

AW HOWARD KEYNOTE ADDRESS - Mr Bob Reid¹, TasGlobal Seeds Pty Ltd

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Appreciation

First and foremost I would like to thank the Trustees of the A.W. Howard Trust for awarding me this most prestigious of Medals. I remember reading about Amos Howard over 40 years ago and thinking at that time what an innovative man he was in being able to recognize a somewhat insignificant plant such as subterranean clover that had the potential to make such a huge contribution to Australian agriculture.

The Trust established in 1964 has gone on to make an enormous contribution to the promotion of pasture research in this country and has been instrumental in fostering the careers of so many agricultural scientists so its legacy and that of Amos Howard is both significant and expanding.

ABSTRACT:

This Howard oration narrates the course that I have taken over the last 50 years in my field of expertise, pasture genetic resources and their utilization in Australian grazing systems. It also provides me with the opportunity to recognise many of my mentors and colleagues that have helped me make my professional journey the interesting and rewarding one it continues to be. My career has continually evolved, from focusing on the evaluation of new and novel germplasm in the dry tropics of northern Australia through to a totally global perspective of “what grows where” and how this can be applied to modern agriculture. It has involved working in every aspect of pasture research, but primarily was centered on plant collecting, field evaluation, and the development of new and improved cultivars matched to environment. I participated in 10 major plant collecting missions, and 15 of lesser importance which have, resulted to date in the development and release of approximately 25 new cultivars. Of these I am particularly proud of the genepool of *Desmanthus* species which has resulted in cultivars being released in both Australia and in Texas, USA; of Uplands Cocksfoot (*Dactylis glomerata*) which is now the most widely sown cultivar of the species in SE Australia; of Reid (*Aeschynomene villosa*); of Rubitas Red clover (*Trifolium pratense*) and Arrotas Arrowleaf Clover (T, *vesiculosum*).

I had the good fortune to be appointed as the Germplasm Acquisition Officer, and later as Acting Head of the Field Program of the International Board for Plant Genetic resources, based in Rome, Italy. In that role I was able to increase both the funding to wild species collection and the number of pasture species collecting missions. Later spending five years as Director of Agriculture in the Falkland Islands, working with a team of dedicated Australian pasture scientists, I was able to implement a National Pasture Improvement Scheme, which eventually led to the building of an export abattoir.

In 2003 I formed a commercial partnership known as Tasglobal Seeds with the primary aim of promoting Tasmanian bred pasture cultivars to Tasmanian farmers and encouraging their adoption. As Tasglobal Seeds I developed a joint private enterprise-public pasture breeding program with the

Tasmanian Institute of Agriculture which is the first such agreement of its type in Australia where the royalties generated are invested back into the breeding program.

I welcomed formation of the Australian Pastures Genebank which has secured the future of the pasture genetic resource base for the next generation of long term cultivar development work. Threats to future supply of germplasm are primarily those associated with overseas land degradation and global climate change, and the internal bureaucracy adopting a no risk import policy and failing to keep up-to-date with pastoral demands. On the positive side there are some excellent generic and individual species collections available to solve many of the pastoral problems currently apparent in Australia and those likely to be presented by climate change and finite input supplies.

Australian Pasture Plant Genetic Resources : A Personal Journey of Discovery

Early history

My interest in pastures and the potential for their improvement began when as an 18year old I joined the British Voluntary Services Organization and was sent to the Falkland Islands as a teacher. There I was charged with teaching children in their homes on the outlying islands, and living and working alongside the local sheep farmers. I soon realized that pastures in the Islands were of very low quality and that some of the best grazing ecosystems were highly degraded. I read all I could get my hands on about pasture improvement and, after an 18 month stay, on the Islands I had at least some appreciation of the complexity of this area of plant science.

Returning to the UK I found myself “somewhat restless” and with a need to see more of the big, wide world, I migrated to Australia as a “10 Pound Pom” (although please note that I am a very proud Scot). Within weeks I found myself as a station hand or ringer on a property called Bimerah, about 100kms SW of Longreach in Central –Western Queensland.

I arrived in March 1963 just days after a big flood, that not only made getting about somewhat difficult but provided hordes of sandflies that drove both the kangaroos mad and the somewhat soft-skinned new chum almost mad. Not being used to 35°C heat it took a little while to adjust to the climate to say the least. The work was hard, tough and rough, but I enjoyed both it along with the folk I with whom I had the pleasure to work. I still have very fond memories of those years in the “black soil” country. Even then I found myself looking at the country and thinking of how it could be improved.

CSIRO, Division of Tropical Pastures, Davies Laboratory.

In 1965 I found myself in Townsville North Queensland looking for work. I applied for a job at the CSIRO, Davies Laboratory and to my surprise was appointed as a Technical Assistant Level 1 assigned to work for Dr. Martin Playne in his studies on the nutritive value of tropical pasture species. These being the days when the value of Townsville Stylo (*Stylosanthes humilis*) was being seriously recognised and the push to improve tropical pastures was well underway. Within a few weeks of joining CSIRO I knew what I wanted to do with the rest of my life, and within a few months I had enrolled at James Cook University. I was very lucky that Martin had a flexible attitude towards my working hours allowing me to start early, put a day’s work in then spend the rest of my time attending lectures. My studies focused on botany and biogeography and I graduated with Honours in 1972.

In 1968 I transferred to the Plant Introduction Section under the tutelage of Dr. Bob Burt which allowed me to concentrate on what was to become my specialty - Pasture Plant Genetic Resources. Besides expanding my knowledge of the tropical species; their geographic source, use and potential, I deepened my appreciation of pasture science and the tropical Australian environment. Being based in Davies Laboratory I was exposed to a host of scientific disciplines including. soil science and animal production as well as availing myself of the mentorship of such notables as Dr. Peter Gillard and Les Edey (Tropical Pastures), Dr. Roger Jones (Plant Nutrition) and Ray Isbell and Graham Murtha (Soils). In 1972 I was promoted to the position of Experimental Officer and given the role of expanding the Plant

Introduction Section which involved a much increased liaison with colleagues at the CSIRO Cunningham Laboratory and also with the Pasture Group of the Queensland Department of Primary Industries (QDPI). I was fortunate to come under the influence of Ray Strickland and Ron Williams (plant introduction) and Drs Bob Clements and Mark Hutton (Plant Breeding) all of whom provided me with advice, support and encouragement.

From the start of my involvement in the Plant Introduction Section I was very impressed with the performance of Butterfly Pea (*Clitoria ternatea*) at the Lansdown Research Station. With the support of Bob Burt I assembled probably the best collection of the species in Australia and proceeded to characterize it. After about one year into the project we received a visit from the Cunningham Laboratory “urus”, and after their inspection of my plots I was told, politely, that this must be the ‘the third coming’ of *Clitoria* and maybe I should put my efforts into something a bit more rewarding. Their rationale being the species had been widely tested by the CSIRO at both Katherine and Kununurra and while promising, had never reached its potential. As a young researcher I was devastated. Not long after I visited Trevor Hall (QDPI) at Cloncurry where *Clitoria* was performing very well, and after some discussion we agreed that I would finish the characterization and pass the best lines to him for regional evaluation. This was done, the work published and I moved on. Trevor planted trials on the clay soils of Milgarra Station in the Gulf country and was so impressed he released a composite cultivar called Milgarra. Thirty five years later there are some 200,000 Ha. planted in Central Queensland. I’m sure there are many lessons to be learnt from this story.

Plant collecting missions

By the mid 70’s I thought I knew a lot about the tropical plant species. So much for the arrogance of youth! In truth I was just starting to put “the picture” together and from then on the real learning curve began largely through the many plant collecting missions I conducted and the opportunities they provided me to learn the relationships between plants and place. In this discussion I have only detailed four collecting missions as examples of the range from very broad to specific.

First Collecting Mission

In 1977 I took off for Cuba, Argentina, Brazil and Colombia (in that order) and was away from home for five months. After my first week in Cuba I realized two things namely my botanical knowledge of tropical legumes was not as good as I thought and my Spanish was abysmal. Nevertheless I learnt quickly and besides improving both of the above I began to appreciate the problems that the developing world faced, and indeed, still faces. After meeting up with Ray Isbell in Peru, and a quick visit to the Amazon jungle, it was on to Argentina.

The target area in Argentina was the subtropical north with the provinces of Salta and S.S de Jujuy being the centre of interest. Travelling by car in 1977 proved to be somewhat difficult as the Military Junta

had taken power just a few months before and the "dirty war" was in full flow. Both Ray and I had difficulties being foreigners with numerous repeated searches, body pat-downs and middle of the night passport inspections being commonplace, and once had to endure shots being fired over our heads. Although not the best time to be wandering around the countryside it was a fascinating trip as I was able to collect some completely new, (to Australia that is) species and ecotypes. From this mission the cultivar Marc (*Desmanthus virgatus*) emerged and was successfully developed by Bob Clem, QDPI.

Brazil at that time was also governed by a military dictatorship but that did not pose any problems with internal travel. Indeed in some remote areas it meant that access was markedly improved. Interest in tropical legume research was on the increase and I began to get a better understanding of how legumes would be used. I was very well looked after by the pasture group of the University of Campinas, Sao Paulo in particular Dr. Paulo Barduil-Alcantara, who some nearly 40 years later has become a most valuable co-operator with Tasglobal Seeds in its expansion into Latin America. The highlight of the Brazilian segment of the mission was being able to join a team of Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA) pasture scientists and Dr. Rainer Schultze-Kraft, Centro Internacional de Agricultura Tropical (CIAT) on a collecting trip into the States of Matto Grosso and Para. Many of the species collected were completely new to pasture scientists and in later years became important in the CIAT cultivar development program. Travelling in this part of Brazil exposed me for the first time to the huge areas of rainforest being cleared, and the associated developmental problems, both physical and human. Not the least it was the first time I had seen people (settlers) being transported into the newly cleared areas in cattle trucks. Unfortunately I contracted severe amoebic dysentery and had to spend a week in hospital in Cuiaba where I was given small doses of arsenic to treat the condition. I was cured but now have such red cheeks you would think I am permanently wind burned.

CIAT in Colombia was my final destination on this mission and there I was able meet with pasture scientists from all over Latin America. Their focus was on agriculture in the humid tropics particularly using the acid soils of the Llanos of Colombia and Venezuela.

Besides returning to Australia with useful germplasm and having had some wonderful experiences, on reflection I felt that it would have been of more value if I had concentrated on smaller areas for collection and spent more time on the ground. Admittedly I did get some of the best "hands on" taxonomic training with tropical legumes, particularly with new and or little known species that was to prove invaluable in later years

Second collecting mission

In 1979 a symposium organized by CSIRO, was held in Townsville on the subject of The Genetic Resources of Pasture Plants. In the foreword of the proceedings Dr. Ted Henzell wrote "immediately following our Symposium the International Board for Plant genetic Resources (that co-sponsored the symposium) convened a working group to discuss world priorities for forage plant genetic conservation. This was an important first step in what must be a continuing activity of high priority". I was fortunate

to be involved with this working group and in many ways it set the scene for my career for the next 15 years. Seizing the initiative, CSIRO, after many internal discussions, decided to support a major collecting mission with Mexico as the target country. It was known as a country that was rich in legumes but had only been superficially collected. All the major genera of interest were found there including *Desmodium*, *Leucaena*, and *Macroptilium*. Some had even already provided cultivars that were being promoted in Australian pastures. It was decided that in order to get the very best out of the opportunity I should spend time based in country. This not only allowed me to cover the land in more detail but to revisit sites in order to maximize the opportunity of collecting seed. It was also decided that my family would accompany me. During my time overseas Trevor Hall was seconded to the Davies Laboratory to continue with my research program.

We arrived in Mexico in October, settled in quickly in the city of Cuernavaca where I was provided with support (vehicle, office, labour and land for trials) by the Instituto Nacional de investigaciones Agropecuaria (INIA) with whom CSIRO had entered into a co-operative agreement. I had permission to collect all over the country with any seed collected to be divided between the two organizations. Also I brought to Mexico a very wide range of pasture germplasm that was to be multiplied and distributed to INIA research stations throughout the country.

Living in Mexico at first proved to be very difficult with all the associated problems of adapting to a new way of life. As a family we quickly found our feet but not before we nearly lost my daughter to severe amoebiasis. Within weeks I was on my first collecting trip to Baja California Sur and was immediately rewarded with exciting new and novel germplasm. Over the next 18 months I was able to collect in every Mexican state, except one (Baja California Norte). Virtually from the beginning it was clear that some sites would need to be visited more than once. For example on the first visit all the species of interest were identified and often seed of the annuals collected. Subsequent visits were required to collect seed of the perennials and late flowering trees and shrubs such as *Leucaena* species. Between collecting trips I spent as much time as I could at the National Herbarium of Mexico where I was able to glean collection site characterisation data and in many cases when the plants were likely to have ripe seed. In August 1980 I was joined by Dr. Al Kretschmer, University of Florida, and we visited three herbaria in the USA (Austin, Texas, Phoenix and Tucson, Arizona). Botanists from these institutions had collected widely in Mexico, particularly in the northern states of Chihuahua, Coahuila and Sonora. Information learned from these visits very quickly translated into further successful collecting in all northern states. In November of that year Trevor Hall came to Mexico on vacation and we managed to collect together in Sinaloa and Sonora. It was in these states that we were able to truly appreciate the value of the genus *Desmanthus*, and to a lesser extent *Macroptilium*. Plants from both genera were found in very arid areas, usually under heavy grazing pressure and on vertisols, and at the time we were both firmly of the belief representatives would find a place in Central-Western Queensland. It has taken some 30 years but at last *Desmanthus* species are finally commercially available to farmers.

Mexico is the centre of origin for the genus *Leucaena* and before my visit the number of species represented in the world's gene banks was very limited to say the least. I was able to collect seed from all the known species, some being very rare indeed and I doubt whether they still exist in the wild. Some of the accessions have been widely used in breeding programs, particularly those conducted by

the University of Queensland.

Mexico not only provided valuable pasture germplasm for our programs in Australia but also for other countries. As examples a composite cultivar of *Desmanthus bicornutus* was released in Texas, and *Chamaecrista rotundifolia* is now planted on acid soils throughout sub-tropical China.

Collecting in Mexico was never easy with one having to face all the problems associated with a developing country including everyday police corruption (mordidas), poor roads in rural areas, limited accommodation, and criminal elements, especially in those states bordering the USA. On the positive side I was welcomed everywhere I went. Even in the poorest villages people opened up their homes and shared their local knowledge which was invaluable because I knew the species collected would be of value not only to Australia but across the world.

Leaving Mexico in February 1981 I went to CIAT, Colombia for four months, learning something of their pasture species screening systems, particularly on the acid soils of the Llanos, and working within the genebank. I managed to join Rainer Shultze- Kraft on a collecting mission to the Caribbean coastal region of Colombia where besides collecting some *Centrosema* species previously poorly represented in genebanks, I became something of an expert in recognizing small fields of marijuana and where we should not collect!

I returned to the Davies Laboratory and proceeded to start the evaluation process of much of what I had collected. For the next 4 years, besides my field work, I continued to both take part in overseas collecting (Indonesia, Mexico and South Africa) and herbarium studies (Papua- New Guinea). The Mexican mission in 1984 was funded by the International Board for Plant Genetic Resources and I was joined by Dr. AL Kretschmer from the University of Florida. We concentrated our efforts on the sub-tropical highland of Vera Cruz an area that was new to us both. From this mission two cultivars of *Aeschynomene villosa*, namely Kretschmer and Reid were developed and commercially released. I left CSIRO in 1985 to join, albeit briefly, the Tasmanian Department of Agriculture based at the Elliot Research Station. I stayed long enough to get a basic understanding of temperate pastures and had the good fortune to spend quality time with Dr. Jim Carpenter, who encouraged me to start thinking about new temperate species with better adaptation to Tasmanian conditions.

International Board for Plant Genetic Resources (IBPGR)

In mid-1987 I received a request from Prof. (J.T.) Trevor Williams asking if I would be available to join the IBPGR as its Germplasm Acquisition Officer, based in Rome, Italy. I had met Trevor briefly, in 1978, when we were both detained at the same time by the Border Police in the departure lounge of the airport in Cali, Colombia which was a normal practice in those days to raise funds for the Police Benevolent Fund.

I was granted extended leave of absence from the Tasmanian Department and took up my new position in late summer of the same year.

I had always been interested in plant genetic resources but my new role was in every sense of the word an “eye opener”. I was immediately commissioned to review the whole acquisition program since IBPGR’s start in 1974 and to report to the Board’s Program Committee. This was in some ways akin to being “thrown off the deep end” but it did very quickly give me a detailed oversight not only of all the germplasm acquisition activities but of the overall structure and role of the organization and its place within the Consultative Group on International Agricultural Research (CGIAR).

The Program Committee recommended that more attention be paid to priority targets, to planning future collecting missions in greater detail, and to improving follow-up operations by establishing links between collection, grow-out, and documentation procedures. Over the years, IBPGR-supported collecting missions have been active in at least 115 different countries. In the early days, priority was given to collecting landraces and primitive cultivars but following my appointment greater emphasis was placed on wild material. This led to an expansion of using ecogeographical surveys with an IBPGR consultant, Dr. Nigel Maxted preparing detailed surveys of areas and taxa that were about to be collected, or about which information was required to make collecting decisions. In relation to pastures, in the first group of studies, I noted ecological recommendations for the exploration of plant genetic resources in the following countries. In the Central African Republic, Mauritania and southern Chad ecological information on the exploration of the genetic resources of wild *Eleusine*, in Africa, wild *Pennisetum*, in Kenya wild Sorghum, in Ethiopia, Kenya and Sudan, the ecology and distribution of wild *Vigna*, in Botswana, Malawi, Swaziland, Tanzania, Zaire, Zambia and Zimbabwe. The distribution of *Avena macrostachya* in Algeria was also studied. Over the next few years all of these were collected to a greater or lesser degree.

My role however meant that I had to look after virtually every conceivable food plant, (Forest species were not part of IBPGR’s remit at that time). For example in my first year besides over-seeing the missions already underway (cocoa in Bolivia, arachis in Brazil, maize in Paraguay, Guatemala and Honduras and breadfruit in Fiji amongst many others; I initiated 14 new missions which included the collection of *Triticeae* in China, *Lycopersicum* in Chile, *Helianthus* in the USA and *Mangifera* in Indonesia.

For the next 3 years I found myself involved in virtually every aspect of the global genetic resource initiative so it is very difficult to summarize all of these in a few paragraphs., I have therefore focused on a few examples which highlight the primary areas of IBPGR activities with more detail being available from the IBPGR Annual Reports for the period 1987 to 1991. The collecting program expanded quickly, with the appointment of three dedicated IBPGR collectors, based in Cyprus and Zimbabwe. However most of the collecting activities were conducted through National Programs and I was continually involved in assessing these and where IBPGR could assist. By 1990 three seed handling units were fully operational based at the Centro Agronomico Tropical de Investigacion y Ensenza (CATIE), Costa Rica, the University of Singapore, and Kew in the UK. Their principal function was to clean seed for storage, complete the passport data and forward the material to the final destination.

Management and use of information, facilitates, effective collecting, conservation and utilization of plant genetic resources within the broad area of information management, documentation includes all the functions related to acquisition, classification, storage, management and seed dissemination. For

example in 1990 IBPGR produced standardized descriptor lists for wild *Arachis*, *Brassica*, *Beta*, annual *Medicago*, Maize and *Raphanus* in English, French and Spanish. To date, IBPGR (now Biodiversity International) is still the best source and custodian of crop databases.

Throughout my time at IBPGR I was required to attend many workshops, participate in working groups and convene expert teams to advise on specific issues. Amongst the most memorable were the IBPGR/ICARDA *Medicago* workshop in 1989, the CYMMIT Conference on Maize Genetic Resources in 1989, the CIAT/IBPGR *Arachis* Working Group in 1990 and the FAO/IBPGR Expert Consultation looking at the potential of a permafrost storage at Svalbard, Norway.

In early 1990 I was appointed Acting Head of IBPGR's Field Program with responsibility for germplasm acquisition, training, documentation, the eight Regional Offices and three Seed Handling Units. One of my first tasks was to visit the Vavilov Institute in St. Petersburg to examine ways in which that famous organization could be more closely integrated into the global scene, using the support of IBPGR. Within a matter of months a Memorandum of Understanding was signed between the two organizations. At the signing I was awarded the Vavilov Medal and to this day still maintain contact with some of my Russian colleagues.

Before leaving IBPGR in 1991 I was asked to take part in the development of a new Strategic Plan for IBPGR. The consultation process was complex with more than 80 scientists from 40 countries taking part. The meetings resulted in widespread approval of the general strategic principles proposed by the Institute and generated both new and positive suggestions. The Plan was approved in 1992.

My stay in Rome was one of the great periods in my working life, best described as fast, furious (visiting some 36 countries), challenging but immensely rewarding. I made many friends across the world, some of whom I still work with today so I would like to take this opportunity to recognise and thank a few; including the late Trevor Williams for "giving me a go", Dick van Sloten, Jan Konopka, Luigi Guarino, Ruth Raymond, Eliseu Bettencourt and Emile Frison, who all great guys to work with.

Tasmania

Returning to Tasmania I consulted the then Director of the Department of Primary Industries (DPI), Dr. Alan Smith, as to what he wanted me to do. To my surprise he requested me to look over the Tasmanian pasture situation and to come back to him with a proposal. This I did after many consultations with farmers, fellow researchers and industry organizations. I deduced that someone with my background would best serve the agricultural community by developing pasture plants much better adapted to the Tasmanian Midlands, rather than the expected new perennial ryegrass and white clover cultivars. The area of interest was drought prone, suffered severe often out of season frosts, was infected by root eating grubs and the quality of the dominant barley grass pastures left much to be desired. All of these problems were imposed on one of the best sheep rearing areas in temperate Australia.

My first, and as it turned out correct, approach was to find those areas of the world that had a climate

similar to the target area, and to select one that had a wealth of species known to be of value. I quickly settled on a region in northern Spain and with funding from the then Australian Wool Corporation undertook another collecting mission

Third collecting mission

I determined that the area of most interest was in the provinces of Castille and Leon, as both had low rainfall areas and generally acid soils. As it turned out the time of collection was almost perfect so with a few exceptions I was able to find mature seeds on all the target species. The primary plant of interest was *Dactylis glomerata* var. *hispanica* which was common, particularly at the driest sites. I was somewhat surprised to find just how variable it was with both broad and fine-leaved ecotypes often growing within metres of each other. The area overall was very rich in annual legumes and on the somewhat more acid soils *Ornithopus*, *Trifolium* and *Vicia* species were well represented. At one site on a sandy soil near Zamora I collected 12 species within 100 square meters. A bonus find on better quality soils was a number of *Trifolium pratense* var. *stoloniferum* ecotypes. I was familiar with the cultivar Astred, developed from material collected in southern Portugal, but had not expected to find similar forms in this colder and more temperature extreme area. I did find some forms of *Medicago sativa* that were completely stoloniferous but I was too early to collect seed. These plants were very impressive as they were clearly quite old and growing on sites that were periodically subjected to heavy grazing by sheep. I concluded another very focused collecting mission was required.

Within weeks of returning from Spain seed was sown in small plots and the following year trials were planted across the State. We deliberately chose very dry and challenging sites, and included what is arguably the driest site in Tasmania, namely the north facing slopes of the Sendace Hills. Some of the *Dactylis* lines are still present, having gone through two serious droughts under virtually continuous grazing by sheep. This mission, to date, has been the source of three cultivars, namely Uplands and Sendace (*D.glomerata* var.*hispanica*) and Rubitas (*T.pratense*). The former is now probably the most widely sown cocksfoot across south-east Australia.

During this time we identified, from other sources, some very interesting new germplasm which evolved into the cultivars Arrotas (*T. vesiculosum*), Kuratas (*T.ambiguum*), Permatas (*T.tumens*), Yellotas (*O.compressus*), Serratas (*O. sativus*), Megatas (*D.glomerata*), and Exceltas (*Bromus coloratus*).

At this point I would like to acknowledge that all this work was very much a team effort and would not have been possible without the enthusiastic support of Eric Hall (who took over the program when I went to the Falkland Islands), Andrea Hurst and Gary Martin, Tasmanian Institute of Agriculture (TIA) and Stuart Smith, DPIPWE. Collecting is often the easiest part of these types of programs with the real long term work being the breeding and field evaluations.

Whilst with the DPI I was asked to join two collecting missions. The first was a joint CLIMA/ ICARDA mission to Morocco and Tunisia searching for annual legumes. On this mission I had the good fortune to work with Dr. Clive Francis, from whom I learnt a lot and sought his advice on many pasture germplasm subjects until his untimely death. We all owe Clive a debt of gratitude as he was a true champion for pasture genetic resources. Secondly I joined an ICARDA mission to Ecuador collecting

landraces of Old World germplasm including *Hordeum vulgare* and *Vicia faba* which was originally brought from the Iberian Peninsula and considered to now to be extinct there.

I was asked by the Australian Centre for international Agricultural Research at this time to join a review team to look at a proposed animal nutrition project in Qinghai Province (Tibet) of China. After two visits the project did not get approved, however I was able, for the first time, to get some understanding of the problems facing pastoralists in the high altitude areas of Central Asia.

Falkland Islands

In mid-1996 I was contacted by old friends in the Falkland Islands who urged me apply for the position of Director of Agriculture. The Falklands Government had ascertained that a productive and sustainable agricultural sector was needed to form the basis of a diverse economy and with the coffers being in a healthy state from fishing licences, funds were available to expand the Department of Agriculture. I was appointed and took up residence in Stanley in November of that year. As it turned out it was the first time in my public service life that I was asked to put a plan and associated budget together and have it funded in its entirety.

The pattern of Falkland Island agriculture had changed very little since the introduction of sheep farming in the mid-19th century. The infertility of the organic soils coupled with the very windy and cool oceanic climate together with the great distance from the principal market in the United Kingdom, had ensured that wool was the only agricultural export. Over the years there had been many reports to Government as to how to improve pastures and increase stock numbers, but virtually none of the recommendations had been implemented. (It should be noted here that one of the best had been authored and implemented in 1939 by Dr. William Davies, brother of Dr. Jack Davies, who is very well known of in Australia). However after the conflict with Argentina ended in 1982 a great many changes occurred within the Islands and without doubt, the greatest change in agriculture was sub-division of large landholdings to develop smaller, owner occupied, farms. Unfortunately by the early 1990's there was a global downturn in wool price so the Government determined that it had to support the rural sector.

The new initiative focused on a very generous, heavily subsidized, pasture improvement program. A team of researchers was quickly assembled and within no time they were called Bob Reid's Australian Mafia. It was made up of Dr. Sean Miller (Sheep Nutrition), Dr. David Parsons (Pasture Agronomist) and Robin Thompson (Beef Specialist). Working as a team and across their specialist fields within three years they had built on previous research and their own initiatives to develop an excellent strategy to put the pasture improvement plan in place. Based essentially on the application of rock phosphate and a local calcified seaweed (lime source), the legumes White clover and *Lotus uliginosus*, and well known grasses such as perennial ryegrass and cocksfoot, they were able to demonstrate that it was not the climate but poor soil that was limiting establishment of improved pasture; and that the new pastures were productive. Sean's work focused on evaluating links between nutrition and survival in young sheep, evaluating supplementation strategies to improve nutrition of sheep during their first year

of life and improving ewe nutrition pre and post-lambing. David concentrated on screening legume species for suitability to be used in improved pastures and it was his work on *Lotus uliginosus* that demonstrated it was a well-adapted species. Robin, quite literally starting from scratch, developed a National Beef Herd, often under very trying conditions including building the first set of modern cattle yards seen in the Islands. All this effort eventually led to a situation where a modern abattoir was built and today the Falkland Islands have a profitable meat export industry as well as wool.

Tasglobal Seeds

I returned to Tasmania in late 2001 determined to retire and spend my time breeding and cultivating my rare bulb collection. This however was not to be, for, within a matter of weeks I was approached by Robert Dent to look at the possibility of setting up a pasture seed business. Rob and I had first met in 1993 when we were members of the winning team of the Tasmanian Enterprise Workshop, and in the intervening years he had gone on to establish a successful seed cleaning business. We both knew that the pasture cultivar development program being undertaken by TIA was consistently looking for funds, and although the material due for release was of the highest genetic quality, it was not getting to farmers as fast as it should. It was at this point that we approached both TIA and DPIPWE with a proposal that we join them in a commercial process whereby we organize seed production, promote and market the cultivars in return for a royalty which would be used to support continuation of the program. Knowing something of how government bureaucracies work I must admit that I was not at all hopeful that the proposal would be approved. To my surprise the relevant managers approved it in principle within a matter of weeks, with the stipulation that it put to public tender. This was done and to my further surprise Tasglobal Seeds were the only applicant. That is when I knew we had done the right thing as now there was a pathway to get Tasmanian bred and/or developed material onto Tasmanian farms. I believe this was the first time this type of joint private enterprise/public pasture cultivar development had occurred. It has overall worked well but it certainly took much longer than we originally thought before sufficient funds were generated to the satisfaction of both parties. This program is still a work in progress and we can confidently expect some valuable cultivars to be produced in the coming years.

Tasglobal Seeds has also its own development and breeding programs and over the last 10 years has released two oat cultivars, Carrick and Negrita, a forage pea, Hadspen, a vetch (*Vicia benghalensis*) Benatas, a perennial ryegrass, Wintas 2 and a tall fescue, Versatas. We also have an interest in developing a Teff cultivar (*Eragrostis tef*) for Tasmanian conditions and I would acknowledge here the financial support we have received from the Rural Research and Development Corporation in support of this activity.

From the beginning Tasglobal recognized it had to expand its activities well beyond Tasmania in order not only to both generate funds but also to fully utilize the potential of the germplasm we had access to. In part this was brought about by the success of the Hispanic Cocksfoot Uplands and the many requests we had from farmers and our distribution partners to develop *Dactylis* lines that were even more

drought tolerant. This led to another focused collecting mission to Spain.

Fourth collecting mission

In July/ August 2007 Rob Dent and I went to south east Spain specifically to collect a range of *Dactylis glomerata* var. *hispanica* Material. After a detailed ecogeographic study we deduced that a collecting mission would concentrate on a limited area within a 100km radius of Almeria, in what is often described as the only true desert in Europe. With annual rainfall ranging from a low of 125mm to 350 mm and generally alkaline soils (pH 7.5 to 10.00), and a long history of grazing the region looked to be very promising. Our collecting technique was to quickly drive over the area to assess what was there and whether we could gain access. Then after identifying the most interesting and or promising sites we covered them on foot, often “well off the beaten track”. By the end of the very first day we knew that the mission was a success and at the end of 10 days we had collected some 120 accessions of the target species. Our elation was heightened by the fact that some accessions were collected on soils with salt crystals on the surface and others from black cracking clays with a pH of 8.5. Neither of these two site characteristics were represented by plants in our current collections. These accessions are now under evaluation and we are looking forward to them being a source of cultivars for the Mallee and Wimmera.

Tasglobal decided in 2011 to expand into New Zealand and entered into a distribution agreement with Kiwi Seeds, in Blenheim, North Island. This was done on the basis that much of New Zealand has a climate very similar to Tasmania and after having a series of severe droughts farmers recognised the need for alternative species to ryegrass and white which had been severely stressed by the extended dry period. It is early days yet but suffice to say that the uptake of Tasglobal products has exceeded all our initial expectations.

In 2012 I was approached by an old friend from my early days in South America, Paulo Barduil Alcantara, who is now the senior consultant to Matsuda, which is arguably the biggest pasture seed company in Brazil. , Matsuda, was looking to expand its operations into the temperate regions of South America, particularly in Argentina, Brazil, Chile and the high altitude areas of the Andean countries. After a visit from the senior management team to Tasmania in 2013 and a return visit by myself to Brazil the following year, both companies agreed to enter into a formal alliance to progress the development of new and novel pasture germplasm. Trials are already underway in Rio Grande do Sul.

Comments and Issues in Pasture Genetic Resources in Australia

Background

With my interests you would expect that I have something to say about where we are going with pasture genetic resources. However before that a little background. Over the last 80 years, some huge increases in animal production have been achieved in Australia, essentially by the amendment of soil nutrient deficiencies and the sowing of introduced pasture species. This process started in the temperate zone, driven, arguably, by the pioneering and successful work of Amos Howard with sub-clover, and later taken up in the tropics with the rapid spread of Townsville Stylo. As it became apparent

that the early pasture cultivars were less widely adapted than originally claimed, the need was recognised to develop more variation within species or seek new species to meet specific requirements. Much of the early germplasm was obtained through exchange with overseas government institutions or private introductions and was a somewhat hit and miss affair, but after WW2 Australia was most fortunate in being able to attract some very talented people into the field of plant introduction and collecting. When William Hartley led the first Australian mission to South America in 1947-48 he set the standard for all his successors. His methodical approach based on climate classification, use of distribution data in herbarium collections, using local contacts to understand both botanical and agronomic issues, and a sense of where the targeted plants might fit into the Australian pastoral landscape, resulted in a quantum leap in providing new pasture germplasm. At this time pasture scientists were introduced to species such as legumes from the genera *Aeschynomene*, *Desmodium* and *Stylosanthes*, and grasses from *Bromus* and *Paspalum*. that are now regular features of the farming scene.

Organized collecting grew apace over the next 50 years and we were enriched by a host of new and exciting pasture plants. The pioneers in the temperate region were Colin Donald, John Miles and Eric Crawford and in the tropics Tommy Atkinson, Bob Burt, Ron Williams and Ray Strickland. Ray I think needs a special mention. In 1974 he covered a wide range of environments in eastern and southern Africa and drove over 4500kms in a 4 wheel-drive vehicle, starting in Mombassa, Kenya, and ending up in Durban, South Africa. A no mean feat at the time considering the difficult physical and social conditions encountered, not the least being a civil war and landmines. His collections, particularly within the genus *Digitaria*, continue to be source of new cultivars. These pioneer collectors were followed by a host of dedicated collectors completing in excess of 100 missions to date, approximately 125 grass and 200 legume cultivars have been directly produced or bred from the germplasm collected. Today this activity has been much reduced, even to the point that the word "exotic" is seen as a threat by some sectors of the community resulting in significant restrictions governing importation of new plant genetic material. Such an attitude that has to be countered if Australia is to ameliorate the worst effects of climate change and continue to meet its share of the responsibility for feeding a growing world population.

Genebanks

Slowly but eventually it was deemed necessary that the Australian collections had to be collated, curated and stored. Thus Western Australia developed the Trifolium Genetic Resource Centre, South Australia the Medicago Genetic Resource Centre, and later CSIRO, a Tropical pasture Genetic Resource Centre which was later moved to Biloela, Qld under the control of QDPI. The system worked very well for about 30 years but with the gradual reduction in public funding for pasture research these Centres fell on hard times. It seemed for about 15 years that the responsibility for them, even after numerous reports supporting their continued existence, was put in the "too hard basket ". Eventually, I am very happy to report that, "good sense" has prevailed and that we now have the Australian Pastures Genebank (APG) established, hosted by the South Australian Research and Development Institute, jointly funded by the major Rural Research and Development Corporations and operationally supported by all the State Departments. It will operate under the framework of the International Treaty on Plant

genetic Resources for Food and Agriculture and is mandated to do all the necessary things associated with a world class genebank. Upon completion of the major genebank collection transfers it is estimated that the APG will be the custodian of the world's largest collection of pasture and forage germplasm, with between 85,000-90,000 accessions from over 2,400 pastures and forage species. It is also estimated that around 70,000 accessions will be unique to the APG in that they are not maintained in genebanks anywhere else in the world. This facility will not only ensure that Australia, meets its International obligations in relation to the use and protection of germplasm, but that it also has access to the best possible source of material for future plant breeding activities. I can only wish Steve Hughes and his Technical Advisory Committee well in their deliberations and that the funding for the enterprise continues into the future well beyond the initial five year period.

The future

We, the agricultural community, will be in need of plant genetic resources for a long time into the future. There are not only the current problems to solve such as more productive salt tolerant species, C4 grass species for temperate zones, legumes for clay soils in the subtropics but we will be facing relatively rapid environment alteration owing to climate change, the almost certain advent of new or modified insect and disease issues, and simple market forces which will control what is produced. Having the APG goes a long way in ensuring that we can cope but we must not be complacent.

Threats

Climate change probably tops the list of agricultural threats as all over the world interested parties are reporting plant species being found where they were not before, essentially from warm to cold. However we should not forget that even if the climate was not changing we humans have already had an enormous impact on the environment. Land degradation alone has reached the stage globally where it is equal to an area the size of the continent of South America. Large scale changes in land use have denuded complete ecosystems. The tropical rainforests receive a lot of publicity but there are others of almost equal size, such as the high western plateau of China, ploughed up on a huge scale some 30 years ago and the upward movement of general agriculture in the mountains of East Africa. It should not surprise us that species such as *Arachis pintoi* from central Brazil are no longer to be found in the wild despite their value to agriculture.

Many of us who work in this field, whilst accepting the need for care and constraint in the introduction of new species into Australia, are continually being frustrated by the implementation of the current Biodiversity legislation. It is good that we have a tough introduction process as we have made mistakes in the past but we do not need one that stifles innovation and sends the wrong message to investors in pasture plant development. We are currently working within a bureaucratic system that works on a no risk theory. One could even possibly argue that this would be acceptable in a "steady state" world, but we are not in such a world. It is worth pointing out that if the criteria for allowing a species into Australia had been in place 80 or 90 years ago, we would not now be promoting such important species as most of the clovers including Subterranean, Balansa, and White; and grasses such as Phalaris. Amos Howard would have been most unhappy and frustrated I'm sure.

Let me share with you a few more examples. The genus *Dorycnium* has three shrubby species that have agricultural potential. *D.pentaphyllum* will probably only be used as a honey bee plant. *D.hirsutum* and *D.rectum* have significant potential with the former being widely distributed across southern Australia and the latter only on Research Stations (or supervised trial sites).

D. hirsutum is now widely planted, has no restrictions on its release even though it re-seeds profusely, particularly on sandy soils whereas *D.rectum* has been classified as posing a potential weed threat but at none of its trial sites (some being 20 years of age) has there been any significant seedling recruitment. This species will grow on land that is somewhat winter wet, has both shelter belt and browse qualities, some salt tolerance, is palatable to sheep and retains green leaf well into summer. Surely such a valuable plant should be promoted, especially in areas such as the Western Districts of Victoria where a summer active perennial legume is required.

The genus *Desmanthus* has a number of species that are proving valuable in the tropics of Australia. Some, such as *D.virgatus*, *D pubescens* and *D leptophyllus* have provided cultivars. In the 1979-81 period a number of other species were collected in Mexico, particularly on clay soils in semi-arid areas. These were soon cleared through quarantine, seed produced and trial sites planted throughout North and Central Queensland. Some 15 to 20 years later the old trial sites were revisited and the surviving plants noted, collected and seed produced. Clearly they were well adapted and had survived under grazing, where all other species had failed. One of the species was *D. bicornutus*. When one looks at the AQIS ICON site to assess whether this species may be introduced it is listed as having weed potential and not permitted.

It should be noted that this species is not only non-weedy in its native environment, but has not become so in Queensland, where a plant adapted to clay soils and is drought tolerant is so desperately needed. The system in place to protect our agricultural base is clearly not working in this example, made all the more obvious when the species in question is part of a composite *Desmanthus* cultivar that is being promoted commercially through the Australian tropics.

Opportunities

With my background, both scientific and commercial, it should not surprise anyone that I have a propensity to look ahead as to what, and for where, opportunities exist to utilize new and novel germplasm. In the Australian pastoral environment I would like to bring your attention, (in addition to those noted above) to the following.

We have hardly scratched the surface with the genus *Dactylis* (Cocksfoot) long known in Australia, but often considered as the second choice, as being productive but somewhat unpalatable and difficult to manage. However there are now two new directions of investigation underway with *D.glomerata* Firstly, looking for accessions that have higher nutritive value for use in high production systems, such as dairy and or irrigated pastures. This has been encouraged by the release of cultivar Megatas, bred by Eric Hall, ex Tasmanian Institute of Agriculture.

D.glomerata var. *hispanica* has always been of interest to farmers in the low rainfall, truly Mediterranean areas of Australia. A number of cultivars have been released but none have made an impact principally because of problems with the commercial production of seed. New accessions have now been identified that are not only good seed producers but will extend the use of this species into low rainfall regions with alkaline soils, such as the Mallee.

Talish clover (*Trifolium tumens*) was recommended to me as “a plant to watch” by Eric Crawford in 1985. This is a long lived perennial with an exceptionally long taproot which confirms drought tolerance and a crown just below the surface giving it tolerance to hard, prolonged grazing. We in Tasmania assembled a small collection which Eric Hall advanced by joining a SARDI sponsored collecting mission to Azerbaijan in 2004 during which he was able to collect a further 38 accessions. A cultivar has been released but is not yet commercially available. At virtually every site where this plant has been evaluated it has topped the table for persistence and there is considerable overseas interest in it. Commercial seed production is proving to be a problem but that is an agronomic failing rather than one of the plant.

We know that there is a demand for C4 grass species in central and southern NSW, with similar calls coming from the relatively mild coastal districts of South and Western Australia. To date agronomists have looked at and had some limited success with species of *Digitaria* and *Panicum* originating from breeding programs in southern Queensland, but the currently available cultivars lack the cold tolerance required to survive. Both these genera have their origin in South Africa and both the USDA and CSIRO (Ray Strickland) have collected there. A study of the site of collection data has indicated that there are already accessions in the respective genebanks that would seemingly be prime candidates for evaluation. This offers a great opportunity for a young research scientist.

I have for a long time been intrigued by the problem of “pasture rundown’ found in the Brigalow, and associated soil regions, of south-central Queensland with an area of 12million Hectares. Productivity decline is widespread and very serious, with a 50% reduction in pasture and animal production. It is estimated that there will be a “farm gate” cost of greater than, \$17 billion over the next few years. As with all these types of situations there is not one simple solution but the evidence clearly points to one of the most important being better adapted pasture legumes. There has been some excellent work done by the QDPI over the last 20 years and some species have shown promise but success has been somewhat patchy, with the notable exception of *Leucaena*. I argue that the currently recommended legumes are only indicative of the genera and or species that can do the job and that we can do better. The issues facing the current researchers are difficult to say the least being inadequate establishment techniques, lack of perceived persistence by farmers, (although this is slowly improving), insufficient information on the potential production benefits, (except for *Leucaena*), and I suspect problems with specific rhizobium. From my experience in Mexico I can assure the reader that there is no lack of promising legumes to be found on alkaline clay soils in semi-arid sub- tropical areas. Indeed at one site that I am familiar with in the State of Coahuila I collected both *Desmanthus virgatus* and *Stylosanthes calycicola*, both common and growing within an introduced Buffel grass pasture, and in an area with a climatic pattern that is similar to Charleville, in Queensland. Both, I think, are still represented in the Genebank and surely worth examination. If rhizobium is the issue I would be happy to return to Mexico to collect.

This region has the potential to be one of the major producers of beef in Australia, and with beef prices at an all-time high, there is a great opportunity for farmers to improve their pasture base and give themselves some long term sustainability. The work being done by Gavin Peck and Stuart Buck needs all the support it can get.

Penultimately there are a number of people I would like to thank for their help, encouragement and support over my career in my chosen field. I have of course chosen not to retire as I think professionally I still have something to offer. However I owe thanks to all of those listed in the above text, but two people deserve special mention by me. My Mexican mission was both difficult and successful but I would not have been able to cope without my constant travelling companion, protector and guide, Dr. Jesus" Chucho" Gonzalez. In Tasmania I formed both great friendship and working relationship with Eric Hall, between us we have accomplished a lot, but please be assured the best is yet to come.

Finally a big thank you to Rhondda, Andrew, James and Rebecca. You had to "put up with a lot" but I can assure you none of it would have happened without your support.

Ladies and gentlemen thank you for your patience and attention and again my appreciation to the A W Howard Trust for affording me this opportunity to share my experiences and passion with you.