

Kenton Stewart Wall Campbell 1927–2017

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ABSTRACT

A career of almost seventy years positioned Ken Campbell as one of the most outstanding researchers in Australian palaeontology during the twentieth century. He published widely on a range of palaeontological subjects, mastering the complex morphology and taxonomy of several fossil invertebrate groups including brachiopods, corals, ammonoids, and trilobites, as well as various groups of specialised early vertebrates (lungfishes, onychodontids, stem-tetrapods, actinopterygians). He was elected to the Australian Academy of Science in 1983. Ken Campbell was a man of deep personal beliefs, integrity, and great depth of character. He was an excellent teacher, and a mentor to many successful students of geology and palaeontology, who themselves went on to make major scientific contributions both in this country and overseas.

Keywords: Australian National University, Burrinjuck limestones, Devonian fishes, geology, Gogo WA, invertebrate palaeontology, lungfish evolution, vertebrate palaeontology, Wee Jasper NSW.

Early years and education

Kenton (Ken) Stewart Wall Campbell (Fig. 1)¹ was born on 7 September 1927 in Ipswich, Queensland. His parents were Roy Duncan Stewart Campbell and Thelma Lilian Campbell (née Walker). His middle names ‘Stewart’ and ‘Wall’ were the maiden names of his two grandmothers, Ken being the first grandchild for both. Ken was the eldest of three children, with a sister Vivienne Beth (called Beth), and a brother, Bernard.

Like many others, the Campbell family suffered hard times during the Great Depression. In 1932, Ken’s father Roy Campbell lost his job in a large department store. Until the end of 1937 the family struggled with two small businesses (a newsagency at Boonah and a corner store at Ashgrove). Following these unsuccessful ventures they had to board with Ken’s maternal grandparents (Fig. 2), after which the family moved house several times. Fortunately, the three Campbell children had some educational continuity, attending Silkstone State School, Ipswich, over this interval. Ken recalled being singled out by a teacher in fifth grade for his excellent schoolwork. He found this both surprising and encouraging, in contrast to home, where there were no books that stimulated his intellectual interest. The family in-laws were mainly manual workers, or tradesmen employed in the Ipswich railway workshops, where Ken’s great-grandfather James Henry Wall had attained the position of Chief Boiler Inspector for the Queensland Railways. Ken Campbell’s own recollections record that family conversations were mainly about jobs, money, and personal relationships, but ‘never on ideas’. Having later learnt that this same fifth-grade teacher also belonged to the Royal Society of Queensland, Ken surmised that perhaps he had ‘planted seeds of interest in natural history’ when Ken was still at school.

¹Preliminary drafts of this memoir derived from John Long’s article in *The Conversation* (26 June 2017; Long 2017), and Gavin Young’s obituary (December 2017) in *Nomen Nudum* (AAP newsletter; Young 2017). Other sources of information include Peter Pridmore’s summary for Ken’s retirement dinner, Peter Jell’s summary (1993a) for the 1993 Festschrift, and the obituary by Patrick De Deckker and Tony Eggleton (September 2017) in *The Australian Geologist* (GSA newsletter).



Fig. 1. Professor Ken Campbell FAA in 1997 (Campbell family image).

When war was declared in September 1939, Ken's father joined the army as a member of the Field Security Police. With a secure income for the first time since 1932, the family moved into their own house at Camp Hill, Brisbane, in early 1940. Roy Campbell found success in this new position, being promoted through the ranks, and after the war had a short-term posting to Sydney, involved with Australian security intelligence. He retired as a senior Queensland public servant in 1968. In his final primary school year at Coorparoo State School, Brisbane, Ken performed well in the external scholarship examinations, and gained a place at Brisbane Grammar School (Supplementary Fig. S1). Fees were subsidised by the State government, but even so, Ken recognised the considerable sacrifice by his parents to fund this, given the minimal soldiers' pay at the time.

At Brisbane Grammar, excellence was cherished in an environment of strong academic competition, providing a good grounding in physics and chemistry, and Ken excelled in all forms of mathematics, including Euclidean geometry. This spatial sense he recognised in retrospect as an important attribute in his successful career in geology and palaeontology. Latin was a requirement for boys with higher entrance scores, which to Ken 'seemed like sheer torture', but he later recognised its benefits, both in his command of English, and in the nomenclatural requirements of systematic palaeontology. Ken was introduced to a Christian group, Crusaders, which held weekly lunchtime discussions, and it was the leader of this group who first suggested to Ken that he might consider going to university. Nobody in his family had ever attended university, and the possibility never arose in family discussions. Although his

parents were not enthusiastic, they did nothing to discourage him.

All of Ken's secondary schooling was during the war years. Students were well aware they could be in the armed services as soon as they finished, lending a certain urgency to their efforts. By his final school year (1944), the last year of the war, there were stringent quotas everywhere, and strong competition for the small number of university free places awarded to top students in the senior examination. With his 'distinct aptitude for Science and Mathematics' (Supplementary Fig. S1), Ken Campbell won a scholarship for the science faculty at the University of Queensland (UQ), which that year took in only thirty-five students.

First year science at UQ covered physics, chemistry, and mathematics, with a fourth subject of choice. Geology had been on offer at Brisbane Grammar, but Ken had not studied it. However, his very good Crusader friend Ross Staines had taken geology, was very enthusiastic, and persuaded Ken to give it a try. This decision proved a serendipitous choice for Australian geology and palaeontology.

Ken and Ross spent much time together in the laboratory, and became experts at specimen identification. They also repeated many of the one-day geological excursions in their spare time. Ken recalled noticing inconsistencies in the field explanations given to students at different sites, and he made this point in the examination, presenting his own alternative explanation. He felt that the foundations of geology were taught as accepted fact, to the exclusion of developing new concepts. Perhaps this independent thinking was noticed, and he emerged as one of the top first-year students in geology. He continued this subject, with mathematics and chemistry, for his second year. In third-year he combined geology with mathematics, but had already developed an interest in fossils as evidence of evolution. He wrote an essay on nautiloid evolution that attracted the attention of Dr (later Professor) Dorothy Hill (see [Campbell and Jell 1998, 1999](#)).

Dr Hill suggested an extra year of study to do Honours under her supervision. But in those stringent times, another year supported by the family, rather than getting a school teacher job (Ken's first inclination), needed serious consideration. Dr Hill resolved the dilemma by offering Ken a paid research assistant position, under a grant she had received to analyse microfossils (Foraminifera) from Timor oil exploration wells. In retrospect, Ken Campbell recognised that taking up Dr Hill's offer in 1948 was one of the most important decisions of his career, setting the scene for a lifetime's work in scientific research. Ken's Honours project involved geological mapping of an area in the Brisbane River valley, requiring an onerous train trip to Esk and then pushbike to the field. Later, he improved the travel situation by buying an ex-army BSA motorbike ([Fig. 3](#)). Working as a part-time research assistant gave him two years to complete his mapping project.



Fig. 2. Ken Campbell as a teenager (~1940) beside his influential maternal grandfather, Walter Walker. The Walkers were significant in supporting Ken's parents during the Great Depression (Campbell family image).



Fig. 3. Ken Campbell on his ex-army BSA motorbike departing for his honours field area in 1949 (Campbell family image).

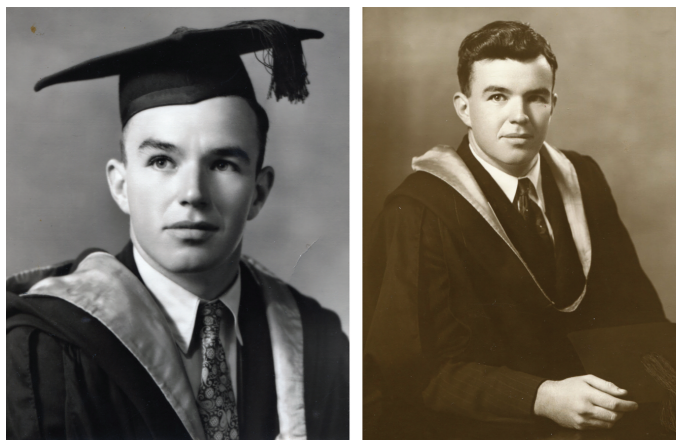


Fig. 4. Ken Campbell awarded his BSc in 1947 (L), and MSc in 1951 (Campbell family images).

Ken Campbell graduated Bachelor of Science with First Class Honours in 1949, this work resulting in his first publication on 'The Geology of the Cressbrook-Buaraba area' (Campbell 1952).

Early career positions

During 1950–1 Ken obtained an 'Assistant Geologist' position with the Queensland Geological Survey, helping compile a geological map of North Queensland using reconnaissance aerial photographs taken by the US Army during the war. He also went with the Shell Oil Company to central Queensland, sampling Permian fossils at Cattle Creek and Ingelara. This assisted his study of the fossil material from his Honours mapping area. His involvement in both projects was organised by Dorothy Hill. He worked on geological mapping during the day, and pursued his palaeontological interests after hours. He submitted his study of the Permo-Carboniferous fauna of the Ingelara Beds for his MSc Degree at UQ, awarded in 1951 (Fig. 4).

Ken was unconvinced about his north Queensland geology compilation, a piecemeal activity that seemed no more than a first hypothesis to be tested with new field data. He was never prepared to take scientific data for granted—he wanted to analyse it for himself before accepting any evidence as reliable. No doubt this had been a quality recognised by Dorothy Hill in her young Honours student, indicating an aptitude for scientific research. Through Dr Hill he put a proposal to the Geological Survey for further fieldwork, but this was not supported. Meanwhile, Ken had become acquainted with a young lady employed as personal assistant to Dr Hill, Daphne (Daph) Watson, the love of his life, to whom he later proposed. Daphne Margaret was the daughter of Charles James Johnston Watson (Queensland public servant in forestry) and Elvessa Watson (housewife, née Winterford).

Frustrated by the lack of support from the Geological Survey, and against Dr Hill's wishes, Ken decided not to pursue the geological mapping project, but rather look for a job as a school teacher. Engaged to be married, he now felt a responsibility for obtaining reliable employment. Ken and Daph were married in May 1951 (Fig. 5), and were together for sixty-four years until Daphne died in June 2015. They had three children: Rodney Graeme, Rosslyn Anne, and Ian Robert.

Ken took up a position as a Mathematics Master at Albury Grammar School in January 1951, returning to Brisbane in May to be married. But this school-teaching lasted less than a year. The colder climate challenged the two Queenslanders, and Ken recounted geological disagreements at Albury, the geography teacher asserting the Snowy Mountains was a folded mountain belt, which the Mathematics Master knew was wrong. But his



Fig. 5. Daphne and Ken Campbell on their wedding day, 12 May 1951 (Campbell family image).

disenchantment with church schools was resolved towards the end of 1951. Ken received a message from Brisbane that the New England University College in Armidale was



Fig. 6. Ken Campbell (in the hat) cooking lunch for his students (L to R: W. Findlay, J. Fittler, J. Marquet, H. Werner) on a University of New England Geology I excursion in 1955 (J. Pickett image).

looking for a temporary lecturer in palaeontology. Ken contacted the Head of Department, Dr Alan Voisey (see Supplementary Fig. S2), who arranged to interview him. This took place in December 1951, over breakfast at the kitchen table, when Ken stopped in Armidale on the way to Brisbane for Christmas. Ken was offered the position, and this ended his brief secondary school teaching career. Nevertheless, his teaching commitment to university students remained a hallmark of his later career.

New England University College

Ken and Daphne Campbell moved to Armidale for the start of the 1952 academic year. Ken taught palaeontology, stratigraphy, and some sedimentology, and did much field-work, both with students and for his own research, especially in the Carboniferous west of Tamworth.

Before year's end Dr Voisey had taken leave for a Visiting Professorship in the US. At the same time, the only other Geology staff member won a scholarship to Cambridge. Thus, Ken Campbell, temporary lecturer, became head of a department with a staff of one! The following year Ken was made permanent, remaining at the University of New England (as the institution became on 1 January 1954) as lecturer, then senior lecturer, until the end of 1960. He put much effort into teaching undergraduate geology (Fig. 6), and pursued his palaeontological research during long vacations at UQ under Dorothy Hill's supervision. This research was submitted as a thesis entitled 'Upper Palaeozoic Studies', for which he was awarded his PhD in 1958.

Over the next decade Ken published many significant papers on Permo-Carboniferous fossils, with a special focus on brachiopods. During his period at Armidale, and following his mentor Professor Hill's example at UQ, Ken developed a strong palaeontology school. His brachiopod studies greatly benefitted during the first overseas visit for the Campbell family, to Cambridge in 1958, thanks to a Nuffield Dominion Travelling Fellowship. Working in the Geology Department and Sedgwick Museum (see Supplementary Fig. S3), he was again following his mentor Dorothy Hill, an earlier member of the 'Sedgwick Club' whilst doing her PhD there in 1930–32 (see Campbell and Jell 1998, fig. 2). His experience at the University of Cambridge was an academic game-changer for Ken Campbell, convincing him of the value of sabbatical leave. Being at the heart of academia, and experiencing brachiopod expert Martin Rudwick's strict adherence to scientific method, inspired a deeper consideration of functional morphology, a focus Ken retained throughout his palaeontological research. A major outcome of that brachiopod research was his 146-page monograph (Campbell 1965a) on Australian Permian terebratuloids.



Fig. 7. ANU Geology III student excursion to Mandurama in 1968. Standing, L to R: Keith Crook, Alex Grady, Barry Webby (Univ. Sydney), Prof. David Brown, N. Arndt, P. Davoren, P. Madsen. Seated, L to R: Ken Campbell, W. Bucknell, L. Chalker, M. Huleatt, G. Young, N. Williams, V. Labutis, A. Felton, P. Simpson, D. Bigg, I. Powell (A. Felton image).

The Australian National University

In 1959, Geology was one of four departments established in a new 'Faculty of Science' at the Australian National University (ANU) in Canberra (see [Rickard and Caton 2010](#)). Foundation Geology Professor David Brown (also a palaeontologist) advertised for an additional staff position in micropalaeontology. Although he had not worked on Foraminifera since his honours year, Ken Campbell felt he could teach microfossils adequately to undergraduates. The University of New England was now established, and attracting excellent undergraduate and postgraduate students, but Ken felt some isolation in Armidale, given the distance from major centres of palaeontological research in Brisbane and Sydney. He applied for the ANU position, and was appointed Senior Lecturer, to commence in the 1962 academic year. His Carboniferous/Permian research was recognised as adding strength to the teaching program being developed at ANU by Professor Brown. The Campbell family moved to Canberra, which remained Ken's home base for the rest of his career.

Arriving in Canberra, Ken turned his attention to Siluro-Devonian palaeontology as displayed across the region of south-eastern Australia ([Fig. 7](#)). His trilobite research (first paper: [Amos and others \(1960\)](#)) now developed through collaboration with Professor Harry Whittington ([Fig. 8](#)) at Harvard in 1965 (NSF Award; see Honours and Awards in Supplementary Material). These visits resulted in significant monographs on silicified Silurian trilobites from Maine ([Whittington and Campbell 1967](#)), and two bulletins for the Oklahoma Geological Survey ([Campbell](#)

[1967, 1977](#)). Other invertebrate groups he published on after arriving at ANU included cephalopods, receptaculitids, and echinoderms.

A major output from ANU Geology in 1968 was Ken's contribution (with David Brown and ANU sedimentologist Keith Crook) to the widely acclaimed textbook *The Geological Evolution of Australia and New Zealand* ([Brown and others 1968](#)). This was the first comprehensive stratigraphic summary for the Australasian region, and was a testament to the strong staff collaboration in the new ANU Geology Department established by Professor Brown, whose early departmental appointments covering 'a wide range of geological studies' meant 'it was a pleasure to work in the departmental environment' ([Campbell 2009](#)).

Also nearby were the spectacularly fossiliferous Devonian limestones around Burrinjuck Dam, about 50 km north-west of Canberra. These were regularly visited for student field trips, with various third-year mapping, Honours, MSc and PhD projects undertaken there. The area had also produced Devonian fish samples, including unique braincase preservation revealed by acid etching, as first documented by [White \(1952\)](#) of the British Natural History Museum (BMNH), who organised another collecting expedition to Burrinjuck to search for more braincase specimens. This involved four months' fossil collecting in 1963 on the ANU's doorstep, but without Professor Brown's knowledge. This caused great concern, resulting in letters of protest to the BMNH (some 560 fossil fish samples had been removed to London; see [Young 2015a](#)). This internationally-significant vertebrate fossil resource resulted in Ken's later major research program on the evolution of the Dipnoi (lung-



Fig. 8. Daphne Campbell with Dorothy and Professor Harry Whittington FRS in Cambridge, 1985 (Ken Campbell photographer; Campbell family image).

fishes), his first publication on this subject being [Campbell \(1965b\)](#).

Ken Campbell became Head of ANU Geology (a 3-year appointment) when Prof. Brown relinquished his chair at the end of 1976. Ken also served as Deputy Dean (one year) and Dean of the ANU Faculty of Science (two years), before being appointed Professor and Head of Department in 1982. He stood down as departmental head in 1988, but remained Professor of Geology until his retirement at the end of 1992. Ken was elected to the Australian Academy of Science in 1983, and his research continued to receive recognition (for example, [Fig. 9](#)).

Ken Campbell always stood up for what he believed in, and confronted many new challenges in a rapidly changing university environment. His new roles as Science Dean and departmental head for Geology consumed much time and energy, although any diminution of Ken's teaching and research output is hardly evident. In 1991 ANU Geology was required to vacate its original purpose-built building,

to make way for an engineering department. Ken was very concerned that loss of the original Geology building was taking place during his tenure as Professor of Geology. With strong support from other faculty and departmental staff, he fought long and hard to resist this move, to no avail. However, the efforts of resistance ensured that the new accommodation, in the former ANU Botany Building, was the best that could be obtained under the circumstances (see [Rickard and Caton 2010](#)). Ken showed a selfless determination that due recognition be given to his esteemed friend and colleague Prof. David Brown for founding the Geology Department, and one of his last official acts, in March 2011, was presiding over the opening of a commemoration stone for D. A. Brown that Ken had commissioned to be mounted in the foyer of the original Geology building (Supplementary Fig. S42).

Teacher, mentor

Although Ken's sojourn as a school teacher was short-lived, his teaching commitment to university students remained a hallmark of his later career. Arriving at New England University College, he characterised duties of his new position in terms of 'the big three: lectures, students and research'. Thus, scientific research should represent only about a third of his activities as a university lecturer.

Pedestrian teaching and rote learning, that he had sometimes endured as a student, were anathema to Ken Campbell. After his discussions with Martin Rudwick at Cambridge in 1958, he revised the approach to his invertebrate palaeontology lectures, instilling a functional aspect to consider fossils as living animals. Ken recalled a student complimenting him after his return from overseas, that his lectures were now more interesting than previously. Without compromising scientific rigour, he was approachable to all, and very generous with his time.

In addition to Ken's decades of teaching invertebrate palaeontology to undergraduates, he mentored and supervised numerous students at higher levels, many of whom went on to make major contributions to earth science both in Australia and overseas. At UNE he supervised three of his geology students for honours, and later postgraduate (MSc, PhD) theses (Brian Engel, John Roberts, John Pickett), and another postgraduate Alan Cvancara (Fulbright scholar). His listed students at ANU included 17 honours, five graduate diplomas, five MSc/MPhil, and eleven PhDs (see [Jell 1993a](#); [Rickard and Caton 2010](#)). Additional ANU students he mentored later included undergraduates Faye Lux and Greg Bell, and postgraduates James Hunt (MSc, 2009), Alice Clement (PhD, 2010) and Lynne Bean (PhD, 2020). Ken and his long-term research collaborator Dick Barwick (first co-authored publications [Campbell and Barwick 1982a, 1982b](#)) were particularly proud of their former ANU student Charles Marshall ([Fig. 10](#); Supplementary Fig.

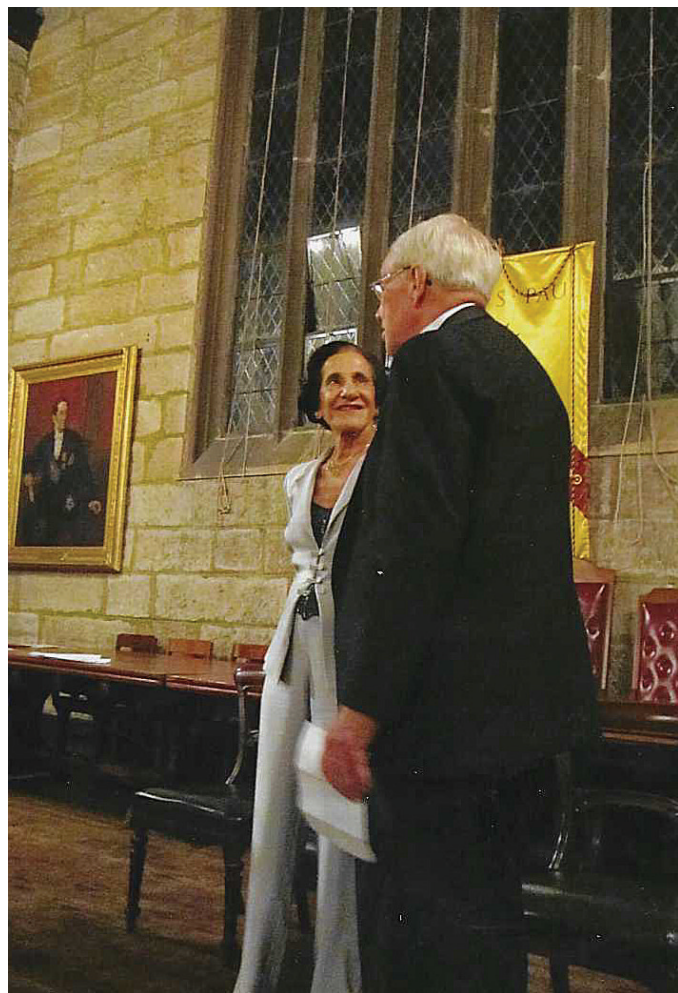


Fig. 9. Ken Campbell in 2010 receiving the W.B. Clarke Medal from Sydney University Professor Marie Bashir, the 37th (and first woman) Governor of NSW (Campbell family image).



Fig. 10. Ken's long-term research collaborator, zoologist Dr R.E. (Dick) Barwick (L), and their former student Professor Charles Marshall (University of California), visit Ken and Daphne Campbell at St. Andrew's Retirement Village in Canberra, 27 July 2012. Note, hanging on the wall behind them is Dick Barwick's painted reconstruction of Devonian lungfish at Gogo. This was the last time Ken saw Dick, who died on 10 November 2012 (G. Young image).

S34). Charles completed his PhD in Chicago, and after a postdoc at Indiana University went to UCLA, and was later appointed to a prestigious Harvard Professorship in palaeontology.

From the 1960s, vertebrate palaeontology (VP) had been offered as a third-year undergraduate unit at ANU Geology, initially taught by Professor Brown to cover all vertebrate groups (agnathans, jawed fishes, amphibians, reptiles, birds and mammals). Australian marsupials were covered by M. Plane (Bureau of Mineral Resources) until the early 1970s. From 1978 until his retirement, Ken Campbell took over all VP teaching, offering a course in alternate years comprising some 18–21 lectures and 12 practical sessions, to which Gavin Young contributed six or seven lectures and practicals on Devonian fishes. From 1988 mammals were taught by Dr David Ride, now an ANU Visiting Fellow. From 1997 the course was reinstated but much reduced, focusing only on Palaeozoic vertebrates, the main research strength at ANU. With the department renamed 'Earth and Marine Sciences' (2004) there was increased focus on marine palaeontology, to which general palaeontology ('Evolution of Life on Earth') was appended. For VP, only three lectures and two practical sessions could be offered, later reduced to one practical, being squeezed into the general second-year palaeontology course (covering all invertebrate groups).

Even though reduced, the VP component regularly attracted amongst the highest student numbers for second-year earth science units, with a strong contingent from biology. In 2008, after the department was merged with the Research School of Earth Sciences (RSES), Ken Campbell lobbied unsuccessfully for reinstatement of vertebrate palaeontology as a stand-alone unit to boost student

numbers. However, the reality, as stated by then RSES Director Brian Kennett, was that palaeontology was not part of the RSES strategic plan. Vertebrate research was supported mainly by outside funding, and was viewed as a minor part of ANU earth science activities except as kept going by visiting fellows.

By that time Ken no longer gave lectures, but until 2011 he participated in the author's fossil fish practical sessions, to demonstrate the exceptional Gogo lungfish material – amazing fossils of skulls and braincases with all the jaws and gill arch cartilages in place. Ken's commitment and teaching engagement, his consummate skill in handling some of the world's most precious and fragile fossils, and his deep knowledge of the subject, still engendered great enthusiasm, interest, and respect from all undergraduate students. From 2012 lectures were given in the new RSES building, whilst the fragile fossil fish collection remained in the strongroom of the previous Geology building, which made them inaccessible for teaching.

Ken's highly deserved reputation as a dedicated teacher was recognised in the ANU Geology Department from 1993, with the award of the 'K.S.W. Campbell Prize' to students or staff members 'in honour of Professor Ken Campbell for an outstanding contribution to teaching' (Rickard and Caton 2010, table 8.3), a tradition continued after the merger with RSES (DeDeckker and Eggleton 2017).

Service to the academic and scientific communities

In addition to his research output, Ken Campbell contributed to the academic and scientific communities in many other ways, serving on various councils and committees at the ANU, and in the Australian Academy of Science (AAS). These included Staff Member of the Student Loan Fund (1966–73); ANU Press editorial committee (1969–76); Chairman, ANU Printing and Publishing committee (1977–8), ANU board of the School of General Studies (1975–80); ANU Council member (1978–80); Faculties Research Fund member (1983–5), and its Chairman (1986–7); Forestry Review committee member (1984); Chairman, Review Committee, Geology Department UQ (1986), and so on. He served as a member of council for the Australian Academy of Science, and was a member of several AAS committees, including chairing the Schools Geology advisory committee, and the committee for the AAS Dorothy Hill Award and lecture, which he instigated and for which he raised funding. He also organised various symposia and edited major volumes, for example *Essays in Honour of Dorothy Hill* (Campbell 1969), the *Third Gondwana Symposium* in 1973 (Supplementary Fig. S7) that produced a 705-page volume (Campbell 1975), the *Evolution & Biogeography of Early Vertebrates* symposium (with Alex Ritchie and

Gavin Young) in 1983 (Supplementary Fig. S9), and the *Rates of Evolution* Symposium with Max Day (Campbell and Day 1987).

Ken Campbell also gave much time and service to various scientific societies, including as a long-term editorial board member for the Geological Society of Australia, and vice-president of the Australian Geosciences Council. With David Brown, he served on the committee for the 25th International Geological Congress in Sydney (1976). He participated in various working groups to organise amalgamation of Dorothy Hill's Queensland Palaeontographical Society with the GSA 'Specialist Group in Palaeontology & Biostratigraphy', to form the Association of Australasian Palaeontologists (AAP) (Pridmore and others 1994). Ken was Vice-President of the inaugural AAP committee, and the second AAP President (1976–7), and played a key role in establishing the new AAP journal *Alcheringa* (Supplementary Fig. S8).

During the last 15 years of his career, Ken Campbell also devoted much effort towards two issues close to his heart: the continuation of vertebrate palaeontology teaching and research at ANU, and long-term protection for the internationally significant fossil vertebrate collection at ANU. These concerns went back decades (Supplementary Fig. S48), from the start of acid-etching fossil fish nodules collected on their first ANU trip to Gogo, WA, in 1970 (for detail, see Young 2015b). In 1965 Ken had used acetic acid (developed in London to extract bone from limestone) to prepare his lungfish skull from Burrinjuck. At the same time, Errol White FRS of the BMNH was researching Devonian lungfish, including jaws from Burrinjuck (White 1965, 1966), and arranged for technical advice on acid-etching to be provided to ANU. Now the new Gogo samples were producing exceptional articulated lungfish specimens, comparable to modern fish skeletons, the reason why the Gogo specimens in London were recognised among the world's best-preserved vertebrate fossils, their scientific value 'incalculable' (Ahlberg 1989; for background on Gogo fossils and British collecting, see Long 1988, 2006; Long and Trinajstić 2010).

In the original Geology building, Ken's precious lungfish specimens were locked away in a special storeroom adjacent to the professorial office. Only he and Prof. Brown had keys, and the fragile skulls could only be examined or handled under supervision. Having his fossil collection destroyed by fire in Armidale during the 1958 visit to Cambridge, Ken was acutely aware of the need for fireproofing. When the Geology Department relocated in 1991, as Professor he ensured an acid laboratory in the refurbished Botany building, and a new locked fireproof store to house the exceptionally fragile acid-etched fossil fish skulls and braincases from Burrinjuck and Gogo, and other type and valuable fossils (Supplementary Fig. S35). The main Geology Museum, including numerous purchased overseas and historically significant fossils, unpublished honours and

postgraduate material etc. was re-established in the ground floor of the later-named 'DA Brown Building'.

Ken Campbell's concerns increased when the last Geology Museum curator (Dr Tim Munson) finished at ANU and was not replaced (2001). The insecurity of university collections generally had already been canvassed in the 1995 *Cinderella Collections* Report (Australian Vice-Chancellors' Committee 1995). Ken approached the ANU Vice-Chancellor, lobbying for appropriate recognition and care by the ANU for all of its research collections. In most other Australian universities these were either held in dedicated university museums, or lodged in appropriate collecting institutions (for example, the various State Museums). There was little momentum from other parts of the university, so Ken focussed his efforts only on the ANU palaeontological collections.

In 2005 Ken proposed a collaboration with the National Museum of Australia (NMA) through its Director Craddock Morton (a former student). The collections would remain on campus as long as research continued, the NMA taking ultimate responsibility. Only later it was learnt (from subsequent NMA Director Andrew Sayer) that these negotiations had been thwarted from higher levels within ANU. Ken also lobbied Pro Vice-Chancellor Professor Mandy Thomas for a survey of all ANU collections across campus, leading to a formal ANU Collections Policy document from the PVC's office in January 2009. Nevertheless, funding remained the major issue. Ken and his predecessor David Brown had each donated \$10,000 towards a collections endowment fund, and Ken now approached one of his most successful former students, Dr Bob Day, former Chief Government Geologist and Director-General of Mines and Energy in Queensland, to financially support VP research and a part-time curatorial position for the palaeontology collection (Supplementary Fig. S40). However, a later proposal from the RSES Director to re-allocate this endowment contribution to scientific fields other than palaeontology was not accepted by Bob Day, who then transferred his funding towards a postdoctoral position in vertebrate palaeontology at UQ (for more detail see Young 2021). Ken had moved into St Andrew's Retirement Village by the time the DA Brown Geology building was vacated by RSES in 2014–5, when the rock and fossil collections were moved to a new facility.

Community service and outreach

From the start of his career as an Albury school teacher, Ken Campbell was always concerned to engender an understanding of science both in primary and secondary education, and outside academia to the public at large. When the NSW Education Department Wyndham Scheme added geology as a subject in 1962, Ken organised geology short courses for school science teachers. Together with Mike Rickard they

contributed an article on the state of geological teaching to the *Australian Bicentennial Project Bulletin* (1987–88). During the 1990 field trip to Gogo, Western Australia (Supplementary Figs S19–S20), Ken organised a film cameraman to fly over the Kimberley Devonian reef complexes to produce an educational film on geology and fossils for students and the general public (narrated by Dick Barwick). Ken put together labelled Devonian coral and brachiopod samples for friends Ian and Helen Cathles to display to the public at their Wee Jasper Homestead. With postdoctoral fellow Dr Peter Pridmore, they prepared a fossil fish display at the Canberra Zoo and Aquarium, where living Australian lungfish *Neoceratodus* could be viewed by the public (fish collected in Queensland under permit by Dr Pridmore and funded by Ken Campbell's ARC grant). Ken's family recalled numerous amateur groups that he took on field trips, including church groups (helping to keep 'creation scientists' at bay). As late as January 2004, Ken Campbell was negotiating the rocks at Snapper Point on the NSW south coast to demonstrate Permian geology for ANU Kioloa 'Open Week', true dedication to explaining science to the general public for someone now in his late 70s.

Ken Campbell was a religious man. He had a Christian upbringing, and held deep views about his faith. His family assessed the intersection of his scientific engagement and religious faith in the following terms: 'by exploring how the history of the natural world informed his understanding of God as Creator. For him, the "Creationists" portrayed a static world, which in Ken's opinion did creation, evolution, and God a great disservice. He marvelled not just at evolution, with its breadth and dynamism, but also that God might be interested in him as a person. One of his favourite biblical verses, as quoted to his son Ian one night from the patio at their family home, with his arm sweeping across the cosmos, was from Psalm 8: "What is man that you are mindful of him, the son of man that you should care for him?" This was God's universe, with an infinitesimally small, yet none-the-less-important-to-God Ken Campbell standing in it'.

Ken Campbell was a long-serving Elder of the Presbyterian Church of Saint Andrew, Canberra, and ran both courses in Bible studies as well as geology excursions. He could be described as a "Theistic Evolutionist", and was strongly opposed to literal Christian fundamentalism (for example, his article on 'problems with creation science'; [Campbell 1989](#)). Ken Campbell never let his personal beliefs get in the way, but rather, they inspired his research on fossils and evolution.

Scientific research

Ken Campbell's main research can be briefly categorised as the study of fossils (palaeontology), and the interpretation

of fossils as living animals (palaeobiology). He also published on a range of other sub-disciplines across the earth and biological sciences (see his full bibliography in Supplementary Material). His palaeontological contributions may be grouped under three broad time divisions of his university career, reflecting his geographic location and academic environment at the time: (i) Carboniferous and Permian biostratigraphy and faunas (1952–83), (ii) taxonomy and functional morphology of Siluro-Devonian trilobites and associated faunas (1967–82), and (iii) vertebrate palaeontology, in particular the taxonomy, functional morphology, and evolutionary history of lungfishes (1965–2014). These time divisions overlap significantly, demonstrating his ability to research and publish in several lines of scientific investigation concurrently.

Vertebrate palaeontology and palaeobiology were the dominant components of Ken's later research (some 40% of published output, mainly in his last three decades). He also made significant contributions to general geology (~12% published output) and general palaeontology (~13%). The latter includes biostratigraphy and biogeography, aspects of palaeontology that contribute to the solution of earth science problems, by using fossils as a set of information-rich sedimentary rock inclusions. Other more specific palaeobiological contributions include detailed studies on trilobites (~12% publication output), and brachiopods (~10%), and lesser contributions on other groups (for example crinoids, corals, ammonoids ~5%). Echinoderms were used as exemplars in a number of contributions to evolutionary theory (~5% of publications).

A detailed analysis of Ken Campbell's research impact for these different taxonomic groupings and other topics is given in the Supplementary Material.

A hallmark of Ken's research was his wide collaboration with geologists and palaeontologists across Australia and overseas. His substantial research on Carboniferous-Permian geology, biostratigraphy, and invertebrate faunal correlations in New England and elsewhere was brought together in his seven mainly co-authored contributions to the *Geology of New South Wales* ([Packham 1969](#)). He sought out, and collaborated with, noted overseas palaeontological researchers such as Martin Rudwick (brachiopods, functional morphology), Harry Whittington FRS ([Fig. 9](#)) on trilobites and other arthropods, and David Raup (evolutionary rates documented by the fossil record). Extending his research interests into biology, his collaborations included co-convening with Max Day the *Rates of Evolution* symposium (1985), and on population biology and gene regulation with George Miklos (Supplementary Fig. S18; see for example [Miklos and Campbell 1994](#)).

Beginning his lungfish research, Ken sought out Keith Thomson (Yale) to collaborate on the new *Dipnorhynchus* skull he had found in 1965 ([Thomson and Campbell 1971](#)). Subsequently Ken collaborated with many distinguished overseas vertebrate paleontologists on lungfishes. In 1981

he was a Visiting Scientist at the Field Museum in Chicago, and in 1985 Visiting Professor in the Anatomy Department, Guy's Hospital Medical School, London, researching lungfish dentition and evolution of teeth with Professor Moya Smith. Other overseas collaborators were Professor H.-P. Schultze (University of Kansas), Professor Dick Fox (University of Alberta), Dr Elga Mark-Kurik (Tallinn), Dr Mahala Andrews (Edinburgh), and Professor Per Ahlberg (Uppsala).

The latter two researchers were involved in his last major monograph, its authorship indicative of Ken Campbell's integrity and generosity of character. This concerned a completely different group of Devonian lobe-finned fishes, the genus *Onychodus*, previously poorly known from large jaw fragments collected in North America in the 1850s. Then exceptional complete skeletons were discovered at Gogo (Supplementary Fig. S30). Mahala Andrews had spent years at the Royal Scottish Museum, Edinburgh, studying specimens acquired during the initial 1967 British Gogo expedition. John Long prepared some superb additional *Onychodus* specimens at the ANU in 1985–86, and later collected more for the Western Australian Museum. Mahala Andrews examined the Australian material during two visits to ANU (1983, 1989), the second time after Ken Campbell proposed a collaboration at ANU to finish her monograph. Regrettably, she died in 1997, leaving her research unfinished. Ken Campbell made a massive effort over the next decade to finalise it. He visited Scotland in 1998 (Supplementary Figs S26–S29) and arranged to borrow from Edinburgh all documentation from 25 years research by Dr Andrews, including many photographs, line drawings and preliminary sketches, but she had left no text. Thus, a new draft had to be written for the entire description of hundreds of bones in the skeleton, for which 75 superb new illustrations were prepared by Richard Barwick. The 110-page monograph was published as [Andrews](#)

and others (2006). Ken ensured that Mahala Andrews was named as first author (and put himself last).

Noted for his meticulous analysis of fossils in the laboratory, Ken Campbell never overlooked information provided by their geological context, a point he always impressed on students. Beginning with his student fieldwork in Queensland, Ken's career involved extensive field investigations in geology, fossil collecting, and numerous student excursions, covering much of eastern Australia, and across to the remote north-west Kimberley region at Gogo (Supplementary Figs S4, S19–S20). Overseas, his collaborations also included geological fieldwork in many countries, often remote.

An example was his 1968 visit to Russia, an interesting introduction to geopolitics, with unanticipated adventures. He was Australian representative on the International Stratigraphic Commission for meetings in Leningrad, Moscow, and Prague, tasked with identifying the best stratigraphic section to represent a 'global stratotype' for the boundary between the Silurian and Devonian Periods on the geological timescale. Ken proposed the excellent Yass-Burrinjuck exposures near Canberra, but this was considered too far from the scientific centres of Europe and North America. Russian stratigraphic sections included near Novosibirsk in Siberia (Supplementary Fig. S3), the Kuznetsk Basin (Ukraine), and Lvov on the Polish border. Travelling via East Germany to the International Geological Congress (IGC) in Prague, Ken met with Dr Herman Jaeger (1967 ANU Visiting Fellow) to collect brachiopods relevant to his recently published work on terebratuloids ([Campbell 1965a](#)). In a quarry they were confronted by soldiers carrying sub-machine guns, placated by Dr Jaeger before fossil collecting could continue.

In central Prague to attend the IGC, Ken woke in the early hours to see Russian T54 tanks rumbling down the street outside his hotel (Supplementary Fig. S3), the Russians having invaded the previous night (21 August 1968). Briefly venturing outside, into streets full of tanks and armed troop vehicles, he avoided Czech snipers shooting at the Russians from surrounding buildings. The IGC was aborted, and a few days later Ken was evacuated with other conference delegates on an overnight train to Vienna organised by the American Embassy. He could then finally contact his stressed family back in Canberra, whose only news of the invasion was from the local media. In the haste, all his fossil specimens were left behind, and his camera was stolen. Thus ended an overseas trip to collect fossils that proved to be much more action-packed than anticipated.

During his career, Ken had some 21 fossil species and four fossil genera named in his honour by palaeontological colleagues in Australia, the United States, China, and Canada (see Supplementary Material S2), including four fossil fishes ([Fig. 11](#)). The breadth of recognition his research achieved is indicated by contents of the 459-page

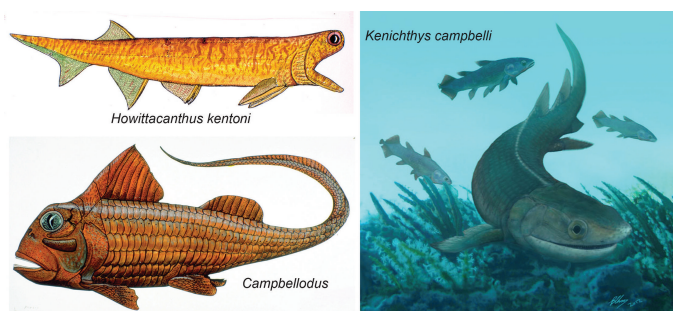


Fig. 11. Reconstructions (J. Long, B. Choo) of some Devonian fishes named in honour of Ken Campbell: the acanthodian *Howittacanthus kentoni* from Victoria (upper L), the ptyctodontid placoderm *Campbellodus decipiens* from Gogo WA (lower L), and the tetrapodomorph lobe-fin *Kenichthys campbelli* from Yunnan, China (R). *Kenichthys* later proved to be a key transitional form in the origin of tetrapods ([Zhu and Ahlberg 2004](#)).

'Festschrift' of 'Palaeontological studies in honour of Ken Campbell' (Jell 1993b). It has 49 contributors representing most Australian universities and museums, and including overseas researchers from Alberta, Beijing, California, Chicago, Kansas, Texas, and New York.

In his last publications Ken embraced the latest technology in fossil research, collaborating with Prof. Tim Senden (Supplementary Figs S50 and S52) in the ANU Research School of Physics, where high resolution micro-CT scanners were applied to investigate internal structures of the braincase, bone histology, and sensory canal systems (for example, Campbell and others 2012).

Ken's many fellowships, honours, and awards during his distinguished career are listed in the Supplementary Material. His last award (2012), near the end of his career when health problems were appearing, was the Raymond C. Moore Medal of the US Society for Sedimentary Geology. The citation read: 'The extraordinary breadth and global significance of your research achievements, your diverse international collaborations, and the exceptional scientific progeny your teachings have spawned, all qualify you for this appropriate honor'. This accolade was greatly appreciated, and lifted his spirits.

Concluding remarks

Ken Campbell experienced increasing health problems in 2011–12. Much earlier, he had suffered a minor stroke, from which he made a remarkable recovery, recounting the story of a clinical psychologist/speech pathologist assessing him for memory loss. He was asked to name three animals beginning with 'D' (Dog, Duck ... perhaps?). Ken refrained from continuing with *Dipnorhynchus*, and many other fossil names he could have listed to confound the medical specialist!

From late 2011 Ken had continued his research mainly from a home office, but still regularly visited his previous office and laboratory space in the DA Brown Building at ANU for his collaboration with Dick Barwick (regrettably, Dick died in November 2012). In mid-2012 Ken and Daphne Campbell moved into temporary respite care whilst Ken's condition was monitored. In late 2012 Ken and Daph moved into John Flynn House at St Andrew's Retirement Village, Woden, ACT. They occupied adjacent rooms, Ken's room mainly functioning as a research office, where he received local and overseas research colleagues (Supplementary Figs S49, S52, S53), and Daph's room for entertainment of visitors. Ken's last publication was for Dick Barwick's Festschrift (Campbell and Wragg 2014), but he was still preparing manuscripts and working on the text for a book during 2017.

The passing of Emeritus Professor Ken Campbell FAA on 17 June 2017, in his 91st year, marked the end of an era of high quality palaeontological research at ANU, and an

academic career of almost 70 years that placed Ken as one of the most outstanding researchers in Australian palaeontology during the 20th century. When Ken Campbell began as an undergraduate in geology at UQ, his original mentor and teacher, Professor Dorothy Hill FAA FRS (1907–97) was establishing a centre for palaeontology that later achieved international recognition. Ken emulated that legacy in his five decades of palaeontological research and teaching at ANU.

Supplementary material

Supplementary material can be accessed from the article page online.

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