In this talk, I will explore the many and varied tasks of the exploration geologist, covering two careers since the 1920’s. I will outline my father’s career, also a geologist, who spent his time in the mining industry, and my own career, now covering some 60 years. My father represents yesterday, I am today, and perhaps you are tomorrow.

My father, like myself, came into geology and exploration by accident. He studied at Sheffield University, ostensibly to further his industrial chemistry, but in the end majored in geology. He completed his Masters in 1924, having mapped the “Llandovery Overlap” – whatever that may be. It only became significant because his mapping and interpretation differed from that of Professor Fearsides, his prof. Some high level row ensued.

In 1924 he went to Burma – to work not as a geologist, but in the copper smelter of Burma Corporation. There he met Rio’s Sir Frank Espie’s father. They disagreed on some aspect of pouring gold bullion, and after a year, my father returned to England, got married and went back to Burma, this time to develop tin mines at Mawchi. Here he learned a lot about the use of small boats to map up rivers, and how to work with horses and elephants. Also the importance of the regular supply of opium from China, to avoid the miners going on strike. Not a lot of science perhaps, but useful knowledge and experience.

After Burma, he joined a London firm of Consulting Engineers, Sir Robert Williams and Co. When Cecil Rhodes was convinced the Big Hole in Kimberley was going to collapse, Robert reassured him, they became friends and he was awarded, for his reassurance, some huge mineral concessions in what was Northern Rhodesia. Sir Robert had ideas – we would now describe as geotectonic thinking – that because metal deposits were well developed in Africa on the divides between the Vaal and Limpopo rivers, the Zambesi - Limpopo, and the Congo - Zambesi, that the Nile -Congo divide should have some metal potential.

The Nile Congo Divide Syndicate was established, and my father and two other Europeans explored and mapped probably a million square kilometres in Northern Uganda and Southern Sudan, over a space of about two years. The three parties, each with about 40 porters, would map and march up to 50 kilometres per day – using such maps as existed, a compass and Abney level, with a series of pans and balances. The drainages were sampled. Players No. 5, round
cigarette tins of screened gravel, were panned off, and the heavies and gold grains were counted, and if sufficient, weighed on a field balance. I don’t know if this sampling found anything, but I do know the mapping was well regarded years later. One outcome of their identification of carbonatites in the Rift Valley, led to the Tororo carbonatite being mined as a source of phosphates for Uganda.

Whilst most of the work was on foot, they did have access to two ton trucks to carry in supplies, and take out rock samples. There were some roads. Working in the Rift was exciting. Earthquakes were frequent, and the whole party could be thrown to the ground. The Africans said “Mungu na pita” (God has passed by). Forty porters had to be fed, and fortunately game was plentiful. Your prowess as a geologist was aided by being a good shot, so that there was fresh meat every few days. The rare Post Office, where telegrams could be sent and received in Morse Code, were the sole mode of communication. The military had a network of heliographs, on the Uganda/Sudan border, and the news of my birth in 1928, was relayed by the King’s African Rifles, from hill top to hill top, into the Sudan.

Their work in the Sudan re-discovered primitive copper mining at Hoffrat el Nahas and an ultramafic at Qala en Nahl, a talc-magnesite Rock, with potential for refractory brick making. My father spent 1930-1932 working on its potential at Sheffield University. I doubt that it was ever used commercially. His reward for 2 years work during the Depression, was the office clock.

He returned to the Sudan in 1932, but was plagued with Nile Boils – the London School of Tropical Medicine prepared a serum from his own blood to help combat the condition – there was no antibiotics, but he was recommended to keep out of the Nile Valley. He then spent time in Kenya and Tanganyika in the Kakamega Goldfield, and the Geita and Mawe Meru Goldfield, and also the Lupa Goldfield in the south.

In 1935 my father was back in England, working in the City of London for Kentan Gold Areas, to arrange the financing of the Geita Gold Mines. I can see him now in the City Dress, the navy blue suit, black Homburg hat and rolled umbrella. After the financing, he went back to East Africa to participate in the development of the underground workings at Geita. He fell out with the General Manager and didn’t stay long.

In 1937 he joined Rio Tinto, which created Mineral Properties Investigations, to go to Western Australia and secretly report on what assets might be valuable in the debris of the De Bernales scandal, which had bled many millions of pounds from the City of London. I still have in my possession, a book with all the Western Australia properties he examined, and strangely, not a lot of new gold finds have been made since his day!

He had a dream, after studying the Murchison Goldfield, that from the amount of alluvial gold, large dry blowers, similar but bigger than those operating in the Lupa in Tanganyika, might make an attractive large scale mining proposition. He got quite excited, but at the time the only tenement type available, was a mineral claim, far too small for such an enterprise, and the idea had to be abandoned.’’
In 1939 the Second World War started, and mercury, for detonators, mined in Spain and Italy, was unsatisfactory for the British War effort. MPI sent him to Sarawak to explore for cinnabar, and evaluate some mercury claims on offer to Rio Tinto. He was not pleased about this, and demanded that his wife and two sons join him in Kuching. They agreed, and in August 1940 I found myself in the Guest House of Rajah Sir Charles Vyner Brook’s private domain, Sarawak. I would go into the jungle with my father, to explore.

As in the Sudan, where testing was done with a pan, so in Sarawak, there was no laboratory and the explorer had to create his own. A small oven, silver plates, and a balance was all that was needed to determine the mercury content of a cinnabar concentrate. A dulang used in the jungle to prepare a concentrate, was the field method. It was while I was learning to use a dulang, panning for cinnabar, that I found my first diamond. I remember it well!

This project was just gaining traction, when the intelligence services were advising the Rajah of the imminence of a war with Japan. My father, being a mining man, was asked by the Rajah to place charges to destroy the Kuching Airport in the event of an attack. It was a twist of fate, that he shared an office with a Eurasian Radio Ham, who just happened to be a Japanese Spy. He had two young daughters, very attractive to this 12 year old.

In September 1941, he closed down the MPI offices in Kuching, and sailed for Australia, where I was esconced at school. He spent some months writing up his final reports on Sarawak on his portable typewriter – a treasure from his African days. Japan entered the war in December, 1941, but the Kuching airport was not blown. There was no work for the explorer in Australia during the war years, so he joined the Royal Australian Engineers – taught military engineering in NS.W., and finally worked in the Victoria Barracks in Military Intelligence, planning the re-occupation of Borneo, using his quite detailed knowledge of landforms, forests, infrastructure and river transport.

He was demobbed on 2nd January, 1946, and in March of that year, went as Consulting Geologist to Lake George Mines at Captain’s Flat, out of Canberra. He engaged Ken Glasson, also recently demobbed from the AIF, as his assistant. Together they embarked on a programme of regional exploration and geological interpretation. My father was appointed General Manager of the mine later in 1946, and stayed there until failing health led to his retirement in 1951.

It was during his time at Captain’s Flat, that the Geological Department, under Ken Glasson, became significant in size and capability. Father was a believer in whole rock analysis, and the Chief Chemist on the mine, Jack Le Gerche, turned them out by the dozen. An early application of whole rock chemistry to the exploration effort. After his retirement, he was retained as a consultant, but died six months later – a short career of 27 years. During his time, he travelled extensively, gaining experience. Geology, in the mining industry, was in its infancy, but as at Captain’s Flat, he was preparing the way.
**Exploration Today – being my career**

In the 1940’s the Geology Department at UWA was up the hill away from the main campus. We benefited greatly from the expertise of 3 men – Professor E de Courcy Clarke, who had mapped extensively all over WA – Dr. Rex Prider, who wrote his PhD in Cambridge, and was a well respected petrologist, had in his early days worked underground in Kalgoorlie – and Dr. Rhodes Fairbridge, the big-picture man. Rhodes was educated at Queens in Canada, and Oxford. He lectured in soft rock geology, including geotectonics. He was one of the early authorities on climate change. He was a friend of Sam Carey, and Rhodes led us into the major structural trends, and “The Pulse of the Earth”. UWA had an excellent trio, and my learning there, has stood me in good stead all my professional life. Like my father, I went to university to major in chemistry – my top subject at school, but needed a fifth first year unit, and studied geology! I got hooked, and did four years with honours in geology.

At the end of my first year, I worked the long holiday under Reg Clappison, at the Copperhead Mine in Bullfinch, W.A., learning about surveying and underground mapping. At the end of my second year, with two other students, and financed by my then girl friends father and his pals, we created the Swan Surprise Mining Syndicate, to explore in the Pilbara in W.A. With our ex U.S. Army International 2 Tonner (only two wheel drive) we ventured into the world of the explorer.. I suppose we learned most about de-bogging the truck and how to survive. We tried shooting and eating Kangaroo and Galahs. We saw wonderful rocks, worked briefly – like a few days – at the Wittenoon Gorge blue asbestos mine, and travelled up into the Hammersley Ranges and saw lots of iron stone. We pegged a few mineral claims at Lordens Patch, for the syndicates gold, spent time in the Whim Creek pub – next to the Mons Cupri copper mine, and met Lang Hancock in the bar. Matt Ellis, the then Government Geologist in W.A., was a mate of my fathers, and he advised us on what we might need and what we might find. I remember his words clearly “Don’t come back saying you’ve seen mountains of iron ore. We all know it’s there, but it will never be exploited – it’s too far from the coast, and the government would never permit it.” I remember a discussion with Dave Stone, the publican, and Lang, about iron in the Pilbara – Lang was in those days, a pastoralist.

With my father as General Manager, and Ken Glasson as Chief Geologist, most of the UWA Geology Students from 1948 onwards, got work at Captain’s Flat during the Christmas holidays. It was a great experience – aerial photographs were now becoming available – and along with Ken, we learned about mapping using air photos. Geophysics was being used - and I remember with excitement, the running of Self Potential surveys south of the mine – pyrite rich sediments, but alas no lead zinc or copper. Ken was keen to continue exploration northwards, and had my father not died, curtailing exploration, Ken’s department would possibly have found Woodlawn.

In 1949, the openings and pay for geologists in Australia was very limited. I was offered a job by Don Campbell of Western Mining, but my investigation of pay suggested better money off shore. In South Africa geologists were regarded as the lowest form of animal life, and on the mines they reported to the Chief Sampler! I elected to go to East Africa – following father’s footsteps – and sailed from Sydney in January 1950, bound for the Geita Gold Mine. I was paid in sterling, the princely sum of £45 per month, equivalent to Aus £56 per month, about 25% more than Don Campbell was offering!
I had 4 mines under my control as Assistant Geologist. There was no geologist! I was put in charge of all sampling, diamond drilling, grade control, and, of course, geological mapping. I quickly learned about fire assaying, because the Assay Laboratory didn’t seem to give consistent results. Whilst the mines had all been started pre-war, there was not a lot of information on the plans that was helpful, and much of the assaying was plain wrong. The hows and whys of the deposits needed work. I was quickly put in charge of preparing ore reserves.

Around 1953 the company appointed New Consolidated Goldfields as its Consultants, and I then was guided by consultants from South Africa. Gerry Mortimer, later to become the Chief Executive of Goldfields, was our Liaison Officer, and he and I worked closely on grade control and reconciliation with ore reserves. There was a battle to get Geita reporting standards to fit the Goldfields model. Percy Klulow, the Chief Sampler of Goldfields, would come and assist me with ore reserve calculations, and “God”, in the form of Buller Smart, the Consulting Engineer, would come from time to time to oversee the whole operation. It was great training.

Having trained in mineragraphy, and by identifying particulate gold, inside grains of pyrrhotite, we achieved a major improvement in mill recovery in the sulphide ores. Recovery had long been a problem that had defeated experts from London and South Africa. I was seconded to work with Dr G Chad Norris, out of West Africa, to try to crack the problem, and it was the pyrrhotite with a lack of oxygen during agitation that reduced recovery. We fixed it, the geologist cum metallurgist!

Exploration technology was a real handicap in the early part of my career. Trenches had to be cut by hand, there was no such thing as excavators, RAB drills or RC drills, so in thick laterite covered terrain there was a problem. Underground diamond drilling with a bar mounted drill, was usable up to about 50 metres. Surface diamond drilling to around 500 metres was a rare event, usually requiring government financial assistance. Highlevel laterites had been largely stripped away from the top of the ranges. The scree covered hill slopes were mappable, and could be prospected by loaming and trenching, but the low level laterites were a a drill and blast job to cut a trench. When we were excavating the Club swimming pool, drilled by club volunteers on Sundays, using hammer and tap, it seemed to take years to get down through 3 metres of laterite.

As improvisation was the name of the game, I built a Self Potential kit, having been impressed with the SP results we had got at Captain’s Flat. Would geophysics help to see through the laterite in the valleys? One Sunday, my wife and I set out an array of pots with a potentiometer borrowed from the electricians. The anomalies were so large that I didn’t believe my own results – must be some error in design. Only when I went back 50 years later, and saw a huge open pit over a newly found high grade body, did I realise what I had missed!

Airborne geophysics was in its infancy in the 1950’s, and I persuaded the Geological Survey of Tanganyika to trial 3 airborne electromagnetic systems over the Geita Special Exploration Licence. As I recall, they did not identify many recommended targets, but we did realise that the two aircraft system, working in tandem in line ahead, was far too dangerous for the second following aircraft, in the Geita Hills. We nearly lost one! I have never heard of it since.
Neighbouring properties were, from time to time, for sale, and it was the task of the exploration geologist to report on them. When uranium exploration came into vogue, Dean Morgan, of the Atomic Energy Authority, came to Geita. His father had discovered the Mawe Meru Mine, and sold it to Kentan, and Dean and his brother were rich men in their own right. Olly Morgan, the father, would drive around the Geita district in a Rolls Royce!! Dean convinced me to do some uranium exploration in some conglomerates south of Mwanza, on the shores of Lake Victoria. I assembled a party, and using the District Commissioner’s launch, took rate meters over these rocks. We found no Blind River, but it was a new experience using a scintillometer.

After one two and a half year contract, during which time my wife came from West Australia, and we were married in Mombassa, we came back to W.A. on leave. We went up to Kalgoorlie as guests of Lake View and Star, and I put in some time with Harold Jensen, its Chief Geologist – seeing how their geological department was organised. This proved useful when I got back to Africa.

After two contracts, up to 1955, and with a complete change to South African management, I was invited to go back for a third contract as Underground Manager, in charge of mining operations as well as geology. We had a great drive in efficiency, which effectively meant reducing the African work force from 3000 to 750. This was no mean task changing practices which had been in place for over 15 years.

Better technology was now becoming available; tungsten carbide had replaced hand forged steel, around 1953, light airlegs and jackhammers came in to replace the heavier bar machines, more Eimco Loaders replaced hand bogging. Development headings were quite small, and hand trucking was still the order of the day. Some battery locos existed on the tramming levels. Major savings were made by cutting down from 4 mines to 2, and concentrating most of the production from one. We continued to find it hard to beat inflation, and with gold fixed at US $35 per ounce, it became increasingly difficult to make a profit.

We saw a further saving in mining method – long hole drilling and ring blasting was being used underground in the Copperbelt in Northern Rhodesia, and we were keen to try it out. I personally loaded our first 10,000 tonne blast – got an awful headache from handling the long fat sticks of gelignite. It was a big bang. However, it was a great success with good fragmentation.

At the end of my contract in 1958, it had been my intention to go to Canada to get some Canadian experience. Geita, when I arrived, had been staffed by Canadians, and I liked working with them. However, one of the periodic downturns for geologists was in swing, and the Geita London Office, Tanganyika Holdings wanted me to stay in London as a Technical Consultant, doing consulting work for Geita, but also to supervise exploration joint ventures in Africa with Rio Tinto and Anglo American. This led me along many interesting corridors. However, it was the debacle of independence in 1960, and the subsequent civil war in the Belgian Congo, which changed my career as an explorer.

Tanganyika Concessions was the major shareholder in the Belgian mining giant Union Miniere du Haut Katanga. Tanganyika Concessions was managed in London by Tanganyika Holdings, and when the mines in the Congo were effectively confiscated by the new Congolese
Government in January 1967, there was a major corporate crisis. There was something like US$150 million copper stockpile outside the Congo, of which the Belgians took control. They considered it part compensation for the sequestration of their assets.

Sir Mark Turner, of Rio Tinto, had successfully responded to the sequestration of the Rio Tinto’s Spanish assets by the Spanish Government, and received US$ 75 million in compensation. He was also, for a time, a director of Tanganyika, and it was suggested that Union Miniere should follow Rio Tinto’s example of re-establishment, by seeking to develop or acquire mines in Australia and Canada, using funds released from the stockpile. As the resident Australian, it fell to my lot to organise Belgian expeditions to Australia, to establish Union Miniere Australia Limited in 1967, and engage Ken Glasson, now from Sydney University, as its director of exploration. They were anxious to find a Belgian geologist in Australia, and I well remember engaging Ed Eshuys in the Southern Cross Hotel.

Working in London for 10 years let me into the world of mining finance and corporate valuation. I had flown, in 1963, on an exploration mission to Canada, sitting next to Allen Sykes, who had just published “The Finance and Analysis of Capital Projects”. I had been brought up using “Hoskold’s Formula” for mining valuations, and learned a lot from Merrett and Sykes, and pioneered a mining valuation section in Tanganyika, along the lines of that established by Gerry Mortimer at Goldfields.

It was Godfrey Burrell (or Geoff Burrell in Australia) of Poseidon fame, via Duncan Derry, who led me into tin exploration in Cornwall. Tanganyika Holdings needed U.K. income, and Godfrey convinced the Tanganyika Board that he could deliver some income in Cornwall. The story of Baltrink Tin could fill a book, but Burrell left for Australia without securing title, and the project was dumped on my lap. With the site geologist, we built a Colorimetric Tin Laboratory, which proved useful for tracing tin reefs below the ploughed Cornish pastures. Whilst Godfrey had dealt with the rights to walk over the farmers’ property, the mineral rights had been separated from the surface rights, some back to the 16th Century. When I researched mineral rights in the Public Library in Truro, and found that one 4 acre paddock had 144 owners of the mineral rights, I gave up! Surface rights were usually passed down via the eldest son. Mineral rights, separated from Surface rights, were given to other family members, and their descendants. In 400 years, the possibilities were endless.

Oscar Weiss, the geophysicist to whom was attributed the Orange Free State Goldfield, was in London seeking to finance an “Airborne Sniffer System”. The Sniffer could detect metal colloids in the atmosphere when flown over metal deposits. The technology assembled by some Cambridge boffin, and mounted in an aircraft, could indeed detect Mount Lyell in Tasmania, Broken Hill, both in Australia and Northern Rhodesia. The project required finance, and I was asked to do a note for Barclays’ Bank, who invested £250,000 in it. I never heard any more about it, or Oscar.

During my 10 years in London, I would return to Australia to look after Tanganyika interests in an exploration joint venture in Australia, with Rio Tinto, and look at possible strategic acquisitions for the group. With Union Miniere bedded down by 1968, and being a director, I sought to establish a branch of Tanganyika Holdings in Australia. It was designed as a listening
post for investment opportunities, and given a minimal budget to explore for non-Union Miniere commodities like diamonds and platinum.

I came back to live in Australia in 1969, with an office in Melbourne and Perth. The practise of joint venturing had become established in the 1960’s, because it permitted US companies a tax effective way of exploring outside the US. Multi party joint ventures, well managed, could give greater exploration exposure for a minimum expenditure per party.

With only modest exploration funds available, and with diamonds as a target commodity, a joint venture to explore for diamonds in the Kimberley was the appropriate vehicle. The Kalumburu Joint Venture was conceived in 1969, and worked its first field season in the Kimberleys of Western Australia in early 1972. I have too often talked about the “Road to Argyle” so today, will say little beyond acknowledging Rex Prider’s contribution, pointing out his idea, that the lamproites of the West Kimberley were “consanguineous with the kimberlites of Kimberley in South Africa”, and the need to establish a laboratory that had adequate controls in it to avoid giving phony results. I carried the scars of poor laboratory practice from the days at Geita. From the drawing board in 1969 to the discovery of Argyle in 1979, via Ellendale in 1976, was a great experience.

Managing, what was initially, a 5 party joint venture, I found each party had its own funding problems. The Australian parties had limited financial resources for a secret activity, and the overseas ones had difficulty bringing money into Australia. There was also a reluctance to invest more money from overseas, due to the perceived political problem with Mr. Rex O’Connor telling the overseas companies to go home! The introduction of CRA, later to become Rio Tinto; took the heat off funding for a time, but ever increasing budgets, fuelled by success, led to selling down until only Ashton Mining, essentially a parastatal of the Government of Malaysia, and Rio Tinto were left.

I remained Chairman, of what became known as the Ashton Joint Venture, after Kalumburu, for 21 years, until my retirement as a director of Ashton Mining in 1990. Argyle, discovered in 1979, and brought to production as the world’s largest producer of natural diamonds in 1985, was also a world first in diamond mine finance. It was the first time syndicates of international banks had ever financed a diamond mine, to the tune of $325 million. Hitherto, most diamond mines were found and opened by De Beers, and financed in house.

Back in Australia, and prior to the diamond take off, I had been involved in Coopers Creek Mining and Exploration, exploring for platinum in East Gippsland; with Nickel Mines of Australia, with Reg Sprigg, at Wingellina; The Swifts Creek Goldfield in East Gippsland – to redevelop the Warden, and the Cassilis Mines; At Omeo and Landsbrough, perhaps dredging; and the discovery of a Bentonite deposit near Portland, in Victoria, to ship to Port Latta for Savage River iron pelletising.

In addition, with Ashton, we searched the Northern Territory from west to east for diamonds, discovering the Merlin Diamond Mine; the diamond bearing kimberlites of Finland and Mauritania, and the platinum possibilities of Goodnews Bay in Alaska.
Ashton, post 1985, made an excursion into gold, by the acquisition of Carr Boyd Minerals and Hill Minerals. Ashton acquired through these acquisitions the Spectral Scanning Technology developed by Frank Honey, called Geo Scan. It was Ron Lyon, who shared a laboratory with me in my honours year at UWA, (who worked on the technology for the Lunar orbiting vehicles for the NASA space programme, while at Stamford) who told me something of the wonders of Spectral Scanning, but I found to my cost, many of its limitations.

Each stage of my multifaceted career, since my first year at university, has taught me something. Bullfinch taught me surveying and underground mapping – Rex Prider taught me mineralogy and petrology, and let me do an Honours Thesis on heavy minerals at Captain’s Flat – the investigation was a washout, but little did I realise that in diamond search we would use all I learned about heavy mineral identification. Captain’s Flat and Ken Glasson, gave me regional mapping and photo interpretation. The nine years in East Africa, taught me the importance of accurate laboratory measurement of underground sampling, and ore reserve calculation and reconciliation. The problem of laterite cover and seeing below surface as impediments to exploration was clearly demonstrated. The world of Metallurgy relies on an understanding of the mineragraphy of different ore types, and again accuracy in determination of mineral aggregates is vital. As important as anything, the Geita years taught me the value of man management, and how to get the best out of your team.

The decade in England, whilst broadening my mind and skills as an explorer, introduced me to the world of mining finance, the workings of boards of directors, and the political scene. In UK politics – where, after Prime Minister Harold McMillan’s “Winds of Change” speech about Africa, I heard at a board lunch some Tory Nabob say, “McMillan must go”. He went! Also International Politics – London and Belgian, meddling in the affairs of the independent Congo – sending arms into the Katanga to support rebels.

At the same time, being in London, and able to meet the Top Brass of significant companies, gave me insights into how the industry works, which I would never have had had I gone to Canada in 1968. Nor would I have had chances to sit on boards with luminaries such as Harry Openheimer, and Capt., Rt. Hon. Charles Waterhouse. MP

In retrospect, my return to Australia continued to broaden my skills. I gained far more exposure to geophysics, which has advanced enormously from my porous pot endeavours, and early airborne EM. The creation of a new Australian diamond exploration technology, and its support laboratory, was a major learning, which we subsequently took around the world. Alex Frank, one of Dr. Williamon’s diamond explorers in East Africa, in the 1950’s introduced me to pyrope garnet as a diamond indicator. I saw it again in the first diamond bearing sample from the Kalumburu Joint Venture, on the evening of my 45th birthday, in 1973.

The notion of satellite imaging as an exploration tool, was beyond conception at the start of my career – now it is routine when entering a new area. From UWA, in my time, we always prided ourselves in saying, that we could be dropped by parachute anywhere in the world, and start mapping with a chain, a compass, and a level. We knew little of the use of air photographs, being largely classified, and nothing of satellite imaging.
Exploration Tomorrow – A vision of issues

What does the future hold for the exploration geologist of tomorrow? Whilst I feel we have made great strides during my own time, and technology never dreamed of as a tool for the explorer, has been developed, there is still no substitute for a hat, hammer, and a good pair of boots. Whilst I hold geophysics and geophysicists in high regard, and value their input, it is always the ground truthing which carries the day. If the location, in whatever the sensing medium, is out, and the location on the ground, is less than perfect, the skill of the geophysicist is all wasted, and the drill hole to test it fails. I know of instances where this has certainly happened, and important deposits missed. Similarly, samples rich in diamond indicators in Northern Australia, have been unable to be re-located. Clearly, the sampling geologist was lost. Field location of targets is not rocket science, but even today with the advent of the GPS, its importance must be stressed.

Remote sensing, be it by magnetic fields, induced fields, radiometric measuring, scanning, or airborne gravity, will all continue to be developed with the hopeful objective of cutting time in the field, on the flat feet. My experience with all the above has not been good. They seem most able to identify the target after, and not before discovery! Perhaps this is too cynical.

The oil explorer has been in front of the hard rock explorer with their development of 3D seismic. For the mineral explorer, the cost seems prohibitive, but its use could be invaluable. Cost prevented its use in mapping the Muni Muni layered intrusive in W.A, and I can think of many others. In the same vein Ashton discovered the Buffalo Hill Kimberlite province in Alberta, just by the reinterpretation of existing seismic data! Oh! to have an oil industry budget.

However, it is through the further development of micro analytical techniques for rocks and mineral grains, that I suspect will provide a great leap forward. The ability to age date a single grain by its various isotopes, and its characteristic trace element composition, will become more generally used by the explorer. The zoning of minerals from their cores to rims, telling something of the temperature and pressure surrounding its origins, will reveal much to the explorationist of the future. I see the interpretation of paragenesis, the real time dating of the various mineralising events, to be of the greatest importance, leading to a new understanding of the processes of metal emplacement.

In the black slate goldfields, the carbonate spotting and distance from a gold source, has been deduced by the definition of two phases of carbonate growth, with different characteristics in composition and time. From early Ashton days, the ability to differentiate kimberlitic chromite from basaltic chromite, and the compositional zoning of the grains, proved a valuable tool in exploration.

Another key development of the future will come from a better understanding of geotectonics, and what processes actually occur beneath the crust, because it is only the top surface where we are able to map, and then only when it is not under water. Ocean floor dredging and coring is already showing the need for re-thinking the relationship between continents and oceans, and
submarine topography. Seismic tomography, looking at the different velocity layering down into the mantle, using earthquake energy, is giving geologists and geophysicists new ideas on what is happening at depth. The SKIPPY programme, covering the Australian continent, gave a series of new ideas of the underpinning of the continent.

Some new thinking on the origins of oil and natural gas, and whether much comes from the mantle rather than decaying matter, will be developed. The substantial volumes of methane trapped beneath the waters of the Black Sea, could be related to the deep fracturing running along the length of Turkey, and similar large volumes of methane hydrate, seem to follow the fractured margin along the east coast of Japan. If such a relationship between mantle hydrocarbons and oil fields could be established, then the recently identified sedimentary basins in the Indian and Pacific Oceans, may have offshore oilfield potential. It should not be forgotten that drill holes into Proterozoic rocks in the Northern Territory, beneath Cambrian basalts, have yielded oil and gas. The fracturing in the Batten Trough nearby, is of a deep seated nature, and brings up diamond bearing kimberlites from the mantle, from a depth of 200 kms. Does this oil come from the mantle?

As more and more deep seismic data becomes available, and the nature of the deep fracturing becomes better understood. I anticipate metal search will be increasingly oriented towards global macrostructures, much loved by the likes of Sam Carey and Tim O’Driscoll. The movement of metal from the mantle into sedimentary basins, and then being further distributed by secondary migration, will become much clearer, and tools for the explorer will evolve. I remember trying to plot major metal deposits globally, on a stereographic net, and thought I could see some global trends. There is a brain problem with the global scale, and the human scale, which makes much research more difficult.

I think exciting times are before us as we wrestle with Rhodes Fairbridges much loved Global Tectonics, and seek to understand more the vagaries of our home, Planet Earth. I should add as a footnote, that I retired as an executive of Ashton Mining in September, 1990, and since that time I have continued to practise as a Consultant, and also kept my hand in as, from time to time, the Chairman of Australian Diamond Exploration NL, Helix Resources NL, North Australian Diamonds Limited, and to the present time Lion Selection Limited. There have been some exciting happenings in all of them but that’s for another day. I hope the story of what for me, has been an interesting and varied career, may prove to be of interest to you all, who are the industry of the future.

Thank you
E.W.J. Tyler
February, 2009