Reminiscences

Five tributes presented at the John G. Bolton Memorial Symposium held at the Parkes Observatory, 9–10 December 1993

Some Reminiscences of John Bolton

J. P. Wild

4/1 Grant Crescent, Griffith,
A.C.T. 2603, Australia.

I would like to take up something that John Whiteoak said at the symposium yesterday in relation to Cowra or Parkes as the possible site for the 64-m telescope. In my memory, what really happened was that E. G. (Taffy) Bowen was determined to locate the telescope on the Nepean River near Camden. It would have been a very beautiful, but very noisy site, and most people were resigned to having the telescope there. But I argued very strongly that it should go 'over the mountains'. Taffy was good enough to arrange a meeting of radio astronomers to discuss the matter (to his credit he did not attend himself), with the result that a group, an unlikely team consisting of B. Y. (Bernie) Mills, W. N. (Chris) Christiansen and me, set out to look for an alternative site, and we finished up at Cowra. We were going to recommend Cowra but Chris had second thoughts, and said he would like to push on a little further—and he found this magnificent site near Parkes. So it was really Chris's discovery. It was left to Kevin Sheridan, Frank Gardner and me, with the aid of a low-flying aircraft, to do some tests to make sure that the site did not suffer from interference from industrial noise from the town of Parkes itself.

My only other contribution to the Parkes Observatory was to be put in charge of the cocktail party for the opening ceremony, and I have vivid memories of it. It was a very, very hot windy day, and I remember shuffling beer into the reception room at a great rate, and shuffling it out to Lord De L'Isle's motor-cycle police escort. I believe there was a small accident on the way to the airport!

John Bolton and I had extraordinarily parallel careers. We were both born in the town of Sheffield in Yorkshire. We both went to Cambridge and did a two-year wartime degree. We both joined the Navy and were radar officers in the Pacific; I was on the battleship *King George V* and he was on the aircraft carrier *Unicorn*. We both applied for the same job at Radiophysics after the war and he got it. He was in Sydney and I was in England, but I more or less talked my way into another job at Radiophysics. We both married Sydney girls within the same month, marriages which were terminated by the death of one of the partners; his lasted for 45 years and mine for 43 years. We were once joint vice-captains of the Radiophysics cricket team and we both became directors on the same day: he at the Parkes radio telescope and I at the Culgoora radioheliograph—it's a fair parallel. That I became a 'solar man' was entirely due to John Bolton. It happened like this: when I wormed my way into the solar-noise group, I had the option of working with John at Dover Heights or

working with Lindsay McCready to build a solar radio spectrograph; I chose the latter because I knew that if I worked with John I would be second fiddle; if I worked with Lindsay, I knew he would give me my head.

It was at the URSI Conference in 1952, the first international scientific conference (of any kind) in Australia, that John really found his feet. Until then he was rather a bossed-about research officer when, suddenly, he found himself an international star; and how he loved it.

I met him in 1956 at the California Institute of Technology where I spent a few weeks. I had just been across the Mexican border and I arrived back with a gallon of white Mexican rum. John and his wife Letty were delighted with this and decided that they would hold a party. At the party there was such a galaxy of names: Willie Fowler, Fred Hoyle, Walter Baade, Rudolph Minkowski, Jesse Greenstein—everyone you could think of was there, except the hostess, Letty. This was because we had spent the evening before perfecting the mixture of this cocktail and she had very kindly agreed to be the testing ground. She told me that she had never had a bigger headache in her life!

Returning to Parkes when John was director, I remember that he had a special aversion to administrators or clerical staff who crossed his path. I recall a Head-Office notice on the observatory notice board laying down the bureaucratic law on a number of matters. John simply wrote across the notice in large letters: 'Head Office has no jurisdiction at Parkes'.

Recently, I wrote an obituary in the English newspaper, *The Independent*, on John. I ended by saying that I had spent many happy hours with him, playing table tennis at Caltech's Owens Valley observatory, playing billiards in the tower of the 200-inch Palomar telescope and, in Sydney, playing cricket with the Radiophysics team. I always found him fiercely competitive and once suggested that his batting concentration was reminiscent of Herbert Sutcliffe's. This competitiveness, as far as I was concerned, I enjoyed but, as on the cricket field, I would rather have had John Bolton on the same side.

John Bolton—On doing and being

Marcus Price

Australia Telescope National Facility, CSIRO,
P.O. Box 276, Parkes, N.S.W. 2870, Australia.

This symposium has been a great celebration of the life and work of John Bolton. We have all learned new things which have served to increase our affection and respect for him. I want to take this opportunity to point out that all of John's activities were guided by his philosophy of DOING. I learned of this philosophy in two ways. First, by watching him, and second, during a rare, philosophical, conversation I once had with him while driving from Canberra to Parkes. He asserted that most people have trouble sorting out what they want to *do* from what they want to *be*. He felt that *being* was accomplished and justified only by *doing* and that *doing* was by far the more important.

John, clearly, was a doer. We have heard at this symposium of his many accomplishments. In every case he was an active participant. Even in his earliest days at the Radiophysics Laboratory he was not content merely to work on others' projects, but quickly formulated and initiated his own projects (sometimes slightly unofficially). When he went to California (to Caltech)—it was to build a radio observatory, not to become a Professor or Observatory Director, although he became both. He was appointed a professor of physics at Caltech and director of the Owens Valley Observatory. After he returned to Parkes, he became the director (or Dishmaster, as some called him) of the Australian National Radio Astronomy Observatory. But, this latter role was simply one that allowed him to be fully involved in all that went on at the new observatory—digging, surveying, mixing concrete, observing, and directing other observing programs were all part of his philosophy of *doing*.

John had a special relationship with his students. He was a friend (although not always perceived as friendly!) to them. He expected them to be doers as well. They learned to do all of the things necessary to accomplish their research—from integrating a Bessel function to turning a bolt on a lathe. Ultimately, he expected his students to be able to build a radio observatory. He knew that if you could build it, you could direct it. And this has turned out to be the case, as a large number of his students have gone on to become directors of observatories and research programs around the world.

At Parkes, even after he had turned the day-to-day operation of the observatory over to others, he continued to be an active researcher. He stayed away from the higher level of Radiophysics Laboratory politics and spent his time at telescopes—both optical and radio—to further pursue his goal of identifying and understanding the distribution of sources.

It is a tribute to John Bolton that his former students (and his observatory) continue to be *doers*—still contributing to the science of astronomy and still adding to our knowledge of the Universe—as John always did. Thank you, John.

How I got a Job in Astronomy

R. N. Manchester

Australia Telescope National Facility, CSIRO,
Epping, N.S.W. 2121, Australia.

John Bolton helped many of the people here at this memorial symposium, and many others around the world, into a career in astronomy. I am one of them. So my story is not unique in this sense, but I would like to tell it as an example of how John helped shape the careers of so many.

I grew up in New Zealand and, at an early age, developed an interest in astronomy, mainly fostered by a judicious choice of books for birthday or Christmas by my uncle, an electrical engineer who also had a deep interest in astronomy. There was little (or no) opportunity to pursue studies in astronomy at either school or university, and so I completed a reasonably conventional degree in physics and mathematics at the University of Canterbury in 1963. There was a strong ionospheric and meteor-radar group led by Dr C. D. Ellyett at the

University of Canterbury and I had worked with them at their Rolleston field station for a couple of summer vacations. This seemed closer to the stars than the alternative research areas in the physics department, so I joined the group as a Ph.D. student, working initially on ionospheric absorption of low-frequency (about 30 MHz) radio emission from the Galaxy and the Sun. A few months after I started, Dr Ellyett announced that he had accepted the post of professor of physics at the University of Newcastle, NSW. To cut a long story short, essentially his whole research team, six people with me as the junior member, moved across the Tasman in early 1965 to take up residence in Newcastle.

The research programs begun at Canterbury were continued at Newcastle. I had an idea for a project in one of these areas—geomagnetic micro-pulsations or ultra-low-frequency ($\sim$1 Hz) oscillations of the geomagnetic field, and convinced Professor Ellyett that I should change my Ph.D. topic to this. He agreed, and I set up recording sites at Newcastle and Hobart to study how these waves propagated toward the equatorial zone. My idea turned out to be correct and around late 1967 I began writing my thesis and thinking about my future. My latent interest in astronomy began to surface and I decided to explore the possibility of obtaining a post-doctoral position, preferably in radio astronomy and preferably overseas. An obvious first step was to visit the Radiophysics Laboratory of CSIRO in Sydney. There I met Brian Robinson who suggested I talk to John Bolton at Parkes, because John was the person most knowledgeable about the overseas scene.

So, a few weeks later, my wife Barbara and I travelled out to Parkes to see John. I still remember very well the thrill of seeing the red lights on the telescope from the Dubbo road for the first time, then driving right up to the base of the telescope and seeing the big dish at close hand. (The thrill has worn off somewhat now, but I am still impressed by the sight of the dish tipped over at 50° or so and lit by the floodlights—it really is a beautiful instrument.) We met John the next morning, and the first thing he did was to take us on a ride down the track on the 60-footer, showing us the hydraulic pumps and the trailing cable system with great enthusiasm. Then, after a tour of the main dish, we joined the morning-tea group at the big table on the ground floor of the tower. After tea, we continued talking and I discussed with John my ideas of getting a post-doc in radio astronomy somewhere overseas. He started going through the likely places, saying: 'Well, so and so is a good place, but they probably wouldn't take you because of your lack of experience, and so and so, they'd take you, but you wouldn't want to go *there*.' After 10 minutes or so of this, I began to feel a bit depressed about the prospects. Then, out of the blue, he said: 'How would you like to come here?' He explained that they were to take delivery of their first computer, a PDP-9, in March or April of the next year. The proposition was that, if I helped them program the PDP-9, they would teach me astronomy. And that is pretty much how it worked out.

It didn't take too long for Barbara and me to decide that this seemed too good an opportunity to refuse and we duly arrived at Parkes in a very hot February, 1968. Although I didn't realise it at the time, this was just a week before the Hewish *et al.* paper, announcing the discovery of the first pulsar, appeared in *Nature*. John and his wife Letty were overseas at the time and they made their house in Court Street available to us for the first few weeks of our stay. All

we had to do was feed their 17-year-old cat (Sweetie Pie) her chopped kidney and milk every day, and water the garden. On my first day at work, John Shimmins presented me with his design for a digital interface to the computer and asked me if I thought it would work. As I had almost no experience in digital electronics, this was a bit of a challenge, but after a couple of weeks I decided that it should work and, fortunately, it did.

The computer arrived more-or-less on schedule and I spent much of the next few months writing subroutines to read in the time, date, hour-angle etc. At John Bolton's request, I also wrote what was, I believe, the first program to record and analyse telescope data, a program to compute positions and flux densities of sources from scans in RA and Dec. In addition to this work, I began a collaboration with Brian Robinson and Miller Goss to observe OH sources in the Galaxy. It was indirectly through this that I had my first taste of pulsar research. Radhakrishnan was hot on the trail of the Vela pulsar polarisation and came up to Parkes to use the OH receiver, and I was roped in to help him. It was during these observations that we discovered the first Vela glitch.

John Bolton did eventually help me get an overseas post-doctoral position. In early 1969 I applied for, and was offered, a research associate position at the National Radio Astronomy Observatory in Charlottesville, Virginia. I was sure, and just a few days ago Ken Kellermann verified, that John wrote a very good letter of recommendation for me, which no doubt was why I got the job.

So, that is how I got into astronomy. I owe a lot to John Bolton and I will always be grateful to him for giving me a start in this fascinating subject.

Parkes and NASA

Michael J. Dinn

Canberra Deep Space Communications Complex,
Tidbinbilla, A.C.T., Australia.

John Bolton's influence on NASA started way back in 1958. The Deep Space Network (DSN) selected its first antenna for Goldstone, California, using John's work as a major information source. The following bears witness: 'Merrick and his colleagues wasted little time in seeking a design. They soon learned of a survey of precision radio astronomy instruments that had been compiled by Caltech radio astronomer John G. Bolton.... From this survey (and some others) they identified... more than forty suppliers, vendors and agencies.' (Quoted from a history of the NASA/JPL Deep Space Network to be published.)

In the early 1960s, Bolton also worked with the California Institute of Technology's Jet Propulsion Laboratory (JPL), assisting them to adapt the Parkes design for use as the DSN's 64-m antenna. These antennas were built in the late 1960*s* and early 1970*s* and have been crucial to NASA's planetary program.

Apollo Missions

Under John's leadership, Parkes played a crucial role in supporting the Apollo 11 and other Apollo missions. Originally, Apollo communications were

designed around a 3-m 'umbrella' type antenna set up on the lunar surface to support television through the Manned Space Flight Network's 26-m antennas at Honeysuckle Creek and Tidbinbilla in Australia. However, on Apollo 11, NASA wanted to simplify the lunar phase as much as possible, and to provide TV coverage during the descent down the ladder to the lunar surface. This meant having to rely on the lunar module's 1-m antenna which, in turn, made the communication link through the 26-m ground antenna very marginal. Even more importantly from a mission safety point of view, NASA wanted the best communications possible to provide data from the astronauts' backpacks—known as portable life-support systems (PLSS), relayed via the lunar module to the Earth.

NASA therefore asked to use CSIRO's Parkes antenna. CSIRO provided the S-band feed (main and offset) and low-noise amplifiers, and NASA supplied the receivers. Installation was carried out by a combined effort from CSIRO, Goddard Space Flight Center and Tidbinbilla personnel.

Temporary microwave links were installed between Parkes and Honeysuckle Creek via Sydney for the telemetry spectrum (which included the PLSS data). The data were demodulated, synchronised, blocked and sent to Houston from Honeysuckle Creek. The slow-scan television (10 frames a second) was separated from the spectrum in Sydney (at OTC Broadway) and scan-converted to US NTSC standards. In addition, a scan-converted signal was sent to OTC from Honeysuckle Creek using temporary microwave links into Canberra. Selection between the two Australian video sources was made at OTC Broadway by a Goddard Space Flight Center representative who called himself 'Sydney Video'. The ABC converted the signal to comply with the PAL video standard and released it within Australia, a fraction of a second before the rest of the world saw it.

The television camera was mounted on a pallet in the base of the lunar module, such that when Neil Armstrong pulled a lanyard at the top of the steps, the pallet swung down and the camera pointed at the descending ladder, though the camera and picture were upside down. A switch was included in the scan converters at Honeysuckle, OTC and Goldstone (California) to cope with this, and to send an upright picture.

The original mission schedule required the astronauts to sleep after landing and before exiting the lunar module, in which case only the Australian tracking facilities (Parkes, Honeysuckle Creek and Tidbinbilla) would have had a lunar view at the time. In the event, there was no sleep period and they exited early. This meant that the Goldstone and Honeysuckle Creek antennas were in view but, at the time television signals first came through and Armstrong stepped on the Moon, the Parkes antenna had not quite exited its 30° elevation limit, although John told me that an acceptable signal was received via the offset feed.

Goldstone and Honeysuckle received the first TV images simultaneously—after Buzz Aldrin pushed in the TV circuit breaker. Goldstone must have forgotten to operate their polarity inversion switch, because Houston TV (and the 'Capcom' system for talking to the astronauts) said that the picture was upside down. After two minutes, Houston selected Honeysuckle's video, just before Armstrong stepped on the Moon. It was said later that Honeysuckle's signal was superior to Goldstone's, though this should not have been the case because the Goldstone source was their 64-m antenna. Houston tried Goldstone again for a short while

but went back to Honeysuckle. About nine minutes after TV signals first came through, Honeysuckle started processing Parkes PLSS data in preference to its own and, shortly thereafter, 'Sydney Video' advised that he had a very good picture from Parkes. Houston asked for it and commented: '... beautiful picture, thank you'. The Houston Network Controller, Ernie Randall, then came on to say to Tom Reid at Honeysuckle: '... pass on to the Parkes people their labour was not in vain, they've given us the best TV yet.' The Parkes data were then used in preference to Goldstone's or Honeysuckle's for the rest of the lunar stay.

Because there had been mild disagreement between John Bolton and me as to the exact sequence described above, I discussed it with him during the Parkes 30th anniversary celebration symposium in November 1991. By that time I had also stumbled over an audio tape of the events, and John and I eventually agreed on the following (for the historical record): 'The first Apollo 11 television image of the first step onto the Moon, released worldwide (and a fraction of a second earlier to Australia) was from Honeysuckle Creek, but the majority, and the best, of the images were from Parkes, starting about eight minutes after the first lunar step.'

John told me that he and Taffy Bowen spoke with Bill Merrick of JPL after the event, and Bill said that the TV signal got lost somehow at Goldstone. I have made several attempts over the years to find out what really happened, but unsuccessfully.

Apollo 13

Under John's leadership, Parkes also supported the Apollo 13 mission. Parkes was not scheduled to track because, I think, of the relatively northerly declination of the Moon (hence short view periods) and/or the mission time-line did not require a 64-m performance capability on the Australian longitude. During the trans-lunar phase, there was an explosion in one of the service module fuel-cell tanks. This meant that there was no power for the command module—the one used by the crew for the normal mission. At this stage, the lunar module was docked to the command module so, luckily, the crew could move into the lunar module and use its life-support systems and electrical power sources. (The command module had only sufficient power to carry out the final Earth re-entry phase.) This meant that the lunar module's systems had to be used for ground communications. These were not designed with trans-lunar cruise in mind, and resulted in relatively weak and intermittent signals. Another major complication was that the lunar module used almost the same frequencies as the third stage of the Saturn 5 launch rocket—known as the instrument unit attached to the 'S4B' stage. On this mission, additional batteries had been fitted so that the S4B transmitter could be tracked up to the point of (intentional) lunar impact, the result of which would be picked up by seismometers left by Apollos 11 and 12. From a ground-station point of view though, this meant that the receivers had to distinguish between the lunar module and the S4B signals—a difficult task. One advantage of the 64-m antenna was its narrower beamwidth (compared with the 26-m antenna), thus allowing it to point more directly at the lunar module and reducing the interfering S4B signal.

So, given all the above, NASA asked for Parkes support very soon after the accident. Within a matter of a couple of hours, John had Parkes pointing

at the lunar module, with the telemetry signal being fed back to Honeysuckle Creek for processing. Eventually, the Apollo 13 mission was brought to a safe conclusion, with the crew using the lunar module as the lifeboat until shortly before re-entry, when they transferred back to the command module for normal re-entry and splash-down. This was certainly the most hazardous part of the Apollo program from an Australian point of view, and the Parkes element, under John's leadership, contributed enormously to the success of the rescue.

Bolton contributed directly to the establishment of NASA's tracking capabilities and to the support of critical NASA missions, setting precedents which were successfully built upon in the 1980s during Parkes' involvement in the Voyager missions. Other NASA missions, such as Galileo, will probably also look to Parkes to provide assistance.

This cooperative environment, pioneered by John Bolton, made great contributions to the success of NASA's programs.

John Bolton and the Anglo-Australian Telescope

S. C. B. Gascoigne

3 Anstey Street, Pearce,
A.C.T. 2607, Australia.

Besides his eminence as a radio astronomer, John Bolton was a great expert on optical telescopes—his strong engineering bent and his years at the California Institute of Technology, rubbing shoulders with the likes of Bruce Rule, Ira Bowen and Rudolph Minkowski and his later friendship with Mike Jeffery, all saw to that. So, about 1963 when the Anglo-Australian Telescope (AAT, though not yet known by that name) became a serious proposition, and Bart Bok, Director of the Mount Stromlo Observatory, set up a small committee to frame technical specifications, John was an obvious candidate. But already Bok had written to Mark Oliphant, on 7 December 1962, describing a fragment of the discussion on the design between Bolton and Fred Hoyle in Sydney: '... mistake to obtain a carbon copy of the Kitt Peak National Observatory ... something more like Parkes.' Presumably the possibility of an alt–az mounting was discussed, John being a great proponent of the same. (Harry Minnett told me it was not always so; it didn't happen until after John went to Parkes.) Actually the time was not yet ripe for an optical alt–az. The drive problem looked too formidable in those pre-computer days and optical people did not appreciate the engineering difficulties, especially those associated with the declination bearings of large equatorial telescopes.

The other committee members were Bok himself, Alex Rodgers, Herman Wehner and me. Once it had been agreed to stay with an equatorial mounting, probably the most important decision was to go for a 150-inch mirror rather than the 120-inch originally proposed; at this stage the rest was pretty much a matter of keeping abreast of, and informed about, current technology. Perhaps the important meeting was in 1964 when a British party consisting of Richard Woolley, Alan Hunter his Chief Assistant, John Pope his senior engineer, and

Professor Roderick Redman from Cambridge, came out for extended discussions. We visited Siding Spring mountain near Coonabarabran in NSW, Mt Serle in the northern Flinders Ranges, and Parkes before returning to Canberra to write the final submission. This was presented to the Australian Academy of Science and the British Royal Society, and formed the basis of the submission that went to the two governments. One contribution specifically from John Bolton was his estimate of the size and cost of the organisation needed to run the telescope; it was the precursor of the Anglo-Australian Observatory (AAO). He suggested a total of 31 people: three scientists, one of whom would be the director, and a complement of experimental and technical officers, various tradesmen and so on. It was a good guess, especially as it was made before the need for a strong team of computer programmers and systems engineers became apparent. Both sides accepted it much as it stood, but for some never-explained reason it was excluded from the final agreement. More was the pity because that omission led directly to the bitter dispute between the Australian National University and the AAT Board which caused so much ill feeling and concern.

This concern led Sir Hugh Ennor, Secretary of the Australian Department of Science, to convene a meeting in 1972 of leading Australian astronomers to ascertain their views. John's contribution is recorded in the minutes: 'The primary objective was the efficiency of the telescope with the availability of support instruments a secondary factor. A permanent staff whose main function was to assist other members of the AAT would add a level of continuity to its operation. He considered that similar arrangements had worked well elsewhere and he supported the Board's proposal.'

This bland extract fails completely to reproduce the vigour and incisiveness with which John actually spoke, and makes no reference at all to a toe-to-toe exchange between him and Olin Eggen over the numbers involved. (Eggen had replaced Bok as Director of the Mt Stromlo Observatory in 1966.) Eggen, one assumes with the Palomar 200-inch telescope in mind, insisted on a staff of somewhere in the region of six (I have a distinct recollection of the number four coming up at one point). John of course stuck to his thirty. This was damaging to Eggen because it demonstrated that he, and the ANU hierarchy with him, had clearly failed to appreciate the complexity and sophistication of the AAT compared to the Palomar instrument. The latter of course was designed and largely built in the 1930s.

John's influence on the project went much further than I can suggest from these scrappy memories. He was close to E. G. (Taffy) Bowen, the Board Chairman until 1973, and it was taken for granted that Taffy consulted him regularly. In addition, he and the old Parkes hands—Mike Jeffery, Harry Minnett, Jack Rothwell, Maston Beard and others, all of whom worked in the AAT Project Office—had known each other since the Parkes telescope was erected and I would imagine that his hands-on, sometimes abrasive style had its effect on a whole generation of Australian telescope builders and users. John took a great interest in the AAT, was always well informed on its progress and visited us from time to time during the commissioning phase. He had of course been through that phase himself with the Parkes telescope and not much escaped his eagle eye. But he seemed to like what he saw, and we hoped so; John Bolton's approbation was not lightly given but, once given, it was something to treasure.