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THE REMARKABLE GERMAN CONTRIBUTION TO AUSTRALIAN METEOROLOGY

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Since the earliest years of the colonial period, German scientists have made a remarkable contribution to the development of Australian meteorology. One of the first reliable series of meteorological observations in New South Wales, at Sir Thomas Brisbane's Parramatta Observatory (1822–1823), was carried out under the scientific leadership of, and primarily by, Karl Ludwig Christian Rümker, who had been trained in Germany in astronomy and meteorology and, after several years at sea, had taught at the Hamburg school of navigation (Loewe 1970a). And the acknowledged pioneer of scientific meteorology in colonial Victoria was Georg Balthaser Neumayer, a student of Rümker (after Rümker's return to Germany), who established and operated Melbourne's Flagstaff Observatory from 1857 to 1863 (Gibbs 1975).

Neumayer's contribution to nineteenth century meteorology in Australia has been comprehensively documented by Home (1991) and in various papers presented to the Royal Society of Victoria's Neumayer Symposium in May 2009 on the one hundredth anniversary of his death (Dodd 2011). The Neumayer story was further elaborated in Dr Cornelia Ludecke's paper for the Humboldt Kolleg/Joint Symposium of October 2014 (the present volume), presented on her behalf by Professor Rod Home. Neumayer's direct influence on the scientific development of Australian meteorology during his years in Victoria was outstanding and his indirect influence continued through to the end of his long and distinguished career in German, polar and international meteorology (Home 2011; Williams 2011; Zillman 2011). Largely because of Neumayer, the German influence on nineteenth century meteorology in Australia is well known and widely respected on the broader history of science scene (Moyal 1976).

It is not, however, so widely recognised that the contribution of German scientists to Australian meteorology was as great, if not greater, in the twentieth century. Four remarkable figures stand out: Dr Fritz Loewe (1895–1974), Professor Werner Schwerdtfeger (1909–1985), Dr Uwe Radok (1916–2009) and Professor Peter Schwerdtfeger (1935–2013), but there were also many other eminent German-born meteorologists who spent significant periods in Australia including:

- Dr Fritz Albrecht, who worked at the University of Melbourne in the 1950s. He made important contributions to the study of the radiation climate of Australia (e.g. Albrecht 1956) and maintained a solar radiation station at his home in Box Hill. He published extensively in English and German on the radiation and heat budgets of the southern hemisphere and the globe (e.g. Albrecht 1960).
- Dr Andrzej Berson, who grew up in Germany but moved to Poland in 1935 and then to the United Kingdom. After serving in the D-Day forecasting team at Dunstable during World War II and moving to Sweden after the war, he joined the CSIRO Division of Meteorological Physics at Aspendale in 1953. He had a major influence on the development of Australian synoptic meteorology and meso-meteorology in the 1950s, 1960s and 1970s (Garratt et al. 1998).
- Dr Eric Kraus, an expert in precipitation processes (Kraus 1959) and air-sea interaction (Kraus 1972) who carried out some of the early CSIRO research on rainmaking after World War II and who worked with the Snowy Mountains Hydro-Electric Authority in the 1950s and early 1960s before moving to the United States for the rest of his career.
- Dr Rainer Radok (brother of Uwe), who served as founding director of Flinders University's Horace Lamb Centre for Oceanographic Research in the 1960s and 1970s (Radok 1967). While he was more oceanographer than meteorologist, and a somewhat controversial figure on the local scene, he built the foundation for the subsequent strong atmosphere–ocean partnership in South Australia.
- Dr Peter Funk, who, in his few years at CSIRO Aspendale before his untimely death, pioneered the development of a new generation of all-wave and net radiation sensors (e.g. Funk 1959) which became the basis for greatly improved understanding of radiation processes at the surface of the land and ocean.
- Dr Klaus Fraedrich, who served as a visiting scientist

in the joint Bureau of Meteorology–CSIRO Australian Numerical Meteorology Research Centre (ANMRC) in the early 1980s (Bourke 1984) before returning to a distinguished research career in Germany.

Each of these and several other German-born scientists made important contributions to many aspects of Australian operational and research meteorology in the Bureau of Meteorology, CSIRO and several universities. But it was the Loewe-Radok-Schwerdtfeger (uncle and nephew) leadership of Australian academic meteorology over half a century at Melbourne and Flinders universities which so influenced the development of the field in Australia and shaped the professional careers of at least two generations of senior leadership of the Bureau of Meteorology (Gibbs 1999; Radok 1993).

DR FRITZ LOEWE

Figure 1: Dr Fritz Loewe (1895–1974). Head of the Meteorology Department at the University of Melbourne from 1937 to 1959. (Photo from Schwerdtfeger, 1975)

No single individual more influenced the education of the World War II and post-war generation of Bureau meteorologists than Dr Fritz Loewe, in his role as head of the Meteorology Department of the University of Melbourne from its inception in 1937 until his retirement at the end of 1959.

Fritz Loewe (Figure 1) was born in Berlin on 11 March 1895, the son of a Prussian judge. As a youth, he enjoyed climbing with his father in the Swiss Alps and developed a lifelong love of mountains, snow and ice. At age 18, he went to study geography and physics in Grenoble (France) but his studies were interrupted by his service as a wireless operator in a German artillery unit during World War I, where he saw action on both the Eastern and Western Fronts and was awarded the Iron Cross, First Class (Schwerdtfeger 1975). After the war, he resumed his studies in meteorology, gaining his doctorate in 1924. His research interests turned to radiation and Atlantic oceanography and he spent some years at the Lindenberg Observatory near Berlin with duties including taking meteorological observations from the open cockpit of an aircraft up to 6000 metres. Then came three years 1929–1931 with the historic scientific expeditions on the Greenland Ice Cap led by Professor Alfred Wegener (the originator of the initially controversial theory of continental drift) during which Wegener himself perished and Dr Loewe lost his toes to frostbite (cut off with a pen knife and tin snips) in an ice cave with the outside temperature averaging -40°C. After the Greenland expeditions, he returned to a university position in Berlin. He had married his wife, Else, a fellow geography student, in 1927 and their daughters Ruth and Susanne were born in 1933 and 1934. But, in 1934, as part of the Nazi harassment of the Jews, he was dismissed from his university post and jailed briefly before being allowed to leave with his family for England where he worked for the next few years at the Scott Polar Research Institute at Cambridge (Wilcock 1977).

Meanwhile, in Australia pressures were developing for additional aeronautical and meteorological research expertise to address the growing needs of civil and military aviation. At the invitation of Dr (later Sir Raymond) Priestley, Vice Chancellor of the University of Melbourne, the Loewes arrived in Melbourne in March 1937 and, within a short while, Dr Loewe had become a key figure on the Melbourne meteorological scene. He provided lectures to Bureau of Meteorology recruits, engaged in public debate on the potential value of an Antarctic meteorological station for weather forecasting in Australia and undertook research into peculiarly Australian meteorological problems such as the (then) well-established mid-March cold spell in Victoria (Loewe 1939).

During World War II, in addition to lecturing to the rapidly expanding contingent of young meteorological recruits to the Bureau (by then the RAAF Meteorological Service), including future director Dr Bill Gibbs and most of the senior figures of the Bureau through the 1950s, 1960s and 1970s, Dr Loewe continued his synoptic, glaciological and climatological research (e.g. Loewe 1945). Over the period 1944–1947, with the involvement of Dr Fritz Wagner (a survivor of the 1941 sinking of the German merchant cruiser Kormoran in the sea battle with HMAS

Sydney off Western Australia) Dr Loewe also began an active program of agro-meteorological research in the Goulburn Valley (Day 2007). Immediately after the war, he was passed over for the post of Chief Scientific Officer in the Bureau but, with the support of Dr Harry Treloar who had been seconded from the Bureau, was provided with a government grant for research into methods of long-range forecasting.

During the 1950s, Dr Loewe continued his teaching, Antarctic research (wintering at the French Antarctic base at Port Martin in 1951) and study of issues as diverse as the filling of Lake Eyre, sea water temperatures in the Southern Ocean, Arctic sea smoke at low latitudes and solar radiation over Australia. He was a frequent contributor of articles to the then still young *Australian Meteorological Magazine*, a practice he continued after his official retirement from the University of Melbourne in 1959. In his retirement, he travelled widely and wrote extensively, including on the early history of Australian meteorology (e.g. Loewe 1965, 1970a) and on the life and work of Alfred Wegener (Loewe 1970b). He also maintained his lifelong research interest in glaciers and the physics of snow and ice (Loewe 1974a). His last scientific publication, submitted a few weeks before his death in March 1974, was on the water content of clouds in the Southern Hemisphere (Loewe, 1974b).

Fritz Loewe was a gentle, unassuming man and a kind and generous mentor to many in the Australian meteorological community from the 1940s to the 1970s. Even in his later years, he could often be seen riding his bike from the University of Melbourne to the Antarctic Division in St Kilda Road, usually via a stop at the International Antarctic Meteorological Research Centre at 501 Swanston Street. His spoken English was not always easy to understand but he was a great storyteller and his command of the language was superb: as in his eloquent 1960 retirement address at the university (Bureau of Meteorology 1974):

> My time of wandering to unknown shores is over, intellectually as well as bodily. What is left are memories, some still clear and heart-warming, some already dissolving into blurred impressions and vague emotions. But I was happy in my time to have seen, understood and felt some of the wonders of earth and sky, and I take with me into the years that are left, a remembrance of the great and the good I have been privileged to see and know …

And, perhaps, even more moving were the closing lines of the address on ‘Sixty Years with Ice’ that he had been due to deliver to University of Melbourne Mountaineering Club (which, decades earlier, he had co-founded) just a few days after his death and which was later published by the university (Budd 1974; Loewe 1974a).

> For each of us comes the time when we have to resign and when the fog of age begins to hide the glorious summits we once hoped to reach. But we can still remember the heights we once climbed, the unknown features we were the first to see, the mountain sun that illuminated our life’s path. And as the night draws nearer we can still say with the guardian of the lookout in the German play:
>
> For seeing intended
>
> Employed for my sight
>
> The heights are my dwelling
>
> The world my delight.

His memory lives on through the naming of the Fritz Loewe Lecture Theatre in the School of Earth Sciences at the University of Melbourne.

PROFESSOR WERNER SCHWERDTFEGER

Though Professor Werner Schwerdtfeger spent less than a year in Australia, filling in for Dr Loewe at the University of Melbourne in 1957–1958, he had a major influence on Australian meteorology through his teaching and writing and especially through his collaboration with Australian meteorologists, after he left Melbourne, on Antarctic and Southern Ocean research.

Werner Schwerdtfeger was born on 12 July 1909 in Cologne and studied at the University of Freiberg (personal communication from Peter Schwerdtfeger in 2010 based on a biography of Werner Schwerdtfeger prepared by F. Selinger for the Bavarian Academy of Sciences). After serving as a senior meteorologist with the Luftwaffe during World War II, he worked for more than a decade in the Argentine Meteorological Service and at the University of Buenos Aires before coming to Melbourne on leave during the International Geophysical Year. He subsequently taught at the University of California (Los Angeles), the University of Colorado and, finally, at the University of Wisconsin until his retirement. He died in Madison on 18 January 1985.

In Melbourne, he took a special interest in Southern Ocean synoptic meteorology and in analysing the early years of ANARE (Australian National Antarctic Research Expeditions) observations. He provided the Melbourne meteorological community with an early warning of the perils of using observational time series for demonstration of long-term climate change, finishing one notable short written exchange with Dr E.L. Deacon of CSIRO with the none-too-gentle advice that ‘… unless their homogeneity

can be proven beyond reasonable doubt, temperature series had better not be used as evidence of climatic change' (Schwerdtfeger 1959).

At Wisconsin, Professor Schwerdtfeger emerged as the pre-eminent international authority on high southern latitude climatology (Schwerdtfeger 1970) and supervised a series of PhD students who soon made their way to Melbourne as the US government-sponsored members of the International Antarctic Meteorological Research Centre, headed by former Loewe student and Schwerdtfeger colleague Mr Henry Phillpot. The pioneering work by Schwerdtfeger protégé Dr David Martin (Martin 1968) on the interpretation of satellite imagery over the Southern Ocean provided the basis for several decades of operational practice (Guymer 1978) in Southern Ocean synoptic analysis in World Meteorological Centre Melbourne. Professor Schwerdtfeger also served as father figure to a generation of young Australian meteorologists who passed through Wisconsin in the 1960s and 1970s.

DR UWE RADOK

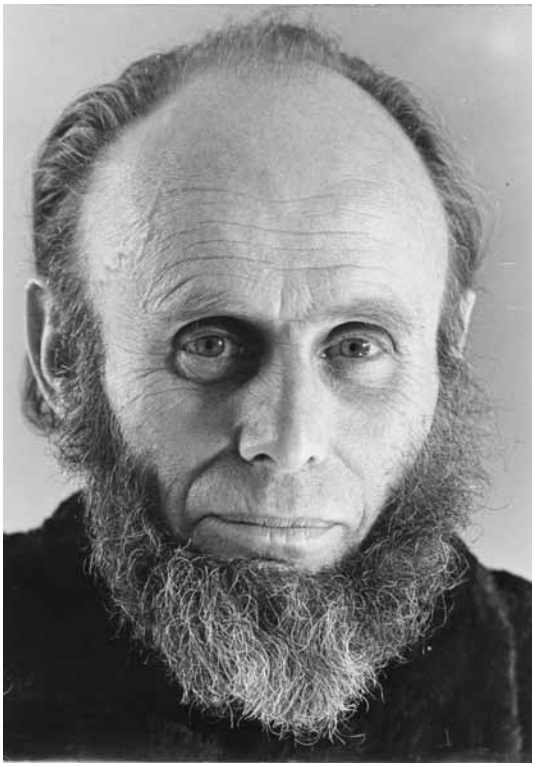

Figure 2: Dr Uwe Radok (1916–2009). Reader in Charge of the Meteorology Department at the University of Melbourne from 1960 to 1977. (Photo by Helmut Newton, courtesy of Ian Allison)

Uwe Radok (Figure 2) was born on 8 February 1916. He did his university studies in Germany in the early 1930s but fled to England in 1938 as Nazism took hold. He worked as an engineering draftsman in Scotland but was interned in the early years of the war and then shipped to Australia as one of the famous 'Dunera boys'. Once in Australia, he was subjected to a further period of internment at Tatura (which he shared with photographer Helmut Newton) before being released to join the Australian army in 1942. At the end of the war, he joined the University of Melbourne as a technical assistant to Dr Loewe (Gibbs 1999). He completed his PhD (as Loewe's only doctoral student) and became, to all his many subsequent students, 'the Doc'. He took over as head of the Meteorology Department on Loewe's retirement in 1960. He and his wife Anita had three daughters: Helen, Claudia and Jacquie.

During the 1960s and 1970s, from his position as 'Reader in Charge' of the Meteorology Department, Dr Radok conducted and led a wide-ranging research program and served as thesis supervisor and mentor for a host of Bureau of Meteorology, CSIRO and other researchers, many of whom became the leading figures of Australian meteorology in the 1980s and 1990s (Radok 1993). His Masters and PhD graduates and special protégés from the early years included Dr Ian Allison, Dr Bob Brook, Professor Bill Budd, Dr Doug Gauntlett, Dr Jenny Hopwood, Dr Dick Jenssen, Dr Tom Keenan, Dr Tom Lyons, Mr Ross Maine, Mr Bruce Neal, Professor Neville Nicholls, Mr Peter Noar, Mr Peter Price, Dr Kevin Spillane, Ms Mary Voice and Mr Ken Wilson. By 1980, the Meteorology Department under the leadership of Drs Loewe and Radok had produced 45 Masters graduates, 15 PhDs and two DScs (Budd 1980).

On the research front, he established links with, and beyond, the Bureau and CSIRO including especially with the Antarctic Division, the Snowy Mountains Hydro-Electric Authority and the Weapons Research Establishment. He published extensively and authored papers jointly with other expatriate Germans such as Andrzej Berson and Eric Kraus. He built up a powerful and internationally respected research program in Antarctic glaciology. With Alison Grant, he undertook early studies of aerological data over Australia (Radok & Grant 1957). With Dick Jenssen and Ross Maine, he pioneered numerical weather prediction in Australia (e.g. Radok 1958). And with Kevin Spillane and Professor Elmar Reiter of Colorado State University, he made globally important discoveries on the mechanisms of clear air turbulence.

Like Dr Loewe, Dr Radok was an early and frequent contributor of articles to the *Australian Meteorological Magazine* (e.g. Radok 1954) and he worked tirelessly to build international linkages for his research students from the Bureau and CSIRO. But, despite his own prodigious scientific output and the high regard in which he was held by all his former students and colleagues, he was never promoted to professor and he spent his final years at Melbourne feeling unrecognised and unappreciated. When his post was eventually upgraded to professor, rather than

apply for his own position, he left to spend the last working decade of his highly productive meteorological career in the United States (Boulder, Colorado). But he and Anita eventually returned to Australia to retire on the NSW north coast. Uwe Radok died on 28 August 2009 aged 93. His ashes were scattered into the sea from the trawl deck of the *Aurora Australis* alongside an iceberg north-east of Davis Station, Antarctica, on 20 March 2010.

In his honour, on the initiative of Bob Brook and Peter Schwerdtfeger, the Australian Meteorological and Oceanographic Society (AMOS) founded the annual 'Uwe Radok Award' for the best PhD thesis in meteorology at an Australian university.

PROFESSOR PETER SCHWERDTFEGER

Figure 3: Professor Peter Schwerdtfeger FTSE (1935–2013). Lecturer in the Meteorology, Department of the University of Melbourne from 1962 to 1971 and Professor of Meteorology at the Flinders University of South Australia from 1971 to 1999. (Photo courtesy of Bill Mackey, ATSE)

Peter Schwerdtfeger (Figure 3) was born on 23 December 1935 in Gottingen, Germany, the son of Hans and Hanna. The family left Germany in 1936 for fear of political persecution as a result of Hans' criticism of the Nazi regime. They lived for a time in Prague, then Zurich, before moving to Adelaide in August 1939 where Hans was appointed to a university position in mathematics. Peter started school in Adelaide but continued his education at University High School and the University of Melbourne after the family moved to Melbourne. He gained his Bachelors (1957) and Masters (1959) degrees at Melbourne and his PhD at McGill University in Canada in 1962.

He was appointed Lecturer in the Meteorology Department of Melbourne University in 1962 and subsequently spent short periods at the University of Alaska in 1965 and the University of Cologne in 1969. At Melbourne, with Dr Radok, he initiated an innovative program in micrometeorology (at the university's field station at Mt Derrimut), worked closely with the Bureau of Meteorology and the Antarctic Division and emerged as a colourful and engaging figure on the Melbourne meteorological scene. In 1971, he was promoted to Flinders University as the first professor of meteorology at an Australian university and, at the time, one of the youngest, if not the youngest, professor in any field in Australia. He spent the rest of his career in Adelaide, for most of the time as Director of the Flinders Institute of Atmospheric and Marine Sciences (FIAMS) from where he founded Airborne Research Australia (ARA) in 1995. He and his wife, Arija, lived at Mt Lofty, east of Adelaide, for 42 years where their two children, India and Karl, grew up. The family home fell to the 1983 Ash Wednesday bush fires during Peter's tenure (1977–1984) as inaugural chair of the Board of the South Australian Country Fire Service. He retired from Flinders as Emeritus Professor in 1999 to pursue his aviation research interests at ARA with colleague pilot-scientist Jorg Hacker (Hacker & Schwerdtfeger 1997). He died in Adelaide on 20 August 2013 at the age of 77.

Professor Schwerdtfeger was an outstanding 'hands-on' experimental scientist and a larger-than-life personality on the Australian meteorological scene for the best part of fifty years. He became deeply involved in Antarctic meteorology and glaciology and an expert on the prospect of towing icebergs to low latitudes as a source of fresh water. At Flinders, he built up a strong group of research students who went on to a range of senior positions in Australian and international meteorology. He published a text book (Schwerdtfeger 1976) on micrometeorological measurement and was a pioneer of many new approaches to the use of aircraft in meteorological field programs.

Peter Schwerdtfeger was awarded an Alexander von Humboldt Fellowship in 1969. He was the foundation president of the Australian Association of von Humboldt Fellows and he continued to serve as president of the association until 2009. In 2010, he was honoured as the first Distinguished Member of the association which also established the Peter Schwerdtfeger Award for Early Career Research. He was elected to the Fellowship of the Australian Academy of Technological Sciences and Engineering (ATSE) in 1988 and was awarded the Max Planck Research Prize in 1992. He engaged widely with the Australian meteorological community and was the driving force in attracting colleagues 'from the East' to

the 1984 Arkaroola Conference on Rainfall Variability in Australia (Australian Academy of Science and Bureau of Meteorology 1984).

Peter Schwerdtfeger was appointed to many government and other committees, including the Antarctic Science Advisory Committee in the 1990s. He served on the Bureau of Meteorology Advisory Board from 2001–2004 and, at the request of the Minister, represented the board on the Australian delegation to the 2003 World Meteorological Congress (Zillman 2013). Until his last few years, he remained closely in touch with his professional colleagues in Australia and worldwide and, despite his gradual alienation from his former university, he maintained his deep commitment to airborne research and continued as a generous host, mentor and friend to former students and colleagues.

Outside meteorology, Peter Schwerdtfeger was a keen gardener, environmentalist and amateur architect. He was also a gifted violinist and he travelled, read and wrote widely. And, like several other German-born meteorologists before him, he had, as was noted at his funeral service, 'an uncanny ability to use the English language'. As the last member of the powerful German-born nucleus of the Meteorology Department of the University of Melbourne from the 1930s to the 1970s, and as founder of the Association of von Humboldt Fellows, it was especially sad that he was not still around to join in the symposium in Melbourne in October 2014.

CONCLUSION

Australian meteorology has high standing on the international scene. A significant part of the credit for its twenty-first century reputation for meticulous observation and research excellence is due to its nineteenth century German pioneers and the remarkable band of German-born meteorologists who shaped its scientific development through the second half of the twentieth century.

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