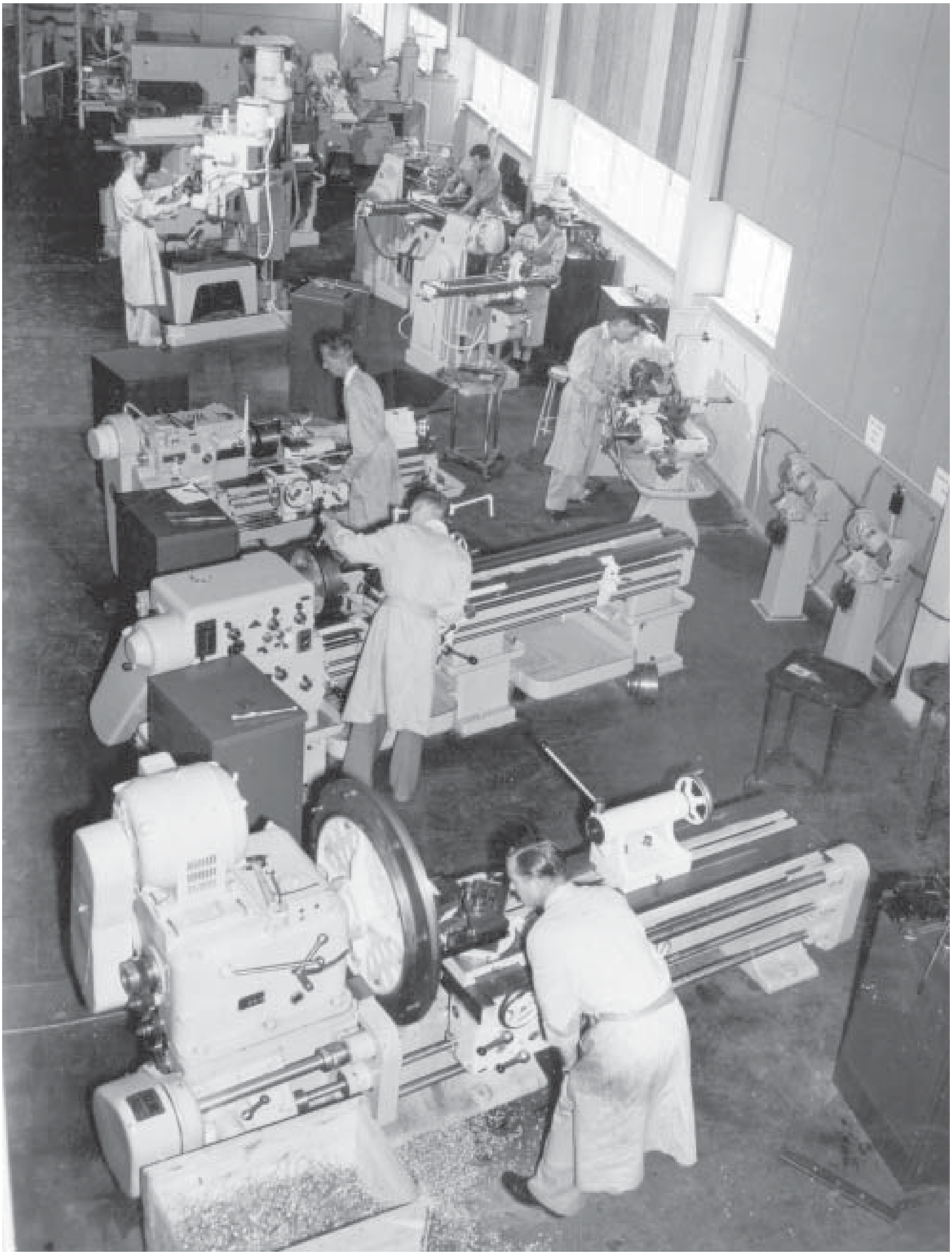
Chapter 5

The Underlying Strength



A busy workshop scene in September 1952.

An Appreciation

Where armies march on their stomachs, research progress relies no less on an infrastructure to support it. The infrastructure extends beyond technical staff and the workshops to the management and administration necessary for them to function, and in turn to the tea ladies, the source of good cheer and the essential providers of information. Research output, the visible measure of performance, sits delicately poised atop a pyramid. A solid base, provided by the whole mix of School Services and general staff of the departments and other sections, is the *sine qua non* of that performance, but insufficient in itself. First class facilities and proper support are essential prerequisites but do not guarantee first class research; research staff must exploit them effectively to justify the existence of both the facilities and their underlying base. Generally, the complex inter-dependence of all School activities on one another is well-recognised, appreciated and acknowledged. Human nature being as it is though, the opportunity to acknowledge the wide-ranging support provided to research should never be overlooked[1]. For many years, the School extolled the strengths of the mechanical workshop and School services as jewels in its crown, yet did not include the staff within annual reports. That omission has been addressed in recent years. Frequently, technical and workshop staff are acknowledged or included as co-authors when new research equipment is first reported, but yesterday's heroes soon become routine tools of trade, taken for granted by incoming staff and students, and even by those responsible for them in the first place. Paradoxically then, but also of necessity due to both the very extent of technical and other assistance that could be appropriately included and to convention, acknowledgment in the highly visible research publications could be regarded more typically as minimal. A research paper in nuclear physics typically contains a line such as:

A 120 MeV ^{16}O beam from the ANU 14UD accelerator was used to bombard a target, 1.5 mg/cm^2 thick, of . . . . .

Not mentioned are the facts that the accelerator operated reliably at 15 MV, significantly above the rated voltage, for many days and with a good intensity beam from a no less reliable ion source. That accelerator performance became possible only after a sustained program of upgrading involving many over some years. Maybe it was the time that ion source operation relied upon the purchasing section having located a hard-to-find length of high voltage cable needed to replace a section that failed. Nor is it in any way clear that the target was prepared from a few milligrams of expensive, isotopically-separated material that had to be reduced chemically to provide a tiny, metallic globule of some exotic element, to be then rolled sequentially to a precise thickness.

Again, that same research paper may well continue:

Reaction products were detected and identified using a multi-electrode gas detector . . . .

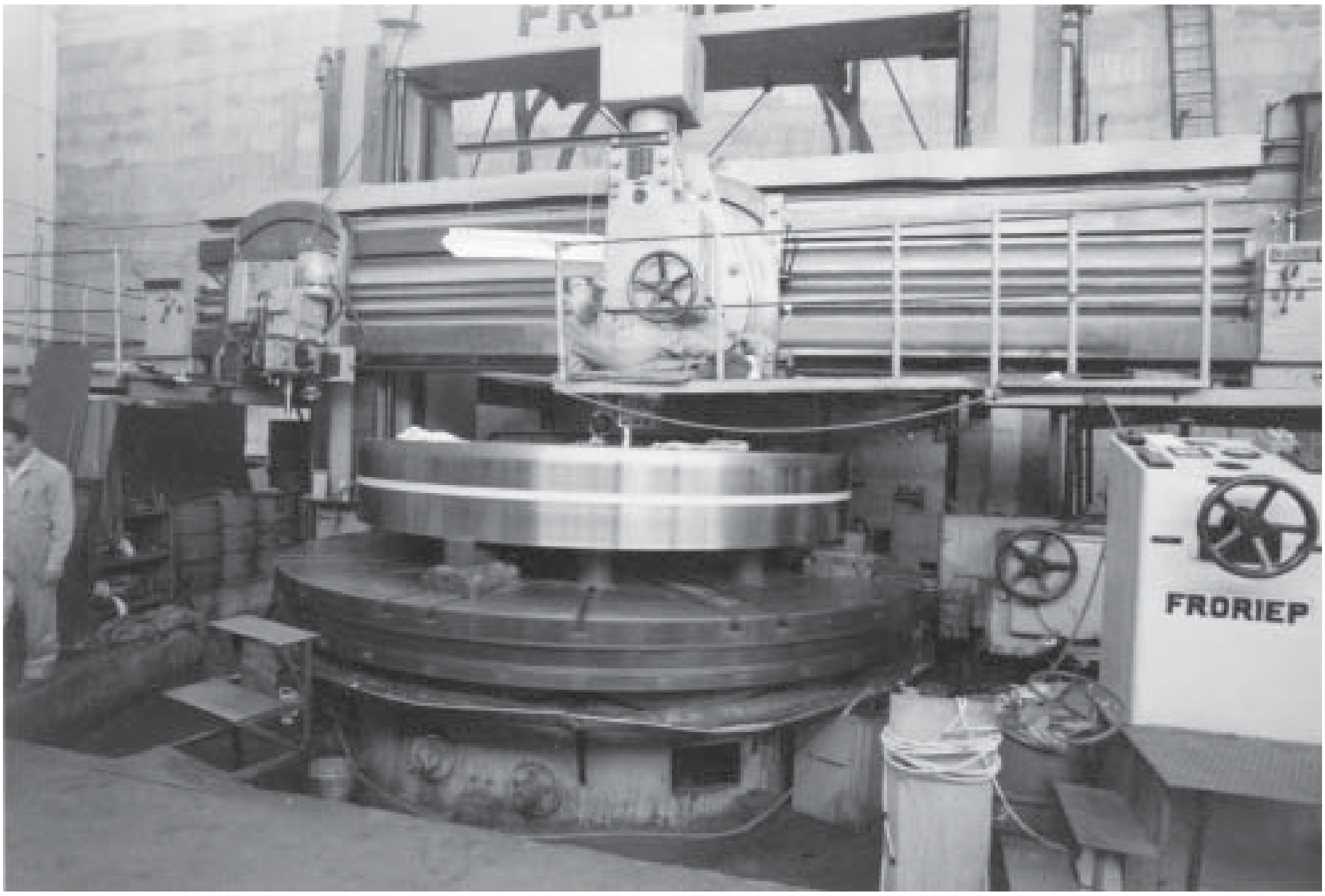
Hidden there are the experience of years contributing to the technical development and workshop construction of the detector, backed with a fast computer-managed data acquisition system and a suite of data reduction and analysis programs.

Importantly, but equally it is by no means obvious, others in similar laboratories elsewhere sense, respect and indeed often envy those unspoken achievements. Unsung does not always mean unrecognised.

Perhaps the most enduring and satisfying tributes are manifested by major pieces of research equipment given sustained use, which stand as monuments to the work and skills that created them. The homopolar generator was one excellent example or, again using Nuclear Physics, the 51 cm scattering chamber there. First constructed in the early sixties, the chamber was upgraded several years later, then nickel-plated and again upgraded for use with near ultra-high vacuum in the mid-seventies. After nearly thirty years of use in its various guises, it was removed from a 14UD beam line to make way for new equipment. There are now plans to re-install it in 1997 on a different beam line. Artisans of several past decades can proudly show fruits of their labours to their grandchildren.

Workshop Facilities

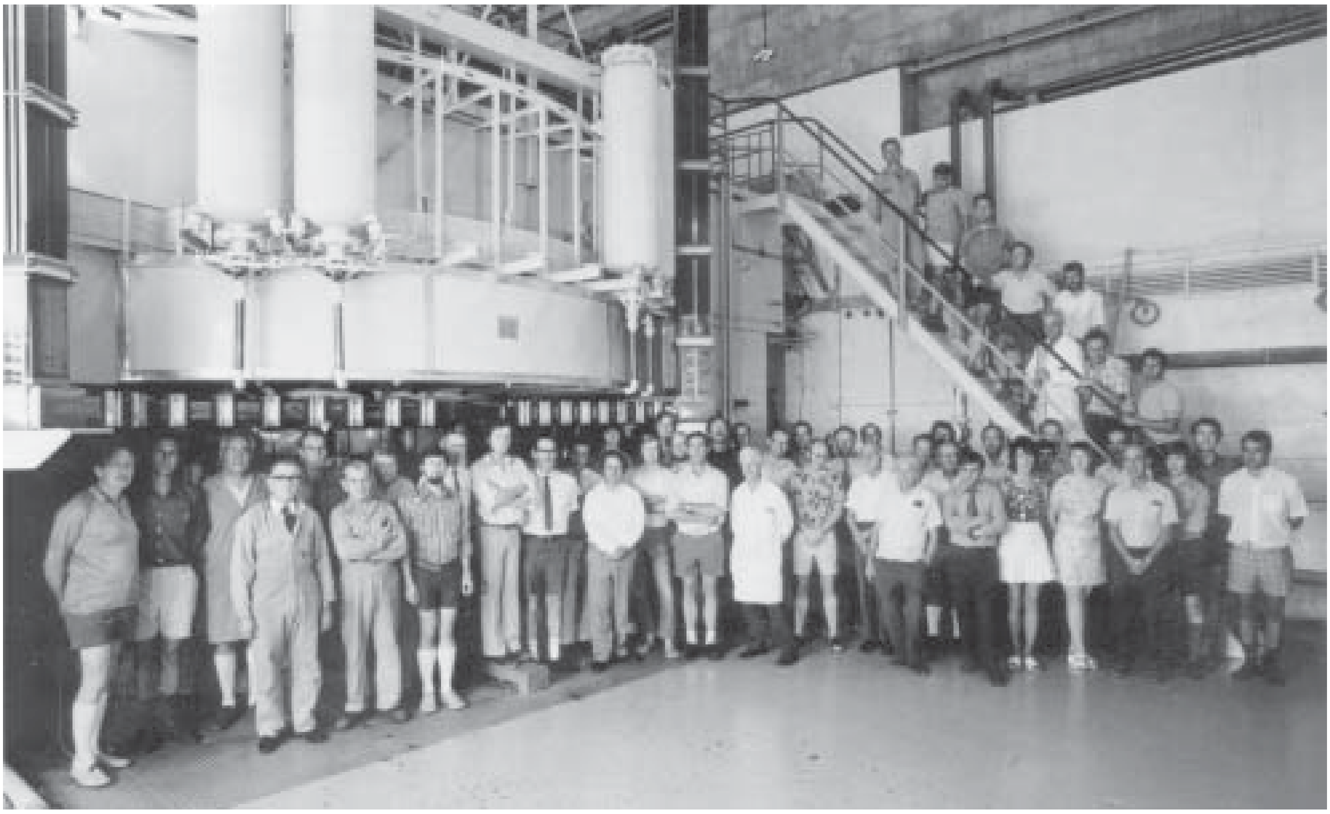
Traditionally, a mechanical workshop has always been part of a physics department to produce and maintain demonstration apparatus and the equipment used for practical laboratory classes, as well as providing support to research. Given the lack of industry in Canberra, and the remoteness of the capital from the major centres, Oliphant's planning included much more comprehensive facilities for the new School.



Even so, the School workshop grew slowly from humble beginnings. In 1951, the temporary building adjacent to the Old Hospital Buildings housed a small workshop manned by Gil Lea, the first machinist to be appointed. Once the Cockcroft Building was completed, the area still occupied by the present workshop was gradually fitted out with lathes and milling machines. The first foreman, Bill McCall, arrived in 1951. An early photograph, taken in September of 1952, shows a well-equipped area, manned by seven dust-coated artisans plying their trades industriously. Almost certainly, the entire muster of the workshop at that time was on display. By 1955, Andy James, the foreman appointed after the untimely death of McCall in 1953, presided over a fully-staffed workshop with about twenty tradesmen. A precision shop had been established and a large boring mill, obtained from the Krupps armaments works as war reparation, had been set up in the accelerator wing. Unfortunately, records of early staffing have not been located, but a number of the machinists from 1955 or before,

Δ *An assembled rotor of the homopolar generator on the boring mill, that was located in the accelerator wing. The white central band is the final silicone seal of the region containing the bonded, insulating pads.*

Final welding of one of the legs that comprised the supporting tripod for the 14UD pressure vessel. The accelerator, including the 30 tonnes of insulating gas, weighs almost 200 tonnes.



The Department of Engineering Physics, augmented by workshop staff, gathered for a now-forgotten occasion in March 1974. Of main interest here are three of the workshop stalwarts, Joe Kalmar (second left at the back), Eric Shrimpton (second left at the front) and Eric Massey next to him. Dick Marshall is to the left of Kalmar, Ken Inall at the centre (white-coated) and Stephen Kaneff is the third left from Inall.

Mechanical Workshop Staff (1987).

1. *Tony Patrech*
2. *Colin Rundle*
3. *Alan Hayes*
4. *Tim Christie*
5. *John Bottega*
6. *Greg Jackson*
7. *Frank Valeri*
8. *John Manley*
9. *Wilf Boehm*
10. *Ron Cruikshank*
11. *David Hall*
12. *Pandu Arkeri*
13. *Gordon Jones*
14. *Bill Miles*
15. *Herb Zeilinger*
16. *Dennis Blackall*
17. *Joe Polasek*
18. *Craig MacLeod*
19. *Graham Cornish*
20. *Rob Gresham*
21. *Harry Jenner*
22. *Owen Kershaw*
23. *Vince McGee*

including Eric Massey, Joe Kalmar, Eric "Shrimpo" Shrimpton and Gil Lea, remained with the School for many years.

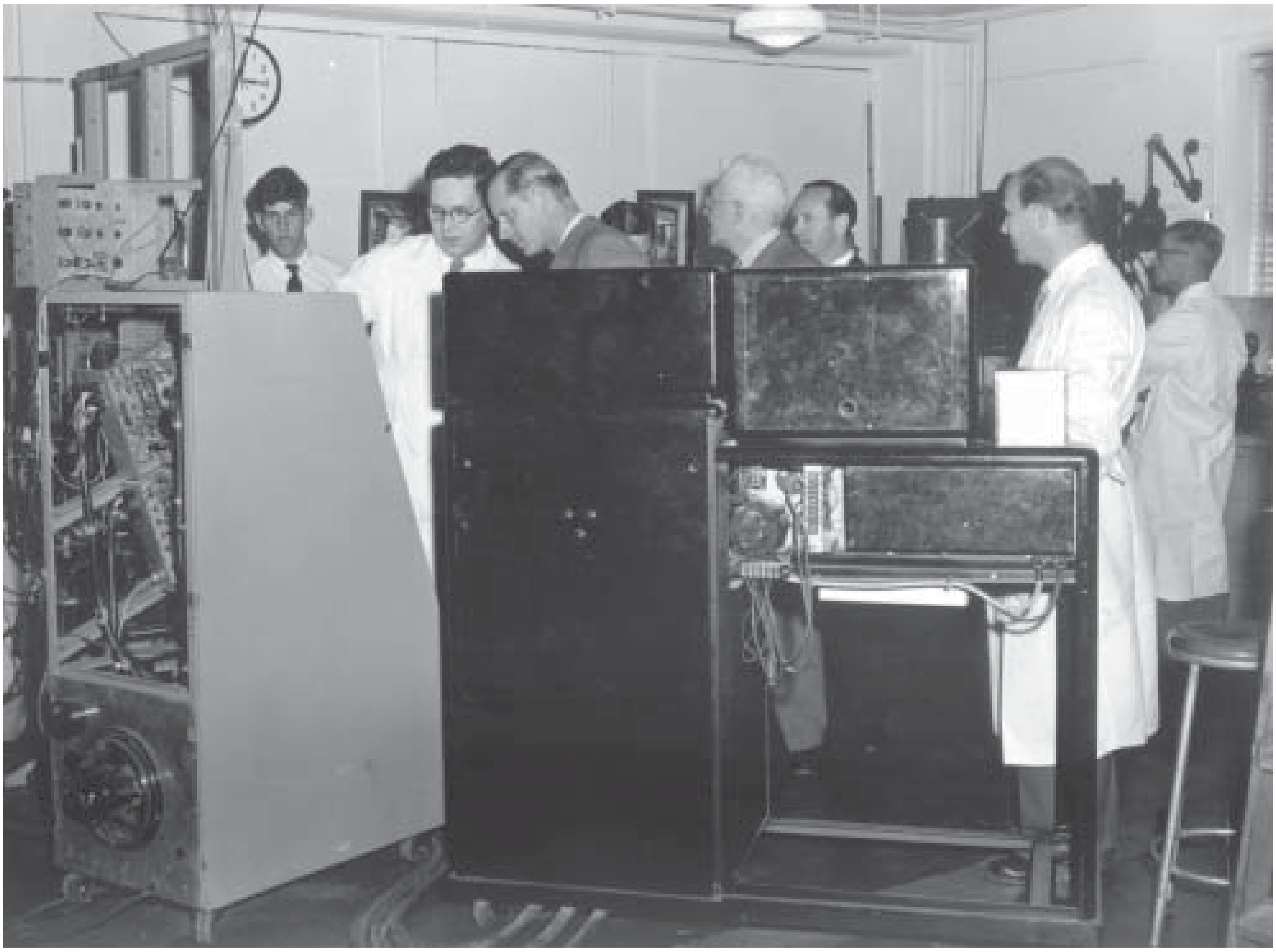
Academic staff are not always popular with workshop foremen, especially if they go beyond monitoring progress of work in hand. James was particularly sensitive to potential problems. From time to time, an academic would be ordered "out of the shop" for real or imagined interference in job procedure or scheduling. His successors, Col Steele between 1966 and 1984 and then Pandu Arkeri, managed to maintain harmonious relations, though retaining control, without such dramatic evictions.

Workshop staff, working closely with technical and academic staff have produced an awesome range of equipment over the years. On the one hand, the massive rotors of the homopolar generators, the solar dishes of White Cliffs and the tripod support structure of the 14UD accelerator represent the largest undertakings to contrast on the other, with precision instrumentation such as the surface forces apparatus and components of the 2.3 m telescope. The workshop has kept pace with changing customer demands and technology. Where in the fifties, everything seemed to be made of brass joined with silver solder, nowadays stainless steel and argon arc welding are *de rigeur*. Workshop staffing gradually diminished to about half of the original strength as budgets shrank, though improved productivity from the introduction of computer-controlled milling and turning has minimised the impact of the cuts.

Apprentice training has been always an important role of the workshop. Outstanding apprentices have been produced over the years, many of them winning awards. A significant number of those trained in the workshop have gone on to become technicians in the School and elsewhere at the ANU. After fifty years, the "old guard" of imported workshop and technical staff has been replaced by local products, no less skilled nor dedicated.

The Electronics Unit

From the very beginnings of the School, the Electronics Unit has, as would be expected, provided vital support to experimental programs relying on electronic instrumentation. The Electronics Unit was first established in the Old Hospital Buildings in early 1952[2] by Frank Reynolds. He left in 1956, to be replaced by Dick Graf. Reynolds died some years ago, but is immortalised by TV commercials for a successful appliance organisation that he founded after leaving the School. During those early years, the unit had a staff of three that worked mostly on nuclear physics instrumentation, and to a lesser extent geophysics equipment. In particular, three Hutchinson-Scarrott type pulse height analysers[3] (the so-called "kicksorters") were produced for Nuclear Physics between 1954 and 1956. Such devices revolutionised nuclear physics research. However, their design included more than 100 vacuum tubes, many of them operating at the limit of performance. The maintenance demands were heavy. The memory of the kicksorters was all of 1205 bytes, then considered a remarkable technical achievement.



As the pressure on the resources of the unit grew with School expansion, and with the rapidly changing technology as tubes were replaced by transistors, an engineer John Waugh was hired in 1959 to strengthen the unit. Waugh (the Red Terror[4]) became head of the unit with Graf as deputy. Waugh introduced the production of printed circuit boards. Over the years the staff of Electronics increased gradually from 3 to about 12. A number of notable electronics practitioners got their start in the Electronics Unit; included are Malcolm Gamlin (who moved to the Research School of Earth Sciences then BMR), Chuck Young (who now heads the electronics group in the Research School of Chemistry), Arthur McGuffin (who completed a mechanical apprenticeship before moving to electronics and who now is a computer guru in the School, John Kennedy (who now heads the electronics group in Nuclear Physics), and Tony Cullen (who started out as an electrician but continues to prac-

The School Electronics Unit (July 1992).

Back Row (L to R)
Tom Rhymes, Michael Blacksell, Oscar Labasse, Dennis Gibson, Paul Coksley, Nimish Pandey, Marek Kaminski.

Front Row (L to R)
Tony Cullen, Cathy Gillespie, David Kelly, Walter Bagnarol.

◅ *Though the pulse height analysers were crucial to the work of the Department of Nuclear Physics, they were never photographed - from the front at any rate. Here, John Carver is shown explaining the analyser to the Duke of Edinburgh (November 1956).*

The Honour Board of School Services

Laboratory Managers

Ron Purchase	1950-1957
"Robby" Robertson	1957-1966
Rob Whittle	1966-1976
John Morphett	1976-1981
Murray Hollis	1982-

Workshop Foremen or Managers

Bill McCall	1951-1953
Andy James	1954-1966
Col Steele	1966-1983
Pandu Arkeri	1984-

Electronics Unit

Frank Reynolds	1952-1956
Dick Graf	1956-1959
John Waugh	1959-1963
Dick Graf	1963-1969
Neville Esau	1970-1990
Tom Rhymes	1990-

Joinery

Peter Darling	1950-1991
Steve Brooks	1991-

Purchasing or Supply Officers[5]

Stan Wilson	
Bill Butterfield	
Ivor Silins	1975-1985
Alan Shaw	1986-1988
Margaret Mitchell (acting)	1988-1990
Ann Cartwright	1990-1992
Mark Rowland	1992-

School Secretaries[5]

David Glenn	1978
Richard Hickman	1979-1993
Pam Dower	1993
Sylvia Hibberd	1993-

tice electronics in the unit after 22 years). Graf was also pivotal in setting up the first industrial electronics course at the Canberra TAFE in 1965.

John Waugh left the Electronics Unit in 1963. Graf took charge of the Unit again until retiring in 1969. His replacement, Neville Esau, came with a strong knowledge of high performance analog design. During the 1960s there had been a shift of emphasis from nuclear pulse electronics, that had become commercially available, to the low noise, low current measurement requirements of the Ion Diffusion unit. Also, higher speed circuitry became more important as laser research was begun. The Unit's RF capability was greatly strengthened. Digital electronics also began to develop in the Unit. Neville Esau left in 1990 to head the electronics section of the Bureau of Mineral Resources. Tom Rhymes (a former PhD graduate of the School) has been the head of the Unit for the last 5 years.

Currently the Unit has a strong emphasis on digital control systems. Work has moved away from pure production to more of one of systems integration: the focus is on instrumentation which is unique. Software and hardware are designed for embedded microprocessors to produce intelligent instruments like turbo pump controllers, vacuum system controllers, electrostatic lens controllers, or high reliability toxic gas monitoring systems. One of the 'services' of the Unit which has continued over many years is the provision of a very broad range of electronics measurement equipment for use by researchers in the School. In the past, this consisted of a high quality standards measurement capability, but now is more concerned with high speed and digital capture capability. The Unit has always provided a strong maintenance function by servicing the broad range of electronic equipment within the School. Often, this task has proved very demanding as some of the equipment has little or no documentation.

Throughout the 50 years of the Electronics Unit, one of the important 'products' of the Unit has been a stream of outstanding apprentices (trainees). Some of the trainees have achieved top of class results in their course work and one (Michael Blacksell) has represented Australia internationally in the Workskills Olympics.

1 Sometimes though even the best of intentions go astray. Several years ago, a department mounted a tribute comprised of informal photos of all those *in the School who had contributed to a project. At least one of the subjects objected strenuously to the "unauthorised" use of such material. The photographs were destroyed to keep the peace.*

2 Some of the years given in this section rely on less than confident recollections. Documentation to verify them has not been found.

3 The pulse height analysers were the forerunners of the modern data acquisition systems, backed with computers having memories that were unthinkable of in the fifties. Data were stored and incremented synchronously as magneto-strictive pulses in long nickel wires. The pulse train circulated continuously in the wire, taking some milliseconds to traverse the length before being re-transmitted. Via an intermediate analog to digital converter, the voltage distribution of 0-100 V input pulses from a nuclear detector could be mapped into 120 channels, with a maximum count of 32767 counts in each channel (ie the memory was 1205 bytes).

In 1957/58, commercial analysers became available using nickel or quartz (ie exploiting the piezoelectric effect) line memories. Thereafter, ferrite memories took over in stand-alone devices until computer-based systems began to be developed in the mid-sixties. The first such system was implemented in Nuclear Physics in 1967 by Dale Hebbard.

4 Unsurprisingly, the red referred to his hair colour. The terror stemmed from a fiery temperament, here at least consistent with the popular belief that the two characteristics go together. That quick fire temperament caused a few problems. Waugh and David Robertson from Particle Physics became embroiled in a dispute about safety standards, following the NaK explosion in 1962 (Chapter 2). They contacted the local throw-away, suburban paper, The Territorial. Though what was said to the reporter remains unclear, the headline asserted that all of Acton, and even the somewhat distant hospital, were in danger from the five tons of NaK used by the generator. A subsequent enquiry found otherwise.

Waugh once took the unusual step of writing to the editor of the Journal of Nuclear Instruments and Methods to accuse two members of Nuclear Physics of unprofessional behaviour (in jargon of today, it would have been failure to acknowledge intellectual property). The editor wisely left the Vice-Chancellor to resolve the matter. The claims of the outburst were again found to be contrary to the facts of the matter.

5 School records earlier than 1975 have not been located. Silins certainly held his position prior to 1975.