TELECOMMUNICATIONS IN AUSTRALIA: AN HISTORICAL PERSPECTIVE, 1854–1930*

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Australian history has been conspicuously short on the examination of the history of technical subjects and of the role technological development has played in the country's evolution. As early as 1961, Geoffrey Blainey observed: "We historians are uneasy outside the old triad of political, social and religious history; we are inclined to avoid the history of technical subjects even more than did the historians of the last century with their narrower compass of history."[1] The comment remains valid today. The history of technology in Australia stands as a broad and relatively empty canvas on which to depict the major underpinnings — and their social interconnections — of an increasingly industrialised society.

This paper is preliminary and exploratory. It focuses on three central issues:

(i) the emergence in a country governed, or as Blainey suggests, 'tyrannised' by distance, of a vital telegraph and telephonic network;

(ii) the role of Australia as an importer and advanced adapter of telecommunications technology transferred from Britain, the USA, and Europe;

(iii) the emergence of a federally institutionalised framework for the spread of telecommunications and, with it, the development of an engineering culture in Australia.

THE PLUNGE TO INTERCONNECTIVITY

It was nine years after Samuel Morse tapped his famous message, "What Hath God Wrought", from Washington to Baltimore, in May 1844, that Australians responded to the prospects of the new

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telegraph technology. It was brought to Australia by Samuel McGowan (1829–1887), a Canadian trained in the law who had been acquainted with Morse and directly associated with Morse's colleague, Ezra Cornell, inventor of the first telegraph insulators and a principal of the early telegraph industry.[2] McGowan, who had managed the New York-Buffalo Line, was one of a bevy of entrepreneurs who canvassed subscriptions for America's spreading private enterprise lines. He combined zeal with technical knowledge and, in 1853, attracted by reports of Victorian gold, emigrated to Melbourne bringing with him several sets of the new Morse instruments, batteries, insulators, and other necessary materials with the express intention of developing a private company to establish and work telegraph lines between Melbourne, Sydney, Adelaide, and the goldfields at Ballarat and Bendigo. It marked the first transfer of electric telegraph technology to Australia.

In the event, Government intervention forestalled the private development of telegraphy in Victoria. McGowan's demonstration of his apparatus in Melbourne stirred excited praise. "To us, old Colonials who have left Britain years ago", the Melbourne *Argus* editorial reflected the following day, "there is something very delightful in the actual contemplation of this, the most perfect of modern inventions . . . We call the electric telegraph the most perfect invention of modern times . . . as anything more perfect than this is scarcely conceivable, and we really begin to wonder what will be left for the next generation, upon which to expend the restless energies of the human mind. Let us set about electric telegraphy at once."

By September 1853, tenders were invited by the Victorian Government for the construction of a line between Melbourne and Williamstown. The contract went to McGowan. By March 1854, the short line was in operation, and within three years, the Colony of Victoria was webbed by a network of telegraph lines stretching from Melbourne to Ballarat, towards the South Australian border at Portland, and north and north-west to the Murray River border. The closed circuit system of morse transmission was employed and the received signals were recorded on an embossing recorder. While much of the construction work was empirical, ad hoc, and derivative of the example of the Melbourne to Williamstown line, it was more than a mechanic craftsman system; yet little has yet come to light on the contractors who tendered for and successfully completed the extension of the wires.

There were some hitches in operating skills: telegraphers had to be trained. In New South Wales, where Parliament voted £38,000

for building a telegraph line to link Sydney with the Victorian border at Albury in 1857, the first completed telegraph line "for the business of transmitting intelligence" from Sydney 18 miles to Liverpool hiccoughed into operation in December that year. Under the watchful eye of the Governor of New South Wales, Sir William Denison, an engineer by training himself, the first message ran, "Can you read my writing?" No answer was received for several minutes, the *Sydney Morning Herald* reported next day, but on the question being repeated "an answer arrived that the pen of the instrument at Liverpool did not mark and was out of order". Secondary messages like "Have you got my writing plain" met silence and at last a terse reply from the Liverpool telegraphist that he "did not get it plain enough". "Whether he was unable to rectify the defect in his instrument", the *Herald* mused, "or believed from not being able to read the writing that all queries were at an end, we are unable to say".[3]

Electric Telegraph Connections, 1854–1877

Despite human inexperience, lines were soon operating south from Sydney over 200 miles to Yass and Gundagai. The Tasmanian Government erected a line from Launceston to Hobart in 1857; a private line linking Adelaide and its Port appeared early in 1856 erected by James MacGeorge, while the South Australian Government, averse to private enterprise, in the same year erected a parallel line from Adelaide to Port Adelaide and on to Semaphore in St Vincent's Gulf. The job cost £6,048. In 1861 the first messages were telegraphed in Queensland from Brisbane to Ipswich and 8 years later the line had extended up the long north coast via Bowen and on to Cardwell. Only Western Australia lagged behind, its first telegraph being erected by private enterprise between Perth and Fremantle, aided by Government-supplied convict labour in 1869. The network was acquired by Government in 1873.

Within a decade of McGowan's initiative, some thousands of miles of Morse's 'Lightening Lines' silhouetted the Australian countryside. Over the long distances 'repeaters' were installed, initially human operators who read the incoming morse signals and transmitted them on to their destination. Much of the growing expertise was of American derivation, though Britain's Wheatstone automatic instrumentation for passing on messages in minor offices in city and suburbs — and its evolutionary improvements — became widely diffused through Australia from the early 1860s.

It was Charles Todd (1826–1910), appointed from England in 1855 as Superintendent of Telegraphs and simultaneously Observer (later Astronomer) of South Australia, who brought British knowledge, experience, materials and scientific underpinnings to telecommunications development in Australia and became a prime mover in Australian telegraph technology. The British telegraph, launched somewhat earlier than Morse's, differed from the American system, though integration and refinments towards internationalisation of the Morse system were increasingly taking place.[4] Todd's early career spanned a period as supernumerary computer at Greenwich Royal Observatory. With skills in mathematics and astronomical observation, he became junior assistant to Professor Challis at Cambridge University, 1848–54, assisting in the determination of longitude by telegraphic means between Cambridge and Greenwich Observatories, and, in 1854 he was back at Greenwich as superintendent of the galvanic aparatus for the transmission of time signals.

This involved him in close co-operation with the Electric Telegraph Co. and with C.V. Walker, one of the pioneer experimenters with submarine cables. Not surprisingly, Todd became steeped in and fascinated by telecommunications

technology and was a prime candidate, supported by the Astronomer Royal, Sir George Airy, for the South Australian post. Todd had never built a telegraph line, but under Airy's guidance he supervised the acquisition of equipment and stores, made important contacts with the telegraph world and assimilated British telegraphic methods and skills. While Airy wondered in private if Todd "had the boldness and independence of character which may be required in an Australian establishment", Todd dreamed of large-scale telegraphic ventures, writing to the explorer Captain Sturt in 1854: "I look forward to . . . the time when the telegraph system will be extended to join the several seats of commerce in Australia and also, it is no idle dream in the present age of wonders, when I shall be able to meet Dr O'Shaughnessey by connecting Asia by submarine cable thence via Calcutta to London".[5]

Todd arrived in Australia with British telegraph plant and one technical assistant, E.C. Cracknell. He declined the offer of bringing operators, determined to rear his own corps of telegraphists. The British technique which he transferred to Australia was the undergrounding of telegraph cable, a method adopted disastrously by Morse in his initial attempt on his Baltimore–Washington experimental line.[6]. Acting on British specifications and instructions, Todd completed the underground line from Port Adelaide to Semaphore. But he quickly regretted his uncritical dependence on British technology which, he wrote, "added very greatly to the cost and was very soon an endless source of trouble as indeed were all underground wires laid in England . . . owing to the insulation becoming defective".[7]

It fell to Todd to negotiate for the Government with Samuel McGowan for the construction of an intercolonial line between Melbourne and Adelaide, which, strung securely above ground, was completed in August 1858 at a cost of £39,000. Three months later the line was joined from Sydney to Melbourne on a uniform system and Australia's three mainland capitals were telegraphically united. Brisbane was linked to Sydney in 1861. British influence and experience was further extended by E.C. Cracknell's appointment as Superintendent of Telegraphs in New South Wales in 1861, and his brother, W.J. Cracknell, as Superintendent of Telegraphs in Queensland in 1863 (both men trained at Oxford): but attempts to make an intercapital join between Melbourne and Tasmania in 1859 foundered on the immense complexity and contemporary difficulties of submarine cabling. While a cable "perfectly made" and coiled in Britain was transshipped and dropped from the SS Omeo across Bass Straits from Williamtown to Cape Otway in 1859, under the troubled eye of Victoria's

Superintendent of Telegraph, Samuel McGowan, the £53,000 venture proved unsuccessful. Contact was intermittent, there were frequent breaks to mend and the cable was abandoned as hopeless in 1860. It was not until 1869 that a second attempt to establish a cable connection successfully linked Tasmania telegraphically with the mainland.[8]

In most Colonies, the telegraph brought promising returns to sponsoring Governments. Telegrams were the new currency of communication. In 1857, three years after the beginning of telegraph operation in Victoria, 13,000 telegrams were transmitted, bringing in £5,648 to the Colonial Department. In South Australia a remarkable 35,792 messages were sent in 1856, yielding a financial return of £1,183 which went some way to covering, and shortly exceeding, the cost of installation. Queensland, with its later investment and larger distances had telegraph wires stretching over 1,131 miles in 1865; it dealt with 47,697 telegrams that year and realized £13,383 for the Government at Brisbane. Internal charges were moderate. Between Adelaide and its port, as one example, the sender paid 6d for the first 20 words exclusive of names and addresses, and thereafter 3d for each additional ten words. Costs rose considerably over longer distances and rocketed when overseas rates were introduced. But Australians took to telegrams like ducks to water. There was something about the laconic staccato style of the communication that suited their unloquacious temperaments. But there were also more powerful impulses. The telegram emerged not only as a vital social link joining families and friends in joy and disaster. It became at once an important legal policy instrument, communicating sentences of law passed in remote outposts, tracking bushrangers and other criminals;[9] transmitting decisions; communicating appointments; assisting railway traffic control;[10] an economic agent diffusing commercial and price information; informing on the state of the local gold market; and in every sense transferring knowledge, instructions and human feelings from city, country, suburbs, capital cities and back again.

By the end of the century Australia had become one of the largest users of the telegraph. "In no country in the world", wrote the statistician T.A. Coghlan in 1900, "has the development of telegraphic communication been so rapid as in Australasia, and in none has it been taken advantage of by the public to anything like the same extent.[11] Thirty-seven years later, Western Australians held the world lead. "The habit of sending telegrams had so captured Australians generally", the *West Australian* newspaper reported that year, "that Western Australians send more telegrams on average than any other people in the world". Australia-wide, the

ratio in relation to the population was higher than in any other country except New Zealand.[12]

A significant impetus to "this most perfect of modern inventions" derived undoubtedly in Australia from striking feats of planners, contractors and linemen who stretched the technology across the continent in the great Overland Telegraph exploit of 1871-2 and five years later built the almost equally challenging East-West Telegraph line from Albany via Eucla to Adelaide.

This is not the place for an analytical account of these epic ventures. Politics underscored the battle for the Overland Telegraph 'route'. Todd has commonly been attributed with the inspiration of the plan to link Australia with a submarine cable brought ashore at Darwin from Java and uniting the isolated continent with an overland line across the centre to Port Augusta in South Australia. Some doubt now turns on Todd's initiating role. There was keen, even bitter, rivalry between the Australian Colonies to seize the advantage of securing one of the submarine cables then snaking their way around the oceans of the world, joining countries and continents, to terminate in their territory. Rivalry between the Governments of Queensland (abetted by New South Wales) and South Australia sharpened significantly in 1870. Queensland backed a cable coming ashore from Java at Darwin and thence by landline to Burketown. South Australia (whose governance controlled Northern Australia) wanted the Java submarine cable landed and connected from Port Darwin by a direct overland route (already demonstrated as a land passage by John McDouall Stuart's overland exploration of 1861-2) to Port Augusta and Adelaide. By swift political negotiation and some sleight of hand, South Australia won through with a contract agreed with the British Australian Telegraph Company in June 1870. Contractual conditions were stringent. The overland line of 2,000 miles across desert and semi-desert country was to be ready for operation in 18 months: the deadline 1 January, 1872. The Colonial Government voted an immediate £120,000. Todd was put in charge. "Then, perhaps for the first time", he reflected, "I fully realised the vastness of the undertaking I had pledged myself to carry out."[13]

In 1870, the technology underlying the Overland Telegraph construction was rudimentary. The project, subdivided into three parts of Southern, Central and Northern Sections, was contracted out, the Southern and Northern parts to private entrepreneurs, while government surveyors and workmen completed the Central Section of 600 miles. Overseers and sub-overseers were involved in close supervision of the work. Todd, ubiquitous supremo, issued

verbal and detailed written instructions and maintained a restless overviewing of the work. Essentially technicians, telegraphers and linemen were self-taught. Transport was crucial. Horse-drawn vehicles carried men and materials to the sites. Instructions conveyed that wooden poles, tapered to specifications and not less than nine inches in diameter at the butt, were to be hoisted and fixed "in a most substantial manner" and positioned at not fewer than 20 to the mile. Three thousand wrought iron poles along with the galvanised iron wire were imported from England and deployed in sectors where suitable wood was unavailable, though their late arrival delayed their fullest use. In softened ground each pole was strutted with a sixteen foot pole to prevent the line wire pulling the pole over, and, in a region of the highest lightening incidence in Australia, each second pole was fitted with a lightning rod. The bare wire line rested on insulators, fastened to spindles attached to pole or crossarm, and overseers kept written check of the daily work of each man, the poles cut and erected, and the length of wire put up each week into the empty sky.[14] Most careful instructions were spelt out for the conservation of that most special technological resource — the horses; and some attempt was made to instruct the working parties to deal moderately with the aborigines, firing only "in the last extremity" as the technological cavalcade plunged unwittingly through sacred sites and tribal lands. In their turn, the aboriginals found their rewards in aiming their spears at the white porcelain insulators "of the best approved pattern" made by the Berlin Imperial Pottery, to claim sharp new cutting shards.

In this human and technological experiment, ingenuity was pressed to its straining point. The early telegraph 'engineers' knew little of theory. In any event, the conditions were novel and unremitting. The constant enemy was leakage, and the insulators (60,000 in all across the 2,000 miles of open wire) were challenged by conditions that began in temperate zones and experienced every variation from misty rain, dry aridity, dust, monsoonal rain, sun temperatures as high as anywhere in the world, and savage assaults from spiders and other insect invasions of the semi-enclosed undersides of the insulators. White ants were to remain a permanent scourge of telecommunications connections in Australia. In 1871 they gnawed their way through wooden poles and were barely daunted by the steel poles imported from the firms of Siemens and Oppenheimer.[15] For these and other reasons repeaters were essential, and maintenance provisions and testing made constant demands on the manpower on the work. With difficult country, engineers used the minimum number of hand repeating stations (11 were installed on the route) scattered near

water holes at intervals of between 300 and 500 miles. With the restricted knowledge of the period, strange false currents caused havoc on the line. Slowly it was learned that these were related to weather conditions and sunspot activity, and the construction proved instructive to research.[16]

For the technicians and linemen, groping with diverse obstructions, demands on their inventiveness were constant and profound. Anxiety steams off the pages of the overseers' diaries. Sunstroke, death, exhaustion played their part. In November 1871, the cable from London, via India and Java was landed at Darwin but monsoons intervened. The Northern Section was not completed until May 1872 and the final join was made at Frews Ironstone Pond on August 22, 1872. Eight months behind schedule, the Overland Telegraph had been completed in two unforgettable years. Uninterrupted communication from Britain now extended across the length of the fifth continent. Lodged at a campsite at Central Mount Stuart that day and connected by a portable telegraph set, Todd was deluged with congratulations from all parts of the Colony. Astronomer, meteorologist as well as an intrepid Superintendent of Telegraphs, Todd was later to make sound scientific use of the arduously installed technology by deploying his repeater outposts and the telegraph system to build a national system of meteorological and climatological intelligence.[17]

The construction of the East-West Telegraph to bring Western Australia into telegraphic contact with Adelaide and the rest of the world was launched from Albany in April 1875. A collaborative enterprise between the Governments of Western and South Australia, it called on much of the expertise and ingenuity demonstrated on the Overland Route, but took over 2½ years to complete. Winding from its starting point at Albany around the Great Australian Bight largely within sight of the sea, the line was erected on jarrah wood poles, most ferried by ship around the Bight, cast off in bundles, rafted ashore, and hoisted by derrick up perpendicular cliffs to be moved by horse or camel cart to the sites inshore. The border town of Eucla became the important, if bizarre, repeater station for the line. Here telegraphists seated on their respective sides of the electrical apparatus took down the morse signals from their capitals and handed them across to their opposite numbers for transmission in different Colonial codes. "Saturday 7pm" ran the first message on 8 December 1877, "Eucla line opened. Hurrah".[18]

The skills and adaptiveness illustrated by Australia's early long-line telegraph construction were notable in any terms and indelibly stamped her attitude and policies towards future tele-

communications techniques. Australia would pioneer many applications of telecommunications technology in the century ahead, and accommodate the applications of an evolving and widely derived range of network systems to suit her particular geographical and human needs. Yet, in the field of early telegraphy, Australians failed to contribute to original inventions or to add to evolving theory of electrical science. The country's remoteness, indeed, fostered negative effects. Dr Edward Dey and Benjamin Babbage (1815–1878), two noted telegraph experimenters in England, both forsook their enquiries on emigrating to South Australia, though Babbage, scientist, explorer, surveyor, and engineering son of the more famous Charles, served Todd in planning the Overland Telegraph, supervised the Southern Sector contractors, and reputedly introduced the concept of concrete telegraph posts in South Australia.[19] In nineteenth century Australia, electrical science was not expounded in the universities and found its expression exclusively and empirically in the rugged but often creative application of technology and materials imported from overseas. Of stimulus to a local manufacturing industry there was none. The cutting and end trimming of wooden poles and some hastily devised insulators for the first telegraph line[20] constituted the main Australian contribution to the early public telegraph network in Australia.[21]

TELEPHONY: THE PROLIFIC EXPERIENCE

In telephony, the Australian experience proved different. Within months of Alexander Graham Bell's patenting of his telephone invention in 1876, Australian experimenters were widely engaged in turning out variants of Bell's instrument in all the Australian Colonies. The 'carrier' was the *Scientific American* of 6 October 1876, detailing and diagramming Bell's experiments, which reached Australia early in 1877.

Australian experimenters moved alongside Bell's improvements in carrying the invention further. W.J. Thomas, working from home-made telephone instruments in Geelong, managed early in 1877 to link houses in his locality both by music and conversation and, more ambitiously, to use the telegraph line between Geelong and Queenscliff, and Queenscliff and Melbourne to convey catches of song. In Tasmania, Alfred Biggs, an astronomer and school teacher at Campbell Town Public School, simultaneously made three hand-type telephones out of Tasmania's beautiful Huon Pine and, after telephoning over short distances, communicated with

Launceston from Campbell Town. In Brisbane in February 1878, a medical practitioner, Dr Severn, experimented with home-made telephones over a mile of telegraph wire and other researchers carried a telephone call from Ipswich over 50 miles of wire. In northern Queensland, the inland coastal telegraph routes were also used to transmit voice communication over as much as 100 miles of line.[22] In Perth newspapers reported successful experiments with telephones over Perth–Fremantle telegraph lines in March 1878.

But by far the most fertile and significant telephone researcher in Australia was Henry Sutton (1856–1912) of Ballarat. Self-taught, an inventor of eclectic talent and range, Sutton from the earliest age was spawning models and machines from electric continuous current dynamos, electric motors, vacuum pumps, heavier than air flight machines, and a television apparatus for transmitting the running of the Melbourne Cup to Ballarat (some 70 years ahead of the technological infrastructure of the time). A distinguished modeller and draughtsman, Sutton devised and constructed some twenty telephone designs, but resisted the practice of patenting on the grounds that discovery "should benefit fellow workers in science".[23] It did. Sixteen of his telephones were subsequently patented by others overseas.

In this aptly named 'period of invention', the Colonial Superintendents of Telegraphs also joined the active process of experimentation and research. E.C. and W.J. Cracknell both carried out experiments in late 1877 and January 1878, respectively in telephonic communication by voice across 140 miles from Maitland to Sydney, and in the first experiments at the Brisbane Telegraph Exchange. Queensland's Superintendent, 'W.J.', was clearly dissatisfied with his crude implements and, on securing Bell's promise of improved models, informed the Queensland Parliament that "further experiments with this scientific wonder will be made".[24] In South Australia, Todd too used Bell-type instruments in January 1878 to achieve telephonic voice communication across telegraph lines between Adelaide and Semaphore, and similar experiments were conducted on parts of the Darwin line between Beltana and Strangways, a distance of 200 miles.

Where did this local ingenuity lead? Certainly some of Sutton's inventions passed by others' patenting into telephonic communication overseas. But it has yet to be discovered whether the labours of indigenous inventors were absorbed by the embryonic telephonic programs in the Australian States. Historiography at present sheds no light.[25] Reports of the Commonwealth Postmaster-General's Department suggest that Australia looked to Britain for standardised telephone equipment for distribution

throughout the country from 1901 until local production of handsets in 1933. Innovation traditionally proved a poor handmaiden to inventive enterprise in the Colonies. Bell, however, recognised the singular ingenuity of Sutton's work, and on a journey to Australia in 1910, visited to see the complete telephone system installed by Sutton in the family warehouse at Ballarat.[26]

Telephony, in fact, spread slowly in Australia. The first installation of a regular service was due to private enterprise and skills, and was brought into operation in two offices of the Melbourne hardware importers Messrs. McLaren Bros. and Rigg in January 1878 with telephones designed by J.S. Edwards of Melbourne.[27] Government telephone exchanges, however, moved slowly. Melbourne installed its first exchange with 17 subscribers in 1880; Sydney had a government operated exchange in 1882; Hobart and Adelaide in 1883; Perth in 1887; and exchanges began to open in provincial towns by the late 1880s. In 1887, the decision to place all telephones in each Colony under government control in association with the colonial Post Offices was made, a policy that predated Britain's move to consolidate its posts and telephone networks by 22 years.

By Federation, there were 33,000 telephones operating in Australia: 100,000, in 1910. With the gradual development of trunk line services between the capital cities (Melbourne-Sydney, 1907; Melbourne-Adelaide, 1914; Sydney-Brisbane, 1923; Perth-Adelaide, 1930; and Hobart-Melbourne, 1936) the figures leapt dramatically forward. Across the wide communication axes of Australia, apart from local calls, 32 million trunk calls were recorded in 1928, 35½ million in 1930 and 40 million in the post-depression year of 1938. By contrast, telegrams sent nationally in 1928 reached 16 million, sank to 13 million in 1938, and assumed decreasing importance vis-a-vis telephone communication by the late 1930s.[28]

Australian telephony would absorb significant technological changes in the first quarter of the twentieth century. The importation from the USA in July 1912 of the Strowger Automatic Telephone Exchange (a 'step by step' automatic dialling system which accelerated connections by allowing subscriber dialling without manual intervention) marked the first introduction of this major exchange system to the southern hemisphere and only two months after its establishment in Great Britain.[29] Installed initially at the Geelong Exchange, Strowger spread quickly to capital and suburban centres to become a foundation part of the Australian telephone network. The transfer of this technology ahead of many

countries characterised the strategic forward planning that became a hallmark of Australian telecommunications policy.

At the same time, the First World War isolated Australia from its sources of imported telephone copper wires and forced the growth of local manufacturing industry. Copper wires were fabricated for the Australian Post Office by E.R. and S. Smelter of Port Kembla in 1918. The Australian firm, Metal Manufacturers, was supplying paper-insulated, lead covered cables by 1923 and (while imports persisted) continued to meet demands for all types of communication network cables, including dry core lead, lead-antimony, covered cables, single pair to a thousand pairs. It amalgamated with British Standard Telephones and Cable Pty. Ltd. to form Austral Standard Cables Pty. Ltd. in 1947. By 1970, Australia had at last become self-sufficient in the manufacture of all types of telephone cable, including coaxial.[30]

INSTITUTIONAL CONSOLIDATION: THE RISE OF AN ENGINEERING CULTURE

Federation brought marked changes to telecommunications organisation. With the Act of Federation of January 1901, the separate administrations of posts and telegraphs in the six Colonies (States as they now became) were consolidated into one Commonwealth bureaucracy, the Postmaster-General's Department (PMG) in March that year. Confronted by "six different Acts, six different regulations and practices differing in every State", the new Commonwealth Government structured a government postal and telecommunications monopoly that, in the Postmaster-General's words, would be "of best service to the people of the Commonwealth". Introducing the Post and Telegraph Bill in the Commonwealth Senate in June 1901, the Postmaster-General, Senator Drake, gave pertinent expression to a philosophy that would underlie telecommunications practice and development in this century. A telegraph monopoly, the Postmaster-General told Parliament, "allows us to look ahead; take advantage of every innovation, and adapt it to the benefit of the public. If the telegraph system had been in the hands of a private proprietor", he reflected, "I am inclined to think that it would have fought against the introduction of the telephone service . . . Instead, the Postal Department . . . welcomed the telephones and assisted to a great extent in making the innovation of practical value to the community".[31]

From its inception, the large new instrumentality was seriously

handicapped in its progress by the shortage of trained staff. The largest employer of manpower in the Commonwealth, the PMG's Department inherited the practices and deficiencies of Colonial times. With growing traffic and a country flexing its sinews further for telephone and telegraph connections in the remoter rural parts, the Department's greatest need was for qualified engineers, mechanics, and technical men. These were in short supply in Australia. Feats of nineteenth century telegraphy and telephone connection had rested on British and American experience and empirical improvisation by practical men. There was minimal formal training in Australia. The Mechanics Institutes, scattered in the capital cities and sometimes allied in provincial centres to the School of Mines, offered some instruction in mechanical electrical engineering. The inventive Henry Sutton taught electricity and applied magnetism to privileged students at Ballarat School of Mines from 1883-7; but such knowledge and capacity was rare. Telegraphers, mechanics, and engineering staff were trained traditionally on the job.

The Australian universities were dauntingly slow in providing professional courses in electrical engineering. Tuition existed in engineering at Melbourne University from the mid-1860s, and William Kernot, M.A. gained the first certificate in engineering in 1866. Kernot in turn taught civil engineering, became first Professor of Engineering at Melbourne University (1883), and took part in a Victorian inquiry into the undergrounding of telephone and telegraph wires:[32] but he offered no instruction in electrical engineering fields. His counterpart at Sydney, Professor William Warren, appointed in 1884, founded the Engineering School, built his courses on American rather than British models, and established three major teaching streams which included electrical engineering by 1910.[33] But professional training in engineering with telecommunications components became available only much later, in the 1950s, despite the existence of engineering schools in Queensland, Adelaide and Perth. The PMG's Department trained most of its own engineers, increasingly building on science degrees from the Australian universities, until 1950-55, when appropriate degree training in electrical engineering appeared.

The situation in fact changed little until after the Second World War. Within the PMG's Department, however, there were early pressures to fashion an organisational structure where engineering played a major role and to upgrade the efficiency and the economy of construction and maintenance.[34] From 1906 operation and planning for telephone communication was assigned to the Chief Electrical Engineer, and in the first decade of the PMG, engineers

were upgraded managerially in the States. But a lacuna of trained engineers remained. Despite inducements to staff to "undertake an approved course of instruction in telegraph and telephone engineering at any recognised institution"[35] pressed in 1911, the Chief Electrical Engineer, John Hesketh, reported in 1912 that, "the supply of staff for the engineering branch in various sections has been insufficient for the past six years, and there appears to be no sign of relief.[36] Harrassed by shortage, the PMG's Department turned to Britain, advertising the post of Assistant Electrical Engineer and recruiting J.M. Crawford from the British Post Office. It was the first of many such tugs on the Imperial apron-string; recurring appeals for engineering reinforcements that continued into the post-Second World War period and surprisingly, into the 70s.[37]

Undoubtedly the universities' failure to grasp the significance of professionally trained manpower for Australia's telecommunications development had serious consequences for the development both of a trained civil service of engineers and for the promotion of local telecommunications R&D. Instructive contrasts clearly lie in the historical relationship between professional engineering education and telecommunications development in countries as diversely productive as Britain, the USA, Canada and Germany.

During the first two decades of the century, notably in 1908–10, the PMG's Department initiated spasmodic efforts to reform its own house. In 1914 a Committee was appointed to investigate the best means of recruiting and training both junior members and the technical staff; but the palliatives of a Technical Library, Technical Societies, and "more adequately equipped Telegraph Training Schools", failed to shake the problem. By 1918, the harrassed but determined Labor Postmaster-General, William Webster, noting the deficiencies of funding and men, declaimed in his Annual Report that he had only "with great difficulty been able to keep the Service off the rocks — it is still in the breakers".[38] It was Webster's successor, W.G. Gibson, who found the passage through the shoals. Faced with mounting public demands for services, inadequate supply and a demonstrable lack of skilled staff, Gibson turned for help to Britain and found it providentially in Harry Percy Brown, British Post Office engineer.

H.P. Brown (1878–1967) was to become one of Australia's public service giants. The son of a former superintendent of the London Telegraph Office, but with little formal training in engineering, Brown had entered the British Post Office and, after rapid advance, held responsibility for the technical planning and management of

all telephone and telegraph plant in Britain. In 1913 he visited India for the East India Railway Company where he acted as adviser on telegraph, telephone and railway traffic control, and in 1916 was put in charge of 'emergency communications' in British home defence, which called on all his power of improvisation. On the Australian Government's overture to the Imperial Government in 1922, Brown was chosen as the man "most capable in all England" for assisting the Australian Government in an advisory role. He arrived in Melbourne late in January 1923 for one year's stay, and remained for the rest of his life. In December 1923, he was appointed Secretary of the PMG's Department at a salary that soared above that of any other public servant.[39]

Brown's appointment was part of a broad Commonwealth Government approach to upgrade the national scientific and technological enterprise. Australia had already looked to Britain for advice and a model for its Advisory Council on Science and Industry which would lead (with high-powered British expertise to guide it) to its permanent Council for Scientific and Industrial Research (CSIR) in 1926.[40] Brown's advent four years earlier was designed to pump knowledge, high engineering experience and, above all, British Post Office management skills into the confused and disorganised PMG's Department. With his acceptance of the permanent executive leadership of that body, its future was assured.

From a debut of press and parliamentary outrage and shock, "Was there no Australian who could hold the post?", Brown 'the human whirlwind' went on to restructure and reorganise the Postmaster-General's Department and to build it on a base of engineering management. Significantly, for the first time, there was an engineer at the top. It was an idea that charmed one professional engineering journal. Mr Brown, the *Chronicle* reported, was appointed less because he was an acknowledged telephone and telegraph expert, but "because he was an engineer". He was, therefore, "a trained thinker . . . and preferable to anyone who has not been taught to think."[41]

Brown's first five years in office were to demonstrate the relevance of his engineering management and planning approach. Extensive reconstruction and major works programs bore his stamp and within four years he had established a research section at headquarters with a staff of eleven. Known widely in the press for his trenchant approaches as 'Poohbah Brown', his impact on postal and telecommunications technology was profound. He holds a pivotal role in the history of Australian telecommunications. First and foremost, he built an engineering environment in which, in

Headquarters' administration and in the States, he cultivated the development of advancing telecommunications around a blend of technical and managerial engineering skills. Though shortages of skilled manpower did not disappear, he provided the encouragement by which engineering staff could rise rapidly along administrative paths and hence play an increasingly visible role in PMG management. His spur to the PMG's Research Laboratories in 1924 provided the means whereby extensive evaluations and testing of new technology in pilot stage could be performed and the adaptive skills of Australian telecommunications staff marshalled to the sound scientific underpinning of national advancement.

The style and character of Brown's administration was already deeply set when he left the PMG's Department in October 1939, and was linked with key new developments such as wireless broadcasting, advanced carrier wave telephony and telegraphy. A quarter century later, the dominance of the telecommunications side of the Australian Post Office (PMG) activities was a central factor in leading to the partition of functions between the historically linked postal, telegraph and telephone services, and the creation, in 1975, of two statutory bodies, the Australian Postal Commission and the Australian Telecommunications Commission (Telecom Australia).

NOTES AND REFERENCES

1. G. Blainey, 'Gold and governors', *Historical Studies Australia and New Zealand*, 9, 36, 1961, p. 338.
2. R. Thompson, *Wiring a Continent*, University of Princeton Press, Princeton, 1947.
3. *Sydney Morning Herald*, 31 December 1857.
4. A uniform telegraph system based on Morse was established by the first International Telegraph Convention, signed in Paris in 1865. The International Telegraph Union followed.
5. Quoted in F.W. Symes, 'Australia and world communications — A summary of developments: 1830–70', paper presented to a symposium to mark the centenary of the Adelaide–Darwin Overland Telegraph Line, Institution of Engineers Australia and the Australian Post Office, August 1972, p. 3. O'Shaughnessey was a telegraph experimenter in the East India Company.
6. Undergrounding swallowed up two-thirds of Morse's $30,000 Congress appropriation. The insulated wire was painfully unravelled by Cornell and later erected on poles above ground.
7. South Australia, *Report of Superintendent of Telegraphs*, Tenth Report, 1884.
8. A subsequent cable laid in 1909 was to have a splendid, if unexpected, future. During 1943 it was pulled up, rewound, and, in the exigencies of war, taken to New Guinea where it was laid from a village near Port Moresby across Torres Strait to Australia's northernmost tip, Cape York. There it provided a vital submarine telegraph link to connect US and Australian troops with mainland headquarters.

9. Ned Kelly, bushranger extraordinary and national folk-hero, was successfully tracked by telegraph.
10. The alliance between the telegraph and the extending railways was important in most countries in the nineteenth century. In Australia, railwaymen kept an informing watch in remote areas on needed repairs to the telegraph line.
11. *A Statistical Account of the Seven Colonies of Australasia, 1899-1900,* Sydney, Government Printer, 8th issue, 1900, p. 713.
12. 1 January 1938, p. 12.
13. Todd Papers, South Australian Archives, Public Lecture Notes, 1873.
14. 'Overland Telegraph Port Augusta to Port Darwin. Instructions to overseers in charge of works', copy, Telecom Telecommunication Museum, Adelaide. M.J. Gooley, 'The construction of the Overland Telegraph Port Augusta to Darwin', paper to Overland Telegraph symposium, op. cit.
15. F.P. O'Grady, 'The Overland Telegraph Line technology of the 1870s', paper to Overland Telegraph symposium, op. cit.
16. ibid.
17. Ann Mozley Moyal, *Scientists in Nineteenth Century Australia,* Cassell Australia, Sydney, 1976, p. 154.
18. J. Moynihan, 'In touch with the world', *Western Australian,* 6 December 1977, p. 58.
19. *Australian Dictionary of Biography, 1851-1890,* Melbourne University Press, Vol. 3, 1969, p. 65.
20. McGowan experienced great trouble with insulators. Melbourne had no glasshouse, the Sydney manufacturer 'botched' the production and McGowan himself had to resort to inventing and manufacturing a quantity made from shellac and tar. *Argus,* 11 March 1854, p. 5.
21. Sir Samuel Jones, 'The development of the Australian telecommunications manufacturing industry', papers to Overland Telegraph symposium, op. cit., p. 32.
22. 'Early experiments in telephony in Australia', typescript, Telecom Western Australia.
23. *Australian Dictionary of Biography, 1851-1890,* Melbourne University Press, Vol. 6, 1976, pp. 226-7. Sutton's 'TV system', which he called 'telephany', used all the latest technology, such as the recently-invented Kerr effect, the Nipkow disc (which Baird was to use in the 'twenties) and the selenium photocell. But its weak link in the 1870s was that the signal had to be transferred by telegraph lines, as radio had yet to arrive, and these were too slow to transmit the dashing horses of the Melbourne Cup successfully. Personal communication with C. Coogan, CSIRO, Melbourne.
24. Superintendent of Telegraphs, *Report to Parliament,* Queensland, 11 March 1878.
25. G. Linge, *Industrial Awakening,* ANU Press, Canberra, 1980 gives a pioneering look at some other aspects of manufacturing invention and innovation.
26. Postmaster-General's Department, *Fourth Annual Report,* 1913-14, p. 37; and see ref. 21.
27. 'Early experiments in telephony in Australia', op. cit., p. 1.
28. Postmaster-General's Department, *Twenty-Fifth Annual Report* and *Twenty-Ninth Annual Report,* 1937 and 1941.
29. The Strowger system demonstrates the converse maxim, "in the midst of death we are in life". A.B. Strowger, a Kansas City undertaker, moved to experiment because he believed the exchange girls were diverting calls intended for him to business elsewhere, designed the world's first automatic telephone system by which each digit, step by step, activated and carried through the connection without the aid of the 'hello girl'. The system was patented in 1891.

30. Sir Samuel Jones, op. cit., p. 33. Along with Austral Standard Cables Pty., other active local firms were Olympic Cables Pty. Ltd., Conquerer Cables Pty. Ltd., and Beacon Cables.
31. Commonwealth of Australia, *Parliamentary Debates,* Senate, 6 June 1901, p. 749.
32. *Australian Dictionary of Biography, 1851-1890,* Melbourne University Press, Vol. 5, 1974, p. 22.
33. ibid., Vol. 6, 1976, p. 357.
34. *Report of Departmental Committee of Inquiry into the Telegraph and Telephone Systems of the States of the Commonwealth,* Government Printer, Adelaide, 1901, Recommendations, p. 37.
35. Postmaster-General's Department, *First Annual Report,* 1910-11, Government Printer, Victoria, 1911, pp. 13, 25. There were no annual reports for the first nine years of the Department's life.
36. Postmaster-General's Department, *Second Annual Report,* 1911-12, Government Printer, Victoria, 1912, p. 24.
37. A campaign in the early 1950s to recruit British engineers followed a notice in the *Annual Report* 1948-9 of a "dearth of qualified men". The campaign of 1971 anticipated adding 50 engineering graduates from Britain.
38. Postmaster-General's Department, *Ninth Annual Report,* 1918-19, Victoria, 1920, p. 21.
39. *Australian Dictionary of Biography, 1891-1939,* Melbourne University Press, Vol. 7, 1979, pp. 437-9 and Press Cutting Books of H.P. Brown in family possession.
40. Sir Frank Heath was borrowed from Britain's DSIR in 1925.
41. January 1924.