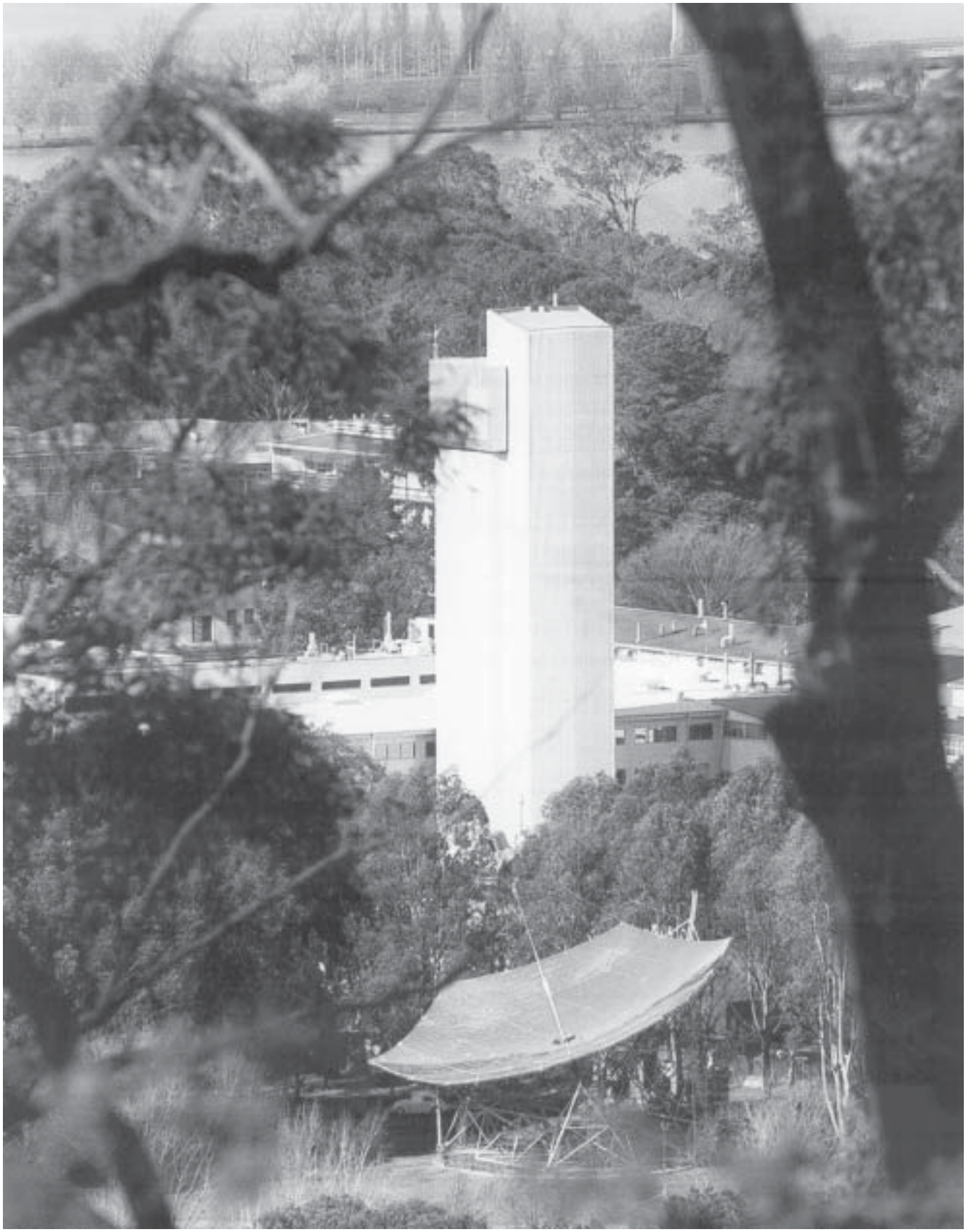
Chapter 3

A Changing School



An interesting composition of symbols of two energy sources, nuclear and solar, on the ANU campus. In another sense, the 14UD tower represents continuity of a research activity from the founding days, to contrast with the large solar dish project that is one of the last vestiges of the once substantial Department of Engineering Physics (1994).

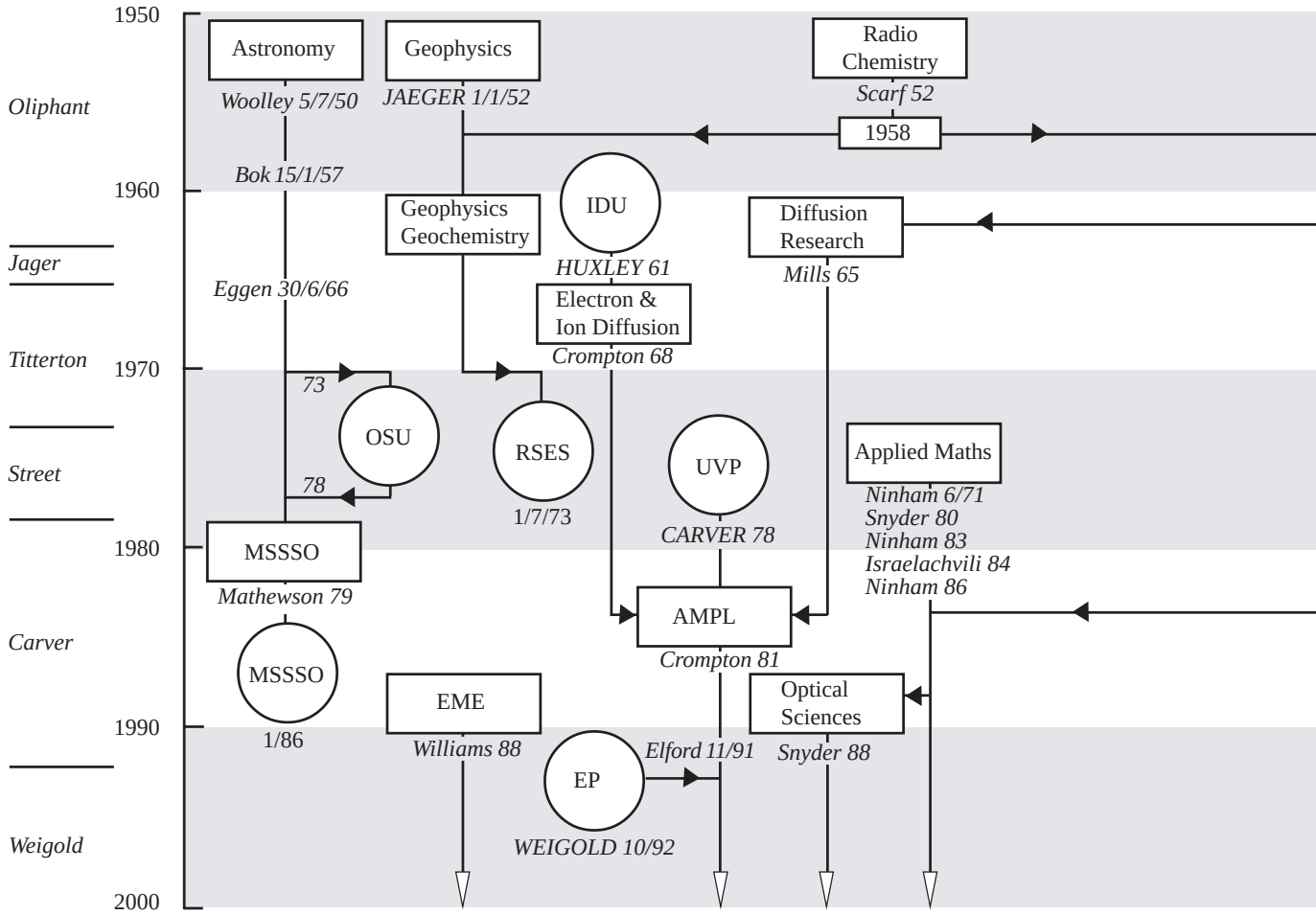
"Hatched, Matched and Dispatched"

A flow chart representation[1] of the historical perspective of the School appears at first sight as something of a tangled web. In fact though, it is proudly promoted by the School as a rich tapestry of dynamic change and development.

Only two of the original departments, Nuclear Physics and Theoretical Physics, still exist in name, but with research directions that have moved throughout to keep pace with the shifting emphases of their respective fields. Particularly since the advent of the 14UD pelletron accelerator, the Department of Nuclear Physics has not only responded to that shifting emphasis but has been able to do much to shape it. Within the same time span, new sections were established. Some flourished, some became amalgamated to form core groups of common or overlapping activity and several were terminated. Most dramatically, three new Schools, the Research School of Earth Sciences, the Research School of Information Sciences and Engineering and the School of Mathematical Sciences, along with two independently reporting units, Mount Stromlo and Siding Spring Observatories and the Computer Centre, were spawned.

The underlying reasons for change are themselves subject to change. It used to be generally true that the reasons could be readily categorised. First, change could arise in a gradual, orderly fashion brought about by altered circumstances - shifts of research emphasis stemming from new discoveries, the working out of a field or staffing movements, or by efforts to gain some advantage from prevailing conditions. Otherwise, change could result from peremptory decision or turbulent differences of philosophy and personality. In varying degrees, all of these elements contributed to the School's structural development.

Nowadays change is supposed, in its very happening, to imply vitality and has become a justified practice for its own sake. The new philosophy confuses the flurry of activity engendered with the vitality of achievement. As long as perception continues to be more important than reality, the philosophy will be embraced. Name changing is part of this modern process. While there was certain merit in the addition of Engineering to the name of the School in 1990 to emphasise activities, perhaps not generally recognised, going on within it, some attempts at re-naming have fortunately been rebuffed. Periodically it has been suggested, both

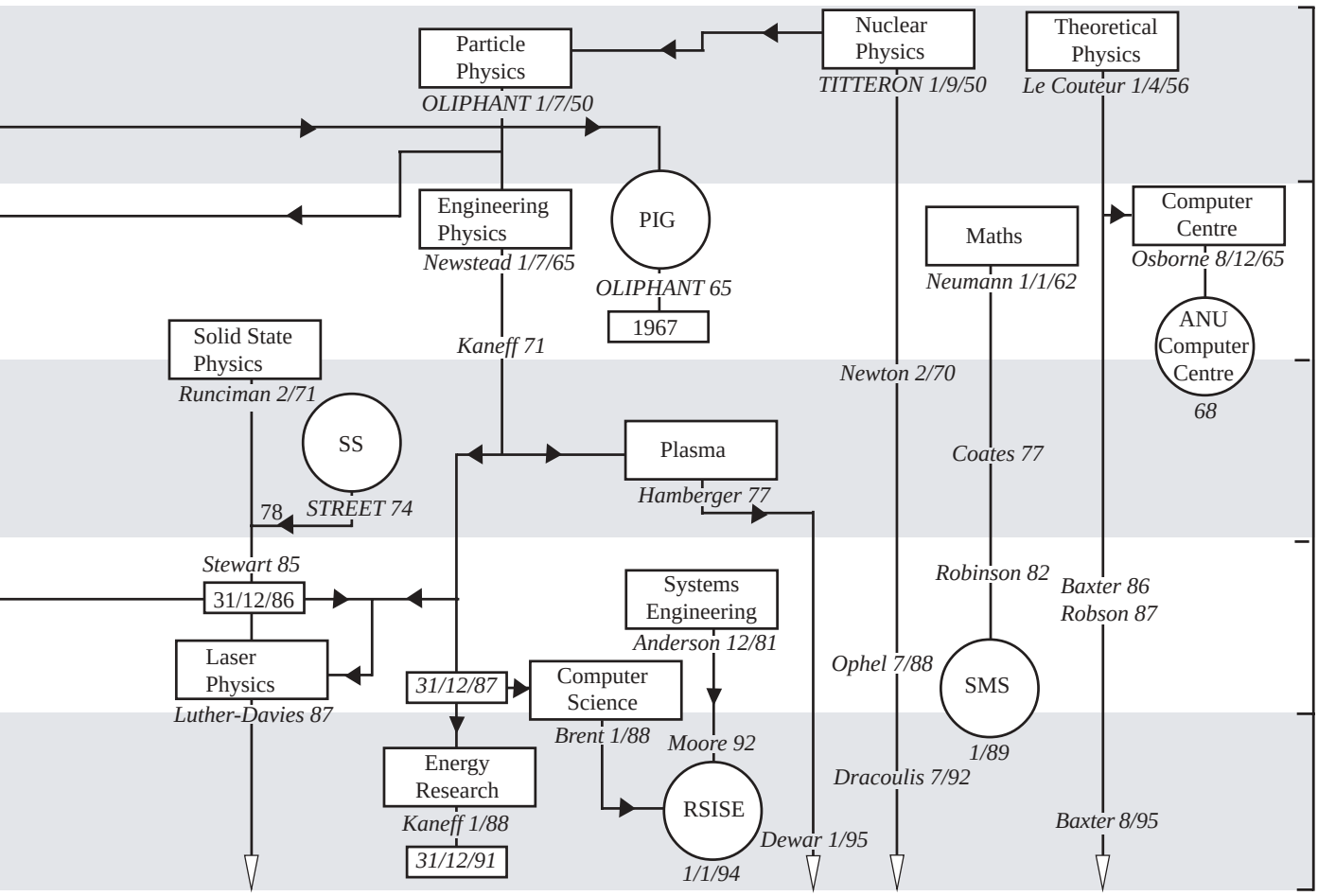


from within and without, that Nuclear Physics would "benefit" from alternative identification, though of course its activities would remain, or that Applied Mathematics should be "more appropriately" labelled. Fortunately, honesty and tradition have prevailed.

The review process has also contributed to change. To many, the all too familiar review would be considered the driving force of the new philosophy espousing change. The frequency and scale of them, along with the increasing complexity of prior preparation, create this impression. Yet reviews have been part of the School and the ANU procedures for many years. Whenever a head of a section resigns or retires, review of the continuance of the activity is mandatory. Should it continue, future directions of research are recommended or stipulated. Reviews rarely, if ever, expose problems or new opportunities hitherto unrecognised. Instead, they can provide the incentive and endorsement for immediate action to be taken to resolve or exploit them, as the case may be.

The School combination of the major experimental groups requiring frequent injections of significant capital funding for large equipment items, inevitably generates pressures for autonomy. The ANU system for the allocation of major equipment funding has perhaps recognised the situation; historically the School has been well-treated. Nonetheless, it is still essential that proposals to go before the Major Equipment Committee are highly-ranked at School level. The belief of the Mount Stromlo and Siding Spring Observatories (MSSSO) that they were disadvantaged in this respect became a factor contrib-

AMPL (Atomic & Molecular Physics Laboratory).
EME (Electronic Materials Engineering).
EP (Electron Physics).
IDU (Ion Diffusion Unit).
OSU Observatory Services Unit).
PIG (Physics of Ionised Gases).
MSSSO (Mount Stromlo & Siding Springs Observatories).
RSES (Research School of Earth Sciences).
RSISE (Research School of Information Science & Engineering).
SMS (School of Mathematical Sciences).
SS (Solid State Physics Unit).
UVP (Ultra-Violet Physics Unit).



uting to a mutually agreed separation at the start of 1986. Here though, it was a relatively painless process since MSSSO was effectively self-contained with respect to technical facilities and was geographically separated.

For the remainder of the School, cohesion as an entity maintains an interesting balance. The presence of the larger experimental departments justifies the extensive central facilities, exploited (in a beneficial, symbiotic sense) by the smaller groups. Separation or, in a worse scenario, termination, of one or more of the large departments might sometimes appear to provide the opportunity for an area to expand or a solution to budget problems. Paradoxically though, the appreciated need to keep the central facilities intact creates a bond that unites the School against major structural change but, at the same time, makes it possible to add new activities effectively at minimal establishment cost. The Department of Electronics Materials Engineering is a good case in point.

There are of course other important bonds. Strong collaborative links exist between many sections, spanning a full spectrum of activity ranging between sustained joint research to the sharing of resources. These links are apparent in the contributions from individual sections.

Many of the developments shown in the perspective are presented in other sections. The subsequent discussion is focussed on the remainder.

A Shifting Foundation

Aside from the creation of Particle Physics in late 1952 as a group separate from the previously all-embracing Nuclear Physics, the first change in the foundation structure involved Radiochemistry. The Department was terminated at the end of 1958. Anecdotal evidence suggests that Oliphant came to the group at morning tea time and announced that he had decided to shut them down. Reg Mills, who was not present for the announcement, was assured later that day by Oliphant that his flourishing diffusion research would continue, but within the Department of Particle Physics. Others in the Department, notably John Richards and Bill Berry, were to be transferred to Geophysics. Scarf was on sabbatical leave in the UK. Subsequent negotiations ended with his early retirement.

Local issues apart, it was a correct decision philo-

sophically. Although radio-chemical techniques remained important and their use widespread, practitioners of them operated within their own discipline (biochemistry provides a good example) so that Radiochemistry never really became established as an identifiable research area in its own right.

New Schools

Initial overtures for a separate School of Earth Sciences, to be developed from the Department of Geophysics, were made by Jaeger as early as 1955. Detailed proposals were presented unsuccessfully by him to the Board of the Institute in 1961 and 1962. The main thrusts were that a School was warranted by the scope of the discipline and that association with RSPhysS, while beneficial for interim establishment, was not appropriate in the long term. At the end of the decade, the issue was re-addressed with a campaign waged largely by Ted Ringwood. Titterton as Director was strongly opposed. He was concerned at the “needless” costs involved in establishing separate administrative and technical services. Moreover, it was clear that should a divorce ensue, the School would have to shoulder the cost of the settlement - workshop staff and equipment. Intensive and acrimonious debate occurred at various levels from Faculty meetings of the School to Council, where Ringwood finally won out. The Research School of Earth Sciences came

◅ *Ted Ringwood.*

▻ *Bernhard and Hanna Neumann. Hanna was appointed as Professor of Mathematics in the School of General Studies.*

into being on July 1 1973. At least one observer at the Council meeting sensed a feeling that Ringwood had failed to present a convincing case. Where Titterton could probably have carried the day by merely stating just that, he responded too aggressively and lost instead. Rightly or wrongly, it was generally considered that Ringwood sought independence, rather than being driven by empire-building motives. Structurally, the new School remained a large department. The passions of separation cooled quickly. Once the technical settlement was resolved, harmonious relations were restored. Over time, significant interaction and collaboration between the Schools have developed.

The other two schools arose in much more tranquil circumstances. The Department of Mathematics had been established in 1962 following the appointment of the eminent mathematician Bernhard Neumann. Within a few years, a strong and productive group was in place. Though in the School, Mathematics was never really part of it. There were no overlaps of research interest so that little interaction developed between it and the rest of the School. Similar situations had developed elsewhere, Statistics in RSSS for example, so that amalgamation was anticipated as a natural development for many years before formal operation of the School of Mathematical Sciences began in 1989.

The creation of the Research School of Information Sciences and Engineering was first put forward in 1992 by the Director, John Carver, to a Heads of Schools meeting and later to BIAS. Again, a new School was seen as a natural development for two elements within the School, Systems Engineering and Computer Science. The proposal was made with blunt candour. If the School were not formed, it was unlikely that Information Science could develop in a way appropriate to the burgeoning field. However, RSPhysSE saw a new School as the means of its own gradual expansion also. Earlier separations provided precedents of there being a subsequent replacement of activity so that School staff numbers returned to levels comparable to those prior to the separation. In alternative terms, RSPhysSE had functioned successfully as a nursery or proving ground for the introduction of new appropriate emerging areas and had every expectation of continuing that role. Thereafter Brian Anderson, the original head of Systems Engineering, played the leading role in the 'politicking' necessary for ultimate Council approval. The new School began in 1994, co-located with RSPhysSE and with shared administration.

New Reporting Units

Despite an entry in a chronology of ANU events, prepared as part of the submission for the ANU-ARC Review in 1995, stating that "MSSSO became part of the ANU in 1978", the Department of Astronomy was very much part of the School and the ANU from 1950. The entry no doubt is a reference to a sequence of events in 1973 when the large Anglo-Australian telescope was being established at Siding Spring. Control and management of the telescope became torrid issues between Olin Eggen, head of Astronomy, with the support of the Vice Chancellor John Crawford on one side and Titterton, as Director of the School, on the other. Titterton, backed explicitly by UK users and, as it transpired later, implicitly by local ones too, argued that it was inappropriate for the major user to control the in-

strument, proposing instead an independent director. Eggen and Crawford fought unsuccessfully with the Telescope Board for ANU control. During the fray, the Observatory Services Unit, comprised of all MSSSO functions other than the academic ones of the Department of Astronomy, became a separate entity, responsible to the Vice-Chancellor. When Eggen left in 1978, the Unit was abandoned. Once again, all of MSSSO came within the ambit of the School.

By 1985, there was mutual recognition that the benefits of continued union were far out-weighed by real or potential disadvantages to MSSSO. Accordingly, MSSSO became a separate reporting body in 1986. Various links, such as exchange representation on the two Faculty Boards, continued.

The first computer "on campus" was an IBM 610 at Mount Stromlo in January 1960. Perhaps more properly to be regarded as an advanced calculator, it was used mainly for numerical calculations required for the time service and for transformations of galactic co-ordinates. Somewhat less than user-friendly, only limited use was made of it by the wider university community. Before then, some ANU groups had made some use of the Silliac at the University of Sydney, although the problems addressed had to be sufficiently complex to justify the effort involved in learning to wrestle with the new-fangled beast.

The revolution in computer use really began with the advent of the IBM 1620, a machine designed for relatively straightforward, general use. Theoretical Physics acquired one in late December 1961, undertaking to operate it as a university facility. Brian Robson was promoted to be Numerical Analyst, responsible for the management of the facility.

Almost immediately, the problem central to computer use emerged. The annual report of 1961 warned that: "It is already clear that this modest computing facility will not satisfy the demands by the university for more than a few months. This computer was chosen on the basis of an understanding that CSIRO would install comprehensive computing facilities in Canberra and that these would be available for use by the University. This large central computer has not materialised, and it may be necessary for the University to install its own large computer in the near future."

The CSIRO did establish later a large computer, the CDC 3600, at the Black Mountain site. By then, it had become clear that it was inappropriate to concentrate computer power at only a few locations.

During 1962, the 1620 was used for an average of 104 hours per week, plainly approaching saturation level. Nonetheless a replacement, the much larger IBM 360/50, was not ordered until 1964. By then, individual departments were considering the purchase of their own computers. Astronomy pressed for a 1620 because the 610 could no longer support the demand for numerical calculations, and Nuclear Physics planned to use a small computer for high-

Top. The first two telescopes at Siding Spring 1964)

Hilary Morton alongside the Tokamak plasma device LT4. (1977)

A group of the pioneers of the Department of Particle Physics, (L to R) Jack Blamey, Mick Cornick, Barry Shenton and Peter Carden (circa 1956).

Brian Robson at the console of the IBM 1620 computer. (1962)

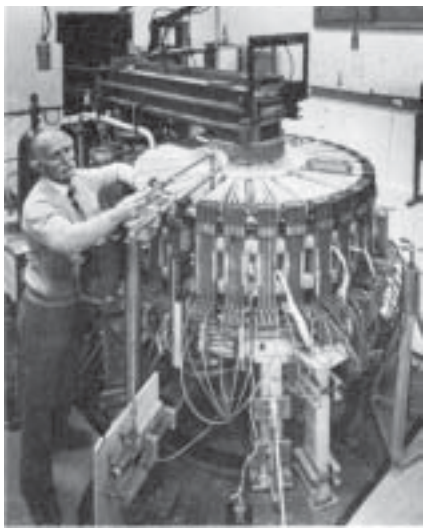
speed data acquisition and on-line analysis. An IBM 1800 was ordered for the latter purposes in 1965 but not delivered until May 1967. The S360/50 was delivered in 1966.

It became evident no less quickly that the demands of maintaining a computer facility as a campus-wide service were beyond the capacity of a department. A separate Computing Centre, to be part of the School, was set-up to operate the 360. Mike Osborne was appointed as head of the Unit at the end of 1965. Again, escalating demand made it clear that even School management was no less inappropriate. The ANU Computer Centre was established in 1968, continuing to operate the 360 within the School and in 1972, a Univac 1108, that was installed in the basement of the R.G. Menzies Library. The Computer Centre moved into the Huxley Building in 1976.

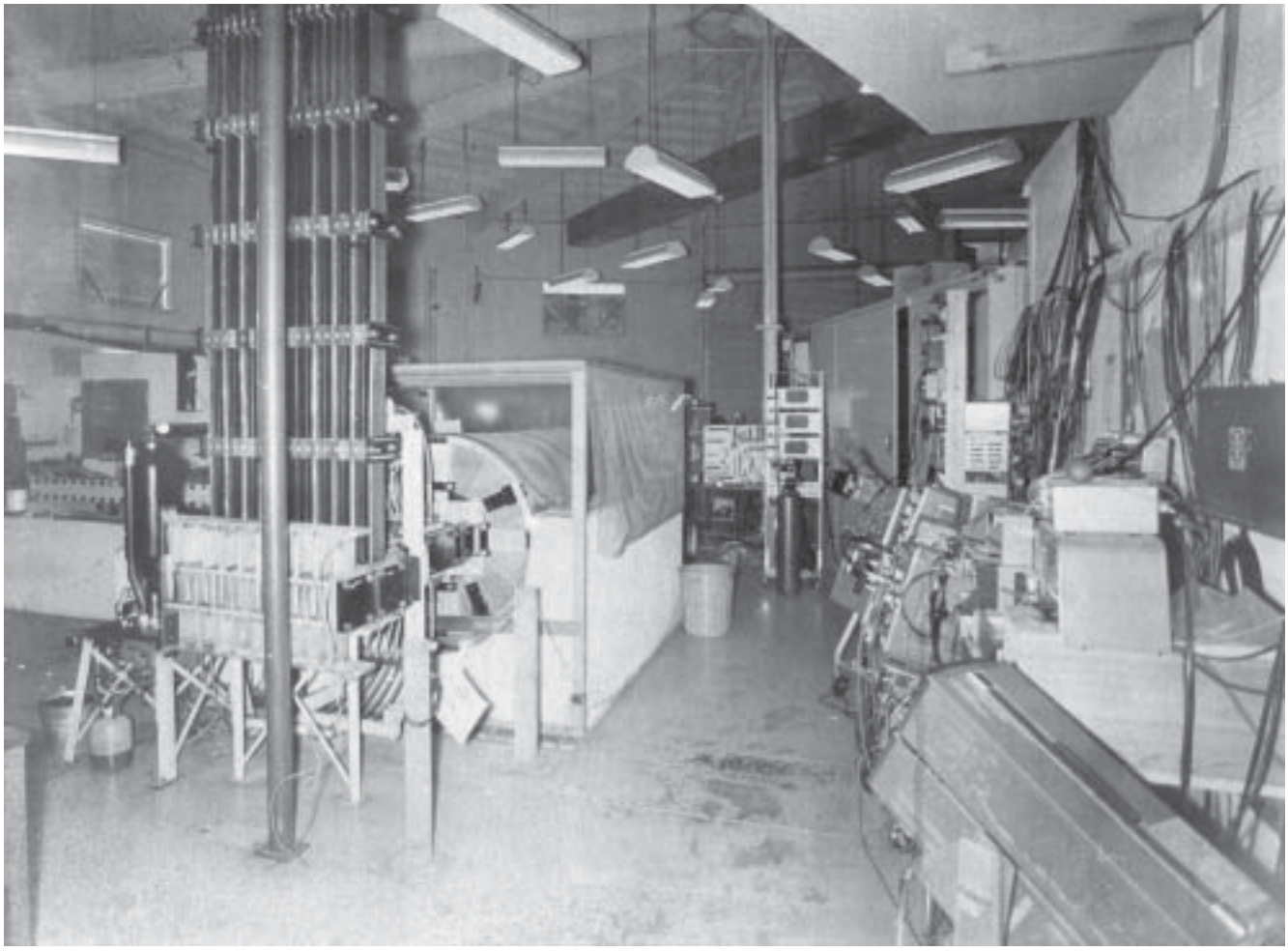
The seemingly insatiable need for more computing facilities led to re-establishment of a School Computer Unit in 1974, equipped initially with PDP-10 and PDP-11 computers. As computing developments have led to devolvement of much of the activity to local areas, the Unit has provided the means of central coordination and networking of the School's computer resources.

The Metamorphosis of Particle Physics

Oliphant stepped down as Director at the end of 1963, and then as head of Particle Physics in mid-1964 to become "just an ordinary Professor of Physics". A small unit, the Physics of Ionised Gases, was established to allow him to indulge in some full-time research prior to retirement. Blamey took over as acting head, pending a review of the department. The outcomes were re-naming to Engineering Physics and the appointment of Gordon Newstead, then Professor of Electrical Engineering at the University of Tasmania, as head. The new department was to centre its research program on the unique attributes of the homopolar generator as a source of controlled high current, high energy pulses. Aside from development work on the generator itself, projects undertaken included the design and application of high field magnets (~30T), the operation of a 15T magnet that was powered from the HPG as a facility for solid state research by groups from universities in Australia and England and the development of high power neodymium-glass lasers and the xenon flash lamps that excited them, with the intention of later transferring energy from the homopolar generator via an inductor to specially designed flash lamps. Several small plasma research devices had been built during a program initiated by Hilary Morton in 1958, with a view that subsequent developments could lead to use of the homopolar generator. Later, a toroidal θ-pinch plasma machine, designed by Bruce Liley, was built (Tokamak LT3, the only Tokamak in the world outside Russia, completed before information on the Russian machine was published). A macroparticle accelerator (rail gun) was designed by Dick Marshall and built to operate at currents up to 400,000 A from the HPG via a transfer inductor. Members of the Department also participated in the design and installation of the Warramunga Seismic Array near Tennant Creek. This array was built and operated for the UK Atomic Energy Authority to detect nuclear explosions. Data from earthquakes and nuclear explosions were used by staff in the departments of Engineering Physics and Geophysics to formulate a revised model of the internal structure of the earth. Another undertaking in the Department was the establishment of an information science section.



Elements of the rail gun assembled by Dick Marshall in the round house.



Newstead retired for health reasons in 1970 and was replaced by Stephen Kaneff. Again, a University review recommended that use of the homopolar generator would define the program, but the plasma research activity was to be wound down over a two year period. Work on the seismic array was to be tapered off also. The aim was to achieve "a tighter, more integrated, structure".

In fact, the diversification initiated under Newstead continued. The rail gun succeeded in accelerating projectiles weighing about 3 g to velocities up to 5.9 km/s, far higher than achieved by any other means to that time. To reach this velocity, the performance was studied in detail using extensive instrumentation, to provide the data needed to improve the design and refine the understanding of the operation of the gun. Aspects of solar energy generation and storage were initiated by Peter Carden, while computer speech and pattern recognition, teaching of handicapped children and satellite data analysis and presentation were added as activities of the information science group. Laser research developed into areas not involving the homopolar generator. Plasma research did not wind down. A larger device (LT4) was designed and constructed to be powered by the homopolar generator.

Major changes were forced on the department as a consequence of the Street Review in 1976. Here again, the School became a path-finder for the ANU by conducting the first School-wide review - then a novelty, but of course now a familiar event.

The review was an interesting one. Rather than establishing a pattern to be followed by other Schools, it provided more of a counter-example by highlighting pitfalls to be avoided. Formally, the review was commissioned by Faculty Board so that the report was not accessible to external parties, including the Vice-Chancellor and Council, without the express approval of Faculty Board. Further, the notion to hold a review was put forward by Robert Street, the Director, after a standard electoral committee had been formed to consider a small number of senior appointments (Professorial Fellowships) across the School. Thus Street was chairman, and in a sense chief prosecutor, with the majority of the committee being ANU senior staff. The remainder came from other Australian institutions; there were no independent, international members. The committee lacked, in appearance and in fact, the impartial expertise for the duty at hand. The School was uneasy about the duality of the Director/Chairman before the review, and much more so after the report was released.

The report caused quite a flurry by concluding that "...the School as a whole lacks an overall image of excellence". Many in the School believed the expressed judgement applied more accurately to the review report rather than the School. Engineering Physics was singled out for the most detailed criticism, leading to specific recommendations for the curtailment of a number of activities. Other departments too were less than happy, taking issue with the misleading nature of less than felicitously worded presentation of apparent factual matters[2]. There were many exhortations about the explicit obligations that Institute staff had to acquit in the future to justify their "favoured status", with too little counter-balance from any stated recognition or appreciation of past performance. The report was a creature of the times yet, in many ways, the overall tone was not too dissimilar from that of the recent 1996 ARC Report. Nuclear Physics, mistakenly believing the review would involve some form of dialogue with the committee subsequent to the report, sent a detailed response to each member. This was deemed a breach of confidence by Street. The acting head, Trevor Ophel, was only saved from "being carpeted before the Vice-Chancellor" by support from a few members of Faculty Board.

Herein was perhaps the greatest difficulty with the review, at least in perception. Street was the sole source of that dialogue or interpretation.

Previously, it was remarked that reviews do not discover problems. Their function is to help to solve them. Clearly, Engineering Physics had expanded its activities beyond a level reasonable for only thirteen staff members. The solutions, proposed by the report and later implemented, were the correct ones, both then and in hindsight.

Sydney Hamberger was appointed as a Professorial Fellow to head a separate Plasma Physics Laboratory that would develop a plasma research program, based on exclusive use of the homopolar generator. Other programs using the generator were closed down. Engineering Physics was to continue with solar and wind energy research and information science, with encouragement to develop laser physics.

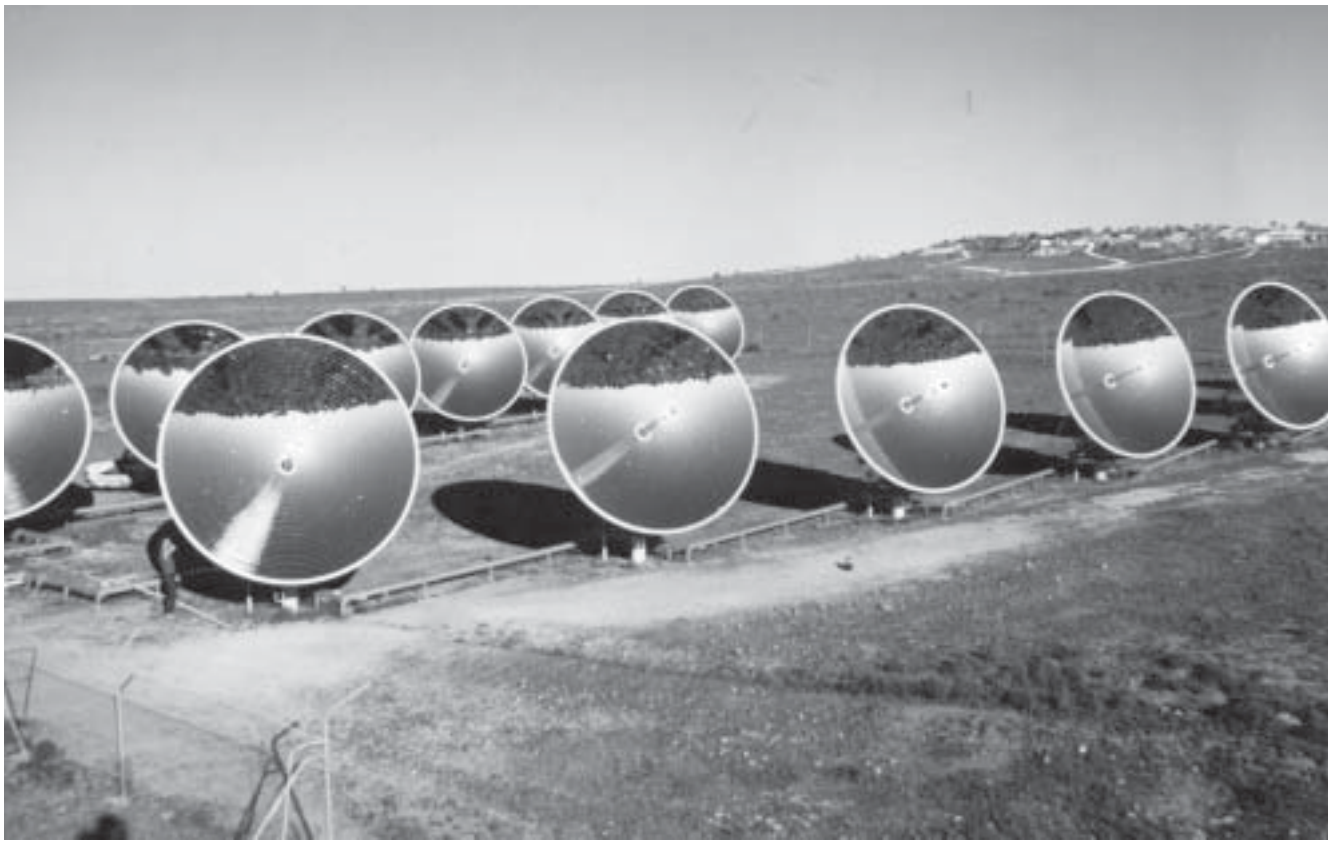
The solar energy research continued along two lines.

Firstly, an evaluation was undertaken by Carden and others of a means of storing energy by solar dissociation of ammonia with storage of the constituent hydrogen and nitrogen until the ammonia was reconstituted to provide the energy when required. This work continued on a very small budget. Secondly, the construction of solar plants was begun using less radical engineering to obtain experience in the field. The first of these was designed and built under a contract between ANUTECH Pty Ltd and the Energy Authority of NSW. The station was to supply 25 kW of electric power to the small opal mining town of White Cliffs, in north west NSW, as the first in the world to supply solar power, with diesel backup, to an isolated township. It did so from 1983 to 1991. Thereafter, a larger diesel carried the growing load until the NSW electricity grid was extended to the town in 1993. During this period, the engine that had been developed for the White Cliffs station was considered the only cost effective engine available for solar plants in the size range of 15 to 70 kW. New power generating units (for example, photovoltaic devices) have been developed since then. The 14 parabolic mirrors remain at White Cliffs and could well serve to demonstrate the enhanced capabilities of the new generators and to provide operating experience with them.

Research conducted by PhD students provided steady development of energy storage by the dissociation of ammonia, confirming the great potential of the concept.

The various activities continued under the umbrella of Engineering Physics, although the Information Science activity was re-named the Computer Science Laboratory, following the appointment of Richard Brent as Professor of Computer Science in September 1985. Though the change involved a considerable shift of research emphasis, the Laboratory remained part of Engineering Physics.

In 1987, the Laser Physics Centre was created with Barry Luther-Davies as head of a separate section uniting the laser team from Engineering Physics and the laser spectroscopy group that had previously been with Solid State Physics. Solid State Physics was dis-established at the end of 1986. Originally set up in 1971 with the intention of it becoming a dominant user of the high field magnet designed by Carden, the Department of Solid State Physics instead developed a research program based on super-conducting magnets. Obviously this departure from the early plans had been a major factor contributing to the demise of the high field magnet project. The foundation head, Alan Runciman, stepped down from headship for health reasons in May 1985 and retired at the end of 1988. Dis-establishment was recommended by the mandatory



The solar collector array at White Cliffs.

review in 1986 and duly implemented. Tenured staff were redeployed either to the new Laser Physics Centre or to Applied Mathematics.

The metamorphosis concluded when recommendations by the 1987 School Review Committee, chaired by Denys Wilkinson, were implemented[3]. Engineering Physics too was dis-established. The remaining two constituent activities became independent sections as the Energy Research Centre and the Computer Science Laboratory in 1988.

The latter became part of a new School in 1994, while the Energy Research Centre ceased to be a formal element of RSPhysSE when Kaneff retired at the end of 1991. Thereafter, Energy Research has continued with School technical assistance, but under the auspices of ANUTECH, a situation very much in the spirit of "the child becoming the father of the man". The formation of ANUTECH Pty Ltd stemmed from School concerns some years before that an agency with limited liability was needed to undertake the contractual obligations of the White Cliffs solar energy project. It is now a wide-ranging marketing arm of the ANU.

There is further irony in the fact that Energy Research evolved, via the intermediate transformation of Engineering Physics, from Particle Physics. The solar energy group railed vociferously against nuclear energy, yet the Energy Research Centre was in a sense an offspring, admittedly several times removed, of Nuclear Physics. When the oft-forgotten relationship between nuclear energy and solar energy is recalled, the course of School history seems perhaps apt, if somewhat convoluted.

1 The flow chart representation had its origins in the internationally-renowned watering hole, known as the dark room, in Nuclear Physics. Rob Elliman from EME pressed for details of the past. Trevor Ophel responded from memory with a hastily drawn sketch on the back of an envelope. Over the past three years, that memory has been corrected and augmented with the many twists and turns of fact, often requiring extensive redrafting. As with a printed circuit board, connections must not cross.

2 In the preface, the report stated that "committee members spent several hours inspecting equipment and laboratories", and later that "the committee aimed to give the School as much freedom as possible to present itself in whatever manner it considered best".

The committee came to Nuclear Physics in April 1976. It was one of the few times that Street had been in the department. The acting head, who had been on study leave for much of 1975, had never seen him before. A tour of the facilities was suggested before discussion and presentations. However, the committee demurred - "we have come to talk". In the event, about half the committee went on a short tour, the remainder waited in the library.

At that stage, the 14UD accelerator was finally running reliably after nearly six years of planning and installation. It had been accepted as of January 1 1975, but much of the first year was spent "ruggedizing" it for reliable operation. Nonetheless, significant work by several groups using it had either been published already or was being prepared for publication. Throughout the installation period, an active research program had been maintained using the original EN tandem, on which heavy ion beam measurements had begun in 1963.

Completion of the 14UD and the results of the early measurements had captured international attention but evidently failed to impress the committee. The report stated equivocally "some studies using heavy ion beams have been initiated, particularly by the head of the department, and it appears that others are contemplated". Nowhere was there any recognition of achievement, either preceding the 14UD or stemming from it.

3 Shakespeare was nearly right. The good is interred in the notes. The Wilkinson review in 1987 was carried out by a committee of eminent scientists drawn largely from leading international research centres. As would be expected, the review report was knowledgable and extremely thorough. It was positive with a clear appreciation of the quality of research being undertaken and of the difficulties faced by the School. The report provided endorsement and a mandate for future directions put forward to the committee by the Director. In the main, recommendations made by the committee were implemented. More general ones, reflecting on broader policy issues such as the tenure/non-tenure ratio, fell on less fertile ground.

The new "Link Building" which as it's name suggests, links the Oliphant building to the Cockroft Building and the refurbished accelerator hall now called the Carver wing.