightening onset of more fierce fires than bushfires experienced by these people in the past. Research indicates that extreme bushfire

conditions - **pyroCb events or firestorms** - have been occurring with increasing frequency since the 1980s.



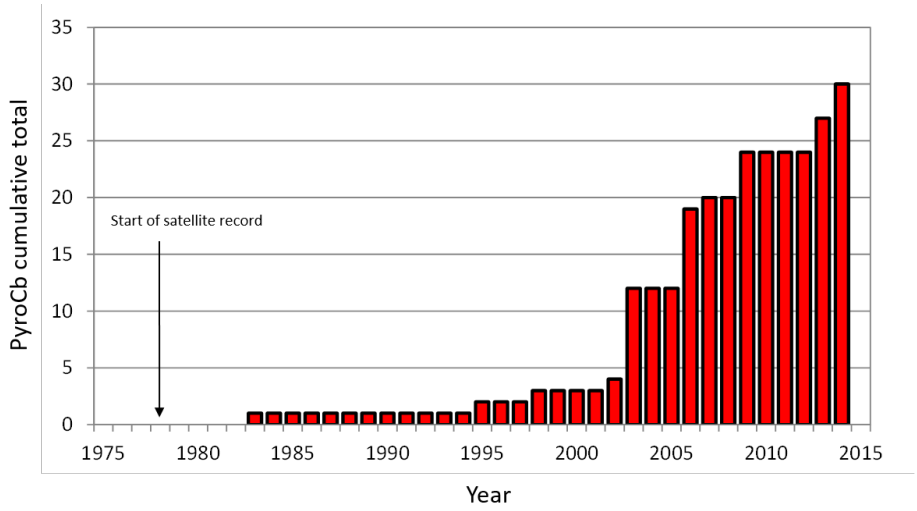
Local surface processes can amplify fire behaviour, for instance, eddies in steep lee-facing slopes can cause lateral fire spread and mass spotting in downwind areas, a process known as fire channelling or vorticity-driven lateral spread (Sharples et al., 2019).

The introduction to a talk on extreme bushfire development: 'Understanding Extreme Bushfire Development'; Dr Jason Sharples will highlight the role that dynamic fire propagation plays in driving 'deep flaming' events, which appear to be critical in triggering the 'violent pyroconvection' characteristic of extreme bushfires, as well as recent work aimed at predicting extreme bushfire occurrences.

Abstract - **Extreme bushfire development:** Extreme bushfires consistently result in loss of life and property, widespread environmental damage and further impact the cultural, economic and political stability of communities. Understanding the factors that combine to produce these significant bushfire events is the focus of sustained research efforts around the globe. Much of this research has concentrated on atmospheric conditions, but given that these events actually manifest as coupled fire-atmosphere events, it is also important to consider the contributions of the fire itself. In this presentation I will discuss some recent research findings into extreme bushfire development. In particular, I will highlight the role that dynamic fire propagation plays in driving 'deep flaming' events, which appear to be critical in triggering the 'violent pyroconvection' characteristic of extreme bushfires. I will also discuss recent work aimed at predicting extreme bushfire occurrences. PyroCbs became a problem in Australia in 2001… they are now known to occur when a fire forms deep flaming under an unstable atmosphere. Deep flaming is the depth of the active fire, as in how far back from the front there is strong heat release. This can be some kilometres, and is not to be confused with the fire front: The talk was given at the **Australian National Botanic Gardens in 2019. [The intro is also found in Issue One 2018 of *Fire Australia*]**

The occurrence of pyroCb clouds 1983 to 2014

[From satellite records]



Dr Sharples has provided an update to the graph (below) put up on the screen at the talk in 2019 which It extends the figures for pyroCb (extreme bushfire) events in Australia from the start of 2019 to the present. It includes confirmed figures plus figures for those pyroCb events pending confirmation (see below the graph). The number of incidents is increasing sharply as Australia continues to warm: **"The unofficial numbers indicate that since the start of 2019 we have had more than 30 additional pyroCb events in Australia, with another 15 still under investigation";** Dr Jason Sharples, Emeritus Professor UNSW, 2020

Previously Dr Sharples et al made this comment: 'Violent fire-driven convection can manifest as towering cumulus or cumulonimbus clouds, the latter of which are known as firestorms (pyroCb firestorms). These extreme fires can have devastating impacts on environment and society, and appear to be a worsening problem. The major concerns surrounding these large pyroconvective events are that their associated fire spread is highly unpredictable and that they're generally not suppressible. Indeed, current methods of fire spread prediction, including the use of empirical and semi-empirical modelling approaches, fall short when attempting to predict fire behaviour associated with these events. In particular, they commonly under-predict the rate of spread in such situations, when broader-scale fire-atmosphere interactions are dominant'. *The role of deep flaming in violent pyroconvection* – 2017; J J Sharples et al.

Again, in the national parliament of Australia early in 2020, the Deputy Prime Minister made a short statement, which included this: 'We've always had bushfires in Australia' – indicating that his party (the once 'country party' a voice for rural people!) wasn't concerned about reports of more dangerous bushfire conditions beginning to occur in northern of NSW!! He too was just being a politician speaking and acting in some other sphere of reality!!

What is so difficult for deniers (including some politicians) to understand about extreme bushfires?

A five minute video of research into bushfire conditions https://australiascience.tv/episode/catastrophic-science-bushfires/ in which Professor Sharples explains how the 2003 extreme bushfire in the Australian Capital Territory produced winds of around 250 kph as the out of control bushfire advanced on the western suburbs of the city of Canberra – a 'first' in bushfire research. Canberra may be well south of the tropical cyclone zone, but cyclonic winds can be generated here! With such massive winds swirling around inside extreme bushfires compromises even large fixed wing fire bombing aircraft.

It truly is strange that our political leaders are just not aware of the increasing dangers of extreme bushfire events – it is most certainly not a case of: 'Oh, we've always had bushfires!"; as was voiced within national parliament early in 2020 – exactly 17 years after

that catastrophic bushfire of 2003 when over 500 homes were destroyed just a few kilometres from the Australian Parliament House (admittedly when the Parliament wasn't sitting!!).

Changes required in fighting pyroCb bushfires

The pyroconvection events visible from Canberra early in the bushfire season, before the bushfire smoke blotted out our view, were happening along the NSW south coast, creating what one journalist, returning to her home area, described as a "***living hell"***.

As Australia approaches **1.5 °C** of warming over the next five years '*living hell'* bushfires may become the norm - for rural and urban areas alike. Research into extreme (pyroCb) bushfires is taking place worldwide, but fighting these fires will require much change in the way they're fought on the ground and in the air.

In the air: Australia is still reliant on aerial firefighting services hired from abroad; an untenable position - and these aircraft are not as yet fitted with IT equipment which might allow them to continue operating in extreme bushfire conditions including thick smoke and very variable winds at low altitudes. Such aircraft are as yet of limited use; but much needed (and owned) to allow more efficient dousing of early bushfire flames.

Current (Sept 2020) reports on the media of the large wild fires raging in California seem to indicate that even their large fleet of fixed wing fire bombers is insufficient to tame the more extreme fires!

Unfortunately, here during last summer's bushfires, a large hired fixed wing fire bombing aircraft from overseas crashed while waterbombing a large bushfire in the Snowy Mountain area; with the loss of the three crew from Canada.

On the ground this past summer there were many harrowing reports of volunteer firefighting teams rescuing those in extreme danger. The crews involved having to make the decision to enter areas with very dangerous fire conditions in an attempt to make a critical rescue; and sometimes having to leave dead relatives while getting those injured (and the terrified) aboard their vehicles. As this may also become the norm, perhaps all such rescues need to be left to more highly trained and better equipped professional fire rescue teams – otherwise there will be greater loss of life within the volunteer firefighting service than currently experienced.

On the odds of extreme bushfires occurring: an analysis by the **World Weather Attribution** (WWA) discovered that the extreme Australian bushfires of last spring and summer (Sept to Feb) were made at least 30% more likely by human induced climate change. A spokeswoman for WWA at Oxford University states that the true figure is likely to be "much larger" and "the models underestimate the role of temperature rises". Australia's rise in temperature of 1.4 °C since 1910 is certainly reflected in the pyroCb graph above, making the influence of human induced warming on these Australian extreme bushfires much closer to a certainty.

The record-breaking heatwave that has **baked Siberia for the past six months was made at least 600 times more likely because of climate change**, which researchers say mean it is "effectively impossible" for it to have occurred without the warming driven by human activities (the) Siberian heatwave was 'impossible' without human-made climate change*:* WWA July 2020.

We can now rapidly and reliably link heatwaves, droughts and hurricanes to human-induced global warming. The science could soon be used as evidence in legal cases brought against fossil fuel companies. Friederike Otto, climate scientist, Oxford University. [Politicians take note!!]

Courts, national and international, may prove to be the best means through which the big polluters will be more rapidly brought into line.

The WWA spokeswoman continued: "Australian Prime Minister Scott Morrison (called the bushfires) 'business as usual', while (political) misinformation campaigns blamed arson by green activists".

Australians could certainly have hoped for better from their national government!

The wider effects of last fire seasons' intense bushfires

When the extreme fires of last spring and summer struck, firefighters on the ground were frequently overwhelmed by large out of control bushfires. Often their only aerial support being small helicopters delivering canvas buckets of water to pour on fire threatened buildings; this lack of much needed aerial support left the ground based firefighters vulnerable. Their main recourse was to save life, limb and property - without a 'large national fixed wing tanker capability' there was little prospect of bringing extreme bushfires under control, so quick and efficient evacuation is becoming the only recourse; but, any local tardiness in bringing about rapid and efficient evacuation places the lives of the numerous teams of volunteer firefighters at risk. Most volunteers operating in any rural area will be locals backed up by other teams from other areas from across the land – and even from abroad – but local crews will be committed to attempt near impossible rescues to reach families and individuals they know all too well.

The beach rescue by the Royal Australian Navy described above (reminiscent of Dunkirk early in WW2) occurred along the coast to the SE of Canberra, where the bushfires were described as a *living hell'* by a journalist. But last minute rescue operations were also underway in many other localities; including getting people affected off Kangaroo Island off the South Australian coast (population 4,700) where a greater part of the Island was burning. Local deaths are extremely traumatic, and a father and adult son were caught and perished in their car as they (eventually) fled their home.

The bushfire on Kangaroo Island - off South Australia, 2020

The overall direct deaths due to last seasons' bushfires, although traumatic for communities firefighting teams and others closely involved, were not as large in number as with major bushfires of the past. The worse bushfire recorded in Australia was Black Saturday, 7-8 Feb 2009 in Victoria, where 173 fatalities occurred and more than 2000 homes were lost (there are no figures quoted for non direct bushfire fatalities, as from the secondary effects of bushfire smoke). The early evacuation of areas close to extreme bushfires is essential, and perhaps the driver of the welcome fall in bushfire death rates since that 'Black Saturday' in Victoria. But, many last moment rescues by volunteer 'firies' were close run, and extremely dangerous. Such incidents, which have so easily led to greater numbers of deaths among volunteer firefighters, is something requiring urgent thought in all bushfire related inquiries.

Loss of trees in the recent fires is substantial and greater than in the past. In south eastern Australia an estimated 21% of native eucalypt forests in that extensive area had been severely burnt. Internationally, forest destruction by fire doesn't usually exceed 5%. The estimate doesn't include the large bushfire on Kangaroo Island, in South Australia, where some 50% of the island, including much natural reserve, has been severely affected by bushfire. Nor the bushfire damage in Tasmania where lightning strike is usually not a problem as the bush is generally too wet; but this is changing. Tasmania has sizeable areas

of remnant Gondwana rainforest which, like the temperate and tropical rainforests of the east coast of mainland Australia, have not experienced bushfire for millennia, but continental wide warming causing prolonged dryness has made these important and species rich remnant wet forests vulnerable to fire. The high Snowies, the location of the Australian mainland's highest peaks (the highest mountain in Australia is the volcano 'Big Ben' [how British can you get] on Australian owned Heard Island in sub Antarctica) were hit by extreme bushfire at the start of the summer in December 2019; a view of blackened trees stands out right up to the snowline. The high country had late spring snowfall, to a depth of around a metre, but the sudden heat of summer and the dryness of the surrounding landscape left the high country exposed to bushfire. Cultivated as well as natural forests were lost to the fires in the high country, contributing to a shortage of logs for saw mills. Also places of interest for tourists, such as the plantation with towering trunks of sugar pines (*Pinus lambertiana*; the tallest of the North American genus) at Laurel Hill, and nestled in the Bago State Forest in Batlow, a plantation almost 100 years old, was totally destroyed – after surviving many bushfires in the (cooler) past.

Extreme weather events could make evolution backfire: brief changes, such as storms, can make the fitness of survivors in normal conditions to such an extent that numbers decline rather than recover … extreme events fuelled by global warming, such as more extensive wildfires, can drive vulnerable populations to extinction: Kelsey Lyberger, University of California, Davis, 2020

Possible loss of Australian native species due to extreme bushfire: Australia has a sad record of biodiversity loss. In the past 20 years, the number of threatened species and ecosystems has grown by one third – from 1,488 to 1,974 – and mammal losses continue at the rate of between one and two a decade. One hundred species have become extinct since 1788 … The national environmental laws have failed to protect the nation's unique flora and fauna. A study found that climate change would increase the rate of losses five fold**:** *Quantifying extinction risk*, CSIRO (the Australian national research body).

Australia's 2019–2020 mega-fires were exacerbated by drought, anthropogenic climate change and existing land-use management. Here, using a combination of remotely sensed data and species distribution models, we found these fires burnt ~97,000 km^2 of vegetation across southern and eastern Australia, which is considered habitat for 832 species of native vertebrate fauna. Seventy taxa had a substantial proportion (>30%) of habitat impacted; 21 of these were already listed as threatened with extinction. To avoid further species declines, Australia must urgently reassess the extinction vulnerability of fire-impacted species and assist the recovery of populations in both burnt and unburnt areas. Population recovery requires multipronged strategies aimed at ameliorating current and fire-induced threats, including proactively protecting unburnt habitats: Journal**:** Nature Ecology & Evolution; July 2020.

While losses mount, Aus is high in climate change deniers: a survey by a local university indicated that of 40 countries surveyed Australia lies third in climate change deniers - US 12%, Sweden 9%, Australia 8%. This 8% of climate deniers is more than double the average for the 40 countries surveyed. With 15% of Australians saying they don't pay any attention to news about climate change … double the global average of 7%: University of Canberra, 2020. This explains much of the political inertia in the Land Down Under!

Most biodiversity, it is said, lies within the top 100 mm of topsoil. But, among the macro species: 'Three quarters of Australia's threatened species are plants, often with restricted range; a single fire could spell the end for species' entire populations': Royal Institution of Australia, March 2020. Most Australian plants, as elsewhere, are angiosperms - flowering plants. They will be missed.

We have the national emblem flower of Australia, the golden wattle (*Acacia pycnantha*) a native to south eastern Australia, in our garden, the tree was some three years old and had grown to three metres; but the hot days of up to 44^{0}C last summer burnt off the top. Now, in a Canberra mid winter, the once healthy and vigorous (iconic) tree has died. Although an understorey as well as open scrub tree in its native habitat, its death struck us as an appropriate symbol of extreme warming!


With a Royal Warrant granted on 19 September 1912, *Acacia pycnantha*, meaning cluster of flowers, is the national flower and is included in the Australian coat of arms.

Threatened native plants in Australia: In the ***International Year of Biodiversity*** (2010) Kew Gardens together with the ICUN estimated that some 30% of Australian wild plants were under threat from various causes. There are more than 25,000 species of native plants, so more than 7,500 species of Australian native plants will be gone by 2100 if nothing is done to preserve them.

Australia is unusual in that two types of trees dominate some 70% of the land as top storey trees, **acacia** or **eucalypt**. The *Acacia* genus, has over 1,000 species and the *Eucalyptus* genus, over 700 species - plus some 160 species recently removed from the genus, so around 900 'eucalypts' in total. Acacias are destroyed by bushfire but reappear from seed in the soil; some eucalypts do the same, but most sprout foliage from their trunks and lignotuber bases (epicormic growth) and the forest survives.

The 900 or so species of Australian eucalypts vary a lot as to the oil content in their leaves - only some twelve species have been chosen to be farmed for eucalypt oil - but, under extreme bushfires conditions most eucalypts will burn. The temperature of a bushfire flame ranges from 300^{o}C to 1100^{o}C, the persistence of the flame depends on the type and amount of fuel and (lasts) usually less than two minutes in forests. However, most living tissue is killed if it reaches a temperature of 60^{o}C for one minute! The radiant heat generated in eucalypt forest bushfires can be intense and dangerous for unprotected personnel and nearby structures. After fire, most species of eucalypts can recover, either from buds located deep in the bark or from buds in a "lignotuber" at the base of the trunk. A few eucalypt species, including the local alpine ash, that do not have these properties are easily killed by fire. They regenerate only from seed shed after the fire. Skeletons of dead alpine ash killed in the ACT 2003 bushfires can be seen above newly regenerated trees along the road in the Brindabella Range.': Quoted by a Canberra authority on eucalypts. The extra heat developed within extreme bushfires may well become a threat to many species of eucalypt.

Some misguided attempts to offset Australia's emissions involves tree planting: "The Australian Government is currently working with communities to plant 20 million trees by 2020 at a cost of $50 million. The benefits of the 20 Million Trees Program have been more than neutralised by a single year of land clearing in Queensland".: states the ABC radio station TripleJ online; October 2018. Besides holding the gold cup in tree clearing (an environmental officer attempting to stop some illegal tree clearing in Queensland was shot dead in 2014!) there is some danger to ancient Gondwana rainforest. The amount of tree clearing (legal and illegal) taking place there not only negates the efforts of the 20 Million Trees Program but the size of the tree planting effort under the program is paltry, in relation to the amount of extra green required to absorb the great quantities of CO2 being emitted; 'extra green' did appear across mainland Australia in 2011.

Total absorption of world CO_2 emissions in 2011: following a prolonged dry period Australia experienced a very wet year in 2011. The extra rainfall occurred right across the land producing enough extra green cover, over mainland Australia, to absorb some 70% of the world's emission of CO_2 for that year; researchers discovered (some time later). The remaining 30% was found to have been absorbed elsewhere in the Southern Hemisphere.

Under that measure any planting of trees, or other plant types, to absorb Australia's total domestic emissions plus the emissions from the burning of large amount of fossil fuels exported from the Wide Brown Land' would require a much, much, larger effort than the tiddling 20 Million Trees project planted to cover 100 km^2 (and costing $50 million!). Domestic emissions together with the emissions from the total fossil fuel export of Aus amount to around 5% (and growing) of the total world emissions: Climate Analytics 2019; the total area of the Australian mainland is 7,595 342 km^2. **The 100 km^2 represents just 1/75,953th of the area of mainland Australia** – that's a long way short of absorbing 70% of the 5% of the world's total emissions (and growing)!

[The 'logic', of course, lies in an attempt by the Australian Government to cover up the very high level of (taxpayers') subsidies going to fossil fuel industries each year!]

[The 'logic' doesn't work, but only for those aware of the deception. Landholders, of course, like the idea of being paid to plant trees; particularly if it covers up tree clearing elsewhere!]

Unfortunately for the world, to maintain such a massive CO_2 absorbing area of greenness as that of 2011 requires an equally massive amount of rainfall – which just isn't possible – but there is another way of absorbing CO_2 from the atmosphere; using methods to absorb the gas directly into the soil. A practice which would be gradual and suited to a post fossil fuel era, when the CO_2 accumulation in the atmosphere needs to be reduced to curb further global warming.

Regenerative agriculture has many parts, but in essence it's where increasing root mass leads to more humus in the soil and greater absorption of CO_2 - as more soil organisms survive – the surviving organisms includes fungal species which also hold water, making the soils more droughtproof and achieving more greenery under increasingly dry conditions. Many regenerative techniques are being practiced and also include a great reduction in the use of artificial fertilisers and chemical sprays. **Regenerative grazing** has proved possible, and even successful, in an arid part of mainland Australia. But, very costly, as establishing smaller grazing paddocks across hundreds of square miles of arid landscape, plus the establishment of the many accompanying new wells to supply drinking water to the many 'paddocks', generate huge infrastructure costs. The stocking rates, though, were tripled on the beef property involved.

Fungal habitats include soil, water, and organisms that may harbor large numbers of understudied fungi, estimated to outnumber plants by at least 6 to 1. More recent estimates based on high-throughput sequencing methods suggest that as many as 5.1 million fungal species exist. Molecular tools in use and under development can be used to discover the world's unknown fungi in less than 1000 years predicted at current new species acquisition rates; American Journal of Botany2020.

Still some way to go to truly understand the soils of farming and grazing; but it's becoming clearer that industrial agriculture and grazing has damaged once healthy and highly productive soils.

For regenerative agriculture and grazing to have great effect on world warming areas in the order of the magnitude of the Australian mainland; and its greenness of 2011 – and that on a permanent basis; not just for one year as in 2011. On that scale food production for the world would become healthier as well as being more productive under less rainfall; which would greatly help in feeding the more populated world of the future.

[I wonder, here, if Shutts is covering this resurgent and regenerative aspect of agriculture and grazing?]

Environmentally improved farmland and forest would see more plant and wildlife species making it to 2100 and beyond - particularly if the temperature equilibrium of the past three million years is restored through the cessation of fossil fuel use. From there, with more CO_2 in the soils and far less in the atmosphere, the world will be gains healthier environments while bushfires become less dangerous as temperatures revert to that of the three million year equilibrium.

Tree felling at scale risks wildlife, in addition to creating more bushfire risk. Particularly within ancient forests.

'When animals lose their habitat they die, they don't just run away and live happily ever after somewhere else.'

Loss of species

The loss of over a billion native animals in the recent extreme bushfires does not auger well. It's now estimated that there was a loss of around 70% of koalas on the eastern side of mainland Aus. This may be seen as representing the scale of loss through more intense bushfires. Injured and badly burnt, but still alive, koalas were being gathered into rescue centres many weeks after the major bushfires came under control. Koalas, were once thought to derive all their fluid needs from Eucalyptus leaves but it's now known that they do require drinking water, and have been under severe stress from dehydration and heat stress for some time - but extreme bushfires are lethal to them. Koalas, already highly endangered, will require large investment to survive as a species. Besides bushfires, land clearing leading to loss of habitat, road fatalities, dog kills, and more, further endanger this iconic species.

Koalas require water, habitat, and the right eucalypts to survive.

Care and rehabilitation of animals injured in a bushfire is key to their continuing survival.

'In the last twenty years, koala populations have dropped by up to two thirds in New South Wales and Queensland. An Australian icon, the koala faces growing threats from land

clearing, droughts, and bushfires as the climate emergency reaches alarming heights.' Greenpeace Australia Pacific.

In very high country, tiny pygmy possums rely on good ground cover, including seasonal snow cover, to survive – their cover is being greatly reduced by warming. Alpine species in general are being driven to ever higher altitude to survive the warming. Part of the pygmy possum's summer meat supply, bogong moths, are also decreasing in number. This summer's bushfires exacerbated these stresses on this tiny creature.

The tiny pygmy possum

Moths and butterflies are tipped to be the bellwethers of human induced climate change. Myriads of the bogong moth which aestivates in the high are rapidly declining in number. Another is the Golden Sun Moth (*Synemon plana*) which has been declared an endangered species in the ACT since 1996 and has special protection status. It is listed as critically endangered nationally, endangered in NSW and threatened in Victoria: ACT Government. Any decline in total moth species is difficult to estimate as most species haven't been named as yet. For the ACT something approaching 1,000 species of moth have been described, but the estimate of moth species for the Territory, is in the thousands – as more and more species are being found on each field trip by the national research body the CSIRO. Some 88 species of butterfly have been recorded in the ACT, but perhaps only 67 are endemic (there are also introduced species, such as the cabbage white; and farther afield, the monarch butterfly from the USA, but it doesn't migrate and feeds on a milkweed introduced from South Africa!) As for all insects and arachnids the field is understudied, and very large; the impact of the increasing number of pyroCb bushfires can't as yet be estimated very accurately.

Birds: 'One might think birds and other fast-moving animals can easily escape fires. But smoke and strong winds can badly disorient them, and mass bird deaths in severe bushfires are common. We saw this in the current fire crisis, when dead birds including rainbow lorikeets and yellow-tailed black-cockatoos washed up on the beach at Mallacoota in Victoria'. The Conversation; online 2020. Canberra residents hit by the 2003 bushfire 'experienced parrots "falling out of the sky like hail!". The local glassy black cockatoo declined rapidly locally, as their food base was massively reduced.

Australian song birds, parrots, owls, corvids and more represent the ancestors of most bird lines inhabiting Eurasia (including the UK) which would make any loss of Australian birds of strong concern to all 'Eurasians'. A patch of Gondwanaland 66 million years ago – as the asteroid hit in the north – seems to have sheltered many wildlife species of that period, including a number of bird lines. Australian and New Guinea (or Sahul) birds – following millions of years of evolution – eventually 'jumped ship' into 'Sundaland' (Indonesia etc.) and then spread out across Eurasia.

Within Australia the long time resilience of the birdlife is being severely tested: Evolving to adjust to a drying land, Australia, over that long period, birds became very flexible in their breeding and survival strategy 'this general and impressive flexibility … allows the birds to breed when conditions are good, it is now beginning to be a trap of a new and troubling kind … there is a trade off between breeding flexibility and tolerance of environmental variations … current climate change events and temperatures … higher for longer than they have ever been before could have devastating effects … specifically on species with great breeding flexibility. This … is a disaster: *Bird Bonds*; Gisela Kaplan, PhD, PhD, hon. DSc, Emeritus Professor, University of New England, Armidale, Australia.

If that's a 'disaster' for the well adapted birds of Sahul - of some 1,760 species - what does it bode for a single species such as *Homo sapiens*?

Bats of all kinds live very long healthy lives, but accelerating warming in Australia is beginning to kill Aussie bats. Australian "flying foxes die when the temperature is greater than 42 degrees Celsius". Temperatures of well above that level are beginning to occur in their favoured habitats.

Flying foxes in normal temperatures in an urban area

And, in excessive heat, clustered on a tree trunk to keep cool in Melbourne, January 2020

Many Australian wildlife species 'are being pushed to the brink by climate change. The trees they sleep in burnt to a crisp, the rivers they feed in running dry'. GetUp Australia 2020. It's also well known that Australia has one of the highest rates of mammal extinction - with 34 species of native mammals already gone.

Images of some of Australia's threatened animal species:

Brushtail possum 

Greater glider 

Brush tailed rock wallaby

Long nosed potoroo 

Tas. devil 

Kangaroo Island dunnart

Platypus; from bushfires & drought. 

Black-tailed dusky (tiny) antechinus 

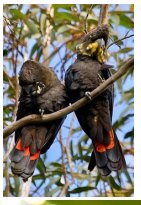
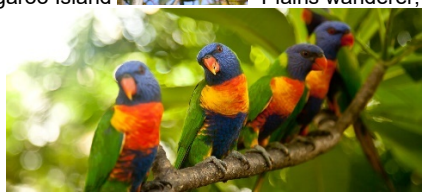
Threatened orange bellied parrot 

Little Penguin; threatened in NSW

King Island brown thornbill 

Swift parrot 

Glossy black

cockatoo, Kangaroo Island  Plains wanderer; found as small groups now  Rainbow lorikeets  "Bushfires  .

Animal deaths in bushfire: third generation forestry worker and volunteer firefighter, Ings, worked shifts of up to 16 hours in apocalyptic conditions 'it got so hot, the sand in the soil melted to glass, causing it to shine. That's a furnace,' says Ings. **But what he remembers most vividly is the 'haunting, piercing screams of dying animals. It's the worst sound you can ever hear' he says.** With the fires now extinguished, parts of the native forest on Ings property resemble a wasteland. 'In areas, we've lost the whole lot: all the trees, all the animals.' He says. That's just on his 500 hectares. Across south east Australia, (millions of) hectares burned. The federal government has set a multimillion dollar restoration programme. It is a huge task that could take decades – even if major fires don't erupt again. Dingos may well be part of the answer; as with the rewilding with wolves elsewhere. Ings' view differs from that of many landowners: 'There's no other native animal that has been so persecuted,' he says. 'It's wrong – especially given how important they are to the ecosystem: Every Dog has its day; Conserving Australia's Dingo.

[Perhaps the sound of the *'haunting, piercing screams of dying animals'* should be played in both houses of the national Parliament to gain attention.]

A recent survey funded by **WWF Australia** has found that 'over 90 per cent of small, ground-dwelling animals have been lost in surveyed areas. … too small to flee from the rapidly moving bushfires.

A commentator has referred to the ongoing damage being suffered by so many Australian native lifeforms as **'omnicide'**.

Now that's a word to keep in mind as Australia approaches **1.5 °C** of warming.

Climate change in Canberra

The speed of warming in Canberra (some 650m above sea level) has been briefly described in a recent online article by an Australian authority on climate change: 'The city I live in, Canberra, experienced an average seven days per year over 35℃ through the 1981-2010 period. Climate models projected that this extreme heat would more than double to 15 days per year by 2030. **Yet in 2019 Canberra experienced 33 days of temperatures over 35℃.'**: Professor Emeritus Will Steffen, Australian National University, Canberra; and a councillor on the Climate Council of Australia.

The Bureau of Meteorology reports that for the whole of this summer the records show there were 56 days over 30 degrees and of these 18 days were over 35 °C. The hottest day for Canberra this summer was **44 °C**. But, a few weeks later nightime temperature dropped to 7 °C – night temperatures have risen less than daytime temperatures. Though snowfall no longer occurs in Canberra winters. It still does occur occasionally on the Brindabella Range lying to the west of Canberra. Walkers there no longer take cross country skis, as snowfalls are now too light. South Westerly winds still bring cold air from the snowfields in the Southern Alps - the ski season starts there on 10th June (the Queen's Birthday). Now in spring 2020 the days of over **35 °C** seem a very long time ago; but summer approaches rapidly!

In recent days (it's early spring in the southern parts of Aus) weather systems arriving out of the Southern Ocean have dramatically dropped daytime temperatures for a number of days

for each passing system, The BoM has referred to these systems as ‘Antarctic Bubbles’. If conditions in Antarctica are the cause of these cold bubbles heading north, then that’s deep worry!

Bushfire in the Australian Capital Territory 2020 and 2003

Australian Capital Territory (the ‘Territory’) experienced no threat of bushfire last summer until late January when a very large bushfire broke out in the Orroral Valley of the Namadgi National Park; a park which takes up most of the ACT. Some 18,000 hectares were burnt out (around 25% of the ACT).

Canberra, a city with a population fast approaching 500,000, is located in the northern part of the Territory, but homes in the endangered southern suburbs of the city were saved by a wind change and some light rainfall which doused much of the bushfire. The light rain arriving from the remains of a tropical cyclone passing along the coast; after devastating Lord Howe Island well to the north and well offshore. Extreme bushfires along the coast were also doused by rain, but farther north the rain from the cyclone was much heavier, causing the heavy flooding mentioned above.

The Orroral Valley bushfire didn’t make it into the city’s water catchment area in the high Brindabella Range bordering the Territory (the highest peak in the Range being about twice as high as Mount Snowden) but it did in the previous severe bushfire, of February 2003, and caused problems in the main city reservoir. Besides destroying over 500 homes in the city the heat of that bushfire melted large research telescopes atop Mount Stromlo, a hill overlooking the western suburbs of Canberra. It also burnt out large commercial forests of pines within the city’s boundary. The image below shows part of the area burnt out by large bushfires during 2001 and 2003; the area is now occupied by the 260 ha National Arboretum - the area was rapidly cleared following the 2003 fire and soon planted with trees native and exotic; in a more fire proof design. Unfortunately, the view in the opposite direction would be of a larger surviving pine forest! That forest surrounds the zoo and is close to an open forested area - fairly close to us but, more importantly, closer to Government House (where royalty, including the Queen, resides when visiting Canberra). The grounds of Government House being a large open forested nature reserve; just across a small river from the zoo. Some timber harvesting from the pine forest is happening, but not with any great speed!

The National Arboretum Canberra; looking north towards Black Mountain.

Some five km from our home

The Orroral Valley bushfire this year spared the NASA/Australian deep space tracking station (tracking the two Voyager spacecraft now exiting the solar system) and the heritage site of a past tracking dish at Honeysuckle Creek; which picked up the first images of Armstrong stepping on the moon in 1959.

The Deep Space tracking dishes

The small ex Honeysuckle Creek dish stands (dish pointing straight up) in the left background at the Tidbinbilla tracking station.

The large dish, in that position, is focusing on one of the Voyager spacecraft

Animal species change, native & exotic: Last summer's Orroral Valley bushfire likely killed or drove out herds of feral horses (Brumbies) and many other ferals, such as six species of deer, wild pigs, hares, rabbits, wild cats, wild dogs, in addition to much wildlife. Sadly, ferals are likely to return quicker than most native wildlife. Brumbies, coming in from the high 'Snowy' country, will eventually move up into the Brindabella Range and endanger the quality of Canberra's water supply by trampling the moss beds which filter the run off into the reservoirs. Professional teams were shooting the brumbies prior to the bushfire outbreak. Kangaroos in near plague proportions around the city are also culled by shooting each year – but the annual toll will be much lighter this year. The kangaroo breeds up rapidly where ever there is a ready supply of water – and the ex cattle grazing land sports numerous ponds and other water features; and the city also has urban lakes!

Driving down through Namadgi national Park recently (mid 2020) the lack of wildlife beneath the burnt trees was striking - as were the snow covered peaks of the NSW snowfields beyond. The snowfields poorly attended this year as covid-19 is reducing visitor numbers. Some epicormic growth out of the lignotubers of eucalypts is evident at ground level, indicating a steady return to a healthy forest, but the overall impression is of a dead zone – as in the middle photo below – stretching up over very visible hills clearly visible through the blackened trunks and branches:

The Orroral Valley bushfire, just over a range of wooded hills from Canberra's southern suburbs - the Orroral bushfire taking hold in the Valley.

Brett McNamara (park ranger & Manager for 30 years) sits (despondently) amid fire debris in Namadgi National Park. The Park won't recover for many years.

Air quality during the bushfires: Canberra's air quality was among the worst of all major cities in the world at the height of this past summer's bushfire crisis (out competing Delhi for a few days!) and it caused many deaths among those susceptible in the Territory; and in the rural surrounds reliant on the health services provided within Canberra.

Nationwide: Bushfire smoke affected some 80% of the nation's population during the crisis; killing an estimated 445 people (Royal Commission into National Natural Disaster). Hospitalisations for cardiovascular problems and respiratory problems numbered in their thousands: Medical Journal of Australia.

Add to this the smoke from off season safety burns, to reduce fuel loads before each fire season, and a very large health problem emerges for large swathes of the nation.

In Canberra where fire for home heating has been discouraged for some time: "If the smell of smoke reveals a deep, painful, truth that many people share ... surely, we can imagine different ways of living": Canberra Times, mid 2020. Perhaps a return to the cooler, and less smoky, fires once practiced by Aboriginal subsistence people to clear away bush and to reactivate grass growth for wildlife (they didn't require fencing!) is a way to go as many are

suggesting, but carrying out these ancient methods on the scale required to clear away vast quantities of forest and grassland fuel in a much warmer and drier period is yet to be tested.

Bushfires in an adjoining jurisdiction to the ACT 2020

Bordering the ACT, the Queanbeyan-Pelerang region bushfire: "was pretty horrendous for locals this year. This was the biggest most active fire season the Queanbeyan-Pelerang region had in living memory. It even surpassed the 2003 fires that impacted Canberra". Said Supt. Paul Jones, Rural Fire Service district manager ... "RFS local volunteers worked for 70 days to control bushfires which consumed …. 56 homes and 148 outbuildings … destroyed, with many more damaged; a fifth of the local government area, 118,66 hectares, was burnt. More than 20 appliances were in the field every day; on blow up or bad days, the entire firefighting fleet of 63 vehicles was committed. Because the whole state (NSW) was so affected, volunteers served many days with minimal assistance. "From outside the area, RFS crews in the Southern Highlands, Cooma Monaro, and the ACT helped. Fire and Rescue NSW, National Parks and Forests, and the Forestry Corporation of NSW were all heavily involved. So were strike teams from Queensland, Tasmania, Victoria, and New Zealand, while teams from Canada and the USA helped the IMT **(**Incident Management Team**)"**: The Queanbeyan Age, April 2020.

The stresses imposed by 'the biggest most active fire season the Queanbeyan-Pelerang region had in living memory' are obvious and represent just how seriously more extreme bushfires are affecting rural communities across eastern Australia. The smoke from this large bushfire also affected health in the ACT. The aiding nations mentioned also receive reciprocal aid from Australian volunteers, and professionals, when serious forest fires broke out in their lands. The large fixed wing water bombing aircraft which took part in fighting bushfire in the high Snowies probably also took part in fighting bushfires active in the Queanbeyan-Pelerang Shire; sadly, that aircraft crashed in the Snowies with the loss of its North American crew of three. 'Pretty horrendous' is one way of describing the ongoing effects of the world's continuing emissions of greenhouse gasses.

Bushfire shelters - family sized

One case of someone surviving an extreme bushfire in a small family sized bushfire shelter, made the news: a husband emerged from the well designed shelter unscathed, to find the home he had been hosing down had survived but, his wife's art studio, containing all her creations, had been reduced to ash! Architects Australia excepted, there is no wide promotion of these shelters; besides good design and adequate construction the main metal door has to remain leakproof, to avoid the effects of carbon monoxide, and a cylinder of compressed air always kept at full pressure.

Even the popular WW2 Anderson Shelter, partly sunk into the ground in UK back gardens, had its faults. Besides many flooding at the start of the first winter they were found to be lacking in good blast proofing of the entrance. I remember a bomb, a close shave for us, killing a number of families taking shelter in their Andersons. Only a very young girl survived in one crowded Anderson, the family had held a get together that evening and all present had recourse to the shelter – bar the baker present who went upstairs to bed early (to be ready for baking next morning) he was blown out of a window and laded safely aboard his bed! We, close by, survived uninjured as the windows came in and the bomb blast lifted the floor; we were sheltering under the dining table, and had been with our bedding for an hour or so beforehand. We had a cat who knew when the Luftwaffe were leaving occupied France and heading our way (he could hear the spitfires to our west form up and head for the English Channel to intercept; we couldn't, but took note of his reaction!). Another family we knew, a mother and four young sons, were killed by a bomb blast while running down their garden to their Anderson's. The baker returned to a rebuilt house and bakery after the war; and produced great hot buns for winter mornings; but the morning after the raid the rescue team didn't seem to notice a bunch of five year old's standing in a tangle of fire hoses

and watching them carry out the dead. Rural fire services in Australia are probably deservedly wary of 'well constructed' bushfire shelters.

Concurrent problems in a warming Australia

The Great Barrier Reef (GBR) has suffered its most widespread bleaching yet. Concurrent with the bushfire season, Australia's GBR has experienced its third mass bleaching event in five years. For the first time, all three sections of the reef have been severely affected. 'The damage occurred in February when the reef was exposed to the hottest month of water temperatures on record. Aerial surveys conducted … during the last two weeks of March revealed that 25 per cent of the reef had been severely bleached and 35 per cent moderately bleached. The northern, central, and southern sections of the reef were all hit. Severe bleaching also struck in 1998, 2002, 2016 and 2017, but was confined to one or two sections. This is the first time that all three sections have simultaneously experienced severe bleaching … "It's heartbreaking." … After the combined 2016 and 2017 bleaching events, about half the coral on the Great Barrier Reef died. It normally takes a decade for even the fastest-growing corals to recover, meaning the latest damage will cripple the reef's ability to bounce back', says Terry Hughes at James Cook University. Another researcher active on the GBR has predicted that 'the GBR system will be reduced to only small areas of surviving coral within 50 years'

In the Sydney area the Bureau of Meteorology recorded a reading of 48.9^{0}C at 3pm in Penrith, part of the western suburbs of greater Sydney, on January 4, smashing the previous record of 47.3C set in January 2018.

An international research team has recently found that 'hourly data from 7877 individual weather stations around the world' pinpoints short bouts of deadly heat and humidity of 35 degrees C or over, on wet & dry thermometers affecting small areas, where people experiencing these ambient conditions would not survive; humidity can genuinely be the killer in climate change because it worsens the effects of heat Prior studies have suggested that even the strongest, best-adapted people cannot carry out normal outdoor activities when the wet-bulb hits 32 degrees … and a reading of 35 is the theoretical limit of survivability. If just a short sharp shower were to fall on an extremely hot day in Penrith, with a thermometer reading in the high 40s, the resulting humidity may well deliver a wet bulb reading of 35^{0}C; this would be virtually fatal for all residents found outdoors in the area while the reading remained that high. Evacuation of the area, or the rescue of the fallen, would not be possible until the reading dropped - by then the whole population of the western suburbs of Sydney would be inclined evacuate the area; a nightmare for government.

Beach erosion along the NSW coast saw homes collapsing onto the beach as storms hit the area. Local councils have borne the cost of shifting sand and rocks and supplying bags of rocks in an effort to stabilise the erosion but it's a losing battle. The residents demand further assistance (in constructing more seawalls) but, even with both state and national subsidising of costly sea defences, rising sea level and more intense storms will lead to the inevitable. Within society in general, the force of the sea is often dangerously underestimated (I learned early while at sea as a cadet deck officer when I experienced, lifeboat smashing, on the lifeboat deck, seas of over 40m on my first voyage!). Sea level rise of around 3mm per annum (and accelerating) doesn't sound a lot, but with the addition of storm conditions then very little can be done to save buildings set along less protected coast. The insurance industry has been putting out warnings for decades, but the number of buildings in such areas has been rising!

Severe hailstorms occurred in Canberra and Sydney during this past summer. In Canberra some 30,000 vehicles received heavy hail damage in one such storm. Large urban heat spikes can attract and intensify such hail storms. Canberra was originally designed as a 'garden city' with streets lined with trees, this has broken down in the newer townships of the city. Radiant heat on a hot day in a newer suburb with less tree cover recorded 45^0C compared to an older suburb with much greater tree cover which recorded 20^0C. Urban forests are as important as rural forests.

Halting disastrous human induced climate change

Christiana Figueres and Tom Rivett-Carnac, who led the 2015 Paris climate negotiations, were recently interviewed:

Questioner: 'And yet, despite a big rise in social pressure, through Greta Thunberg and Extinction Rebellion, for example, we still haven't reduced emissions. Why not?'

TRC: 'The relationship between civil engagement and political change is non-linear. ... Once you reach about 3.5 per cent of a population that is actively engaging in a particular issue and pushing for it consciously, consistently and publicly, then there has never been a scenario where a group like that has failed to achieve its objectives, whether that's women's suffrage, civil rights movements or the end of colonialism. There are very positive and encouraging early signs that the political winds are now moving in this direction. But like everything else on climate, they aren't moving fast enough. We need to accelerate the action'. New Scientist; issue 3273 , 14 March 2020.

[The figure of ***3.5 per cent*** of a population seems to come from a piece of research conducted by a team led by two American women. The research indicates that 'active participation from at least 3.5 percent of the population succeeded (and many succeeded with less) and all the campaigns that achieved that threshold were nonviolent; no violent campaign achieved that threshold'.]

Christiana Figueres, on TV in Australia stated: Australia, more than any other nation has the capacity to produce and store large amounts of green energy. She also compared the covid-19 emergency with the broader climate change emergency: covid-19 is, as yet, an unknown threat to the world, but the threat of rapid climate change is well known, and we know how to address that threat ... Action to mitigate against even greater damage from the changing climate should not be set aside in favour of a less well known threat of disease…There are a number of climate change tipping points which, when triggered, may rapidly overwhelm any effort to halt warming on our part; the world, including Australia, can't chance such an overwhelming threat to our very being.

On the same TV panel Danish authority expressed his amazement that: Australia, having experienced a major bushfire emergency, is not doing more to address emissions and yet has an abundance of natural resources for green energy production. Whereas, in Europe, a country like Germany has made a decision to do away with coal altogether.

In addition, the IMF estimates that with: 'annual energy subsidies in Australia total $29 billion, representing 2.3 per cent of Australian GDP. On a per capita basis, Australian fossil fuel subsidies amount to $1,198 per person' (May 13, 2019).

The answers for Australia – as for the world – are blindingly obvious.

The Land Downunder is still a commodity trader: Australia is a wealthy nation with the economic profile of a developing country (it) once rode on a sheep's back … today we rely on cartloads of coal and tankers of LNG … In the nineteenth century, commodity trade was two thirds of all world trade; by 1966 it was one third; and by 1983 it had halved again to 17% … it is a declining sector of world trade .. Australia's coal … where will we be if the world stops buying it? … "Our interest lies in global action to avoid as much climate change as possible" … Can (politicians) commit to fast and effective action to try to save (our) future, to prevent the catastrophic fires and heatwaves … the species extinction and the famines? After all, governments are our risk managers of last resort … is there a better way forward, which supports renewable energy? Quarterly Essay, mid 2020; Emeritus Professor Judith Brett, professor of politics at La Trobe University.

End of winter 2020

Here in Canberra rainfall has improved, marginally - kangaroos are tending to leave pug marks where they hop - and there are indications of a wet spring and early summer to come, lending hope for a less fierce season of bushfires. The four main city dams are at a combined level of some 56%. The kangaroo population will go on increasing, but the ACT Government will not be shooting large numbers (up five thousand p.a.) as in past years. The ACT has also lost too much native wildlife to bushfire this year.

Snowfall around the ski fields to our south has proved plentiful this year; but this doesn't guarantee that the spring melt isn't followed by devastating bushfires in the high country.

Snowy Mountains backcountry.

Free-ride terrain

An "apocalyptic" bushfire season is not predicted for this coming bushfire season, but one ex state fire and rescue chief, on a recent TV panel, provided a synopsis of an associated meeting held between firefighters, industrial leaders, scientists, insurance industry representatives, and others. It was agreed by those at the meeting that as human induced climate change was the main cause of the apocalyptic bushfires experienced less than six months previously, that apart from more adequately equipping the volunteer firefighter services with better conditions and better equipment and also agreeing on the need for Australian owned larger firebombing aircraft (the nations which provide the large hired firefighting aircraft are also experiencing longer fire seasons, so those aircraft may well become unavailable) those industries responsible for the greatest volume of greenhouse gasses should, besides having all government subsidies cancelled, be levied to raise the funds required. Surprisingly, the panel on air wasn't in total agreement on the levy suggested!

'Business as usual' seems likely to continue for some time.

On linking of extreme weather events directly to warming: a cofounder of World Weather Attribution and her team run thousands of simulations to calculate the odds of extreme weather events occurring with and without current global warming. By advancing this method, and working with lawyers to make the findings more legally useful, Friederika Otto says the methodology being developed by the WWA will make it possible for court cases against polluters become successful. She also says: "In that sense it's an opportunity. In our plans for economic recovery after coronavirus, we have to think about climate change. The changes have to be long term … there are lots of winners and a lot of things are better".

That's definitely worth drinking to!

On bushfires and Aboriginal knowledge: an ex fire and rescue chief has suggested on TV that there should be a greater input of Aboriginal knowledge in hazard burning between bushfire seasons - an input of knowledge gained over at least 60,000 years. Whilst popularly known as traditional burning, cool burning, Indigenous burning, etc., the practice is actually cultural land management: Bhiamie Eckford-Williamson, Euahlayi man and ANU researcher. Traditional fire management applies cool quick burns; these have several benefits: animals, large and small, have enough time to escape; young trees survive and cool burning doesn't ignite tree bark. Cooler fires also self extinguish. Cultural burning is applied more frequently throughout the year than hazard reduction burns - but it's also more labour intensive - **the debate continues.**

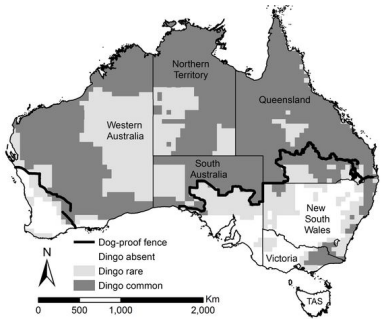
On the need for better stewardship of the Australia landscape: 'subsistence', when applied to subsistence people, means a complexity of activity in stewarding the landscape

and to ensure an adequate food supply. The term 'hunter & gatherer' downgrades that complexity, so 'subsistence stewardship' by 'subsistence people' may be better terms when considering past use of the world's landscapes. When it comes to food production, 'agriculture' wasn't 'invented in one place at one point in history it evolved worldwide wherever our species needed to make a living – and this may be expanded to 'our genus' needed to live.

The loss of species is accelerating throughout Australia: 30% of Australia's 25,000 or so species of plants remain under threat (as predicted in 2010) and for Australian insects: very few of our estimated 250,000 insect species are being formally monitored … If insect populations are in decline, so are the populations of larger animals such as birds and lizards that feed on them: CSIRO, December 2019. Last summer's bushfires burnt some 97,000 km2 of vegetation across southern and eastern Australia, which is considered habitat for 832 species of native vertebrate fauna …Seventy taxa had a substantial proportion (>30%) of habitat impacted; 21 of these were already listed as threatened with extinction. so population recovery is a major concern; recovery of populations in both burnt and unburnt areas; Nature Ecology & Evolution, July 2020.

A gold wasp.
There are around 10,000 wasp species and 2000 bee species in Australia.
Australian insect declines have not been well documented: CSIRO

There are also substantial losses occurring due to the presence of feral animals in the landscape. Ferals include escaped livestock (cattle, buffalo, horses, donkeys, goats, pigs, and more) the purposefully released exotic animals, such as camels, plus the great numbers of feral cats and wild dogs. With wild dogs it's difficult to distinguish between feral crosses and dingoes, but the 5,614 km long Dog Fence is being renewed - which may become problematic if rewilding includes the purposeful release of pure dingoes into the wild!



The Dog ('Dingo') Fence; 5,614 km long; originally built: 1880-85

The dingo itself probably arrived in Australasia with the Austronesian canoe people, who also brought pigs, poultry, rats, and a range of food crops down from (perhaps) Taiwan some 3,000 plus years ago; a form of dingo and wild pigs also exist on New Guinea and surrounding islands.

In traditional Aboriginal society, women travelled with canine companions;
draped around their waists (for warmth) like garments of clothing.

Wongapitcha women carrying dogs: Australian geographic.

The last Tasmanian tiger died a lonely death in the Hobart Zoo in 1936, just 59 days after new state laws aimed at protecting it from extinction were passed in parliament – and today we're making many of the same deadly mistakes, only now it's with dingoes. Will we hunt dingoes to the brink like the Tasmanian tiger? The Conversation

A dead dingo in 2013 (left) and a thylacine hunted in 1869. Tasmanian tiger was last seen in the wild in 1932

Not forgetting the urban areas: Some 46% of Australia's nationally threatened animals can be found in our urban areas. Some of Australia's rarest creatures live right here in our towns and cities: Extinction crisis in Australia's cities and towns, Australian Conservation Foundation, August 2020.

Grey headed flying fox pups - a vulnerable species

Oceania; Australia's close neighbours

Australia and New Zealand are part of Oceania and as the two first world nations in the island group have a heavy responsibility in assisting the minor nations of the region.

For Australia, New Guinea is just five kilometres from the nearest populated Australian island (Boigu Island) and during periods of glaciation New Guinea and Australia form just one island (**Sahul**) yet most maps don't include the whole of New Guinea as part of Oceania - for good reason: The US government managed to engineer a meeting between Indonesia and the Netherlands resulting in the **New York Agreement**, which in 1962 gave control of West Papua to the United Nations and **one year later transferred control to Indonesia**. The Papuans were never consulted (but) the agreement did promise them their right to self determination – a right which is guaranteed by the UN to all people in the world; https://www.freewestpapua.org/. Little in the way of information comes out of the western end of New Guinea, but exploitation continues and this causes almost continuous armed conflict between the Free West Papua movement and Indonesian forces. The UN, in the same period, pressed for 'self determination' in the Australian administered Territory of Papua New Guinea - and Papuan New Guinea became and independent nation in 1975. 'Self determination' is unlikely to take place in West Papua any time soon so that part of New Guinea will remain outside Oceania for the foreseeable future. However, it's likely that Australia will be called on to assist in that part of New Guinea during times of stress for the indigenous population of West Papua.

Papua New Guinea is our nearest neighbour - the people of Boigu Island are related to nearby Papuans - yet, most Australians are unaware of the desperate situation many people of PNG are in as the climate there warms faster, and sea levels rise more rapidly, than in Australia: Satellite data indicate the sea level has risen near Papua New Guinea by about 7 mm per year since 1993. This is larger than the global average; the latest satellite survey indicates a 'global average' rise of around 4.2 mm per annum. The first climate refugees in the world are considered to be a small island community in Papua New Guinea, in 2005, as salt water entered the groundwater system and ruined their food gardens: The Carteret Islanders of Papua New Guinea have become the world's first entire community to be displaced by climate change. They're the first official refugees of global warming – and they're packing up their lives to move out of the way of ever-rising waters that threaten to overtake their homes and crops. The island they call home will be completely underwater by 2015: Asia Pacific Viewpoint, Vol. 57, No. 1, April 2016. For the Highlands of PNG: El Niño conditions (which occur more frequently now) have brought about starvation due to drought in the thickly populated high valleys; and this is exacerbated by frost descending into the higher valleys where the food gardens are completely destroyed; the population of the higher valleys descending into the already distressed lower valleys to seek assistance: Australian National University Pacific unit, 2017. Delivering food supplies out from main centres to the remote locations is a costly challenge. And, ironically, it's precisely when rains begin that death rates soar … while long time temperature records for the Highlands don't exist, some studies report they are one degree hotter than 30 years ago … Temperature change in the Highlands is also visible as lower altitude palms like coconuts bear fruit in places they didn't before, and lower altitude diseases, like malaria, become more prevalent: *'PNG's food bowl is all but empty as drought affects 2 million people*', The Sydney Morning Herald, 2016. Some three million Papua New Guineans live in the highlands of PNG.

Although similarly extreme conditions have, so far, not been reported more widely in Oceania. The danger of sea level rise, particularly on oceanic atolls, will bring more disaster to the region: the ground we played on as children is now a swimming area, the sea like the weather, has changed, we can't predict what will happen but erosion of our island continues and with each storm larger parts of sand and soil, with chunks up to three metres thick; our family graves, originally located in the centre of the island, are being washed away and we have to gather the remains to reinter; an islander interviewed on ABC Radio National, in mid 2020. Tropical cyclones and other storms are increasing in strength and are already causing extreme damage, with calls for assistance from the two larger nations; which triggers immediate airlifting of food and medical supplies to remote islands.

Worldwide: More than 11,000 disasters have been attributed to weather, climate and water-related hazards over the past half century, involving two million deaths, yet one in three people around the world are still not adequately covered by early warning systems. That is one of the key findings of the (USA) 2020 State of Climate Services multi-agency report …

Cyclone Winston: Category 5 Storm, 'The Strongest Ever' To Hit Fiji

The 'Worldometer' puts the population of Oceania at 42 million, with 30 million of that being the combined populations of Australia & New Zealand. Of the 12 million living in the smaller nations of Oceania, most dwell in Papua New Guinea which has a population approaching 9 million (there has been no recent census in PNG). Taking the whole of New Guinea, which is the second largest island - Greenland being largest - its highest mountain, at 4,884 metres, is more than half the height of Everest (the highest on the PNG side is 4,509 metres) plant life on the island numbers 13,634 species ("two thirds endemic") making the island the planet's most speciose island' (surpassing, Madagascar, Borneo and Sumatra): Rhett A. Butler, 5 August 2020: Mongabay. There are 3,962 species of trees in New Guinea or about four times the number found across all of North America. New Guinea and nearby islands alone contain over 1,000 quite separate languages (some 850 of which are within PNG) quite 'separate' languages and different to the extent that a language at one end of New Guinea is more different to a language from the other end than English is compared to Mandarin. Melanesia, including Australia, is home to over 5,000 languages, one of the greatest linguistic diversities in the world. In comparison, Polynesia lacks great diversity, because they are all descendants of a migrant community from southern China (the proto-Austronesians) and have the same language family: World Languages/Oceania.

The Australian explorer, scientist and author, Tim Flannery, describes New Guinea as a landmass which sprawls like a vast prehistoric bird across the sea … New Guinea is Australia's bow wave. Australia racing north eastward at around 70 mm per annum has been accumulating islands and fragments of other continents along its leading edge … This geology also explains why New Guinea's flora and fauna resembles Australia's. Although it is close to south east Asia, New Guinea has no tigers, rhinos or elephants, but it does have kangaroos, New Guinea's kangaroos, however, live in trees. Nine thousand years ago (people) living in high mountain valleys had already developed intensive agriculture …They had begun this process at a time when my European ancestors were still chasing woolly mammoths across the tundra: *Throwim Way Leg;* 'text publishing', 1999.

For such a richly green place as PNG, on the eastern end of the large island, to be experiencing hunger must mean that the very steep rise in temperature adds to concurrent problems of development and steep population rise. Australia is committed to providing a half billion dollars directly to the PNG Government each year and over $100,000 per annum in grants in aid; this in addition to other grants arriving from other nations. And yet, that such high level problems are occurring in the still young nation seems to indicate that social problems may be involved. For another continent it's said: "Every time there's a famine in Africa where they grow maize, if they were growing sorghum millets or other crops, they would survive the drought,": Bruce French of Food Plants International (which lists over 30,000 edible plants of the world so far). There are similar answers may be found for PNG. Some Highlands villagers have long opted for one solution by growing casava (*Manihot esculenta*; domesticated in west-central Brazil) as an insurance against drought; the 'manioc' tubers achieve impressive size as the shrub is allowed to grow over a number of seasons. But that this and other options aren't being acted on more widely indicates that social problems are likely the main cause of climate related food shortages in the Highlands.

Musa ingens, the Giant Highland Banana.
Once grown for its edible corm.

The Australian Administration of the Territory of Papua and New Guinea failed to hand over a working model of rural development at the time of Independence. Australia had been hard pressed by the UN to bring about self determination for the joint Territory of Papua & New Guinea; the 'New Guinea' part being an ex German colony captured by Australian troops at the outbreak of WW1, and this may have led to some confusion among the newly recruited PNG rural development officers. The PNG field service obviously still struggles (I check online) to find an appropriate model for rural development for field officers to put into practice; without such a model the service will continue to be challenged and many rural clans will continue suffer periodic torment from climate change as a consequence!

There is also the reality that most PNG development planning is provided by external experts from across the world, with little or no understanding of the social complexities involved, with the result that most of these outside planned projects are doomed to failure. The inclusion of clan leadership is unlikely to be part of the planning or the implementation processes and this ensures that appropriate implementation would is unlikely to be achieved. In New Guinea and its islands clan leadership is mostly through the Big Man system, where intense competition (and virtually nil hereditary input) produces capable leadership. This is a system I operated within in my decade of field work as a rural development officer in the Territory; from my first day in the field when posted to a patrol post in the Gulf of Papua and a small Big Man arrived at my rat infested bush materials office next the a beach. I achieved immediate success so continued in that vein. Alas, this essential aspect of rural development field work was not included in the eventual handover at Independence. I found the Big Man in each clan and village to be not only, of necessity, of very high intelligence - even those in the Highlands who were raised in Neolithic circumstances (which including cannibalism) and were adults at 'first contact' – but, also of necessity, to have gained very high social nous.

If only our political leaders had that combination of leadership attributes!!

I received virtually no orientation, being a newly recruited field officer on contract for 12 years I was perceived as 'temporary', *which was very lucky*! I avoided being indoctrinated and so entered into field work on a more promising note. Experiencing much success at my first posting I found it essential to seek, and include, the assistance and guidance of Big Man networks in all future field work.

Individuals anywhere in the world, the science tells us, are *'inductive learning machines'* and deep immersion as a leader, be it as a Neolithic clan leader or a leader in high academia will result in equally deep learning. And the more socially intense the learning, the greater the acquisition of social nous. Being a Big Man leader in rural PNG, within village and clan life among close relatives and operating among other clans, exposes those in the position to daily challenges within a complexity of social interactions, and this inevitably leads to a very high level of social nous. Without Big Man inclusion (and his equivalent from among other groups in Oceania) even very well planned rural projects, from external experts or from local project designers are set to fail.

I began my fieldwork on the coast, out of a small patrol post, so didn't realise that working with Big Man networks was an unusual approach until I reached the Highlands. I was advised there that villagers would fall asleep during any talk on development and the clan women were so inferior that they weren't worth bothering to include in the process. Within a week or so of field work with Big Man networks I proved both views untrue! Most pervious rural development effort had been through a farmer trainee program (to produce western style industrial agriculture?!) on Territory wide extension centres; which had failed before I arrived. The 'trainees' had been used as cheap labour to establish cash crops (coffee, coconuts, rubber, cocoa, and livestock) in villages, the villagers didn't complain! It wasn't true rural development, but it did provide valuable capital within clans; which together with the social nous of Big Man networks provided for very promising village projects.

One younger Eastern Highlands Big Man (not a village Big Man but an entrepreneur) who headed up large, government initiated, 'savings and loans society' for the whole population of the Province (he must have received some initial basic formal education; perhaps missionary) stood up at one village meeting and produced an estimate of how much coinage from coffee earnings had be buried across the Province – written on the back of a cigarette packet – he had spoken to three Australian bank managers the afternoon before. 'The coffee harvest season is only half over, yet $2.5 million worth of coins have been buried so far; let nobody say they have no money to invest!' The coffers opened after that (I wished I had thought of gaining that estimate!) and congealed lumps of coinage and old bank notes were produced to gain the investment required to set up a fresh foods marketing cooperative; to market the greater quantities of food garden produce, following pig proofing permanent beef cattle boundary fencing. Such village capital available promised great things to come.

People of subsistence societies live in kin based institutions and these kin based organisations provide members with protection, insurance and security caring for sick, injured and less endowed members as well as the elderly. These intensive kinship networks nurture a non WEIRD psychology (a 'non western' psychology) creating a more collectivist mindset with greater conformity, obedience to authority, nepotism and in group loyalty**:** a loose quote from research comparing western psychology with mainly subsistence groups at the University of Harvard, in 2020; hence the term WEIRD psychology. The western world has evolved (socially) away from most of the world and reached an industrial revolution, and wealth.

When this difference is taken into account for PNG fieldworkers, who each owe allegiance to their own clan but are engaged in the rural development of other clans, it's easy to see that difficulties will arise; particularly in a reluctance to establish a working relationship with Big Man networks within clan systems which are strange to them. Yet these challenges have to be overcome by any rural field service before any development projects can reach permanent success

I had the good fortune to take over the monthly meetings of Big Man networks set up by principle rural development officer, as he was leaving the Province. The meetings were being held to prepare the clans for village cattle projects funded by the World Bank through the Administration; a large expensive project which failed dismally for all the reasons mentioned above; and more! This allowed me to link up with the Big Man networks almost immediately;

On Highland village women, I did experience leadership. I had been advised that all village women weren't worth including in meetings but I soon found otherwise; one of my early village meetings was a village women's meeting! That was a very welcome surprise, and following that clan women became very much part of development; to the extent that they came on visits to a government research station where subsistence plants. All the village women at that first meeting were clothed in trade store garments (their traditional dress for working in their food gardens consisted of very brief bush materials) and looking like a choir; their views on development, expressed by a leading woman, were impressive. The village Big Man had opened the meeting by stating that only women would be able to ask questions of the Big Man visitors (and me). Over 30 years later, in a seminar at the Pacific unit of the ANU in Canberra, I was seated next to the PNG Minister for Women's Affairs, so I asked if she was experiencing success; Only in the eastern Highlands; she said (and she described the location; it was where that village women's meeting occurred). Some advances in rural development prove to be permanent!

Although I have arrived at this view through my Melanesian experience, I believe that involving these intelligent social leaders in virtually all rural adjustment and advancement projects may be seen as essential to gain success across the whole of Oceania.

Social life in Melanesia has massive complexity, indicated by its vast range of languages, but many forms of social complexity ranges right across the whole of Oceania (and the

world) even when just one language becomes dominant. PNG doesn't become less complex as the major lingua franca, Tok Pisin, becomes dominant; or as English grows in potentially greater dominance as formal education becomes the norm across the land. Taking social complexity into account across Oceania will be a big task, but without such an approach there will be a continuing and substantial wastage of funding and resources, and, sadly, there will also be less preparedness for handling the social disasters to come as the climate of the region continues to swiftly change and sea levels to rise even more rapidly.

This will become even more problematic as more nations from outside Oceania take closer interest in the region; 'angling' for more than fish! The People's Republic of China is now taking more interest in the island nations of the Pacific, and that giant nation is more than willing to splash cash around to achieve its own ends. And to what ends remains opaque at present.

For all the above reasons it's certainly time for both the first world nations within Oceania to take greater note of the increasing climate related problems emerging in the region of which they are part; and, hopefully, any reassessment will include finding ways to include intelligent local leadership in the process of adjustment and advancement in all local societies in this far flung oceanic region.

Spring 2020 advances here in Canberra

Winter recedes but, looking at the Brindabella Range to the west, Mt. Gingera, at 1,853m, is covered in snow; the chill can be felt when the wind is in the SW. Warmth will soon return and then, farther south along the Australian Alps, the good, but poorly attended, 2020 ski season will come to an end and the already strong flowing Murrumbidgee River will grow even more robustly. Oddly, as winter ended some time ago, week long cold blasts keep arriving from the Southern Ocean ('Antarctic Bubbles' as the weather people have described them) and make people wonder as too what is occurring in Antarctica!

The bushfire season seems a long time ago and, as good rainfall continues, the summer ahead may prove less bushfire dangerous for Australia How the nation reacts to the findings of the various investigations into last summer's catastrophic bushfires is still theoretical, but if, following the covid-19 emergency, *'business as usual'* still prevails the continued warming will continue to endanger species great and small. The damage done to many species takes time to become apparent, then, with nowhere to go, they will, sadly, just pop out of existence; for them it will be too late.

I suppose we are, in being resistant to change, just like our subsistence ancestors; but they, and this includes the Aborigines of Australia, were much better stewards of the environment. Here in Aus, since 1788, our handling of the environment may be seen as a long decline in stewageship - and there is little sign of a turn around. Time is fast running out.

On the continuing increase in global warming I prefer leave the final word to the director of the **Potsdam Institute for Climate Impact Research**, Johan Rockström, a Swedish professor of Earth Systems Science; in a broadcast, translated from the Swedish, in which he clearly defines the problems and firmly expresses the opinion that the world has just ten years in which to firmly act on halting global warming. A similar period to that which the US needed to turn the 'impossibility' of landing a man on the moon into a reality. To fall short will be disastrous for the world, for the environment, for all life forms, and in particular for humanity. His arguments are

clear and firmly based on research. The English version of his talks may be found at: **https://sverigesradio.se/avsnitt/1425542**

Professor Rostrom

For humanity there really is no way back if our lack of good stewardship of the world's environment continues to be, almost unthinkingly, **omnicidal.**

'What fools these mortals be"

Puck!

Dennis Nicholls
Shuttleworth Agricultural College 1962
Email: dennisnicholls35@yahoo.cm.au

PS – Keeping things in perspective; there are, besides addressing global warming, a number of threats to us as a species:
Not prioritised, these risks are:

1. decline of natural resources, particularly water
2. collapse of ecosystems and loss of biodiversity
3. human population growth beyond Earth's carrying capacity
4. global warming and human-induced climate change
5. chemical pollution of the Earth system, including the atmosphere and oceans
6. rising food insecurity and failing nutritional quality
7. nuclear weapons and other weapons of mass destruction
8. pandemics of new and untreatable disease
9. the advent of powerful, uncontrolled new technology - (such as out of control AI.)
10. national and global failure to understand and act preventatively on these risks.

Commission for the Human Future, Australian National University,
http://www.humansforsurvival.org/

+ Two esoteric threats:

Esoteric threats have become an area of research; there are many more;

. A major volcanic event shutting out sunlight across the planet, and which could destroy the world's food supply.
. A very large and very swift extra terrestrial object striking Earth

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Notes – perhaps for referral! :-

A claim for a 'climate emergency'
Window closing for action to stabilise the Earth's climate:

Translated from the Swedish

Johan Rockström is a global environmental scientist and a diligent debater of climate issues. And he has been appointed "The most powerful environmental person" in Sweden twice. In the program Johan Rockström says there´s a climate emergency - Welcome to 2020 –The year of the Moment of Truth - Swedish radio station, English version of the Swedish Radio show "Vinter i P1".

Part One: Via **The Science Show**, **Australian Broadcast Commission, RN; Broadcast: Sat 29 Aug 2020:**
https://www.abc.net.au/radionational/programs/scienceshow/window-closing-for-action-to-stabilise-the-earth%E2%80%99s-climate/12606342 **Transcript:**

Johan Rockström: Dear friends, welcome to 2020, the year of truth, the moment of truth for our future on Earth, the year when the rapid rising curves of global environmental changes, our damage to the planet, must start bending downwards to give us a chance of having a stable planet to live on. This might sound alarmist, but it is only laying out the facts. … we've made phenomenal progress where we are producing more food and human well-being than ever before … these things have happened entirely at the expense of our planet. Our planet has been forgiving for the past 150 years of industrial development and globalisation, but it has now hit the ceiling … Throughout this period, the science has been clear, and the knowledge is there for those who want to know. But political ineptitude, economic short-sightedness, systematic manipulation by powerful stakeholders, and the media's inability to deal with loud, marginal and false climate change denial has resulted in a negative cocktail that has slowed down action on climate change … We have lost 30 years since the United Nations Intergovernmental Panel on Climate Change, the IPCC, submitted its first report. We've lost ten years since the failure of the climate summit in

Copenhagen, when the problem was finally to be solved. And now it's five years since we signed the Paris Accord in 2015. Despite all the good intentions and the upscaling of renewable energy, global emissions of greenhouse gases continue to rise by 1% to 2% per year. We are burning more oil, coal and natural gas than ever before, just when we promised we would stop. This is only one side of the coin. Behind a stable climate, there is a resilient and strong biosphere; living nature in the oceans and on land. But our animals, plants, forests, soils, ice sheets and seas are following the same, potentially disastrous trends. **The fact is that the planet is in a state of emergency …** … …
Stressed planet sending clear warning signals:

Part Two: Via The Science Show, ABC RN: 5 Sep 2020:
https://www.abc.net.au/radionational/programs/scienceshow/stressed-planet-sending-clear-warning-signs-%E2%80%93-johan-rockstr%C3%B6m-p/12630340 Transcript:

Johan Rockström: My assessment is that the world at large understands that we are facing a global climate crisis. In Madrid at the Climate COP 25 meeting, an official plenary session was organised on the need to understand that we are facing a climate emergency. Science, youth, policy, finance and indigenous communities all made a joint case for a state of climate emergency … the plenary from 11th of December 2019 at 9 o'clock in the morning. It ended with the large stage being occupied by young people from Fridays for Future, pleading with the adult powers in the room to act according to the emergency that science now shows we are facing But alas, despite a constructive shake-up in Madrid, the world is so far not capable of solving the planetary crisis. It is not so much due to the lack of understanding, or even efforts being made, it's the lack of willingness to do what is necessary to continue defending marginal change and the inability to step outside of our conventional frameworks that lock in the economy … With a state of planetary emergency, as with other emergencies, solutions that were previously considered impossible may become possible … And who knows? We might suddenly be able to have a serious discussion on stopping all funding for coal power and all finance flows for fossil fuel infrastructure … during this year of truth. Why not when we meet in Glasgow for COP 26? And perhaps we can now finally talk about setting a global moratorium of destroying the remaining natural ecosystems on Earth, our insurance towards irreversible changes, thanks to their carbon sinks and their ability to circulate nutrients and water. A good point when world leaders can do this is when they meet in China later this year, at the United Nations Convention for Biodiversity in Kunming … we have quite some evidence of impressive action during other states of emergency, just take 9/11, Brexit and the global financial crisis in 2008. …. Over 1,000 municipalities and regions in the world have declared a state of climate emergency. Five countries—the United Kingdom, Portugal, Canada, Argentina and France—have done the same. The aim is not to create panic. It is to mobilise those in power in the world to act. This year, we want a proposal of declaring a state of planetary emergency on the agenda in the United Nations General Assembly. It remains to be seen if we will succeed. In August 2019, a memorial ceremony was held for Okjökull glacier in Iceland. It has melted and shrunk so rapidly that it has lost its status as a glacier … The first official victim of global warming. This is occurring at 1.1°C, the warmest temperature on Earth since we left the last ice age 12,000 years ago … we can now publicly announce the list of the first planetary victims of global warming. It is a largely unexpected list and the victims have fallen at a faster rate than we scientists had anticipated … The Arctic summer ice. The rate at which the ice sheet has shrunk, and in particular that the ice now consists mostly of young first-year ice … Several glaciers in Western Antarctica may already have crossed the tipping point, which means that they are inevitably sliding out into the ocean … For a long time we thought that the Arctic was the more sensitive of the poles. It now appears that big brother Antarctica is probably the more fragile of the two … Our tropical coral reefs … 50% (yes you heard correctly), half of the world's biggest marine ecosystem, the Great Barrier Reef in Australia, has already been lost. Coral reefs cannot cope with the heat … Many systems that can tip over from a good to a bad state have begun to show signs of shifting … …

Part Three: Via The Science Show, ABC RN: 5 Sep 2020
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Fungal habitats include soil, water, and organisms that may harbor large numbers of understudied fungi, estimated to outnumber plants by at least 6 to 1. More recent estimates based on high-throughput sequencing methods suggest that as many as 5.1 million fungal species exist.

Changing climate in the wider world,
The **World Meteorological Organisation** (WMO) Secretary General, Petteri Taalas, on interview, provided a summary of the recent report of the WMO on worldwide climate change: … "So far, we have seen 1 degree C of warming. **During the past 20 years, we have seen the 19 warmest years on record.** Last year was the second warmest year since 1850 – when records began. We have, again, been breaking records in greenhouse gasses: carbon dioxide, methane and nitrous oxide. Of those, carbon dioxide is the most important. It has contributed two thirds of the warming so far and its lifetime in the atmosphere is several hundred years. Recently, we have been observing concentrations of (CO_2 in) **the order of 415 parts per million**; 400 ppm was once regarded as a critical level. During the past century, sea level rise was typically 1 to 2 millimetres per year. During recent years, **we have a rise of sea level of between 4 and 5 millimetres per year**. We have seen glacier melting continue. Melting of the Greenland glaciers increased three fold during the past twenty years, and the Antarctic ice cap has also started melting, which wasn't the case 20 years ago. Many of the impacts of climate change and disasters are through water: groundwater problems, flooding, sea level rise … Those are having **impacts on global food production capacity and human well being**, especially in less developed countries. … Compared to 2015, we have 36 million more people who are **suffering from hunger, more than 800 million people** … And there (is) something like **30,000 (deaths) on a daily basis**…. We have a growing (number) of people who are exposed to heatwaves. Twenty years ago, we had about 20 million people exposed to heatwaves on an annual basis. During the past three years, we have exceeded 200 million people per year. We have seen health impacts of this. In the 2010 European heatwave, we got 50,000 (deaths) mainly in Russia. **In 2003, we had 75,000 (deaths) in central Europe**. We expect the trends we are already seeing to continue. Some estimates give a 1 per cent probability that we will reach the lower limit of the Paris Agreement … on limiting climate change … (to) a 1.5 degree increase … And since **we have recently seen warming of the order of 0.4 degrees per decade**, if that continues for the coming10 years**, it's very likely that we would exceed 1.5 degrees. That's somewhat striking."**
You are known to be a climate optimist. Are you still one after this new report?

"… **yes, because the covid-19 crisis will change the world**. It's going to have an effect on the mentality of people and governments. One could say that this is the mentality that would be needed in solving the climate problem.
Should we focus on covid-19 for now and leave the climate crisis for later?
"… If you compare (deaths) from hunger, the numbers are already much higher than the covid-19 (deaths); New Scientist, May 2020

The Secretary General provides an optimistic view for the world; but Australia is warming at a much faster rate, at 1.4^0 C, than the average for the world. And, the estuaries, river mouths and inlets on the south east coast of the mainland are warming at a much higher rate than the land – by around 0.2 degrees per annum. This is more than "somewhat striking". Australia is in an extremely dangerous position, as the once *'Lucky Country'* will exceed 1.5 degrees (since 1910) before 2025. By then agricultural food production in south eastern Australia may have begun to decline – and the well fed major food exporting land of Aus may be driven to find ways to maintain its food production. A hungry Australia is difficult to imagine as the main part of the nation's food production is currently exported.

Food is at the heart of our future, 2020; This survey report by the *Australian Commission for the Human Future* states that 'Not only (does Australia) need a revolution in renewable energy, we also need to focus on the production of **"renewable food".** We are currently destroying the very resources on which our food system depends and are failing to build into the system a capacity for long term renewal'. Action on climate change was agreed by a group of survey participants to be 'absolutely urgent and central to reclaiming a workable food future' – this future must also include regenerative agriculture to maintain fertility and soil health. Continued warming and the increase in extreme bushfires may well challenge that reclaiming of a 'workable food future' expressed by the participants. The list of problems linked to warming, and an increasing world population, include water availability; which is already becoming a problem in some agricultural areas of the world. Research into C4 plants (a system more productive than the C3 version of photosynthesis) will certainly help; as will the work of putting the C4 working genes into rice to improve yields. Although the pathway to C4 photosynthesis has been around for some 100 million years, only about 4% of plants use C4 photosynthesis. There is much progress being made in transferring the right genes (of up to 30) into rice to increase yields by between 6 to 15%. The three main crops the world currently relies on, wheat, rice and maize, can be improved this way; plus, perhaps, soy beans. About 7% of plant species use a third form of photosynthesis, CAM (crassulacean acid metabolism) including pineapple, aloe vera, vanilla, and agave (as in tequila). CAM plants only need about 20% as much water as the least thirsty C3 and C4 plants: re: Oxford University, Australian National University, and many more places of food plant research. Research offers much promise but time is getting short. The very hot summer of 2003 in France, where main food crop yields dropped around 25% across the board, was a substantial warning! On this front Australia has a substantial buffer as it exports some 70% of agricultural production. Recent survey figures indicate that for the main food exports the percentages exported are 71% for wheat, 76% for beef, 41% for dairy and 18% for horticultural products, over the three years to 2016–17: Snapshot of Australian Agriculture 2020, Department of Agriculture, Water and the Environment

On major changes already occurring across the world: the record-breaking heatwave that baked Siberia recently was made at least 600 times more likely by human-made climate change, meaning it most probably wouldn't have occurred otherwise: New Scientist 15 July 2020. Linking unusual events directly to climate change is not far away.

Taking a very long view: all five of the major mass extinctions, of the deep past, are now understood to have been mainly caused by global warming. Recent research suggests that the sixth mass extinction event is now well underway. The high death rate of wildlife species from the large, hot and numerous, bushfires in Australian last summer, probably means that this *'wide brown land'* may be a leader in the loss of mammal species: "Australia has lost 29 mammals since European colonisation, and feral predators are implicated in 28 of these extinctions. This compares to the loss of only one mammal in North America – the Sea Mink,"; Australia's Threatened Species Commissioner, 2015.
Business as usual will mean a global warming of four to five degrees C (or more) and following the pledges made at the Paris Agreement, of 2015, would mean a warming of about one degree or so less, so, perhaps, three to four degrees C of warming - all disastrous to civilisation as we know it. Any other agreements are, as yet, aspirational.

Yet research related to human induced climate change began in the middle of the nineteenth century and pre WW2, a researcher established that emissions of greenhouse gasses emitted since the start of the industrial revolution were truly warming the world. Post WW2 the Keeling curve has come to represent the atmospheric retention of the greenhouse gas, CO_2, with its noticeable curved reaching upwards to currently stand at 417 ppm of the world's atmosphere - producing a warming of the globe to its highest level for three million years (see: A claim for a 'climate emergency' below). Adding to this established threat: Methane emissions have recently jumped by nearly a tenth in a decade: New Scientist, July 2020

Extreme floods, as in Ironbridge, UK, this year,
is a cost of not tackling climate change.
New Scientist, May 2020

Energy production in Australia

Coronavirus travel restrictions are forecast to slash global energy demand by 6 per cent this year, seven times more than in the global financial crisis (GFC) according to the International Energy Agency ... "Coal is anticipated to bear the brunt, with an 8 per cent drop. Energy Australia said ensuring the market was equipped to handle the exit of coal power plants in the coming years and filling the gap with affordable and reliable power **"isn't engineering, it's planning …** In the next two decades, around a dozen coal fired power stations that currently provide more than half the National Electricity Market's demand will close" … Australia's renewable energy output is on track to its sharpest rise on record in the next two years Independent modelling … forecasts that wind, solar and hydropower's share of the main grid will surge by as … 21 to 27 per cent, and could exceed 30 per cent by the end of next year. … The faster projected growth in output, which has rarely exceeded 3 per cent gigawatts of

new renewable capacity is about to enter the grid … the surge in energy will drive down daytime spot prices and pile greater than expected pressure on aging coal fired power plants, which are far more expensive to run. … "Covid-19 is accelerating and exacerbating the impact of lower demand on wholesale electricity prices … If you look through that, it supports the case for early closure of coal fired power plants" … renewable energy output would "continue to squeeze out coal and gas fired generation" … The variable cost to harness the sun and the wind to produce electricity is a fraction of the cost to burn coal or gas to do the same … renewable energy (is) "the most financially viable in the long term"; article in a national newspaper, mid 2020. In switching to alternative energy sources as part of an international effort to mitigate against major food and environmental losses: 'Australia has an advantage of a more than adequate supply of sun, wind, waves, geo heat, and hydro'. As to continuity of power supply, if fossil fuel energy input is to be gradually reduced, there are many ways and means, including hydro storage; while advanced battery storage technology is now well advanced. There is no physical reason to delay a major switch to using 'green' energy for base power production. Energy Australia is correct in saying it **isn't engineering, it's planning**

That $1,832 per year for fossil fuel subsidies every Australian is paying requires redirecting to bring about a more rapid change in energy supply from fossil fuel to the greener alternative.

Climate outlook overview Issued: 30 July 2020 by the Australian Bureau of Meteorology:

- The fortnight 3 to 16 August is likely to see above average rainfall across large parts of the interior, extending across SA, NSW and much of Queensland and Victoria - **this has come to pass.**
- The outlook for August to October indicates a wetter than average three-month period for most of the eastern two thirds of Australia, but drier than average for the north-west of WA - **if this comes to pass, out of control savannah fires may occur in north-west of WA.**
- Both days and nights are likely to be warmer than average across Australia during August to October, though chances of warmer or cooler than average days and nights are roughly equal across much of south-west WA.
- The tropical Pacific Ocean is expected to approach La Niña levels over the coming months, while warmer than average waters are likely in much of the central and eastern Indian Ocean. Both ocean basins are influencing the wetter August to October outlook.

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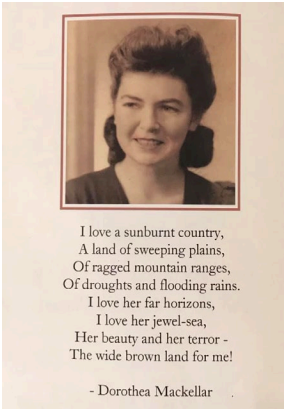
More hot humid days per annum. Warming Greater rainfall (BoM 2011) https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/14_PCCSP_PNG_8pp.pdf

https://www.sciencedaily.com/releases/2020/04/200417103140.htm Neolithic agriculture in PNG highlands – a piece of NZ research



The 19 year old Australian poet; born 1885.
Women of NSW had the vote from 1902, which allowed Dorothea to become active.
Lady Denman, who laid the foundation stone for Canberra on 'Capitol Hill' in 1913, also became active;
in the Suffragette movement which she was head of for some 40 years after returning to the UK.

for 'organisms to develop, there need to be some basic building blocks at genetic, microbiological and molecular levels that are essential, remain constant and are deeply engrained in extant species. … Despite the enormous malleability in nature and the ability of birds to adapt and change … at least some of the basic biological building blocks have to remain and become indispensable ingredients throughout evolution and they may also place certain constraints on evolution.

Whole of Australia weather outlook

The three month outlook of the Bureau of Met (August to October) while confirming ongoing warming across the whole of Australia, also indicates a wet spring across the eastern half of the mainland. In addition, the warming of the adjacent waters of both the Pacific and Indian Oceans indicate the likelihood of a, more welcome, wetter summer. If these outlooks prove to be correct the lack of safety burns in native forests, due to the short and wet period between fire seasons, may not prove to be as dangerous as has been forecast more widely. 'Native forests' include open and closed forest, and rainforest, each differently affected - in the past, remnant Gondwanan rainforest was less likely to burn; last summer's fires have altered that view. Grass fires are another issue, with increases in the number of very hot days in summer (days over 350 C) grassland can dry out rapidly and become a fire hazard - large numbers of farm livestock were burnt to death in situ (many trapped by fences) last summer.

If the coming summer is extra wet, the here in Canberra we may experience another mouse plague, as occurred in the very wet year of 2003; which came at end of prolonged drought conditions. If summer rainfall substantially exceeds the forecast probability of above average falls along the east coast, then another often forecast danger emerges.

The insurance industry, some 20 years ago, stated in a release that some 750,000 properties built along the nation's coastline would, with continuing sea level rise, eventually become uninsurable. With the continuing popularity of 'retiring to the coast', and the services that population shift attracts in coastal zones, that estimate of the insurance industry will by now be much greater. The 'unexpected', but ex tropical cyclone assisted, flood damage and coastal erosion from storms experienced last summer may, with heavier rainfall, be likely to be also much greater. One local government council in the tropical north defied the science by removing mangroves to enable a new urban zone to be fronted by an artificial sandy beach. The warnings of the insurance industry, and of scientists, have long been expressed in public.

Mangroves and seaweeds are good storage systems for the overabundance of CO_2 in the atmosphere, but both natural systems are vanishing along the Australian coast. On a positive note, Australia's seaweed industry is expanding. Kelp is the main species used, but an alien species (probably from Japan via ship's ballast water) and an eradication program which wasn't feasible it's been turned into a commercialised species. Undaria is also known as 'wakame'—a delicacy in Japan and the Republic of Korea**:** Australian Government, online. Marine algae, and microalgae, are mainly bred up to produce food, but there are other uses - at the higher end there is potential for seaweed extract to print skin tissue with 3D technology, the industry also produces beta carotene and, when it's included in cattle feed, it reduces greenhouse gas emissions!

Oceania

Treating all language groups as if there was only one village culture was another aspect of the Administration's approach (or lack of approach) to rural development was something else I found quite odd. What was handed over to the newly independent nation of PNG was a mish mash of odd parts of British/Australian culture, a mainly Westminster system of government plus a British Australian form of local government a slight introduction to industrial agriculture and a law system based on British common law. All third hand and unadjusted to Melanesian clan culture; not a promising mix – and a mix which, with little or no guidance on how to approach rural development, has led to a predictably messy outcome. Poor adjustment to the stresses and strains of development combined with a fast warming climate and very rapid sea level rise are now being realised. Some more fundamental form of international cooperation is required to gain closer, and more suitable, cooperation; contracting outside experts to dream up inadequate and unworkable projects is a process which should have, by now, receded into history – but, sadly, that's not the case.

to the conjecture that a network of such community leaders right across Oceania would be highly beneficial to a region struggling to come to grips with the difficulties of a fast warming world combined with all the social difficulties of absorbing and acting on 'modern' development. A network quite different to that of the politically inspired Pacific Island Forum. Whether it's possible for such a socially aware body to gain high influence in Oceania remains untested, but I believe such a body to be essential for gaining social balance in handling those problems within Oceanic society, and in finding a more socially appropriate way of distributing funding coming into local social groups across Oceania,

Any field officer dealing with agriculture, and by extension rural affairs, carried the title 'didiman', as the first agricultural field officer was one Herr Dietrich ('Herr Didi') and later the service included 'didimisis'; female rural development officers. As a didiman on contract (a 12 year contract; 'permanency' had ceased) I was placed immediately on assignment in the bush having experienced no orientation, I was sent to work out of a (one patrol officer) patrol post. I stood beside a lagoon at one end of a large bay where many cooking fires were visible along with the silhouette of background coconut palms and wondered *'What the hell am I supposed to do here!?'*; the next morning a small Big Man group appeared and my field work began - on the right

note. I thought 'this must be the way all field officers worked when in the field'; it was much later that I realised that I was seen as an oddity. An extreme communist (an aged) French professor, an advisor to Fidel Castro and the Chinese Government of the time (the early 1970s) accused me of promoting the bourgeoisie - and, as Self Government became imminent, I was accused (at interview) of being a 'communist' by my senior field officers! At least I knew, and was subsequently convinced, that I was somewhere very close to being correct in my approach to rural development. Those successes provided an insight into how clans can find their own way into the modern world; which was not as the Administration of the day required it to be. The Australian Administration, under pressure for the UN to bring about 'independence' for Papua & New Guinea (two ex colonial areas combined) floundered with the concept of 'rural development' for the clans people of the 'Territory. The quick answer came up in the form of setting up 'extension centres' (almost mirroring the role of patrol posts in bringing about pacification among warring clans) where 'young farmers' could be trained to undertake (immediately!) all aspects of industrial agriculture. The expensive scheme failed miserably and the 'training' ceased, but the concept lived on and, more deeply troubling, was the only concept of 'rural development' handed over to the new Papuan New Guinean field officers. 50 years later I find papers online written by those in the current rural development service of Papua New Guinea, online, which hark back to those 'colonial' days and the methods used for field work at that time – and wishing to re introduce those (failed) methods once again! They can't be blamed, each field officer coming from their own clan (there are over 850 languages in PNG and most spoken by a number of clans) feel ill equipped to handle development problems being experienced by other clans, and in particular in dealing with each Big Man of prominence knowing how highly regarded the Big Man is within their clan. Australian failed to hand over any successful approach to rural development, so there was no workable concept there from the moment of handover at Independence – and something similar may be said about the Westminster system of parliamentary rule (albeit within a single chamber) and the network of local government (still not part of the Constitution within Australia) which was also handed over at Independence. Add to that the almost complete failure of most envisaged development projects, 'envisaged' by expatriate experts at enormous expense and each doomed to failure through lack of consideration of the complexity of subsistence society (how many billions of dollars would that amount to throughout Oceania?!). All that, and my experience of the complexity of subsistence and the interplay within and between clans of those people living within the Australian Administration, and some of those 'uncontacted' people living outside that bubble (but that's another story!).

'Another story' bar for a short tale of first contact between an expatriate woman and little rain forest women. We, the owner of the two powerful motor boats a catholic missionary priest and us, took a young rain forest man, who had been severely injured and spent two years on the coast, back to his village (a hundred or so kilometres from the patrol post in a direct line) up a side river from the Vailala River. We three men walked up to the village where the elderly present were delighted to witness the return of one of their own; walking back down there was a gripping scene of my wife (all of five feet) standing in a group of tiny (much shorter) Kukukuku women who had emerged from the rainforest to find this strange female walking along the riverside track. The tiny women were holding up my wife dress and feeling the 'quality' of the textile and so obviously delighted, they were also interested in what my wife wore under her dress; the women were wore voluminous grass skirts, rain capes of woven pandanus, bilums (woven bags hung from their foreheads) full of food garden produce and held digging sticks. A magnificent image of 'first contact' between an expatriate woman with stone age clan women, an iconic image – but none of us males had a camera!!! Clan women, when first coming into contact with textiles grasp the material in delight, clan men are completely unimpressed; an odd but perfectly understandable thing. Those tiny women (to remain healthy in rainforest country it seemed required being small; larger coastal Papuans living just a little way up river looked poorly fed and decidedly unhealthy) were obviously highly delighted with the material of my wife's dress (plus the pale skin of my wife's legs where they ran their hands to make sure it was flesh they were looking at. ['Kukukuku' was the name we knew for these tiny people but, of course, they have their own name for their people: Angu or Änga people.]

In rural development there are many quite basic differences between clan women and clan men; but this 'difference' was treated with 'ignore' by the Administration; which was something I found quite odd.

From my experience in the field I feel certain that a greater inclusion of socially savvy community leaders, through a widespread and workable network (the 'network' being developed through much discussion among the socially savvy leaders) is essential to the addressing of the many current problems facing the citizens of Oceania. The focal point of such a network may be placed in any part of Oceania, but one location with promise is the old senate chamber of the 'old' parliament house in Canberra (out of use since the 'new' Australian Parliament House was occupied in 1988; and the old House abandoned; but parts of which have since become the 'Museum of Australian Democracy' centred on the old lower house chamber, and mainly for visiting school children to learn about democracy) may be seen as a candidate 'focal point'; where all communities across the region may discuss their own interpretation of a democratic approach to an urgent adjustment to climate change combined with good rural and urban adjustment. It should not be left to less socially savvy politicians to dream up out of touch 'development projects' - and anybody aware of immediate post WW2 development may remember the UK Ground Nut Scheme and its massive failure!. Meanwhile warming continues and related problems mount throughout the broad spread of Oceania.

The Highlands of PNG gained sweet potato (*Ipomoea batatas*) some 350 years ago, probably derived from much earlier Portuguese settlements to the west, it's a plant which grows in drier soils than traditional food plants; more than 5,000 varieties have been bred up to suit the range of growing conditions right across New Guinea and its islands. Besides accounting for a rapid rise in population, of the highlands, to around three million, over that period (beginning with a volcanic event which depopulated the Highlands around 1670 AD; the earliest evidence of sweet potato there lies atop remains of the volcanic ashfall) the plant has widely replaced traditional staple food plants across PNG; subsistence production accounts for some 85% of the nation's food supply (ANU Pacific unit).

With many years of experience in rural development in PNG I am aware of the social complexity involved. I'm also aware that most development project planning for development is carried out by expatriate experts from across the world and are quite divorced from the social complexity of both rural and urban PNG. In addition, the processes handed over by the Administration at the time of Independence did not provide guidance on exactly how 'rural development' should be carried out within the complexity of clan life. Some would add to this that the single chamber form of the Westminster style of democracy and the form of local government established passed on at Independence are also out of place for the nation. But, I can only comment on the form of rural development I undertook as a rural development officer (a 'didiman') in the field for 10 of the 12 years I worked in the Territory of Papua & New Guinea and later independent PNG.

'Didiman' as the first in that role was one Herr Dietrich, 'Herr Didi', in German New Guinea! The word 'didimisas' came into use much later and both are still in use within the widespread lingua franca language Tok Pisin and in English. 'Tok Pisin' they say comes from the phrase *'talk business'* as spoken by Chinese traders arriving at the islands back in the 19th century; making it similar to the origins of early English, when Anglo-Frisian traders and settlers simplified their language for use outside their original tribal lands!

Arriving in the 'Territory' in the mid 1960s as a 'contract officer' (for 12 years) I received no formal orientation so relied on the Big Man system, a system prevalent across the big island and its neighbouring islands, for guidance in how to induce advancement in their villages. That was a fortunate start as the Big Man, of clan and village, is by necessity highly intelligent and also, as competition is so intense (the role is not inherited) he also develops very high social nous. [We could hope that our political leaders had such high qualifications for their role in leadership!!] Working through Big Man networks meant that all social mores were allowed for in any project attempted, and as networks were, at that time, growing widely these mores included many language groups; particularly in the Highlands where population density is greater through the main valleys. I found it a very successful approach to rural development and didn't realise it was unusual until I was posted to the highlands. This method of adjusting development to suit the mores of the numerous clans was not the system handed over to the incoming didiman graduates of the four agricultural colleges and the university; each graduate attaining four years of tertiary education.

Being pressed by the UN the Australian Administration established a network of agricultural 'extension centres' across the Territory for the purpose of training up village lands in modern ('industrial') agriculture – sans agricultural machinery and much else. Food production in pre contact and post contact parts of the Territory is carried out by women; but no women were recruited. When the system finally proved to be unsustainable, no village industrial farmers eventuated, the use of the 'farmer trainees' as cheap labour for the introduction of cash crops on village land also vanished. By then Self Government was arriving, as were Papuan and New Guinean graduates, so there was no time to develop any alternative method for advancing rural development. Those stationed on extension centres were left to farm their centre's land as demonstration plots; which, sadly, also led to failures.

Returning to PNG a decade or so later on an international program seeking to establish production costs for cash crop production (something not achieved anywhere around the globe; the ANU Pacific unit discovered). I was engaged in village cocoa and copra production on mainland PNG and its islands, it became obvious that the cash crop blocks were in dismal array. A widespread prediction made by groups of clan leaders in the Big Man networks I had worked with in previous decades was that the PNG didiman would not work with them as I had been accustomed to in Lowland and Highland postings. I didn't quite accept the prediction as I, as any expatriate also believed, thought that coming from villages themselves a different approach would evolve; I was as wrong as any other expatriate. Now I can understand that graduates arriving in parts of rural PNG they didn't know, and being faced with advising clans knowing that the Big Man, an individual they would automatically look up to, most would naturally be reluctant to take on the challenge.

The outcome was, again, failure. Sadly, looking at recent didiman papers online there is a tendency to wish to look back on how the 'colonial administration' carried out rural development; something which had failed decades previously! This view was reinforced by a grand replanting of village coffee following an outbreak of coffee rust more than a decade after Independence, when the realisation that a huge amount of village income would be lost almost overnight. The spectre gained ample funding to engage some seven thousand or so didiman field officers and abundant labour to once again plant up (this time rust proof) coffee on village land – just as had occurred under the failed young farmer training scheme.

Lack of rural development is the likely cause of the regular, El Nino related, disasters in the Highlands of PNG and possibly many other, as yet unseen, rural disasters. There is no social security to save the unfortunate (a situation experienced within the UK at the time thousands of convicts were transported to Australia!) and government and public service failures to provide timely food supplies to the unfortunate hungry, leading to many deaths, means that climate related disasters are doomed to be repeated.

The variation across Oceania is immense. New Guinea and nearby islands alone contain over 1,000 quite separate languages (some 850 of which are within PNG) 'separate' and different to the extent that a language from one end of New Guinea is more different to a language from the other end than English is from Mandarin. Melanesia and Australia is home to over 5,000 languages alone, with one of the greatest linguistic diversity in the world. In comparison, Polynesia lacks great diversity, because they are all descendants of a migrant community from southern China (the proto-Austronesians) and have the same language family (but many dialects): World Languages/Oceania; https://en.wikiversity.org/wiki/World_Languages/Oceania. This variation and complexity, the number of cultural units – aligned with the local languages, is accordingly is very large; the organisation would be equally large and would require solid funding.

when viewed geographically. But, many Australians would, when asked, claim New Zealand as our 'closest neighbour' (it's some 2,159 km away across the Tasman Sea; 'The Ditch') when in reality the coast of New Guinea isThen again 'Oceania' is also a vague notion; with borders which tend to fluctuate with each definition. Australia and New Guinea become one very large island, **Sahul**, when sea levels are lower; which directly places Aborigines within the larger grouping of Melanesians. The 'Worldometer' puts the population of Oceania at 42 million; 30 million of that being the combined populations of Australia & New Zealand.

Some Indian Ocean islands become part of Oceania along with the rest of Australia; and some geographers would place the whole of New Guinea within Oceania, and, bar The inclusion of West Papua within Oceania would bring major difficulties into the region. To the east of Oceania lies Easter Island, belonging to Chile, which some geographers include in the region. I have not heard of South Georgia (UK) in the South Atlantic, being included; even though it now grows a fine crop of dandelions!

With global warming beginning to seriously impact the 12 million living in the smaller nations of Oceania, most of those dwelling in Papua New Guinea (approaching 9 million; but there has been no recent census in PNG) so there will be an increasing

pressure for climate change assistance from the two 'first world nations' in the region. Fast rising sea levels are already placing many island groups in danger. For Papua New Guinea: Satellite data indicate the sea level has risen near Papua New Guinea by about 7 mm per year since 1993. This is larger than the global average of 2.8–3.6 mm per year. The first climate refugees in the world are considered to be a small island community in Papua New Guinea, in 2005, as salt water entered the groundwater system and ruined their food gardens: The Carteret Islanders of Papua New Guinea have become the world's first entire community to be displaced by climate change. They're the first official refugees of global warming – and they're packing up their lives to move out of the way of ever-rising waters that threaten to overtake their homes and crops. The island they call home will be completely underwater by 2015: Asia Pacific Viewpoint, Vol. 57, No. 1, April 2016. Populated atolls across Oceania are in danger of imminent contamination b

gardens.

While neither bushfires nor tropical cyclones occur in Papua New Guinea, El Niño conditions (which now occur more frequently) have brought about starvation due to drought in the highlands; and this is exacerbated by frost descending into the higher valleys and completely destroying food gardens; the population of the high valley has to descend into lower valleys to seek assistance: Australian National University Pacific unit, 2017. Delivering food supplies out from main centres to the remote locations remains a costly challenge. And, ironically, it's precisely when the rains begin that death rates soar … while long temperature records for the Highlands don't exist, some studies report they are one degree hotter than 30 years ago … Temperature change in the Highlands is also visible as lower-altitude trees like coconuts bear fruit in places they didn't before, and lower-altitude diseases, like malaria, become more prevalent: '*PNG's food bowl is all but empty as drought affects 2 million people*', The Sydney Morning Herald, 2016. Over three million Papua New Guineans live in the highlands of PNG.

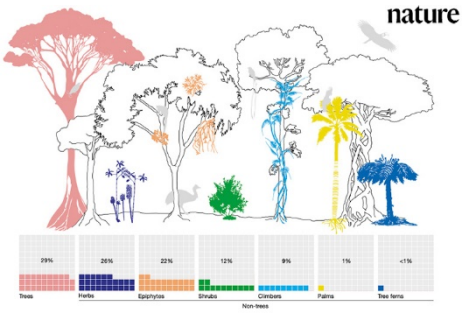
Drought-stricken Maramun village in PNG's Simbu Province.
Much of this Province is very steep country.

The island of New Guinea is the second largest island (Greenland being bigger) and its highest mountain, at 4,884 metres, is more than half the height of Everest (the highest on the PNG side is 4,509 metres). The Australian explorer, scientist and author, Tim Flannery, describes New Guinea as a landmass which sprawls like a vast prehistoric bird across the sea … New Guinea is Australia's bow wave. Australia racing north eastward at around 70 mm per annum has been accumulating islands and fragments of other continents along its leading edge … This geology also explains why New Guinea's flora and fauna resembles Australia's. Although it is close to south east Asia, New Guinea has no tigers, rhinos or elephants, but it does have kangaroos, New Guinea's kangaroos, however, live in trees. Nine thousand years ago (people) living in high mountain valleys had already developed intensive agriculture …They had begun this process at a time when my European ancestors were still chasing woolly mammoths across the tundra. The highlands of New Guinea gained sweet potato (*Ipomoea batatas*) some 350 years ago, probably derived from much earlier Portuguese settlements to the west, it's a plant which grows in drier soils than traditional food plants; more than 5,000 varieties have been bred up to suit the range of growing conditions right across New Guinea and its islands. Besides accounting for a rapid rise in population of the highlands over that period (beginning with a volcanic event which depopulated the Highlands around 1670 AD; the earliest evidence of sweet potato there lies atop remains of the volcanic ashfall) the plant has widely replaced traditional staple food plants across PNG: ANU Pacific unit.

Musa ingens, the Giant Highlands Banana.

Once grown for its edible corm.

Plant life on the island of New Guinea, at 13,634 species ('two thirds endemic') makes the island the planet's 'most speciose island' (surpassing, Madagascar, Borneo and Sumatra):
Rhett A. Butler on 5 August 2020; Mongabay. There are 3,962 species of trees in New Guinea or about four times the number found across all of North America. Unfortunately, more almost two thirds of PNG's forest cover have been removed since Independence, reducing much of the once pristine landscape.



Fraction of species that are trees (pink), herbs (dark blue), epiphytes (orange), shrubs (green), climbers (light blue), non-climbing palms (yellow) and tree ferns (mid blue). Courtesy of NATURE.

New Guinea is just one of the large islands of Melanesia, and then across a wide ocean there are the islands of Polynesia and Micronesia. Environmental problems are evident across the region, on land and, in particular, within the ocean. Billions of dollars flow into the economies of all these nations, in the form of direct input into the political coffers, as between Australia and PNG where over half a billion goes directly into the national government purse there, and also into grant in aid projects. In many cases there is little development and little protection of the environment to show for that sizeable input. Some waste occurs due to a tendency to contract outside experts to design projects, but few of these 'experts' have any deep knowledge of the complexity of the many societies across the region so that most of the final plans and reports lie unattended or, if the planned projects are attempted, fail early in the timespan of the project. As an ex field officer in the Territory of Papua & New Guinea and later independent PNG, I have, with interest, followed up the progress of some rural development projects, and read short accounts of others, and it's quite obvious that little heed had been taken of how Melanesian societies operate – so failure is almost bound to follow. Perhaps it's time for a rethink the approach and to better target all aid on offer. From my point of view, the best people to be consulted before and during project development are community leaders.

During a decade of field work with clan villagers the system I worked with, and through, was the Big Man system of New Guinea and its islands. The Big Man gains his status through intense competition within his clan (more intense than we can imagine) and it requires a high IQ (and many a Big Man I worked with demonstrated an extremely high IQ) but something more than high IQ is involved; and that is high social nous. A Big Man has to have very high social nous to the handle the range of daily social problems which arise within and between clans. Social nous is something not well demonstrated by the great majority of politicians across the world.

I also discovered that there were also women of high social status, but as a male field officer I couldn't delve into that side much; other than to take part in 'women only' village meetings organised by a Big Man (or rather 'women only and dressed appropriately' meetings; to ask questions of the visiting Big Man group; which included me!). Daily wear for subsistence women was traditional, and very brief, so trade stores made up blouses and skirts for village women to wear to church and chapel; this was deemed appropriate dress for other important village meetings. On arriving in the highlands in the late 1960s I had been advised by my senior rural development officers that clan listeners at village meetings tended to roll their eyes or fall asleep when a didiman presented a talk and the women were 'so inferior' that it was better if they didn't attend meetings. ['Didiman' as the first agricultural officer in German New Guinea was one Herr Dietrich; 'Herr Didi'.] Both these pieces of advice were disproved within a few days of field work conducted through the Big Man of clan and village! Those field officers could not be totally blamed for their mistaken views, as the Administration supplied no guidelines on 'rural development'. When pressed by visiting United Nations inspecting teams to achieve early independence for the two (ex British & ex German) colonies the Australian Administration reacted in a number of ways; one of theses was to provide agricultural 'extension centres' for training 'local farmers' (in 'industrial agriculture'?). These were set up across the Territory; and when the scheme was eventually found to be a failure (no 'local farmers' had taken up industrial agriculture!) the extension centres remained in place, with no agreed to purpose for their continuing existence! I joined the service as a 'contract officer' (on a 12 year contract) so received no orientation regarding field work, I was just placed on a patrol post with no guidelines other than a folder of Administration procedures (to help with officer work!). I remember standing beside my beachside (rat infested) bush office on the first evening and looking out at the numerous cooking fires and silhouettes of coconut palms and thinking *'What the hell am I supposed to be doing here?'*. The next morning a small Big Man group arrived and invited me to visit their villages, their food gardens and more – my fieldwork had begun. At the end of the 18 months I was posted there the resident missionary couple (Stan & Madie of the London Missionary Society) who had been there since the 1930s, stated that they had never seen such progress. So, I believed this was the way all rural development officers carried out their duties – I was very, very, wrong, but it wasn't until I was posted to the highlands that I realised how different my approach to field work was compared to the activities of my fellow field officers!!

Shortly after I began my work with Big Man networks in the Eastern Highlands District (now Province) I had a visitor, a French professor, an out & out communist and advisor to Fidel Castro and the then Chinese Government, arrived to spend a day with me in the field (he being sent by people at the University of PNG). There was no time to arrange a village meeting but he did meet a Big Man or two. In his keynote address, at the annual seminar at the University the next day, the professor accused the Administration (me) of promoting the rural bourgeoise! As 'Self Government' approached all expatriate field officers were up for interview to establish which field officers were to be retained as the service 'localised' (PNG graduates were beginning to appear in the field). At my interview the two expatriate field officers interviewing me asked if I was a communist!

At least 'I' knew that I was close to being on the right track for promoting rural development! I continued working through the Big Man network (following a visit from the head of the agricultural department; to ask me what my declining to sign the

interview form was about; he laughed and left me to it!). A departing senior officer in charge of rural development in the Province was about to leave for greener pastures elsewhere so he handed over to me the responsibility of organising and holding a monthly Big Man meetings – meetings called to generate discussion on the imminent establishment of beef cattle projects on village land; a project funded by a very large loan obtained by the Administration from the World Bank. This was of great advantage to me in my field working, as I had immediate access to Big Man networks across the main valleys.

The village beef project was being set up to solve the (non existent) problem of a shortage of protein in village diets across the Territory. [It was assumed at that time that virtually all third world people were short of protein in their diets; this was disproved by a researcher at Oxford during the 1960s; 'if subsistence people suffer a shortage of protein it means they are short of food!!'] The Administration was committed so the giant Territory wide village beef project went ahead – and became the most notable failure in rural development in the history of the Australian Administration. It was however made into a success in non beef producing ways. In the highlands in particular the establishment of an agreed and permanent border fence between clans eliminated a major trigger for clan disputes – which normally ended in open (bow, arrow, and shield) warfare – and, with extra wiring, the fences restrict the roaming rights of village pigs; reducing damage to food gardens.

A recent talk, by a researcher from the ANU Pacific unit here in Canberra, on the 2016/17 climate change related period of starvation in the highlands had me wondering what had gone wrong in PNG since the early 1970s when widespread enclosure with permanent fencing had achieved such advantages! Frost proof food crops and small livestock had also been made available in that period; and an FAO survey indicated that village food production was more than adequate and the Administration was better concentrated effort elsewhere, such as in cash crops. There were periods of hunger (*'Taim Hangri'* in Tok Pisin) due to overlong dry seasons in the major valleys of the highlands, and occasional frost damage in the higher valleys, but these were handled well. It seems that population increase (almost a tripling since Independence) plus fast changing climate (a 1^0C rise in just 30 years) together are putting extreme pressure on subsistence production; and subsistence still produces most of PNGs food supply, around 85%; ANU Pacific unit. The hunger in the highlands also seems to have been exacerbated by a poor response by government in supplying aid. Aid food being mainly imported; mostly rice, flour and canned meat and fish. There are obvious answers to the repeating problem of food shortages and I'm certain these may be achieved through preparation and some infrastructure. The aid dollars are there as is some cash crop income and the desire for advancement is also there, what is missing is access to inbuilt intelligence and certainly the high social nous of village and clan leaders. How to bring in that missing inclusion is the major problem; and it would benefit all community and more so larger projects if ways are developed to generate that necessary inclusion.

This, of course, applies to all the less developed parts of Oceania, and elsewhere on the globe; and it's probable that it also applies widely in well developed nations. In Australia we know of Aboriginal and Torres Strait communities requiring more fitting solutions to their problems, social as well as health and economic – and Torres Strait communities have, just as the relatives over the border in New Guinea, have Big Man networks. But there will be rural and urban communities other than these which would benefit from greater inclusion. Politically for Oceania, there is the Pacific Island Forum, but a network of leaders closer to their local communities is not included in that more 'global' approach. Without it the many problems associated with living in a world of an increasing level of population, less food security and the threat now becoming all too real of a very fast changing climate and its associated fast rising sea level, will just escalate with foreseeable consequences.

I can see the benefits for reasons I have explained, but like acting on scientifically explained, and accepted to be real, climate change it's a matter of full realisation that the problems require immediate attention. I have only lightly defined a necessary network of local leaders for Oceania, and if the location of an 'HQ" for the network similar to the secretariat of the Pacific Island Forum (in Fiji) is to be discussed, then the underutilised part of an old (Provisional) parliament house here in Canberra, in particular the old senate chamber and adjoining offices (the rest of the building is a museum (of Australian Democracy) could be a prospective centre for such a network. But, as with all the other problems that would up for deep discussion!

The variation across Oceania is immense. New Guinea and nearby islands alone contain over 1,000 quite separate languages (some 850 of which are within PNG) 'separate' and different to the extent that a language from one end of New Guinea is more different to a language from the other end than English is from Mandarin. Melanesia and Australia is home to over 5,000 languages alone, with one of the greatest linguistic diversity in the world. In comparison, Polynesia lacks great diversity, because they are all descendants of a migrant community from southern China (the proto-Austronesians) and have the same language family (but many dialects): World Languages/Oceania; https://en.wikiversity.org/wiki/World_Languages/Oceania. This variation and complexity, the number of cultural units – aligned with the local languages, is accordingly is very large; the organisation would be equally large and would require solid funding.

Kukuku women

as is the ever present influence of intelligent and socially aware clan and village leaders; it's unlikely that these advantages have receded.

Good field service is required to join the dots, and this effort may be strengthened by a stimulation of Big Man networks to gain greater cooperation between those two major strengths.

I have experienced such problems being solved in the highlands of PNG through the close involvement of Big Man networks. A food shortage in one year, from a Taim Hangri reduction of garden foods, was converted into an overwhelming production of subsistence the following year – solved by the creation of a fresh food marketing cooperative – the extra supply coming from newly and permanently enclosed village land and some input from machine hire. Many ex patrol officers and others had started up coffee plantations and brought in tractors and farm implements, so light working of grass turf by hired tractors with rotovators. Investment in the new cooperative was slow at first, then a Big Man stood in one village meeting and discussed savings from village coffee production since coffee was first grown on village land (with the use of *cheap* labour during the failed farmer training scheme!). He had, the day before, visited the three Australian banks in the new township of the province

and obtained (as the then bank managers knew him as a business leader; he ran a number) and requested a total value of all (Australian) silver coinage gone out from the banks during the current coffee harvest*; 'let nobody say they don't have the money for investment because just this year $2.5 million of coins have been buried in the ground in the province, and the harvest season is only half over!'*. He had the figures written on the back of a cigarette packet held in his hand! The little missionary education that Big Man had received at that time would be meagre indeed to the education available now. Most of the leaders in the Big Man network at that time had been brought up in a Neolithic society (and had been cannibals) and would speak of a time when they understood the clans in their valley were the only people who existed – when meat consumption was mentioned they would *comment 'we have tried your livestock, pigs, sheep, goats and chickens, but nothing, absolutely nothing, as good as ……..'*.

The Big Man in coastal and highland New Guinea are capable of many things, but as an example of a contribution of a Big Man in getting a project underway and funded, in this case the establishment of that fresh food marketing project mentioned. There was a problem in gaining sufficient, and rapid, investment by villagers. He stood, as a visiting Big Man, in one village meeting and produced a cigarette on which were figures, he was a younger Big Man and had received some basic education (probably in a village missionary school) most of the leaders in the Big Man network at that time had been brought up in a Neolithic society (and had been cannibals). The figures on the cigarette packet were gained the day before at the three Australian bank branches in the town (Goroka) he, running businesses of his own was known to the bank managers, asked at each bank how much Australian silver coinage had gone out that coffee harvesting season and not come back to the banks. Village coffee growing had been established on village land using the trainee village farmers as cheap labour some seasons beforehand. The total was surprising at $2.5 million just half way through the harvest. 'There is no excuse' he said 'for not investing, as the 'missing' money is buried in your villages. Congealed lumps of coinage, plus old Australian notes and including old coins with holes in the middle for carrying on string, appeared in short order and the cooperative, including building work, was in place quite rapidly. I would not have thought of that approach to speeding up rural development!

If a socially savvy network of traditional leaders, including also 'modern' community leaders from the two first world nations, was set up to represent people throughout Oceania and looking for a focal point, then a place in Australia's capital city, currently lying empty and unused, the old senate chamber in the 'old parliament house' would seem appropriate. All political activity moved to the 'new' Parliament House up the hill and only part of the old house is used as a museum (of Australian Democracy).

The difference between male and female views, though also substantial, would also require great consideration. In regards to this I remember my wife and I in 'uncontacted country' (no official patrols had established pacification there) together with two others – returning one of their own, a damaged man, back to his home village a hundred miles or so upriver from the patrol post; he had been living on the coast for two years, so an ecstatic welcome (a return from the dead). We three males, descending from the village, were greeted by a startling sight as we made it back to the river bank and the boats (with powerful motors to fight to flow) a group of the tiny rainforest women were there surrounding my wife, who had decided to take a walk along the river bank leaving the Papuan boatman with the boats. My wife of exactly five feet towered over the little clan women (it seems that being small in stature is essential for healthy survival in rainforest country) who were thrilled to meet her and even more so the textile her dress was made of; they were all (although dressed in voluminous grass skirts and woven pandanus capes; it's wet in rainforest!) handling the textile and lifting the hem to see what my wife wore beneath. This, as missionaries had also described, is the usual reaction of clan women when first introduced to textiles – clan males pay no attention at all to any textile! A slight instance of the difference between women and men at first contact, but underlines some of the difference in female and male views. Unfortunately, that iconic 'first contact' female to female didn't end captured on film – none of us had a camera!!

Another realisation coming out of 'first contact' is the naïve and ready acceptance of all things presented to the newly contacted; and this ready acceptance doesn't fade away entirely until more thorough thought is put into ongoing development; and that more thorough thought needs to be generated locally by socially aware leaders.

y salt water as seas rise and threaten to inundate food