

Ralph Owen Slatyer 1929–2012

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Ralph Slatyer (16 April 1929–26 July 2012) had a distinguished career in the Commonwealth Scientific and Industrial Research Organisation and the Australian National University, in plant–water relations and plant succession, leading the development of physiological plant ecology. He was the founding Professor of Environmental Biology at the Research School of Biological Sciences, at the Australian National University and then Director of the Research School of Biological Sciences, 1984–9. He was Australian Ambassador to United Nations Educational and Scientific Cultural Organisation (1978–81), and as Australia’s first Chief Scientist (1989–92), he set up the Cooperative Research Centres.

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Overview

Ralph Slatyer had a distinguished career in the Commonwealth Scientific and Industrial Organisation (CSIRO) and the Australian National University (ANU), leading the development of modern physiological plant ecology, and achieved international recognition for his research on the water relations of plants, and on plant succession. He had leadership roles at the CSIRO Division of Land Research, where he became a chief research scientist at an extraordinarily young age, and subsequently in 1967 as founding Professor of Environmental Biology at the Research School of Biological Sciences (RSBS), at the ANU and then as director of RSBS (1984–9). However, he was best known as an organizer of science, with his appointment as Australian Ambassador to the United Nations Educational, Scientific and Cultural Organisation (UNESCO) (1978–81), and, as Australia’s first Chief Scientist (1989–92), he was instrumental in setting up the system of Cooperative Research Centres. Internationally, many heritage sites around the world, both natural and cultural, owe a debt to Ralph and colleagues.

Family background

Ralph Owen Slatyer ([Figure 1](#)) was born in Melbourne, Victoria, Australia, on 16 April 1929, the son of Thomas Henry and Jean (née Mackenzie) Slatyer. He was the fourth of five children; the others were Kenneth Henry (Ken) born 1918, Robert Thomas (Bob) 1919, Jean 1925 and David Hugh 1935. Although all were born in Melbourne, the family moved to Perth in 1931, so that Ralph grew up very much identified as a Western Australian.

The name Slatyer is unusual, although the use of a ‘-yer’ suffix on otherwise common names is not unusual. Family members have looked at telephone directories all over the world but have not found any Slatyers except in Australia. Ralph was not fond of receiving mail addressed to Prof. ‘Slatyer’.

Ralph’s father’s grandfather (William) came to Australia from Buckinghamshire, England, in 1853 as a Congregational missionary and established the first Congregational Church in Balmain, Sydney, New South Wales. Ralph’s paternal grandfather (Thomas) was manager of a cattle station in Queensland and a deeply religious person. Ralph’s father, Thomas Henry, was brought up on the cattle station, but being the third of nine children there was pressure to

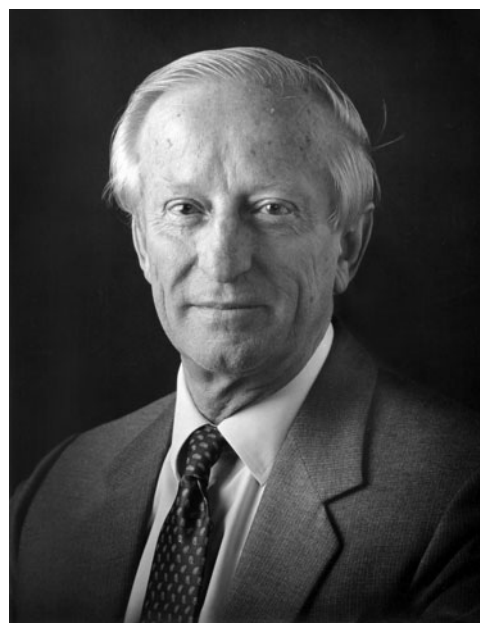


Figure 1. Professor Ralph Slatyer, Director of the Australian National University’s Research School of Biological Sciences 14 September 1984–11 July 1989. Copyright Australian National University 1984.

take up another career and he went into banking, moving from place to place with his growing family as was standard practice in banking at that time. His transfer with family to Perth in 1931 was to become manager of one of the branches of the Commonwealth Bank. He had met Ralph’s mother, Jean Mackenzie, in Rockhampton through his banking career because Jean’s father, Kenneth Murchison Mackenzie, the fourth of eleven children, was also a banker. Jean had won a university scholarship but did not take it up because it would have meant living away from home. Jean’s paternal grandfather (Farquhar Mackenzie) came to Australia as a grazier at about the same time as William Slatyer.

Ralph met June Helen Wade when they were undergraduates at the University of Western Australia (UWA). June became a teacher.

They were married on 16 May 1953 in Perth. They had three children: Anthony James (Tony), born 1954, Bethanne (Beth), born 1957 and Judith Jeane (Judy), born 1960. Ralph always emphasised that he and June were a team. Her warmth and common sense were real assets throughout his career.

Early education

Ralph had a very happy childhood. At age four he met Peter Douglas and their friendship lasted all Ralph's life.¹ After kindergarten Ralph attended Nedlands State School for Years 1–6 (1936–41) and then gained a scholarship to the state's selective entry high school, Perth Modern School. He attended Perth Modern for 1942 and 1943 (years 7 and 8). Late in 1942, he developed bad asthma and missed school for at least half of 1943. For the sake of his health, the family moved to Kalamunda, ~25 km from Perth in the Darling Ranges. A new drug then came on to the market that could be inhaled using a hand nebuliser and he was not seriously troubled again by asthma until his last few years. Ralph spent 1944 (year 9) at the Kalamunda High School and then became a weekly boarder at Wesley College in Perth for the final two years of high school, taking the science-engineering stream. These were war years and Ralph's eldest brother Ken was killed accidentally in New Guinea in early 1944 while testing a new Spitfire aircraft. Ken's death had a major impact on the whole family.

With so many people tied up with the war it was difficult at Wesley to get the mathematical teaching Ralph needed to be admitted into university engineering and he decided on science. He concentrated on agricultural science and found it interesting and important. Even then the food needs of the growing world population posed a major challenge for the future, and there was already talk of the post-war need to populate and develop northern Australia. The Faculty of Agriculture at UWA had a deservedly high reputation, and agriculture in Australia had a strong science base.

1947–50 undergraduate years

Agriculture was a four-year course with options available to develop areas of special interest. The first term of third year and all of the summer vacations had to be spent in the field—either on a farm or an experiment station. Ralph worked for six months at the new WA/CSIRO Kimberley Research Station on the Ord River valley. The landscape impressed him as did the feeling of being a pioneer at the edge of civilisation. The next normal vacation was at the CSIRO Katherine Experiment Station in the Northern Territory, under the overall direction of C. S. 'Chris' Christian, who had pioneered the technique of integrated, geomorphology-based land surveys as a means of quickly assessing the land-use potential of large areas. Ralph found Chris to be a stimulating and congenial leader.

At university after World War 2, there was strong competition between the ex-servicemen and women on the one hand, and the

school leavers on the other, with each group determined to do well, thus promoting hard work and success among both groups around the country. Ralph was strongly influenced by the Dean of Agriculture, Eric Underwood (later FAA and FRS). Ralph graduated with a BSc (Agric) in early 1951, having passed more subjects with distinction than any other student, and was awarded the David Evans Memorial Prize. At UWA, Ralph played hockey and earned a University Blue. He met June at a dance on his twenty-first birthday weekend in 1950. They were almost inseparable from then on, marrying in 1953.

1951–67: research career in CSIRO

1951–5: getting started in research

Chris Christian wanted a person in Canberra to develop the climate side of his assessments of potential land use. Ralph landed the job as a research officer. CSIRO sometimes sent promising researchers overseas to obtain a PhD, but the PhD was not seen as a basic requirement and Chris wanted him to stay in Australia.

Ralph initially worked in the general area of agricultural climatology, developing models to test the adequacy of precipitation and soil water storage to provide growing seasons of adequate length and continuity for successful cultivation of crops in northern Australia. This was a field that had largely been pioneered in Australia, and particularly at the Waite Institute of the University of Adelaide, by Hugh Trumble and James Prescott FAA, FRS who had generated the notion of precipitation/evaporation ratios as measures of the effectiveness of rainfall; $P/E > 0.3$ gave a good fit with winter rainfall effectiveness. Ralph spent several months with Prescott and concluded that the situation in northern Australia was quite different and that field experiments were needed.

He started field experiments at Katherine, Northern Territory, in the extremely dry summer 1951–2, and then ran comparable experiments at the Kimberley Research Station, Western Australia, 1954–5. These summers meant that Ralph was away for three-four months leaving June in Canberra, a new city at that time, with Tony as a baby. It was impossible to have an effective telephone conversation from Katherine because of the state of the lines, and from Kununurra, where the research station is located, there was no phone at all, only a Flying Doctor radio transceiver for telegrams. Ralph missed his family intensely, but the work was pivotal in establishing his career.

Those first two years provided the basis for modelling the soil water and growing season,² and the variable rainfall and poor soil structure³ suggested limited prospects for extensive agricultural development in northern Australia.⁴ At the more physiological level, it was widely accepted at the time that the available soil water for plants was that stored between two soil attributes—field capacity and the permanent wilting percentage that were constant for any one soil. Ralph's work disproved that for dry-land crops and natural vegetation.⁵

¹ Peter Douglas (b. 1929) and Ralph Slatyer were friends who attended Nedlands Primary and Perth Modern School. Douglas made his career in banking, and was Chief General Manager, Management Services, at Westpac before retiring in 1988 after 41 years' service. He was instrumental in the introduction of bank credit cards into Australia.

² Slatyer and Christian (1954). Slatyer (1955). Slatyer (1960).

³ Slatyer (1954).

⁴ Basinski and others (1985).

⁵ Slatyer (1955). Slatyer (1956).



Figure 2. CSIRO Water infiltration experiment ‘60 mile’ Spinifex site, Alice Springs, 1959 (photograph from Slatyer collection, published with permission of Dr Chin Wong).

The UWA permitted Ralph to use one of his CSIRO research projects for an external Master’s degree and he obtained the MSc (Agric) degree in 1955 with a thesis entitled *Studies in Tropical Crop Production: the Katherine (NT) Environment and its Influences on Crops of Cotton, Peanuts and Grain Sorghum*. Later there was encouragement to submit a portfolio of published papers for a DSc (Agric), which was awarded by UWA in 1960. This thesis was entitled *Some Aspects of Plant-soil-water Relationships*.

1955–6: ‘Cook’s Tour’

CSIRO had a practice at that time of sending young researchers overseas for up to a year to familiarise themselves with the latest developments in their fields. Ralph undertook such a ‘Cook’s Tour’ in 1955–6 to Israel, Kenya, Uganda, Nigeria, the United Kingdom (UK), Holland, France, Germany and the United States of America (USA). The lengthy stays were with botanists Paul Weatherley (later FRS) at the University of Nottingham, UK (three months) and Paul Kramer (US National Academy of Sciences, and later FAA) at Duke University, USA (six months). June and Tony, aged one, came too, although not to Israel or Africa.

While at Nottingham, Ralph developed further Paul Weatherley’s technique for quantifying leaf water content as an indicator of water stress and demonstrated the relationship between water content and water potential.⁶ At Duke, he demonstrated that the permanent wilting percentage was a plant characteristic, determined by the osmotic potential of the leaves and therefore varied with different plant types, but mediated by the decline of soil water potential, and the daily lag of absorption behind transpiration.⁷

⁶ Weatherley and Slatyer (1957).

⁷ Slatyer (1957).

⁸ Slatyer (1962).

1956–7: back in Australia

Ralph’s main external activities were with UNESCO and international environmental activities. UNESCO established its major project on arid zones in 1955. The Arid Zone Project was undertaken because there was an expectation that science would somehow make the deserts bloom and the arid zones of the world would provide food and habitat for the increasing world population. The program demonstrated that, instead, the deserts were very fragile ecosystems and would never support substantial populations; furthermore that irrigated agriculture in arid regions would inevitably lead to salinisation and create potential disease problems. The project consisted of a series of symposia, the provision of studentships and the provision of funds for some laboratories. Ralph’s involvement was with the first symposium on Arid Zone Climatology that was held in Canberra in 1956, and next was the 1959 symposium on plant–soil water relationships in Madrid. He then became a regular participant in UNESCO activities both in Australia and internationally.

On return to Australia from his Cook’s Tour, CSIRO provided Ralph with funds to recruit two additional research scientists plus support staff for a Climatology Unit. This led to a two-year study of the water and energy balance of spinifex (see Figure 2) and mulga communities in the Alice Springs region,⁸ and to more sophisticated growing season models developed by Eugene Fitzpatrick and Henry Nix. The early field experiments aroused Ralph’s interest in the manner in which plants responded within the soil–plant–atmosphere continuum, and led him into environmental plant physiology. This was some of the most influential research, internationally, of his scientific career.

His studies were of water transport in the soil-plant-atmosphere system, stomatal control of CO₂ and water vapour exchange, and the effects of environmental factors on transpiration and photosynthesis, and involved both basic and applied research.

Together with Sterling Taylor of Utah State University, Ralph developed a new, unifying, thermodynamics based terminology for the study of plant-soil water relations,⁹ now used everywhere.

The research team grew, by the early 1960s, into an Environmental Biology Group at the CSIRO Division of Land Research and Regional Survey with five or six research scientists and an equivalent number of support staff. Together with a steady flow of stimulating visitors and a small number of students, this resulted in a group of ~20 people. Over Ralph's 16 years at CSIRO, these scientists included John Begg, Ian Cowan (later FAA), Tony Fischer, John Passioura (later FAA), Calvin Rose, Walter Stern and, just before Ralph moved to the ANU in 1967, Barry Osmond (later FAA, FRS). All of these outstanding people obtained chairs or reached the Chief Research Scientist classification in CSIRO.

The culture Ralph fostered at Land Research was one where people met frequently and there were many conversations. There were typically no chairs where they drank tea, and this was to encourage people to move around. It was part of what John Passioura calls Ralph's 'kaleidoscopic management' style. The most famous aspect was croquet at lunchtime. Croquet encouraged talking but had a strongly competitive edge. Occasionally they challenged the astronomers at Mt Stromlo, where 2% excess force hitting downhill had the balls approaching Canberra's suburbs. There were croquet mallets and balls in the cupboard when I inherited Ralph's office at the Research School of Biological Sciences, ANU, preserved by intervening Professors Osmond and Cowan.

Ralph's first book was co-authored with Ian McIlroy in 1961 on *Practical Micro-climatology*.¹⁰ This background fitted him in later life to lead two separate reviews of the Australian Bureau of Meteorology.

In the early 1960s, Paul Kramer asked Ralph if he would co-author a revision of Paul's classic *Plant and Soil Water Relationships*.¹¹ Ralph agreed and spent the 1963–4 academic year at Duke University, USA. The idea was that he would draft chapter material and use it as a basis for lectures to Paul's highly popular graduate course on Water Relations, using the feedback from the students to revise the material. It became apparent that each had their own style and Ralph wrote his own *Plant Water Relationships* published by Academic Press in 1967,¹² involving a more theoretical treatment of each topic. It became a Citation Classic.

Ralph was progressively promoted within CSIRO reaching the level of chief research scientist in 1966 and in the same year was appointed associate chief of the division. He was elected to the Australian Academy of Science (AAS) in 1967, at an early age for such an honour. He was elected to the Royal Society in 1975, to the US National Academy of Sciences in 1976 and to the American

Academy of Arts and Sciences in 1981, based almost entirely on the work he did at CSIRO. Ralph was becoming increasingly interested in natural systems and in the eco-physiology of native species. While he had sufficient freedom to move into these areas within CSIRO, he could see that some of what he wanted to do would not sit comfortably with the division's charter and would be inappropriate for an associate chief.

1967–78: research career at the Australian National University (ANU)

In late 1966, the ANU established the Research School of Biological Sciences (RSBS) and the opportunity arose to move over to the new school. Following Ralph's election to the AAS in April 1967, David Catcheside FAA, FRS, the first director, approached him and they agreed that Ralph would establish an Environmental and Population Biology Group with a view to the population activities being in the area of population ecology rather than population genetics, and a separate population genetics group being established as the school developed.

He took up his appointment on 4 December 1967, the first professor to do so (other than David Catcheside) bringing with him Ian Cowan and Barry Osmond. He also appointed Derek Anderson to a senior fellowship to head up the population ecology work and rapidly filled several research fellow (non-tenured) posts, post-doctoral positions and PhD scholarships. Ian and Barry developed superb programs in stomatal physiology and photosynthetic metabolism, attracting myself and outstanding students such as Chin Wong, Murray Badger FAA, Marilyn Ball FAA, Susanne von Caemmerer FAA, FRS and John Evans FAA, Stephen Powles FAA and colleagues such as Roger Summons FAA, FRS and John Andrews FAA and others who had taken their PhD degrees elsewhere.

The Research School of Biological Sciences was in 1967 one of five research schools that made up the ANU's Institute of Advanced Studies (IAS).¹³ The mission of the IAS was to carry out world-class research, and in so doing, provide opportunities for first-class researchers with minimal teaching and administrative loads. The schools were led by outstanding academics and they were given a great deal of independence. For several years the ANU, comprising the IAS and the School of General Studies, graduated the greatest proportion of Australian PhDs. The budget of the ANU grew enabling RSBS to expand until ~1975.

An important early initiative of Ralph's move to ANU was to convene the inaugural activity under the Australia-United States Agreement on Scientific and Technical Cooperation in 1970. This meeting on photosynthesis and photorespiration is still regarded today as a turning point that has led to four decades of strong US-Australia collaboration and leadership in the field.¹⁴ Strong links developed between what was now Ralph's Department of Environmental Biology and the Stanford/Carnegie Plant Biology group,

⁹ Slatyer and Taylor (1960).

¹⁰ Slatyer and McIlroy (1961).

¹¹ Kramer (1969).

¹² Slatyer (1967), p. 366.

¹³ Foster and Varghese (1996).

¹⁴ Hatch and others (1971).

continued with the Duke group in the United States, and also developed with the Otto Lange/Detlef Schulze groups in Germany, that all continued beyond Ralph's period as an active researcher.

In 1972, Derek Anderson moved to the Chair of Botany at the University of New South Wales (UNSW) so Ralph built up the ecological activities himself, in particular through Ian Noble and a group of post-doctorals and research fellows. Initially his interests were in the eco-physiology of native species, especially snow gum (*Eucalyptus pauciflora*), and then in association with Joe Connell and subsequently Ian Noble, in ecological succession, the gradual process by which ecosystems change and develop over time.

The work on *Eucalyptus pauciflora* was started as a field study in cooperation with Patrice Morrow, a Fulbright Post-Doctoral from California who had undertaken her PhD with Hal Mooney. It then continued with Pam Ferrar, Peter Cochrane and several others involving both field and laboratory studies of photosynthesis and of the germination and establishment characteristics of *E. pauciflora*, from populations from different altitudes (Figure 3). The species is of special interest since it is distributed over a wide range of altitudes, extending from the coast to the alpine and valley bottom tree lines.

The photosynthetic work showed that the temperature optimum varied with the altitude of the population and, for any one population, could vary with acclimation towards ambient temperature. It led to the concept of a 'preferred temperature' and an 'acclimation coefficient' with the gradient of preferred temperature with altitude matching in broad terms the gradient of the wet bulb lapse rate thereby suggesting adaptation to a near-coastal environment.¹⁵

The field experiments involved planting seeds, seedlings and established five-year-old saplings at the natural tree line and at two altitudes above and below the tree line and observing their behaviour over the subsequent 25 years. Several other field experiments were also conducted. While the probability of a seed germinating, becoming established, growing to reproductive maturity and producing viable seed was very low, it was not zero as long as the original seed germinated in a disturbed area where competition was reduced. At both the sites above the tree line the established saplings reached reproductive maturity and produced viable seed. The work therefore raised the prospect that the 1970s tree line was lower than would be expected with the 1970s climate. They concluded that the above tree-line herb fields provided sufficient competition that, in their natural state, the prospect of successful seedling establishment was effectively zero.¹⁶

Ralph spent six months with Joe Connell at the University of California at Santa Barbara, USA, 1973–4, exploring successional patterns. They postulated that there were only three main mechanisms at work to yield these patterns, involving the early species appearing in a succession following disturbance, either facilitating the entry of later species, tolerating their entry or inhibiting their entry. The resultant paper became a Citation Classic.¹⁷

The work led directly to cooperation with Ian Noble in identifying the phenological (natural history) characteristics of various species of plants that determined their ability to enter and remain in

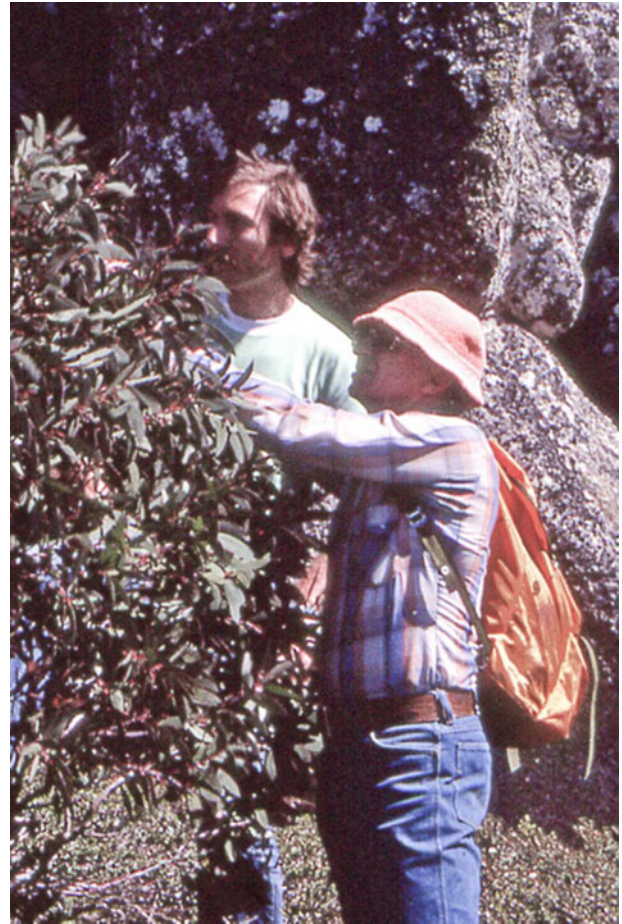


Figure 3. *Eucalyptus pauciflora* treeline experiment in the Snowy Mountains, with Peter Cochrane, March 1982. Courtesy Graeme Worboys, Australian National University.

a community. They termed these characteristics 'vital attributes'. Three main types of species were recognised, based on the method of arrival or persistence of a species at a site during or after a disturbance, the ability to establish and grow to maturity in the developing community, and the time taken for the species to reach critical life stages. Published in 1980, and despite the relative obscurity of the journal, the paper was highly cited.¹⁸

Ralph was very proud of his eleven years of active research at ANU and regarded the Environmental Biology group including key colleagues—Ian Cowan, Ian Noble and Barry Osmond—as one of the very best in the world. The group's strong influence on the school has continued. Professor Brian Gunning (FAA FRS) published a diagram showing the evolution of the plant science groups at the Research School of Biological Sciences and how strongly they became represented in Fellowships of Academies.¹⁹ The influence of Ralph and colleagues is striking.

¹⁵ Slatyer (1978).

¹⁶ Ferrar and others (1988).

¹⁷ Connell and Slatyer (1977).

¹⁸ Noble and Slatyer (1980).

¹⁹ Gunning (1990).

Ralph's interest in the environment and in environmental policy extended beyond RSBS. He worked with Frank Fenner (FAA FRS)²⁰ in the late 1960s and early 1970s to make recommendations to the ANU Council as to whether and how the university should develop activities in natural resource studies. The result was the Centre for Resource and Environmental Studies (CRES), now part of the Fenner School of Environment and Society. Ralph spent a six months sabbatical in the centre; participated in two reviews and chaired its advisory committee for about five years.

Other Australian roles

Ralph was active in the professional societies related to his work, particularly the Australian Institute of Agricultural Science, that already existed, and the Ecological Society of Australia, the Australian Society of Plant Physiologists and the Soil Science Society of Australia as they were established. He subsequently became president of the Ecological Society, 1969–71, at the time when the society was establishing its journal.

He also served on several Academy of Science, and Academy of Technological Sciences and Engineering bodies, as chair of the Australian Foundation for Science, the National Committee on the Environment, the Committee for the Fenner Conferences on the Environment and the Crawford Fund and chair of the ANU Centre for Visiting UNESCO Fellows.

United Nations Educational, Scientific and Cultural Organisation (UNESCO)

Ralph was a member of the Australian National Commission for UNESCO, initially by way of the commission's natural sciences committee, and then of the commission itself and took over the chairmanship in 1976.

Man in the biosphere (MAB)

The UNESCO MAB program had its beginnings with the lead up to the Stockholm Conference on the Human Environment in 1972. Ralph and colleagues were instrumental in having the project on Biosphere Reserves included and it subsequently became the most enduring feature of the MAB program.

Biosphere reserves exchange knowledge and experience on sustainable development innovations across country and continental borders – 669 exist in 120 countries across the world in 2018, fourteen of which are in Australia (for example Uluru, Fitzgerald River, Kosciuszko). Ralph served on the International Coordinating Council for the program and was elected president 1977–8, and re-elected 1979–81. The program is regarded as one of UNESCO's most successful.

1978–81 Australian Ambassador to UNESCO

Ralph's UNESCO activities culminated in his appointment as Australian Ambassador to UNESCO in 1978. The background was rather unusual. The post of ambassador was vacant in 1978 and the prime minister appointed Sir John Kerr, the previous governor general, to it. This led to an outcry in the community because of

Kerr's controversial role in dismissing the Whitlam government in 1975 and as a result Kerr did not take up the post. Ralph was offered the post, but initially declined. A week later, after discussions with family, he changed his mind. Hal Hatch (FAA FRS) jokes that the 'real' reason was that Ralph loved skiing (hence his work on *Eucalyptus pauciflora*, snow gum) and UNESCO got him closer to Chamonix, France.

UNESCO activities involved a mixture of both multilateral politics and real program content, Ralph concentrated on improving the UNESCO programs and on the effectiveness of program delivery, matters of considerable importance to Western countries. He became more involved in the Man in the Biosphere Program, and in the other major science based programs. These included the International Hydrological Program, the International Geological Correlation Program and the newly established Informatics Program. He also took a great interest in the World Heritage Convention (which was jointly operated by the Science and Culture Sectors of UNESCO) and in other sectors' programs, particularly education.

It is worthy of note that during Ralph's term, Australians were elected to chairmanship of all the science based programs, except hydrology, and to membership of all the science based governing bodies and that an Australian was appointed to head the education sector.

Back at RSBS but organising science more widely in the 1980s

When Ralph returned to academia and scientific research, he found that they were somewhat restrictive. He was conscious of a world out there with huge problems that needed to be addressed and found himself looking for challenges beyond the laboratory bench.

1979–83 World Heritage Committee

The World Heritage Convention came into force in 1978. Ralph was appointed as the Australian representative and was elected to the Executive Bureau in 1979. He became chair of the World Heritage Committee Executive Bureau in 1981 and was re-elected in 1982. He then continued on the bureau as chair until 1983. Ralph was careful not to be seen as pushing Australia's interests at the expense of others, and 'stood down' as chair when Australian sites were being considered.

At the end of the 1982 committee session, the delegate of Guinea (*Monsieur Youssouf Diare, Délégué permanent auprès de l'Unesco*) paid the following tribute to Ralph: '58. The delegate of Guinea, speaking on behalf of the members of the Committee, expressed his appreciation for the admirable way in which Professor Slatyer, due to his wisdom, tranquil force and perfect knowledge of the problems of nature conservation, had chaired the sixth session of the Committee'.²¹

I think it is fair to say that many World Heritage sites around the world (both cultural and natural) owe a debt to Ralph and colleagues.

Scientific Committee on Problems of the Environment (SCOPE)

The International Council of Scientific Unions (ICSU) established the Scientific Committee on Problems of the Environment

²⁰ Boyden and others (2013).

²¹ UNESCO (1972).

(SCOPE) in 1970 and the first SCOPE General Assembly was held in Canberra in September 1971, through the Academy of Science and its National Committee on the Environment.²² Frank Fenner and Ralph served on the SCOPE Committee in one role or another from the outset until the early 1990s. They were largely responsible for having the program focused on preparing state of knowledge reports on particular topics or issues, rather than attempting to undertake or support original research. They were also influential in the program being based around several major themes—biogeochemical cycles, ecosystem structure and function, and ecotoxicology. At the May 1982 General Assembly in Ottawa, Ralph was elected to the presidency of SCOPE and served his three year term and then a term as past president.

The highlight was probably SCOPE's major project on the environmental consequences of nuclear war. At the time there was no other international scientific program on this important topic, and no scientific liaison between the United States and the Soviet Union and other nuclear powers. The SCOPE project brought scientists from these countries together for the first time. The report concluded that there would indeed be a nuclear winter resulting from an all-out nuclear war and, while its effect would vary geographically and would depend on the season when such a war occurred, it would threaten not just the combatants but also the world community.

1981–4: chair of the Australian Biological Resources Study (ABRS)

The ABRS, and its operational program, the Bureau of Flora and Fauna, was the Commonwealth's major involvement with biodiversity when it was established in the late 1970s with Sir Rutherford 'Bob' Robertson FAA FRS as chairman. Bob was able to secure funds for the start of the *Flora of Australia* and, when Ralph followed him as chair, he and his colleagues were able to secure long-term funding to ensure its continuation until completion, and the initial funds for the *Fauna of Australia*. Today ABRS continues to provide 'national leadership and support for the discovery, naming and classification of Australia's living organisms'.

1981–4 Australian Centre for International Agricultural Research (ACIAR)

ACIAR was an initiative of Sir John Crawford, at the time the vice chancellor of ANU. It reflected his concern about world food security and his commitment to addressing it. The centre developed an impressive international reputation for achieving real and significant contributions to sustainable food production in developing countries. Ralph was a member of the Policy Advisory Council and of the Board of Management

1982–7: Australian Science and Technology Council (ASTEC)

Despite recommendations by the Academy of Science and other bodies, and several attempts by the government of the day, Australia lacked effective science policy machinery until the establishment of

ASTEC as an interim body by the Whitlam government in 1975 with Sir Louis Matheson FTSE as chairman. Ralph was one of the members. The council reported to the minister for science but only met a few times before the Fraser government was elected and a reconstituted interim body, also under Professor Matheson's chairmanship, was charged with preparing a 'definitive report to assist the government in its decisions on the long-term future of ASTEC'.

Thanks largely to Fraser's interest in science, the government accepted the recommendations for ASTEC to be an independent statutory body that would report directly to him. ASTEC was duly established with Sir Geoffrey Badger [FAA FTSE] and Bob Robertson, who were president and past president of the academy respectively, as chairman and deputy chairman, respectively, and became Australia's major independent policy advisory organisation in 1979. At the request of Prime Minister Fraser, Ralph became chairman of ASTEC in 1982 when Sir Geoffrey completed his term. Ralph continued in this role when the Labor Party was returned to government in 1983 with Bob Hawke as prime minister.

ASTEC made several major contributions during Ralph's chairmanship that influenced government actions, and continue to do so today. One was their recommendations for the introduction of the 150% tax concession for industrial research and development (R&D).²³ Another was for the establishment of the Australian Research Council, bringing several programs together, including the Australian Research Grants Scheme.²⁴ A third was for future directions for CSIRO, which reinforced the need for CSIRO to remain a single organisation, for it to concentrate on applications-oriented research, and for it to be structured on industry sector lines.²⁵ All these have withstood the test of time, except for the tax concession that has been recently severely eroded.

One other major activity was their report, *Australia's Role in the Nuclear Fuel Cycle*.²⁶ Ralph was not keen on doing it, and found that it took a great deal of his time. But the government adopted virtually all of their recommendations that focused particularly on advancing international non-proliferation through being a major player in the industry.

ASTEC was abolished in 1997, when its functions were transferred to the Prime Minister's Science, Engineering and Innovation Council (PMSEIC).

1984–9: directorship of the Research School of Biological Sciences (RSBS)

Ralph became director of RSBS at ANU in 1984. He initiated three experiments in organisation of the school, the first of which sought to replace the departmental structure by a group structure. This was designed to promote more interactions, and to reduce the extent to which department heads kept matters to themselves. The experiment did not work as well as Ralph wanted, partly because he left to take up the chief scientist post in mid-1989 and so was not able to assist its progressive implementation. Nevertheless, the model was adopted in some other parts of the university.

²² White (1987).

²³ ASTEC (1983).

²⁴ ASTEC (1987).

²⁵ ASTEC (1985). ASTEC (1987).

²⁶ ASTEC (1984).



Figure 4. R. O. Slatyer with Prime Minister Bob Hawke and Science Minister Barry Jones at the PM's Science Council. 6 October 1989. Copyright The Federal Capital Press of Australia.

Ralph's second mission was to change the rules for PhD students to become more like the North American system of which he was a great admirer—inclusion of graduate coursework, the supervision of each student by a committee rather than a single supervisor, and the examination of each student primarily by internal examiners. In particular, he wanted each student to be fairly treated: to have progress monitored, to be notified and counselled if there were problems with progress potentially involving discontinuation and to have an expectation that, if there had been no adverse comment, the thesis would be approved on completion. Ralph felt that he made little progress in this area, but in practice RSBS was a leader in such changes throughout the university.

The third mission was to persuade the university to adopt a promotional system for academic staff that extended to full professor. Ralph sowed the seeds although he felt it was a slow process. When he joined the university, the Institute of Advanced Studies had a promotion system that extended to senior fellow. Appointments to professorial fellow and professor (and in the case of the faculties, to associate professor and professor) required an electoral committee and an open competition involving advertisement, and appointments were based on the recommendation of the committee. A promotional system that dealt with 'appointments of people who were clearly of Professorial status', was effectively introduced at about the time Ralph moved to the chief scientist post in 1989.

1989–92 Australia's first chief scientist

In early 1989, following concerns about the need for stronger science policy machinery, Prime Minister Hawke established the Science Council, to be chaired by the prime minister, and a full time position as chief scientist to report directly to the prime minister and

to be located in the Department of the Prime Minister and Cabinet (Figure 4). The prime minister was keen that Ralph take it on as a full-time position and, after several rounds of discussions, he took up the post on a three-year term. With Mike Codd, secretary of the Department of the Prime Minister and Cabinet, Ralph established the Coordination Committee on Science and Technology to consider matters that spread across departmental boundaries or otherwise affected other departments. The committee consisted of deputy secretaries from all departments with significant science and technology interests, plus the heads of science-based agencies such as CSIRO, Australian Nuclear Science and Technology Organisation (ANSTO), and the Australian Research Council (ARC).

Cooperative Research Centre (CRC) Program

Ralph's most significant initiative as chief scientist was the design, development and implementation of the Co-operative Research Centre (CRC) Program. His experience in the 1950s of the co-location of the CSIRO Division of Soils in the Waite Agricultural Research Institute contributed to his initial vision of the scheme. Also, when he was ambassador to UNESCO, he noted the joint laboratories of INRA/CNRS and universities in France.

As chief scientist, Ralph felt that Australia was falling behind leading countries in many areas of science, particularly when the research required well-funded teams of scientists, rather than individual researchers, to stay at the forefront. He also felt that links between researchers and users of research were still poorly developed in most cases, despite encouragement by successive governments. In October 1990, he accompanied the prime minister to the Commonwealth Heads of Government (CHOGM) meeting in Kuala Lumpur. This gave him several opportunities to raise the

notion of a major program to address the deficiencies in the Australian science, technology and innovation system. He then spent several weeks in Europe, the United States, Japan and Korea discussing cooperative research programs with leading science advisors.

What followed required superb skills at bringing together support from ministers, senior bureaucrats, and scientific and academic leaders. Ralph sought \$100 million per year of new Commonwealth funding. Finally, the prime minister agreed with this scale of funding, a cabinet memorandum was prepared and the proposal was ready for consideration by Australian Government Cabinet in February 1990. However, an early election intervened and the issue became political, with Hawke introducing the 'Clever Country' theme. Labor was returned to government and by May 1990, guidelines had been prepared, applications invited and staff appointed to a secretariat. Ralph chaired the CRC committee, and continued to do so until 1993, by which time the first fifty centres had been selected. Subsequently, the government announced additional funding for further centres and there are currently some 30 Cooperative Research Centres.

The program was thought by some to have become too bureaucratic, with too many time-consuming requirements. One measure is the length of the guidelines, which at one stage ran to 47 pages, now back to 25, compared with the original 15 pages Ralph prepared in 1990. One area of debate has been the degree to which industry should lead, *versus* non-industry-led, public good centres. The CRC program has been reviewed at least seven times and has emerged with continued strong support from both major parties. The program is breaking new ground, generating a new culture, and steadily contributing to Australia's transition to a knowledge-based economy.

Salutation

Professor Ralph Slatyer AC, who died aged 83, will be long remembered not only as one of Australia's most distinguished scientists but for his commitment to ecologically sustainable utilisation of the natural environment and for his determination to ensure Australian science was as good as any in the world. He was also dedicated to the benefits of cooperation and teamwork in research, and renowned for investing trust and support in his colleagues.

In retirement, Ralph kept a close interest in ecosystem science, and was particularly interested in attending scientific talks by students and post-doctoral fellows in Marilyn Ball's Ecosystem Dynamics Group, originally founded by Ian Noble. Ralph continued for many years as chair of the Rainforest Cooperative Research Centre, based in Cairns, and sat on many other boards and also conducted high-level reviews for the government.

That he was able in retirement to devote such energy and commitment to his work and family is remarkable, given his deteriorating health. Nevertheless, his overall contribution to science and to Australia has been recognised by the Clunies Ross Foundation Lifetime Award (2001) and by his appointment as a Companion of the Order of Australia (1993). A full list of Slatyer's awards and honours is included in Supplementary Material, together with a complete list of his publications. The Research School of Biology introduced the Ralph Slatyer Medal for Biology in his honour and the CRC Association has an annual Ralph Slatyer Oration.

Ralph Slatyer had ideas for developing Australian science, and he brought them to fruition. Australian science thanks him and salutes him.

Personal

As a man, Ralph Slatyer worked hard but also enjoyed tennis, skiing and his family. He was proud of his children and grand-children. He loved introducing them to the beauties of the Snowy Mountains and enjoying outdoors pursuits in and around their home in Canberra and their retreat at Guerilla Bay.

Many eminent Canberra scientists had beach houses at Guerilla Bay. Ralph and Lloyd Evans started measuring ocean temperature. As scientists they enjoyed monitoring the local environment, became interested in the annual cycle, and shorter-term fluctuations, and were able to speak knowledgeably to friends and visitors who had not yet made up their minds about swimming (it was 13.8°C a few days before Ralph's funeral).

Ralph had lunch with June as often as he could. He tended to leave the arts to her, and once said to me that he saw trends in modern art and music as a gradual loss of rules, so that in the future modern music might well be like white noise. Nevertheless, he was interested in virtually anything one wanted to discuss with him.

Ralph passed away in Canberra on 26 July 2012. A symposium in his memory was held at the ANU on 7 September 2012.

Recognition

Ralph Slatyer's main honours were:

Public honours:

1977 Queen's Silver Jubilee Medal.
1982 Officer of the Order of Australia (AO) in 1982.
1993 Companion of the Order of Australia (AC) in 1993.

Scientific honours:

1967 Fellow of the Australian Academy of Science (FAA).
1975 Fellow of the Royal Society of London (FRS).
1976 Foreign Associate Member of the United States National Academy of Sciences.
1981 Foreign Member of the American Academy of Arts and Sciences.
1992 Fellow of the Australian Academy of Technological Sciences and Engineering.
1996 Honorary Foreign Member of the Korean Academy of Science and Technology.

Academic honours:

1983 Honorary DSc from the University of Western Australia.
1986 Honorary DSc from Duke University, USA.
1992 Honorary DSc from the University of Queensland.
1999 Honorary DAppSc from Charles Sturt University, NT.

Other major awards:

1950 David Evans Memorial Prize, University of Western Australia.
1960 Edgeworth David Medal, Royal Society of NSW.
1968 Medal of the Australian Institute of Agricultural Science.
1991 Medal of the Australian and New Zealand Association for the Advancement of Science.
1998 Medal of the Australian National Commission for UNESCO.
2001 Clunies Ross Award for Lifetime Contribution to Science and Technology.

Conflicts of interest

The author declares no conflict of interest.

Acknowledgements

The above draws heavily on Personal Records that Ralph compiled with June and the family, revised in 2011, and also on an interview of Professor Slatyer by Dr Max Blythe in 1993 for the Australian Academy of Science. It is available on their website.²⁷ I thank June, Tony, Beth and Judy Slatyer, Barry Osmond, John Passioura, the late Lloyd and the late Margaret Evans, Hal and Lyndal Hatch, Sarah Titchen, Peter Cochrane, Max Bourke, Brian Gunning, Pam Shearmur. Ann Moyal's interview with Ralph Slatyer is a valuable record;²⁸ as is Alan Robson's 2011 Ralph Slatyer Lecture.²⁹

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²⁷ Blythe (1993).

²⁸ Moyal (1992–1993)

²⁹ Robson (2011)