



Arthur Edwards

Born in the Sydney suburb of Drummoyne in 1925, Arthur left school at the Intermediate and his first job was with ACI as a labourer. He worked his way up from turning shell cases at ACI to being involved at a senior level with some of the most famous and challenging construction engineering projects in Australia. These projects covered a wide range, from power stations, offshore oil rigs and oil refineries, to radio telescopes and the Sydney Opera House. He now lives with his wife at Kincumber, near Gosford.

(Arthur provided the following overview of his working life, and related information):

Arthur S. Edwards Dip.Eng.(Mech & Struct); MAACE; CCE Emeritus (Ret'd); J.P. Member of Management Committee of Association of Independent Retirees; Member of Community Leader Advisory Committee, Dept of Social Security.

Career in Brief: Left country school in 1939 with Intermediate Certificate. Came to Sydney in 1940 aged 14, took job as a labourer at ACI. Went to school at night to do 4th year. Transferred to machine shop at ACI in 1941 and went to school at night to get Leaving Certificate. Did a full-time crash course in Engineering (Mechanical and Structural) in 1942.

Drafted by Manpower into the Mosquito Engineering team, aged 17, stayed till team disbanded in 1945. (Active member of a mixed church group at this time and assisted in running a home for disadvantaged boys at Ashfield.)

After the war, concentrated studies on analysis of Indeterminate Structures, a

new engineering science to Australia at the time. Worked on Nestles post war construction programme in their Abbotsford factory, then in charge of designing new factories for Sisalcraft Australia in Sydney, Taubman's Paints at Sunshine in Victoria and for BALM Paints in Auckland.

Entered the construction industry in 1956 and worked on the Snowy Mountains Scheme; major steelworks projects for BHP (all sites); iron ore in the west (Mt Tom Price and Mt Newman); bauxite in the north (Gove); offshore/onshore oil and gas in the south (Barracuda and Marlin offshore oil rigs and onshore refineries); coal in the east; plus major power stations, oil refineries, aluminium smelters etc.

Full member American Association of Cost Engineers (AACE) in 1974; Certified Cost Engineer (CCE) in 1978. Retired June 1990 - awarded Emeritus status by AACE International in December 1991.

Retirement relaxation activities: *Playing the keyboard and chess; tending a 1960 Classic Jaguar MkII 3.8litre Saloon; taking part in outings for classic cars over 30 yrs old; Member of Jaguar Drivers' Club Hunter Region, Central Coast Historic Car Club, and Saratoga Probus Club.*

I was born in Drummoyne, a suburb of Sydney, in 1925. I was the second eldest child, but the eldest of two sons. We lived in the first house built in the Abbotsford area, when it was all bush. My mother was well-off, being a descendent of the Cattle family from the West Wyalong area, and my father was a small business battler for most of his life. But he was a motoring pioneer - he was the first man to drive a car in Parramatta, in 1901, and he started the Bega/Cooma Motor Service in 1911. At Abbotsford Primary school I was top of my class until sixth class, when the family moved to Temora. Being a skinny, red-headed city kid I was bullied mercilessly at Temora High and I didn't do well at school there to start with, which upset my mother. However, she paid for my board and lodging during 1942 when I was doing my Engineering course. Apart from this, none of her money filtered down to me - or my father, for that matter. She spent it all on round-the-world trips.

When I left school after doing the Intermediate Certificate my first job was as a labourer at ACI. I worked on the hot bottle machine, which was a hell of a rotten job, I can tell you. I had to operate the machines that made the bottles, but because the glass was molten it was very hot work. No skill in it whatsoever. The only other task I had was to go around on a motor scooter with all the billies on a long stick, to fill up the billies with hot water for the men. In the process of filling up the billies I saw the machine shop, and it looked like a much better place to work than where I was, so I got a transfer to the machine shop.

There I learnt to machine six inch shells for naval guns. This was done on a lathe. I learned how to use the machines on the job. It was this that gave me an interest in engineering. I saw the draughtsman coming down and telling the tradesmen what to do. We worked from 8am till 6 at night, then I'd go to night school after that. (All this gave me a workshop background that proved very valuable later on, especially in controlling men. I had to control men on large construction projects later in my career, and it helped to have been one of them. I wasn't a university graduate engineer sitting up here talking to them down there. I'd come up through the ranks, as it were. And bear in mind, with these big

projects later on it was the team that made them possible, not just me. I realised right from the start that with everybody there's a lot of good and a lot of bad, and I used to concentrate on developing the good parts and ignoring the bad. As a result of that, men liked to work for me - they always wanted to be on my jobs. Sub-contractors were the same, because I always treated sub-contractors fairly and I never ever allowed a small sub-contractor to go broke - I'd always find a way around the contract to get them extra payment.)

After I'd got my Leaving certificate at night in 1942, I enrolled at the Sydney College of Engineering. That involved lectures from nine to five, five days a week, with exercises etc at the weekend. It was the equivalent of a four year part-time course, but it was compressed into one year - because of the war. The Institute of Engineers Australia wouldn't recognise the qualification though. Their course was over four years, but only three nights a week - that's nine hours a week. I was doing eight hours a day! But the main reason they wouldn't accept it was because with the course I did you didn't do a thesis as part of it. My qualification was a Diploma in Engineering, which as far as I'm concerned was all I needed to know.

I've always been at odds with the Institute of Engineers. I got into strife with them later on, in 1948 when I joined the Public Works Department. In my opinion they were a Public Services consulting engineers club. I tried very hard to make myself suitable to them. I went to Sydney Tech at night from 1943 to 1945, doing the Diploma Course there, the ASTC, but I never finished the course because I was working from 8 till 6 and tech started at Ultimo at six, so I was always late. This wasn't so bad with the lectures, but it was terrible for the exams, because I had to do the three hour exams in two and a half hours. I used to go three days a week and not get a decent meal. Consequently I didn't make it, and I had a nervous breakdown in 1945.

The Institute of Engineers weren't recognised outside of Australia, and I wanted an International qualification, and anyway they did nothing whatever for the profession. There were glorified motor mechanics calling themselves engineers, you had licensed engineers working at Qantas who were glorified aircraft mechanics, you had ship's engineers - all *they* were was fitters and turners. I was always at the Institute of Engineers about doing something about raising the status of the profession. Why should we have to go around calling ourselves "professional engineers"? An architect doesn't go around calling himself a "professional architect" does he? Engineering has never been properly recognised in this country, and as a result it's very low-paid. Some of my best friends I lost to America, because engineering in America is on the same level as medicine, and in lots of cases engineers are more highly paid than doctors.

Engineers and draughtsmen were in very short supply during the war - in fact when I was manpowered into the *Mosquito* Engineering Team the draughtsmen were RAAF personnel - sergeant's rank. It was a great disappointment to me that I couldn't be accepted for aircrew because of the priority nature of the *Mosquito* project. I wanted to be a navigator. It was ridiculous. I went through the medical at Woolloomooloo and the recruiting officer asked me why I wanted to be a navigator. I replied that since I was strong on maths and science I thought that I'd be well-equipped, but he said they thought that I'd make a better pilot, because I had first class reflexes and excellent co-ordination. I would have been a pilot, but the second time I went down there they kicked me in the bum and told me not to come back. They wouldn't let me off the *Mosquito* project.

Macarthur wanted an aircraft that could climb much faster than the ones at his disposal - the *Spitfire*, the *Kittyhawk* and the *Beaufighter*. He wanted one that could intercept the Japanese and the *Mosquito* was to be it. It was delayed for nearly twelve months because of problems with the wing spars. In the end it turned out that the problem was with the design, which was for cold conditions in Europe, not for out here, and we had to end up redesigning the whole of the wing spar, which was from wingtip to wingtip because it was all in one piece.

I wasn't experienced enough to have much to do with the wing spar problem - they had top engineers and top mathematicians on that. My job was mainly to design components of the aircraft that had been lost at sea on their way out here, and to design jigs and fixtures that had also been lost at sea on their way out from England. Later on, because I'd got my driver's licence at 17, I was made an Inspector.

The wings were made by General Motors Holdens, the tailplanes were made at Mascot, the fuselages were made by Beales, the piano people at Camperdown, and the whole aircraft was assembled on an assembly line at Bankstown. They were all wood except for the engines - two Rolls Royce *Merlin* engines - they were made by Packard in America, under lend lease agreement between Britain and America. When you think that they had nearly 4000 horsepower in such a light aircraft, no wonder they were fast! They were faster than any of the German fighters. We got everything sorted out by the end of 1943 and ended up making three hundred of them. The wing spar was laminated for strength, but the rest of it was just mainly light plywood.

You grew up very quickly during the war. My whole teenage years were lost to the war - from 14 to 20, though this was the time I was a member of the church group. The father of one of the girls in the group owned a 1942 Chev, which was the latest model in those days. My father had a service station at Temora, the country town I came from, and he used to get a certain allocation of petrol coupons for evaporation of petrol. Every now and again he'd send me down a few coupons and the girl's father would lend us the Chev and everyone would pile in and we'd go for a run. We'd have to save up for two weeks to go to the pictures, but our main activities were church activities and running the home for disadvantaged boys, who were virtually delinquents. This gave me another good insight into handling people - keeping those boys in line.

Although I'm good with men, the other side to this is that I'm not so good at handling women. I don't know why this is - most of the time things I say seem to easily upset a woman, and you can't treat women roughly the way you can a man. In private industry of course, you've got to make a profit, and if a job was going bad I'd really get stuck into the foremen, and I'd really push them. In most cases I'd push them till they actually physically knocked me down. I only had one that never ever knocked me down - who'd take anything that I threw his way. But this only works with men - not women! Helping with running the home was great because I had to go to work for six days a week, tech for three nights a week, and the social part of it, the interaction with girl friends was a good break - mucking around, kissing and cuddling, you know. (We never had sex in those days. The way I was brought up you kept that till you got married. Mind you, I lost a couple of girlfriends because I had that attitude. You can't win, can you!

After the war I got interested in the theory of Indeterminate Structures. When I did the diploma course I made up my mind that I wanted to be involved in structural engineering, because the mathematics determines the size of the

members in a structure, and therefore the calculations and the mathematics were worthwhile. In mechanical design it's not so much the mathematics that determines things, it's what looks right. You might have a shaft subject to bending and torsional stresses and you'd work out that theoretically a one inch shaft would do the job, but you'd know that you'd have to end up with one two inches because of how it looked.

Although I did a lot of mechanical engineering immediately after the war, always my first love was structures. Anyway, I heard about indeterminate structures, which was a different way of approaching things to using normal trusses. It was very useful when I was in New Zealand designing buildings to resist earthquakes. It depends on the way the problem is analysed. There are three different methods: the Hardy Cross analysis (which is the method that I preferred); there's strain energy; and there's the method of area moments. None of these three were being taught in Australia at the time - not even in university or at Sydney Tech. They were subjects that were not in use. They were new, and there was a lot of experimental work. We did a lot of experimental work ourselves. We made a scale model building with scale loads on it and we measured deflections through a microscope. We did a lot of work on the basis of textbooks that I had imported from overseas.

I designed the first rigid frame building, as they're called, in Australia. It was a hanger at Mascot - it had to be clear of any columns. Indeterminate structural analysis enabled you to have much wider spans without support, and the Qantas overhaul hangar at Mascot is the very best example of it. It was designed by Macdonald, Wagner and Priddle, and is a three hinged arch. It spans a 747 aircraft.

Engineering is very creative and I've always been creative. When I was a kid at school I used to win all the art prizes at the local show. (In fact, if it hadn't been for the war, I wanted to be an artist. I might have been a Pro Hart by now.)

The Chief Engineer of the *Mosquito* team, Ray James, had quite a lot of respect for me. There were six cadet engineers on the team of 66 men. Ray was always on my back, and seemed to drive me more than the others. After a while I got jack of it and I fronted him in his office, (which I'm never afraid to do - I'll front anybody) and I asked him why he was on my back. He said it was because I was the only one worth worrying about, and that one day I'd make a damned fine engineer.

The next job I got was with Nestles, designing and installing all new machinery in their factory at Abbotsford. I did all the calculus problems. Calculus is a science that you have to keep using or you soon forget it. They had a machine called a conching machine, which bashes the chocolate backwards and forwards for 24 hours, and that's what gives the chocolate its smoothness. You have a roller going up a variable curve at a variable speed, and where you have two variables you can only work it out with the calculus. When this machine was put into operation the chocolate was shooting out the top and I had to find the correct speed up that variable curve so it wouldn't do that. You say it must have been very satisfying to do. It was. My whole career has been immensely satisfying. But when the Nestles job finished, I finished. That's the way it was. It wasn't like being in a permanent office job.

I got married in 1947, and I got a bit security conscious and joined the Public

Works Department for a rather brief stay (so brief that I haven't listed it in the summary at the start of this chapter). I was appointed Junior Engineer on the construction of the Oberon Dam. It was a slab and buttress design, so the slab had to be waterproof concrete. Oberon being what it is, with big changes in temperature, part of my duties was to do a sieve analysis of the aggregates and redesign the mix twice a day - as well as look after any mechanical work such as the valves, the power, the pumps, and the overhead flying fox.

I didn't stay there long because I got stabbed in the back by one of the foremen. I didn't get off to a very good start. Soon after I got up there I gave this foreman some instructions and I made the mistake of telling him how to do it, and the next thing I know I was on the carpet in the Resident Engineer's office. He said to me, "Look. You've got a diploma. Now you learn to be an engineer. You tell a foreman *what* to do, but you don't tell him *how* to do it." That foreman had it in for me from the very beginning.

The Resident Engineer was very concerned about the vehicles - he was paranoid about them - not putting a scratch or a dent on them. On a construction site! It was bloody ridiculous! I was sent into Bathurst one day to pick up some supplies and when I got back I was called into the Resident Engineer's office and he told me that I'd been seen going through a cattle grid at 50 mph on the way back! So what? This sort of thing kept up so I got in touch with Sydney and asked for a transfer, and they sent me to Dubbo and Narromine doing all the mechanicals on the new silos they were building there. I enjoyed that.

After that they sent me back into the Design Office in Phillip Street. But there wasn't enough to do there, and I used to go around looking for work to do. The next thing I know I was in the Principal Engineer's office, and he asked me why I was going around making waves, and didn't I realise that I'd get my increment at the end of the year whether I was working or not. That was no good to me, so I gave the Department of Public Works away. It was a short stay - only about 18 months. Not only that, the salary was so low. My gross wage was seven pounds fifteen a week and we were paying three pound a week rent for a room and the use of a kitchen and bathroom - and I had a wife and a baby. The next job I got was at Sisalkraft and I got twelve pound fifteen a week - an extra five pounds! That was a hell of a lot of money in those days.

Then I had two jobs in a row with paint companies. Taubmans was at Sunshine in Victoria and BALM Paints, which was the most interesting, was in New Zealand. There we had to design buildings to resist earthquakes, and the rigid frame design was absolutely essential. It posed some very interesting problems and I learnt a lot about this sort of construction.

(When the earthquake hit Newcastle a few years ago I felt a certain amount of exhilaration when it became clear just what had happened to the Workers' Club building. In the fifties, the theory was that the seismic forces acted on the building in direct proportion to the load on the floor. With the Workers' Club the two floors that collapsed were the heavily laden ones, which proved the theory that I'd used in New Zealand in 1953. Up till then I'd never known if the theory was right or not - I'd never seen a building collapsed like that before.)

The Chief Engineer at BALM Paints was very jealous of me because I'd studied these methods, and so was the Engineer at Taubmans. (They were men in their fifties). I was designing buildings and machinery in modern terms. For example, I was talking about ball mills being powered by single electric motors. (You need

the greatest power when you're starting the mill up. Once it's running you need much less, and a new thing at the time was fluid coupling - like in an automatic car transmission. This allowed the motor to get up to speed - when it's got greatest torque - before putting the drive through.) So I was talking in terms of small electric motors with fluid couplings and they were talking about line shafts and bloody flat belt drives! The Chief Engineer ended up going to the Technical Director, who was the top guy, and told him he couldn't get on with me. He was one of the old school and he was just so far out of date it was unreal. I was supposed to stay on there as Maintenance Engineer because I knew the factory so well, but he squashed that for me. The Technical Director told me that my services were no longer required. I wasn't even allowed to go back down to my office to clean out my desk! - they did that for me because they didn't want me to speak to any of the draughtsmen working under me. That really hit me hard because at that time (which was 1954) even though there was no unemployment and there were plenty of jobs, for a professional engineer it takes at least six weeks to go through a series of interviews and get another job - you can't walk in and out of a job like a tradesman can. We were living in half a house and trying to build the rest, and we were well and truly in the red, and my wife had to go out to work. But it was a shock to me because it was the first time that anybody had been other than appreciative of what I'd done. But I got used to that after a while. *(Laughs)*.

But it turned me off large companies, and their internal politics. I'm not into that sort of thing. That's why I went into the construction industry, because in construction you have to work as a team. Your life depends on it. Construction work is extremely dangerous. Everybody on a construction site is equal - I don't care what you say. The engineer can't go up top till the riggers have made it safe. On a country job the cook's probably the most important bloke. Even the shithouse cleaner - if they're not clean then it upsets the men. Everybody on a construction site is important because you've got to work together.

I really enjoyed my career after 1956. That's when it started to get really rewarding because you were building new things and at the same time you were working with a wonderful team of guys. And of course you had to make a profit. But we never had the cost over-runs (except occasionally) that governments consistently get with their major contracts - like the new Parliament House that starts out at 500 million and ends up at 1.2 billion. They had an elaborate panel of government-appointed experts to handle those contracts and I could have done it for them and brought it in on budget and on schedule. It's a matter of sticking to the Critical Path.

You get some ridiculous things. In 1976 I was in charge of building the Warriewood Sewerage Treatment Plant. I'd tendered for it, and negotiated the contract and we were trying to keep to the Critical Path scheduling of activities. But with government departments in general, and Warriewood in particular, the draughtsmen in at the Water Board were getting behind with the drawings. I'd go in to see the Chief Design Engineer and half of the draughtsmen would be asleep or reading a book. It was incredible! In the end I had to hire draughtsmen at weekends on contract rates and back-charge them to the Water Board. But that meant that I was on the job seven days a week - and that went on for 39 days.

Anyway, in 1956 I did some work for the Snowy Mountains Scheme. We built the high pressure pipeline down Brown Mountain to the Bega Valley Power Station. It

was the highest pressure pipeline in Australia until recently, when some of these newer power stations have started to exceed it. The operating pressure at the bottom was 6000 psi and the test pressure was 12000psi - (the test pressure is always double the operating pressure). We were making the pipe in the factory and testing it using a rig I'd designed to get the damned thing up to 12000 psi. That proved too costly in terms of both time and money, so I went to see the head bloke at Bega Valley and convinced him we could go ahead by doing a single hydraulic test on the pipe once it was in the ground.

I also did work inside T1 Power Station, which is the underground power station, and we built both bridges outside T1 Power Station - the road bridge and the cable bridge. I used to go down on site about twice a month because simultaneously I had contracts in Gladstone, Brisbane, Newcastle, Sydney, Port Kembla, the Snowy Mountains, Geelong and Whyalla. This was when I was with Evans Deakin, the first major engineering company that I worked for. They were the largest engineering company in Australia prior to the entry of Transfield into the field. The other two big companies that I worked for were Simon Carves Australia (I joined them to get onto the Bass Strait Project and Gove, up in the Northern Territory) and Electric Power Transmission. Those are the three major companies that I worked for from 1956 to 1986.

With Evans Deakin I was Chief Estimator and Project Manager, based in Sydney, though their head office was in Queensland. The limitation was that in those days I wasn't allowed to tender on anything in excess of \$250,000 - anything over that I had to do in conjunction with head office. But it was a lot more than a quarter of a million is today. I was a regular up to Brisbane. I used to catch the New Guinea flight because you got breakfast on it - until all my stuff ended up in New Guinea one day and I had to go back to the Brisbane flight.

I worked for Evans Deakin twice. I left them to go to Simon Carves to get on to the Bass Strait job. Later, because my ex-boss kept ringing me up and asking me to come back, I went back to Evans Deakin. There were only two above me in NSW, there was the Construction Manager, a bloke called Fitzgerald, and the General Manager, Jock Scott, and although they'd never admit it I virtually ran the place. I didn't really work for Evans Deakin - Jock, my immediate boss was the guy that I worked for. I had a very high regard for Jock and he had a very high regard for me, and we worked well together, so that I more or less bypassed Fitzgerald all the time. It was a case of university degrees versus diplomas. Fitzgerald had a university degree and I didn't, and therefore he was entitled to higher rank even though he did bugger-all. He was hopeless. (Jock had a university degree too, but he did it after the war when they had the special postwar education scheme where ex-service personnel had priority and didn't need the same entrance qualifications and things like that.) This dogged me throughout my career, to be honest with you. As I said before, the Institute of Engineers wouldn't recognise the Diploma that I had. But those guys didn't have the natural ability that I had, which is something you don't learn at university. Sure, I'd have liked to have gone on to university, too, but unfortunately I was the eldest in a family that didn't have much money - plus the fact that we lived in the country. But this has been a battle that I've had all my life, where I've been sort of looked down on in the profession because I didn't have a university degree. Somebody with a degree always seemed to get preference over me when you got down to tin tacks as far as money was concerned.

You'd sort of follow the interesting work. When I joined Simon Carves and worked on Bass Strait - that was fabulous! It was fantastic! Working with their client BHP-Exxon. Mike Lodge was the head of construction for Exxon and he was a marvellous guy. He was a graduate of RMIT (Royal Melbourne Institute of Technology), which is the highest seat of learning in Australia for engineering. (It beats both Sydney and Melbourne Universities, and if you can put "RMIT" after your name then you're really a top engineer.)

When I worked on projects at Mt Tom Price and Mt Newman I used to fly to Perth, and then up. When I was away on supervisory visits I would still have to come back to Sydney and drive to Newcastle once a week. Newcastle Steelworks were my main client, and they were the best people I've ever had to deal with in my life. There was Newcastle, Port Kembla, Whyalla and Kwinana. But I always had to go to Newcastle once a week - sometimes twice, even though I might be down with Exxon-BHP on a visit. I was doing 100,000 miles a year on the road, and most of this was pretty well on my own time. I'd be in Newcastle, or Sydney, then I'd go to the Snowy Mountains overnight. I had a mattress in the back of the ute and this meant that I could stop whenever I liked to sleep, and secondly I could pocket the claim for motel expenses. I covered an enormous mileage because it was easier for me to drive to the sites between here and Whyalla than to cart all my drawings and gear and stuff onto the aircraft. Perth and Gove, of course, were a different kettle of fish.

On one occasion I was driving from the Snowy Mountains to Geelong in the middle of the night and it was pissing down rain - really heavy. By the time I got to Seymour in Victoria I was too tired to keep going, so I pulled in under the awning of a service station, cleaned my teeth and so on, climbed into the back of the ute and settled down to sleep. The next thing I knew there was a thump on the side of the ute and I poked my head out. I was blinded by a torch and by car headlights that were shining on the ute. Somebody had seen my torch and rang the police thinking I was breaking into the place, and the police had come to find out what I was up to. I explained the position and they accepted my explanation and moved off, and I settled down to sleep again. Then there was another thump on the side of the ute. I climbed up again and they said, "We can't start our car - the battery's flat. Could you drive us down to the police station to get another one?" "Gee," I thought, "you blokes are pretty bloody rough!", but nevertheless I took them down and even changed the battery for them since I had all my tools with me. They thanked me profusely, but by this time I was wide awake so I decided to continue on to Melbourne and Geelong.

I enjoyed being out in the field, but I had to do the tenders in the office. Working on tenders is the most stressful job in the world - I don't care what anybody says. You're up against a deadline, and you have to be competitive but at the same time you have to make a profit - and it's a very fine line. With any major project you put all your effort into preparing the tender, then you spend a month or more negotiating with the client, and then, if you win it you start to get this sinking feeling in the pit of your stomach - the worry that you might have left something out, like "Why was I the lowest price?" And you're dealing with millions of dollars. Anything around twelve million dollars was a small contract, and you'd be often up to anything round 350 million. And preparing a bid like that is based on a hell of a lot of experience. It's something that you don't go and learn somewhere. Mike Lodge used to get me to go into that dreadful BHP building in Melbourne with the brown steel partitions to give lectures to his young engineers on estimating and preparing bids and tenders because they, being university graduates, had never had any of that sort of education and experience.

If we won a big tender the whole office would be very happy. Some of the top managers would be, but some mightn't be, depending on the way they looked upon the client. I've had the situation where one of the very top managers of EPT questioned my winning the coal handling plant at Balmain. The Maritime Services Board had made so many mistakes in their design that it was impractical to build it the way they'd designed it. Now you can look at these things two ways. You can approach the client and ask them if you should turn it into a "Design and Construct" project, or you can tender on the information they've given you (and this is the way second class companies do it) and then hit them for six to put it right after it doesn't work right. One of the top people in particular at EPT thought that you should always prepare the tender from the specification that was given to us, but he had no experience in Design and Construct, whereas I'd had all my experience with it when I was at Simon Carves. They used to always work that way. They were the best company I ever worked for and the worst thing I ever did was to leave them. When there was a penalty clause in the contract Simon Carves would not accept a penalty clause without a corresponding bonus clause. Then of course they'd go hell for leather to win the bonus. It was an added incentive to see that you stuck to the critical path and completed on schedule.

Working with BHP as a client we built the *Barracuda* and the *Marlin* offshore oil rigs. The structure that goes down into the sea is called the jacket. We built the jackets on shore. We trained 700 welders to do it. It was the highest standard of welding that had ever been done in Australia. Esso did the right thing - they put a top BHP engineer, Mike Lodge, at the top, and all the American experts under him. They had to have the Americans, because without access to all the American technology there's no way in the world they could have been built. (This is where Whitlam made a mistake when he cut off foreign investment. If you cut off foreign investment you cut off the technology that goes with it.) When the jacket was finished it was floated out and dropped into position, and on top of that goes all the modules that make up the platform. That was floated out, too. It was tremendously exciting. It was really big stuff. When you get to the onshore refineries we were talking in terms of 35 million dollars in 1968 to 1970 - contracts of that order.

The biggest contract I've ever bid on was in 1969 when Melbourne bit the bullet and did what Sydney should have done - they built the South Eastern Purification Plant. Honestly, the effluent out of that plant you could virtually drink. That was by far the most enormous contract that I've ever tendered on. We had a huge staff. We had three or four estimating engineers, we had a whole team of draughtsmen. There were 6625 mechanical prices alone - that's without reinforced concrete, prestressed concrete buildings, power station - (they built their own power station that runs off the gases from the treatment plant). In fact it all turned out to be a waste of effort because the civil engineers who were in charge of it decided that it was too big for an Australian company to handle and they gave it to an American company. We were very upset about it because all they were really doing with us by asking us to tender was keeping the other mob honest. But as I said, they did it and now Melbourne's got no sewerage problems, but Sydney didn't do it - and it's *still* got sewerage problems. You hear Brereton and others on the media saying that the technology is *now* available to do it, well that's bullshit because the technology was available in the sixties. What we've got in Sydney is only primary and secondary treatment, and still we haven't got tertiary treatment.

I had experience across a wide diversity of projects. I could jump from the guts of a power station - that's the high pressure water pumps, the boilers, the turbines, the coal handling plant - everything - I could jump from that to the guts of a refinery, with its cat cracker unit and its converters (we did the Shell refinery out there at Clyde), to the guts of an aluminium smelter - the pots and all the big busbars, and from there through coal handling plants - you name it. Over in America and in Europe they specialise and you get engineers that do one thing in a power station and one thing only. When I was qualifying in '68 to '74 they were building 50 nuclear and thermal power stations simultaneously in the US. We were lucky if they ever built two at a time here in Australia, and certainly it was never on a continuous basis.

I get upset when they want to show pollution on the television and they have a shot of one of those big cooling towers with emissions coming out of the top. But it's only water - it's steam! They don't show the big tall stacks either, because they've got bugger-all coming out of them because the filtering systems and the precipitators are so good these days. Pollution from modern power stations like Bayswater, and Mount Piper is bugger-all now, and the other ones like Liddell and Munmorah have been converted. It's the same when they show the steel works, with the coke ovens and the coal cars. When the coke comes out of the ovens and into the coal cars, the coal cars go in to be quenched and great billows of white steam come up and they always show that as pollution, too.

When I was given the AACE International award in 1991 it was for a whole range of areas such as cost estimation, cost control, business planning, management science, profitability analysis, project management, planning and scheduling. Planning and scheduling was the only area in which you had to be computer literate, and that was the only area that I'm not expert in. I always employed a consultant to actually do the planning and scheduling. I'd set up what we call the logic diagram - all the activities that had to be carried out (and sometimes there were thousands of them on a big job) and I'd also give them a duration in terms of days. From there the consultant would take over. He'd draw up the critical path programme and feed the programme into the computer. If something went wrong with the critical path activity, like delays due to rain or deliveries of materials, you'd then go back to the computer and it spits out the next most critical activity. Most project managers were satisfied with that, but I never was. What I would do was to analyse that activity to try to find a way to bring that activity back down to the time it was originally supposed to be completed by, so that the project completion date remained the same, even if it meant putting more men on, or doing more overtime or whatever.

I always said I didn't want to have anything to do with computers. We always had a lot of younger engineers, and if you really needed to be computer literate in anything, even something like engineering calculations in metric, which I can't do, I'd get one of the younger blokes to do the calculations. I could do it the normal way and convert the answer to metric, but I couldn't do the individual calculations. Metrication was a backward step as far as I'm concerned, even though it's been used in Europe for years. I always said that computers were for another generation, not for mine, but I'm out on my own there to a certain extent. Most of my friends who've retired have got computers, but I haven't. In fact the exam I passed in 1978 to become a CCE (Certified Cost Engineer) I wouldn't be able to pass today because Computer Science is now a subject. It was made a subject

at least ten or twelve years ago.

There's some stories go with all these projects. The worst disaster I was associated with was when we dropped a huge girder at the Liddell Power Station. The two main buildings were the boiler house and the turbine house, and our job was to erect the two turbine house cranes. Each crane has two main girders. You've got the end carriages and then the crane trolley runs on top of those girders, which weigh something of the order of 40 tons. I had the two biggest cranes in the country on the job - one was our own and one was hired from Transfield. We got the first three girders up into position and had the fourth girder almost in position when the Transfield driver felt a movement and thought his crane was going to collapse. He panicked, and he dropped it. The girder came tumbling down, and wrecked both the cranes. Luckily the drivers dived out of them. And of course it wrecked the girder as well - that had to come back to Sydney to be repaired - but the worst thing was that it cracked the massive concrete work where the cooling water comes in. It was an insurance nightmare. But these accidents do occur. (They lost seventeen lives when they were building Eraring Power Station, what with bloody Transfield cutting corners and by-passing safety procedures and that.) Anyway, I didn't have a clue how we were going to get all this concrete out. It was massive. But a guy from CIG approached me about a new technique they had developed called oxygen lancing, and it was an ideal situation for them to try it out. And it went through that concrete like a knife through butter. Nobody was more grateful than I was, I can tell you! I wasn't concerned about the cost, it was the sheer physical problem of how we were going to get it out. He was delighted and so was I.

Another huge project in terms of size was the telescope at Tidbinbilla. You imagine a dish five house frontages in diameter. (I often wonder why more people don't go up and see it - it's just up the mountain from Canberra. It's just an amazing size. The telescope at Parkes is a relative baby compared to it.) When we were building it we were told that the Tidbinbilla telescope was to be used for tracking to Mars, but as we know now it tracked *Voyager* right through the galaxy. The signal from *Voyager* hits the main dish, reflects back up to the sub-reflector at the top of the quad pod, then back down to the cone in the centre that's got all the electronic equipment in it. It's a massive thing that turns on rollers through 360 degrees, and goes 180 degree in a vertical plane.

Working on that job had a lot to do with my boss, actually, who was always onto the prestige jobs. I didn't really go for them much myself - they were a pain in the arse, to be honest, but he used to call them prestige projects. Like the Sydney Opera House. What a pain in the arse that was! You wouldn't credit it! Utzon had his vision of what the interior of the Opera House should be - he had four or five stage sections - one for each act, so that when Act I was finished that stage would go down and Act II would be ready to come up - so you didn't have to change the stage setting. There was the machinery for raising them up and down, and all the machinery overhead as well. It was a magnificent concept. Obviously he'd seen places like The Met, Covent Garden and La Scala, but they're massive buildings compared with the Sydney Opera House. I don't give Utzon anywhere near the credit that a lot do, even for his design, because he had the inspiration of many buildings on the Mediterranean. It's a magnificent building, there's no question about that, but it's not an Opera House - it's a

Concert Hall.

We tried to reason with Utzon, but you couldn't reason with him. He was just so bloody obstinate. And you couldn't get any plans out of him. He wanted me to do the plans, and I said that as far as I was concerned it wasn't on. He had his own firm of consulting engineers - Ove Arup and Partners, and I told him it was up to him to supply us with the drawings. I was the engineer that had to do the installation, and I was convinced that it could be done on a smaller scale. Sir Davis Hughes got fed up with Utzon for the same reasons.

I've since met Davis Hughes up here and been out to lunch with him several times, and it was clear that the thing would never have been completed if it was left up to Utzon. He's recently sent out another cross-section through the Main Hall which proves exactly what we said. He's got two thirds of the Main Hall taken up with stage sections and stage machinery and only one third for the audience. It would have cost \$1500 to go to the opera! We tried to convince him to put in fewer stage sections and less machinery but he just wouldn't be in it so Hughes told him to go and get stuffed. Of course Utzon left in a huff. Now they've ended up with only one stage section and behind where the other sections were supposed to go they've got additional seating for patrons. The original seating, even with the reduction in stage sections, was inadequate, and if you look at the dimensions of the orchestra pit, and the height above the stage - there was just no room. You couldn't possibly have done it the way Utzon wanted it. The building was far too small to be a Grand Opera House. To me, Utzon was something of a prima donna, and Hughes wasn't the philistine he was made out to be. I supported Hughes up here in articles I wrote to the *Sun Weekly* - that's how I got to know him.

When Transfield came onto the engineering scene things began to change. Transfield was started by two Italian engineers who came out in 1954 as employees of EPT, who had the contract for the high voltage power lines from the Snowy Mountains. They were on a two year contract. When they went back to Italy they decided they'd come back out to Australia, which they did in 1957. Now all I can say is that prior to 1957 there was absolutely no corruption in the Australian construction industry - none whatsoever. The Newcastle BHP executives in particular were always straight up and down. The lowest price won the contract, and that was it. They wouldn't even let you take them out to lunch. But I was doing work down in Port Kembla from 1956 to 1962, and in the latter part of that period I was approached to engage in some questionable business practices, and when I refused I was told we wouldn't get any more enquiries to bid on. As bald as that! I said, "You know my reputation. It's that I'm incorruptible." (and that's the reputation I *did* have. Nobody tried to bribe me, because they knew.) I went on, "My reputation means more to me than your bloody work, and so far as I'm concerned, I'm out." And I never did any more work for Port Kembla from 1962 to 1985. (It's not uncommon for company executives to have holiday homes on the coast that have been paid for in various ways by contractors in return for considerations shown to them.)

This sort of thing makes you very cynical - not only about the construction industry, but about modern-day politicians. You don't have to be a genius to work out how they can afford the lifestyle they have and own as much as they do. I've played it straight, but I still earned enough that way to live comfortably. Doing the sort of work that I did kept me away from home a fair bit. I didn't see as much of

my two daughters as I would have liked when they were growing up, but it certainly hasn't had any effect as far as my wife is concerned. The longest I was away was six weeks, when the job rebuilding the coke ovens went badly wrong, which is a story in itself:

Ron Russell, one of the top BHP engineers, rang me up at two o'clock one afternoon and said that he'd like me to go up and see him right away, which I did. (They were bullies like that. They knew how to throw their weight around. I was talking to an ex-BHP executive only last Friday and I said to him: "I've worked out why you're a bully. You're a retired BHP executive and with only one or two exceptions they were all bullies." He thought that was great!). Anyway, Ron Russell said that he had an idea. He thought that we could rebuild the coke oven battery while still maintaining the heat in the ovens. (Once you let the ovens cool down all the highly expensive refractory brickwork is no good and has to be replaced. In those days that would have cost over a million dollars.) This was Ron's idea, and nobody in the hierarchy of BHP agreed with him. It was a very radical suggestion because it had never been done anywhere in the world before, and it's never been done since, because it's too dangerous. They had on site EPT, Transfield, Hornibrooks, but nobody would tender on it. It was too hard. I was considered very favourably by Ron Russell, and he asked me to crawl over the job and have a good look at it and tell him whether I thought his idea was feasible. I did this, and I reported back that as far as I could see we could do it the way he had in mind, and that the biggest problem would be when they took the furnace doors off, when workers would be subject to white heat. We could yank the old frames out and even get the new frames into position, but there was no way we could repair the refractory brickwork around the frames because it would be too hot. He said that if that was our only worry, BHP could handle the repair of the brickwork around the frames. He then told me to go away and work out a price, making sure we were well-covered.

I went over the thing again inch by inch, took into account all the various operations, and worked up a price. I ended up down at the Construction Manager's house at midnight that night. I banged on the door and said to him, "Come on. Get dressed. We're going up to Newcastle." He said "What the hell for?" "Ron Russell wants this price by nine in the morning, and I'm not prepared to take the responsibility. You're the Construction Manager, and it's up to you to come up with me and go over the whole thing." We did that, and we were in Ron Russell's office with the price at nine o'clock the next morning. He looked at it, confirmed that we were well-covered, and said that he'd have a contract drawn up right away, which is what he did. They don't muck about.

Anyway, the bloody job was down a thousand man-hours by the end of the first week. I knew that BHP had their inspectors on those sort of jobs on three 8-hour shifts. We used to work two 12-hour shifts with 48 men on each shift because the men liked the overtime, and you couldn't get good men on the job otherwise. But the way things were, you could get a situation where there was something like a gas leak, and the contractor's men would sit on their bums for ten hours till the problem could be fixed the next morning, because there was nobody there of a night-time to give a decision on what to do. Now ten hours - 48 men - that's 480 man-hours!

Anyway, I got out of the problem by analysing each operation and reducing the number of man-hours it took to do it. I'd put three men on where before there were six, and wanted the same productivity. This is what I used to be able to do with men. Not only that, but I programmed the job twice a day for the day shift

and I programmed it once for the night shift with an alternate task to go over to if something went wrong. By comparing actual man-hours to estimated man-hours like that I was able to tell our management in Brisbane when the job started to become profitable. They still weren't very happy about it, but nevertheless we ended up making five percent profit.

But in the course of the job the Evans Deakin management got very worried about the whole situation and they came down in force. There was a big meeting up in the Boardroom of BHP. Evans Deakin executives were making all sorts of demands, threatening to take all the men off the job. Bill Hall was the Chief Procurement Engineer. He was a terrific bloke, and in my opinion my best friend in the industry. He came down and whispered in my ear, wanting to know if I was being compromised by what was happening. I said that I was, in that the top people from Evans Deakin were making out that the job wasn't going well and that we were losing money, yet neither of those two things were happening, and it reflected back on me because I was the engineer in charge. As far as I was concerned the job was under control by then, even though it had been behind by the 1000 man-hours earlier in the piece. But I'd rectified that by demanding extra production from smaller crews and so on. So he went back up, and he closed the meeting because he realised that there was no point in going any further because it was in fact a sham. (This sort of thing happened on many occasions with Evans Deakin.)

One part of the job was to renew the cast iron rings around the charging holes. I got too close to one of those charging holes one night, and it burnt my socks to my feet. I had to be taken to the Mater Hospital to have my socks taken off.

I was on the job from seven in the morning till ten at night. I had the day shift from seven till seven, then I had to get the night shift under way. I used to go back to the motel about three or four in the afternoon to get a couple of hours sleep. And I was the lowest paid man on the job! The foremen, the supervisors, the tradesmen - they all got paid overtime, even the BHP site engineers were paid overtime, but I just got my salary.

You ask if having so much responsibility so constantly was very stressful - if it took it's toll. I have to say that it never worried me in the slightest. I've been a fairly shy short of guy, but I've never lacked confidence. I've always had the utmost confidence in my own ability. If I thought something could be done, then as far as I'm concerned it could be done. Particularly so since I had this gift, as I call it, to be able to push men to do beyond what their normal capacities would be. But I always gave them a fair deal - that was the whole arrangement. You expand on their good points and ignore the bad. That's the way you get the best out of people.

When we were doing that high pressure pipeline down Brown Mountain that I mentioned earlier, I used to go down there twice a month to check on how everything was going and so forth. In those days there were very few engineers in charge - all my jobs had foremen in charge and I'd visit them once or twice a month or even more often if it was necessary.

I used to choose who to make foreman. I'd advertise for men, not necessarily foremen, and pick them from the ones I hired. For instance, when we did the Sinter Plant at BHP in 1957 I had to get 412 men. I became a very good judge of men through this. I could usually tell if a bloke was fair dinkum, or a troublemaker, or whatever. Of course a few bad eggs would slip through, but for

the most part they were pretty good. I think that leaders are born and not made, and I always looked first for reasonably good leaders. I'd go for the blokes with that bit of extra go, and drive, who could get things done. But also, you never make a good tradesman a foreman because he expects too much of the men under him. In those days, especially in the sixties, I had a really good band of foremen/supervisors such as you don't see today because there are so many engineers now doing what foremen used to do.

Anyway to get back to the pipeline down Brown Mountain: I was in my hut one night when it was pissing down with rain - I had a separate hut - and in the middle of the night there was knocking on my door. It was the foreman. I asked him what the trouble was and he said, "Norm's put his fist through the window and he's cut the main artery in his arm and there's blood everywhere!" (This foreman had a tendency to panic in situations like this. Norm was our best welder, by the way). I said, "Put a tourniquet on it," and he said, "We've tried, but he's mad - he's had a bit too much." So I said, "Well for Christ's sake knock him out - you're big enough - so you can get it on to him!" So he did that. In the meantime I got dressed.

We had a slithery little track all the way round the mountain to the road that went down the mountain - which was not as bad. I slithered around the mountain in the utility and went down to Bemboka to seek some medical assistance. I knocked up the publican and he told me where to go to find the bush nurse. I went there and knocked her up - bear in mind this is in the middle of the night - and I told her the story and asked if there was anything she could do to help. "Just give me five minutes to get some clothes on and I'll come back up with you," she said. I was a strange man - she'd never met me before - yet she came up with me, in dangerous conditions. Unfortunately she took one look at his arm and said that there was nothing she could do, and that we'd have to take him into Bega Hospital to get it stitched. The rain's still pouring down, so it was me and the bush nurse in the front and the foreman and Norm in the back of the ute under a tarpaulin - all the way down to Bemboka to drop off the bush nurse, then on into Bega to get his arm stitched. It saved his life.

There was a guy called Les Foreshaw who in my opinion was the best welder I've ever known. I used to say that he could do an X-ray weld with a coathanger for an electrode. In 1960 we erected the massive guyed derrick to build the cat cracker for Shell out at Clyde. A guyed derrick can cover a whole site and is a terrific height. The cat cracker was to make Super petrol. In fact, the Red Holden engine was supposed to go into the EJ model in 1962, but because the super petrol wasn't available because the plant hadn't been built they had to wait till the next model - the EH, in '64, to use it.

We had the best welders in the country on the job, and there was a lot of chrome molybdenum welding in the cat cracker and in the converters and so forth. (Chrome-moly is for high pressure work. It's used in power stations for the high pressure steam lines and in oil refineries for any high pressure application. It's a very high-tensile alloy.) Now although Les was the best welder I had, he was also a troublemaker. He'd ferment dissatisfaction amongst the men and create problems for me. Nevertheless, we finished the cat cracker and the associated plant so that it was operational, and then Shell decided to build an ethylene plant using technology from Braun in America. We had the inside running on that

because the Chief Engineer at Shell was very happy with the job we'd just done - but nonetheless we had to tender for it.

We won the contract, and on the job we ran into a problem with welding dissimilar metals. We had to butt-weld stainless steel pipes to monel metal pipes. Although welding dissimilar metals always presents a problem, this was one we'd never struck before. I had no idea how to do it, nor did the Yank experts from Braun. I said to them, "There's one man here on site, and if anybody can do it, he can." I called Les over and explained the problem to him. He just said, "Piss off and come back in twenty four hours." The Yank's mouth was hanging open! "Do you let a welder talk to you like *that*?" he said, "With this one I do," I said, "and I do what he says, too!" So we went away for twenty four hours, and when we came back they were all done. But he wasn't about to let anybody know how he did it.

There were two blokes in the Boilermakers' Union there who also used to like to make life very difficult for me. They were left wing. My men didn't make the trouble, it was these two from the Union coming in and demanding things that they weren't entitled to. It got to the stage with them that I said, "Look. I'm sick to death of this. As far as I'm concerned - there's the gate. You don't come onto this site again. If you want to talk to me, make an appointment with Head Office at Caringbah and I'll talk to you there." Strictly speaking I couldn't stop them coming onto the site, but they took notice of me. But they've got all the answers, and you can't match them orally. This is what they concentrate on. By the time I was in my thirties this sort of thing was starting to get under my skin.

Les was like a fifth columnist, but I had to keep him on because he was such a good welder. But by the end of the ethylene plant job I was fed up with him. I called him into the office one Friday afternoon and I said to him, "Listen, Les. You're the best welder I've ever had, but the trouble is, you know it too, and you play on it, and I'm sick to bloody death of all the trouble you cause. As far as I'm concerned, mate, you've got two options. The first is for me to give you the sack - which will be the third time you've been sacked, so you know that'll mean you'll be blacklisted, and that'd be one hell of a waste." (In the fifties and sixties there were top welders walking around Newcastle who couldn't get a job because they were blacklisted for being fired three times. Three times and you were out. On the other hand, the Boilermakers' Society used to keep a black list of engineers. Fortunately I was never on it because I usually gave the guys a proper deal). "...The other option is for you to start up in business for yourself, and because you're so good, I'll feed you the work. Give it some thought over the weekend and let me know what you decide on Monday." On Monday he came into the office and said, "I've decided to accept your offer, Arthur. I'm going into business for myself." And he did. And he never employed a welder or a boilermaker - he put them all on contract. He knew what trouble they could be, so he made them all subcontractors - like they're talking a lot about doing now.

The first job I gave him was some caustic storage tanks for ICI out at Botany. To give you an idea of how good he was: the average single run of weld per day around a tank shell would be about 250 feet for the average good welder. Les would do five or six hundred feet. He was just phenomenal! He'd work out his own procedures, and he wouldn't tell anyone how he did it.

Then we had to do the pipeline from the Molonglo Dam in to Canberra. I gave that job to Les. I said, "Here's my cost price. Away you go. You line up all the pipes and you do all the welding." Which he did. The Commonwealth Department

of Works was so impressed with his welding - the speed, and not a single X-ray reject anywhere, not a fault - that they gave him all the welding in Canberra, and they gave him a house. Even the water-pipes are X-ray welded in Canberra! They really have gilded the lily! So Les has done very well out of it all and has never looked back since that time.

You might have heard about those two guys getting killed in a crane at Newcastle about a month ago. One was the operator of the crane and he was teaching the other guy to drive the crane. It was a BOS (Basic Oxygen Steelmaking) crane, which transports the ladles of molten iron. The full blast of the furnace came back at them and smashed the glass in the cab and burnt them to a cinder. Well, in the early seventies I had the contract with BHP for the design and installation of those BOS cranes. I was in the cabin of those cranes when they were commissioned. The glass was armour-plate glass, and shouldn't have been able to explode or be broken. I've since heard that the cabin had been double-glazed with thinner glass (probably in an attempt to insulate it better from the heat, because it's always hot wherever you are in BHP, but especially so there). If that is the case, then BHP would be at least partly at fault because they removed the armour-plate glass, although in my opinion the major fault was with the driver tipping the ladle too soon - before the furnace was covered.

Evans Deakin had a subsidiary, Hodgkinson Cranes, but BHP wouldn't let them design the cranes. They insisted that they be designed by a firm in England. I wasn't very happy about it because I didn't know anything about them, but I had a very good relationship with the Chief Procurement Engineer up there, Bill Hall. We submitted our tender based on the design from this firm in England - we could only go on the information they gave us. We won the contract and then Bill Hall did a very peculiar thing - something he'd never done before. He said that he wanted me to guarantee the completion of the contract. He wanted to make sure that top people from Evans Deakin wouldn't come down from Brisbane and pull all the men off the job because they were losing too much money. (Evans Deakin used to do that sort of thing to BHP a lot.) Bill had always stood by me and supported me, so I said I would. We ended up losing a lot of money on the job. Bill Hall must have known that our bid was too low, which is why he asked for the guarantee of completion. And it was too low because of that bloody firm in England - when we got the drawings they bore no relation whatsoever to what we'd been told to allow for. He knew that the Evans Deakin mob would be down there wanting reimbursement. I said all this to him, and he said, "That's right Arthur. And we'll reimburse you. I just wanted to make sure that you'd go through with the contract on time, and get the cranes in operation. I had every intention of reimbursing you from the beginning." (*Laughs*).

I had very few strikes on my jobs because I treated the men the right way. I can't remember any strike starting because of something that I did - there was usually an outside cause. My first major contract as a young construction engineer was the Sinter Plant I mentioned earlier, in 1957. I wasn't on my own - there were two other engineers out from the German company who did the design. That was the site where I had 412 men.

It was accepted practice that the riggers go up top first, and as the crane lifts the various members into position they put the bolts in, but only loosely. Then the

boilermakers go up and do all the lining up and tightening up of the bolts. One of BHP's engineers had given my foreman rigger the instruction to carry out the final tightening up but this was considered to be unsafe and everyone ended up out on strike over it. It was a demarcation dispute, and it went on for about six weeks. BHP said that they wanted it resolved one way or the other, and they were prepared to pay us all our costs while the men were out. I wasn't very happy about it because in my view it was a fruitless exercise, and a very costly one. In the end nothing changed.

The second strike I had was associated with a little stack that was to be built down the end of the Sinter Plant. It wasn't part of the contract, and I didn't take any notice of it because it was just a small extra that I thought we'd probably do later on. But it turned out to be Transfield's first job on a BHP Newcastle site. Instead of building the stack in one piece and then sitting it on its base by holding it with two big cranes above its centre of gravity and a small crane at its base to guide it into position over the bolts...(as late as the late eighties construction managers have argued with me that you can't synchronise the use of three cranes, but I can produce photos to show that you can)... but what they started to do was to start to build it stroke by stroke on site. There were three Italians on the job, and what was happening was that one guy would go and get the welding gear and do the welding, then he'd go and get the paintbrush and do the painting - the next thing I know all my men are out again - all 412 of them! Demarcation again! You can't have a welder doing painting or a painter doing welding! I went up to the chief construction engineer and asked him what he was up to, and after some discussion he took them off the job. Discretion was the better part of valour. Just as well he did, too, because I was just about to punch him in the face!

Another memorable strike was when Ted Webb was the managing director of Boral, out at Matraville, (later on they were taken over by Total). He was a pretty forceful character, you know, and sometimes he'd get some funny ideas. We were doing an overhaul of the cat cracker unit, taking out all the trays and everything. From the front gate it was a fair way down to the job site, but the clock-on clock was at the front gate. The guys had to clock on by seven o'clock and then walk down to the job. Bloody Ted, without consulting me, moved the clock from the front gate down to the job. It was a provocative thing to do because it meant the men had to get there that much earlier. So the men are all there out on the road - not so many this time, only about twenty or thirty. The next thing I know it ends up in the Arbitration Court before a Commissioner, with me in there representing Evans Deakin. After hearing the case the Commissioner remarked that the real cause of the problem (Ted Webb) wasn't present in the court, and the upshot of it was that he directed me to negotiate a reasonable outcome of the dispute with Webb. Webb couldn't simply put the clock back up at the gate where it was originally because if he did he'd lose face, so in the end he agreed that the guys got walking time, from the gate down to the site. Apart from those, I can't remember any other strikes that I was involved with.

The Boilermakers were always stirring up trouble. I was in my thirties then, and I always used to say that if I had any grey hairs it was the Boilermakers' Society that caused them. Laurie Short was associated with my wife's family, and I used to ring him up sometimes. He was a very good friend to have. He was the Ironworker's Union, and when the boilermakers weren't working the ironworkers weren't either. I'd let him know if the boilermakers were stirring up trouble or keeping production down, which meant keeping his blokes off the job, and usually the problem would be fixed by the next day. The boilermakers were

extremely left wing. The two organisers used to plague me, till in the end, as I said earlier, I put my foot down and refused to let them come onto the site. That was against the law, because they're entitled to come on to the site, but I wouldn't let them. They didn't challenge this because I think they could see that I was completely fed up.

But there are some very good union officials - there's no doubt about that. There's a place for unions. I've always been an advocate of industry unions though, so that one union can't go on strike and hold up a whole refinery or a power station. I'm a union member myself - I'm an honorary member of the Metals and Engineering Workers' Union. By remaining a member I get the union journal and so get an idea of what's going on. I like to get both sides of the story, and then make up my own mind. That's why I'm a swinging voter. I've voted Labor at times, and I've also voted Liberal. I make up my own mind.

Construction work is very itinerant in nature. You work on one job till it's finished, then go on to another one. I always used to give them a week's pay in lieu of notice. It gives them a week to be looking for another job. If you give them a week's notice they hang around and do bugger-all and tend to cause unrest. I've always tried to do the right thing by the men. In the construction industry you'll never get anything done unless you're part of a team. Teamwork is very important. Your life can depend on it, because it's often very dangerous work. We were in the Rod Mill at BHP one day when the red hot steel rod came out of the rollers and started whipping around everywhere, bouncing off parts of the building. We were diving for cover all over the place.

Its especially dangerous at BHP, and they contribute to that themselves to a certain extent. Throughout my career they would never let an inspector from the Department of Labour and Industry on site. I don't know how they got away with it, but they wouldn't allow it. I've even seen them do high-pressure steam pipework without proper supervision. But they're good to work for, and most of their executives are top guys. They're bullies, though - there's no doubt about that, and you've got to know when to stand up to them. When we were doing the coke oven, we were doing 95% of the work and they were only re-doing the brickwork around the openings, yet they had so many men on the job I was having difficulty finding mine. I just got fed up one day and said to the BHP boss, "Listen, piss off! And take all your men with you!" (and this is in front of Sir Colin Smyles. That sort of thing happened on numerous occasions with BHP.)

When we won the contract to do the telescope at Siding Springs the people from Coonabarabran asked us if we would employ locals to help with building the dome, because there was a lot of local unemployment. We agreed to that. Around the dome we had stages - small platforms like painters use - and there was a welder and a trade assistant on each. On one of the stages one of the welds cracked and the stage went down at one end, and there was a local worker on the down side who fell down to his death. I wasn't there at the time. Alec Milne, the best foreman I've ever had, was on that job. He was a keen bowler and had joined the club at Coonabarabran for the period we were up there, but all the local people absolutely ostracised him after the accident. It virtually brought on a nervous breakdown with him, and I had to take him off the job and put another foreman up there. I told the locals in the bowling club what I thought about it. I explained how we'd made it clear that construction work is dangerous, and it's always on the cards that someone could get hurt or killed. I said, "You insisted

that we use locals, and unfortunately it was one of your number who is no longer with us, but that's part and parcel of construction, and you've got no right to do what you've done to Alec." I brought him back to Sydney, and the poor bugger got hit by a car soon after he got back and he was a complete mess after that.

Alec had been foreman on another job some ten years earlier when another death had occurred - at Comsteel in Newcastle. We were using the bridge of a crane as a platform to work on and we had all sorts of notices down below saying there were men working above and all that. But that didn't stop some arsehole from switching on the crane. I happened to be there that day, and all of the blokes except one got clear. The one that didn't was crushed between the bridge of the crane and the roof. I heard him say, "Arthur, I can't breathe..." and then he was gone. Obviously that accident had some impact on Alec as well. By the late 70s, after the death of the bloke at Siding Springs he'd deteriorated into a virtual vegetable. Later on I was building the steel structures on Kooragang Island for the coal loader, and I thought I'd drop in on him at his place at Carrington to see how he was, and he was jumping out of his skin! He was terrific, and it was really good to see he'd come good again. He'd just gradually got better, apparently.

You ask me if I spent much time off the job with the men I had working for me. I didn't, because you can't do that and maintain authority - it's impossible. It's a rather lonely job - being in charge. You've got to remain aloof from the men despite the fact that you like them and enjoy their company. You enjoy talking to them, and you do the right thing by them, but you have to remain aloof from them because the time will come when you have to do something tough. You can't get emotionally involved with... well, with a few of them I did - with Norm, the welder who cut his arm - I did get emotionally involved. He kept saying to me that he owed me his life. I told him to forget it, that it was part and parcel of the job, but he always felt that way - so there's an emotional involvement there.

Another one of my foremen, two of his little kids were buried alive in an accident where the kids had dug a trench. These really tough construction men, hard drinkers,... underneath they're kids, babies. I had a very close relationship with him because he was shattered by the loss of his two kids. I had to look after him. I suppose some companies would have given him the sack but I let him do whatever he wanted to do, and kept him on the payroll. It all boiled over after about twelve months. I was getting complaints from the other foremen that I was doing too much for George. So much so that I had to recall them all from Whyalla, Kwinana - from wherever they were - to come to Sydney to discuss the discontent with how much I was doing for George. Their complaint was that I was doing too much for George - not only to do with the loss of his kids, but he also used to ask me to fill out his insurance claims for him and things like that - but so did some of the others. I pointed out to them that it was because George asked me to do more for him than they did, and that there was no favouritism because I'd do the same for them if they asked me to. So they all went away satisfied.

I'd rather be back on the job than be retired. My doctor last week remarked on how much I obviously miss my work. Most of all I miss the interaction with people - that's why I volunteered to be on the Management Committee of the Association of Independent Retirees. I felt dead when I retired. I'm seventy years of age now, but I've still got it up here (*taps temple*). I've got a naturally high IQ. It's higher than my brother's - even though he's a PhD and a Professor. The other thing I miss most as I said earlier, is the smell of the steelworks and the dirt and the dust

- particularly the smell. It's a peculiar sort of smell that you sort of get used to.

I mentioned earlier that back when I was going for the ASTC qualification at night I had a nervous breakdown. That incapacitated me for life. I've more or less suffered psychological problems ever since. It's not that it rattled my self-esteem - nothing has ever rattled my confidence, which is why it's hard to describe the impact it had on me. Probably it's because I'm too conscientious in my work. I had a recurrence in 1958, and another one in 1970, and another one in 1982 when my firstborn daughter died. I got hit by a bus in 1979 - that was a direct result of my work because I had a lot on my mind (I was putting together a multi-million dollar tender and wasn't paying enough attention crossing Market Street). As a result both of my hips were wrecked - I have no right hip at all, there's no movement there, and I have an artificial left one. I still kept on with the projects I was working on, I might add. In 1982 I'd gone in to have the second hip done when my daughter died, and I had a relapse.

I've had a lot of things happen to me. I lost the use of my hands in 1970, while we were on the Bass Strait project. I'd have to run five miles in the morning to get blood into my hands, and then I'd have to run another five miles at lunchtime to get the blood into my hands so I could work in the afternoon. This went on for two years, till I found out it was carpal tunnel syndrome. They operated on me for that but it never fully fixed it up. I still couldn't do any heavy work. So that made me pretty depressed too. But it didn't interfere with my work at all - it was more just the way I felt. I go to a very good psychiatrist still. I've been under his care ever since 1982, and I go to see him once every month, though I really don't feel the need to go to him since I've been involved with the Association for Independent Retirees for the past two years. (On Friday I was elected Branch Secretary, and believe you me that's almost a full-time job. So I'm looking forward to that.)

I feel that I'm privileged to have been born with a keen intellect and leadership qualities. Without these I couldn't have moulded together teams of men and subcontractors to get all these projects built that I've been associated with. But it's not been without cost, as I'm a person of extreme sensitivity. I've read that sensitive leaders either end up as alcoholics (like John Curtin - the man I admire most of all Australians) - or in the madhouse. I suppose in some ways you could say that I ended up in the latter category, though as I've said, my relapses into depression didn't interfere with my work. I kept going, despite how I was feeling.

I haven't said much about my career from 1978 till I retired in 1990. This was the period I did what I consider to be my best work - when I was handling five major multi-million dollar contracts. With three of them I prepared the bids and negotiated the contracts - this was from 1978 to 1986. In 1986 development in Australia came to an abrupt halt - Australia seemed to have built all the power stations and refineries and the like that it needed, (apart from the northwest shelf, which was still going). Between 1986 and retirement in 1990 I was a consultant to industry, especially to small business.

I'm quite proud of my contribution to the building of this country - particularly the provision of those essential services which most people take for granted - like when they switch on a light, or turn on a tap, or fill their car with petrol. All these things require complex engineering and construction. And I'm proud that I remained free from corruption and with a reputation for being so. I'm also pleased that I'm seen as being tough but fair by the teams of men that worked

with me. Although my contribution may have been small in absolute terms, I was one of those in the forefront of resource development in this country - development which, taken overall, has brought considerable export income into Australia.

I'm not a regular churchgoer or a born-again Christian or anything like that, but I've always had a deep and enduring faith in God - that He controls my life. This belief is strengthened by being an engineer and research scientist, which has convinced me that everything in the universe, and on this planet in particular, works according to the laws of physics and mathematical formulas - which to my mind couldn't possibly be the case if the Big Bang Theory is to be contemplated. So, contrary to Kerry Packer, I do believe that there is some form of after-life - but just what form it takes I'm not so sure. But to me, the great mystery - God's great mystery - is life itself.

(Recorded July 3 and July 10, 1995.)