EARLY DEVELOPMENT OF ELECTRONIC COMMUNICATIONS IN THE POLICE DEPARTMENT OF NEW SOUTH WALES

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PREFACE

Modern police operational and administrative methods are almost totally constrained by available communications technology. As electronic communications became available in their early forms during the course of the late nineteenth and early twentieth century many police agencies were slow to appreciate the benefits being offered them. Even once modern methods were accepted, great selectivity was exercised in that acceptance.

This paper describes the experience of the Police Department of New South Wales and, more importantly, its employees in respect of two particular communication technologies - the telephone and wireless. The story commences at the beginning and continues until the end of Word War II. In other words, it is a selective account of the early development of electronic communications in the department.

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Electronic communications are critical to modern society. It is difficult to appreciate that, with the exception of the telegraph wire, electronic communications have only been available for a little over one century. Reaction to the new means of communication varied greatly throughout the modern world. Some institutions eagerly accepted the new technology whilst others either rejected it or, for various reasons, ignored it.

Although this article concerns the early development of electronic communications in the police department of New South Wales (PDNSW), the subject is better comprehended against a background of international reaction to the phenomenon. For that reason, a brief international introduction is provided to the development of electronic communications technology in the late nineteenth and early twentieth century, with special reference to the police community.

International developments

Prior to the introduction of the telegraph during the mid-nineteenth century, communications were scarcely more rapid than those obtaining a millenium previously. Probably only the automobile equals the telegraph in terms of technological impact upon the modern police service and, it is notable that these innovations enjoyed a distinctly symbiotic relationship in the early development of police mobile operations.

The telegraph's capacity to communicate precise meanings almost instantly[1] over long distances ensured it quickly became an essential tool of government and commerce alike. Police generally were not quick to adopt the new technology, although by 30 December 1867, just 18 months after the completion of the Atlantic cable, Commissioner Richard Mayne of

London's metropolitan police force could claim that every one of his police stations was connected with police headquarters by telegraph.[2] In 1869, the British General Post Office was granted a monopoly of telegraph business. Europe generally followed this lead but, in America and Canada control remained with the private sector. Some years later, in 1876, Alexander Graham Bell patented the telephone. This spin off of telegraph technology spread even faster than its progenitor, particularly in eastern USA during the 'eighties. Between them, these two technologies permitted speedy communications between police agencies as well as between headquarters and divisional stations. What a massive advance in police communications was represented by that capacity! In 1878, the various metropolitan stations in Sydney were 'connected by telegraph wire.'[3] In 1890, industrial disturbances at Broken Hill in NSW required immediate police reinforcements to that city. Within minutes the request was encoded and sent, via the Railways Department's telegraph, the 1125 kilometers to Sydney.[4] The only significant delay incurred in getting required reinforcements to the "Silver City" was imposed by the speed of the trains which transported them.

At the same time as some American police departments were installing telephones, eg, the Mayor of Albany was connected by telephone to the city police department's five precinct stations in 1877 and Detroit's police department installed its one telephone in 1883,[5] experiments were being made with recall and call boxes. Initially, recall boxes were pillars placed at convenient locations in the streets. These pillars or boxes contained mechanical devices which permitted the exchange of fixed messages between beat officers and divisional or precinct stations. Messages such as "send assistance" or "send ambulance" could be sent by police officers and citizens alike. More advanced models included a flashing light capable

of alerting a patrolling foot officer several blocks away. The Gamewell Company was the first to market multi-alarm boxes and Chicago was the first city to instal them. Detroit followed shortly after in 1884 and Indianapolis followed suit in 1895.[6] With the advent of the telephone, greatly improved communications were made possible by means of police call boxes, as opposed to the mechanical message sending previously possible. In fact, where the telegraph had permitted internal electric communications down to divisional level, the telephonically equipped callbox (or pillar) permitted rapid communication right down to the man on the beat - provided he was in the vicinity of the callbox. Apart from considerations of quality or convenience of transmission, only one further step remained to be completed in the range of internal police communications - that of immediate stationhouse contact with foot and (with the introduction of the automobile) mobile officers. By 1890, the police department of New South Wales (PDNSW) had only 25 telephones in the Sydney area, each connected to its local exchange. This shortage was partly offset by utilising Fire Department telephones where necessary. In addition, 139 citizens throughout the Sydney metropolitan area placed their private telephones at the service of police. Patrol officers were provided with a list of these citizens and their addresses so that recourse could be had to them when necessary.[7] PDNSW did not establish its own exchange until about 1886[8] with a switchboard at the old Central Police Station (located on the site of what is now the Queen Victoria Building, George Street) until relocated to Central Lane in 1892. The exchange was moved to police headquarters (at the intersection of Phillip and Hunter Streets) in 1911[9] and, in 1933-1934, a separate police telephone system was established.[10,11] At that time the police exchange number was changed from B6941 to B030.

The telegraph, telephone and teleprinter (which was developed at

roughly the same time as the telephone) all depended on wires being laid. This characteristic naturally affected those locations not favored by the presence of the necessary wire or lines. People in locations not served by railway, for example, were likely to be the last to be serviced. Persons in moving vehicles such as cars and trains could not be serviced by wire. What was needed was a wireless means of communication! The breakthrough came in 1895, when Guglielmo Marconi invented a wireless form of telegraphy, later to be known alternatively as "radio" or "wireless". Two years later, Marconi founded a wireless company in England and commenced operating a ship-to-shore wireless telegraphy service. By 1900, he was able to transmit messages 200 miles and, a year later in 1901, he managed to span the Atlantic with his signals. Shortly after that, in 1904, the Indianapolis police department started using that other great aid to modern policing, the automobile.

The Wireless Telegraphy Act 1905 vested exclusive responsibility for establishing and operating stations for telegraphic transmissions in the federal department of the Post Master General. Only ships of the King's navy were excluded from this monopoly. The same Statute enabled the federal government to grant licences to establish wireless stations. In 1919, it was amended to include wireless telegraphy.

During 1911, the Inspector-General PDNSW recorded that his department's telephone was not as complete as he desired owing to shortage of funds but, nevertheless, a number of additional police stations had been connected with local exchanges. Some of the police telephone lines had been converted to direct lines which bypassed exchanges and which reportedly resulted in a noticeably improved signal.[12]

By 1912, the Pacific Ocean, from San Francisco to Honolulu had been traversed by wireless. In 1915, continental USA was also spanned, from Arlington, Virginia, to Mare Island, California.[13] It is impossible to be sure which police department was the first to utilise wireless for mobile operational purposes but, it is recorded that New York's City police department employed wireless telegraphy in 1916 to maintain contact with its harbor launches.[14]

The teletypewriter was becoming accepted as a useful tool about the same time, having the great advantage of a hard copy product. Essex County police department in New Jersey and Nassau County in New York were among the first to utilise it. But, it was not until the mid-late 'twenties that teletypewriters were widely adopted. By 1929, the Pennsylvania State Police had 110 teletype points in 95 cities.[15]

In 1917, the Detroit police department was experimenting with two person patrol cars. Vehicles and crews were located at telephone points throughout the city. Upon receipt of an appropriate message, a car would quickly proceed to the location indicated and take necessary action. The tactic must have proved successful for in 1925, whilst on a world tour, Inspector-General James Mitchell, observed it still in practice. According to Mitchell, the car crews comprised a driver and three detectives, handling mainly robbery calls.[16] This interesting Detroit police initiative represented one of the earliest efforts to marry the two technologies of electronic communications and motor vehicles in the cause of crime control. Although still relying primarily on telephone in the operational field in 1925, Detroit's police department started experimenting with wireless as early as 1921. By 1922, the London metropolitan police force was utilising patrol cars fitted for wireless

telephony, transmissions emanating from a base station with the callsign 2LO. Some vehicles were equipped with transmitters thereby permitting two way mobile voice communications. The following year, the Force reverted to wireless telegraphy as telephony had proved too unstable as well as being subject to interference from commercial broadcasts. Many other police agencies were to experience this early change from voice to code due to early problems with short wave transmissions. Supporters of wireless telegraphy claimed it was the preferable medium anyway as it was speedier as well as more secure.[17]

In addition to maintaining wireless telegraphy communications between base stations and mobile units, London's metropolitan police also experimented with using large balloons suspended in the air in the vicinity of major fixed events, eg, sports arenas. Police observers suspended beneath a balloon, appropriately equipped with wireless, were able to inform police on the ground of traffic and crowd movements, etc. One young wireless enthusiast in the Victoria police department observed this technique whilst on a visit to London in 1923.[18] London's CID was equipped with vans fitted for two way wireless telegraphy, although the Assistant Commissioner (Crime) reported in 1925 that wireless communications had not proved of any great benefit to his men at that time.[19]

Nineteen twenty-six saw the Berkeley police department commence its own wireless service with a 75 watt Hartley transmitter. The device was made in part from impounded whiskey still components by a young engineering student at the University of California.[20] Berkeley's police chief, the legendary August Vollmer, decided to have his own equipment after learning that commercial radio manufacturers considered the medium held no potential

for police applications.[21] It is thought Berkeley's was the first police owned radio station in America. At that time, Detroit was still experimenting with wireless.[22] It was not until 7 April 1927, though, that Detroit's police department actually commenced regular radio transmission. During that period Detroit's chief, WP Rutledge, and Berkeley's chief, August Vollmer, were the two major reformers in the US police community and it seems probable an element of friendly rivalry was involved in introducing the various innovations for which both were responsible.

It will be seen that the police service in the English speaking world moved into the various electronic communications media in a generally hesitant way and with widely differing approaches. Local constraints such as funds, legal controls and personalities no doubt contributed greatly to this patchy reaction to technological change. For instance, in New South Wales, there were insufficient funds to establish a completely satisfactory police telephone system until 1934.[23] Teletype was too expensive, a factor of government monopoly and, in any case, was considered inappropriate (for reasons never satisfactorily articulated) to the state's needs.[24] The decision was debatable but, sound or not, it set the department's communications priorities for many years thereafter. There was, too, the inevitable resistance of some older members, including at least one senior officer, to the introduction of new technology. Wireless, for example, was declared by some to be unnecessary, being designed essentially to spy on members.[25] A similar reaction occurred in Chicago in 1880 when police boxes were introduced. It seems the introduction of fresh technology has the effect of reducing personal discretion in the field and raising employee suspicions and resistance. Similarly, when the Metropolitan St Louis police department introduced its Fleet Vehicle

Location device in the mid 'seventies, the immediate assumption of patrol personnel was that management's motivation was merely to exert tighter supervision over them. Resistance was not confined to rank and file employees. There was even some feeling among police planners that radio had little to offer the police service. An editorial in the Michigan State Police employees' magazine as late as March 1927 put forward such a view.[26] On the other hand, a commission of radio and police officials meeting in Holland declared in 1926 that wireless offered the police service a communications medium that was efficient, quick and, trustworthy.[27] This view was confirmed in 1928 at the fifth meeting of the International Criminal Police Conference, held in Berne, especially with respect to the medium's capacity to aid in the apprehension of criminals and the enforcement of the law.[28]

It may be seen from the foregoing that the various forms of electronic communication available in the first quarter of the twentieth century were, with the exception of the telephone, utilised unevenly within the police community. Indeed, apart from some progressive police agencies in England and North America, most police departments were slow to employ such means of communications despite their obvious advantages.

Even under the enterprising eye of Commissioner James Mitchell, PDNSW was slow to adopt new communications means. However, once PDNSW did acquire some understanding of the utility of wireless, it quickly achieved Australasian hegemony in the field. The department's only other outstanding innovation in the communications field concerned the combination of telephone and callbox. Once again, PDNSW was far from being the first agency into the field but, once having accepted the idea of callboxes they were implemented in the metropolitan area with great

enthusiasm.

This description of the development of electronic communications in PDNSW from the beginning until the early post WWII era concentrates on wireless and callbox utilisation.

Wireless

The first two-way radio station in Australasia was erected by the Marconi Company in 1905 at Queenscliff, Victoria.[29] Amalgamated Wireless Australasia was formed in 1914 and was closely associated with many major events in the early days of radio development. Eight years later, in 1922, the company applied for permission to provide a broadcasting service to all states. By that time, military authorities were showing interest, an interest not at first shared by police authorities. Fortunately, a number of wireless enthusiasts existed in the lower echelons of the Victoria Police and, as a result of their influence, wireless was adopted by police perhaps five or six years earlier than might otherwise have been the case.[30]

The first police department to utilise wireless operationally in Australasia was the police department of Victoria (PDV). In May 1923, that department fitted a Hotchkiss tourer with a seven valve Marconi receiver.[31] The Victorian use of radio resulted from repeated urgings by several young police employees possessing an avid interest in the medium. It is interesting to reflect that the first police use of the medium was made in respect of mobile communications, rather than point to point transmissions. PDNSW experience was similar.

Following Victoria's initiative, Commissioner James Mitchell

approved PDNSWs use of wireless telephony which commenced 9 September 1924. In his annual report for that year he reported satisfactory results were obtained[32]. A transmitter was installed at the Police Telephone Exchange (J4512). Concurrently, a wireless receiver was installed in one of the three detective vehicles employed on night patrol. It was promptly christened the "wireless patrol", a appellation which persisted for more than 50 years. At that time, it appears, the three vehicles had no fixed patrols. The vehicle fitted for wireless was a Buick tourer. It had a four person crew, consisting of two detectives, a driver and, a radio technician as operator. The seven valve receiver was fastened to the floor at the rear of the vehicle's frontseat. A flap was used to conceal the glow from the valves. Attached to the underside of the car's hood was a loop aerial designed to avoid directional effects. The operator's earphones were connected to the set by a long lead which permitted him to sit back in his seat. There was no transmitter and so the crew leader, along with the non-wireless car crew chiefs, had to telephone Central police station switchboard to both notify their location and receive any calls awaiting him. Early logs maintained by wireless operators are full of such entries. Messages for transmission were telephoned from stations or the Police Telephone Exchange operator to the AWA station at Willoughby. From there, they were transmitted by voice. Reception was usually of poor quality, electrical transformers produced staccato buzzing sounds and trams created a shrill whine. It was all very difficult for the operator. As one radio expert commented after having ridden along with a wireless patrol for a shift:

> ... if ever car receivers become popular it will first be necessary for the Electricity Department to turn loose a gang of men armed with a loop receiver in order to clear up the noises - otherwise they would be distinctly unpopular.[33]

The same observer heard Sydney Radio communicating with SS Niagara on the police wavelength. It will be remembered London's police also experienced similar problems with early telephony as did PDV. Thus, in 1926, a Buick tourer was fitted with a morse receiver tuned to 92 meters instead. The quality of wireless telegraphy was found to be superior to that of wireless telephony. Equipment was rented from AWA and operated by a small group of police wireless enthusiasts assembled for the purpose. The group was led by Constable WE Salmon, a former ship's radio officer who retired in 1962 as Sydney's Metropolitan Superintendent. Most of the department's wireless technicians were proficient in morse, so the change from telephony to telegraphy posed few problems.

The PDNSW wireless patrol was doubled in 1927 when a Studebaker tourer was also fitted for wireless telegraphy reception. For mobile purposes Sydney was at that time divided into two patrols, eastern and western. A third, northern, wireless patrol was later added, about 1931. Later again, a fourth wireless patrol, the far western was established. Each patrol was assigned a wireless car. The patrols were directly responsible to the Metropolitan Superintendent and had no divisional ties. Until two-way wireless communications became possible, crews continued to periodically telephone the police switchboard operator (on B6941). PDNSW wireless wavelength continued on 92 meters, shortwave, as did also PDV. Occasionally, Sydney would receive Melbourne's traffic, or vice versa, and conversations would ensue.

The identification callsign initially assigned the PDNSW police wireless station by the PMGs department was 2PD but, was changed to VKG1 in 1927 - the same year transmissions commenced from AWAs wireless station at Pennant Hills. With the advent of the regular wireless (telegraphy)

patrol the police telephone exchange was connected to the transmitter by landline. The telephone exchange operator cum wireless telegraphist was thus able to despatch signals to the mobile patrols straight from his switchboard.

At first, wireless patrols operated only on night shift (2100-0500 hrs). Later, in 1930, they were extended to include the afternoon shift (1400-2100 hrs). Patrol wireless operators, when rostered on morning shift (0500-1300 hrs) or afternoon shift (before there were patrols), worked a normal shift either at a police station (prior to being formally taken on wireless section strength) or, at the detective office. The wireless staff were originally placed within the Criminal Investigation Branch's (CIB) organisation.[34] The officer in charge of CIB during those early days was Inspector WJ Mackay. He took a close interest in the application of electronic communications to police work, although he had little technical grasp of the media.[35] All applicants for posting to the wireless section were personally and carefully selected by him.

The early tourer vehicles used for wireless patrol were draughty and most uncomfortable, especially in wintertime. Crews had to wrap themselves in scarves, topcoats, thick socks and hats, as the cars had no heaters. In the early days there were few vehicles on the road at night and there were relatively few vehicle models in existence. Some of the wireless patrol drivers recognised the make of oncoming vehicles by the space between their headlamps as well as the height of those same headlamps above the road surface. This ability permitted a number of arrests of offenders using vehicles in the commission of a crime, the descriptions of which had been transmitted over police radio. Many streets contained tram tracks which made even wireless telegraphy reception difficult. Wireless patrol

drivers generally had an excellent knowledge of the streets within their patrols, those containing tracks and those not. When transmitting, despatchers would give the broad destination first, eg, Bondi. The operator would inform the driver accordingly. Drivers would then turn their vehicle in the required direction and head for the suburb in question. Until given a precise address, drivers kept to streets without tram tracks so as to minimise static and thus aid receipt of the remainder of the message. Once the message was completely received, the driver would be then free to select the most convenient thoroughfare, regardless of whether it contained tram tracks.[36]

As mentioned earlier, wireless telephony equipment was mounted on vehicle floors, at the rear of vehicle front seats. Originally, only receivers were supplied but, as radio technology advanced, two way wireless telegraphy communications became possible. In 1932, a morse key and transmitter were added to wireless patrols. Messages were transcribed direct by the operator on to a message pad if his vehicle were in motion or, by typewriter, if it was stationary. Headphones remained necessary for several years.

Motor vehicles were poorly sprung in the 'twenties and road surfaces were rough. As one old hand reminisced, 'operating a morse key [under such circumstances] was the ultimate in frustration.'[37] Another hazard for operators was that their headphones were attached to receivers. On more than one occasion, wishing to leave their vehicles in a hurry to assist crew mates, forgetful operators found themselves unceremoniously wrenched backwards into their vehicles.

Aerials varied. One model utilised a telescopic mast which could be

raised or lowered through the roof as required. Another model had the aerial secured on the front offside mudguard, suspended over the vehicle cabin by a fixed mast and, finally, fastened to the rear bumper. The general effect was not unlike a ship at sea. Similar aerials were also used elsewhere, including New York city, where vehicle patrols were equipped with telescopic aerials to aid their two-way telephony communications in 1933.[38]

Police mobile wireless patrols caught the public imagination in the twenties and thirties. This interest in no small degree stemmed from Edgar Wallace's exciting novel, The Flying Squad. Certainly, the press were avid reporters of patrol exploits. Most were good publicity for the department, although some were embarrassing. One such report concerned two patrol crews. The first was seen by a nearby resident checking commercial premises. The resident, believing them to be breakers, promptly telephoned Regent Street police station. The message was passed to the second crew which sped to the scene and surrounded the "breakers" at gunpoint. Only then was it realised that all concerned were police officers.[39] On another occasion, a more serious mishap occurred. Two patrols were chasing a stolen car in Surry Hills. The car halted and the thieves ran off, pursued by a number of patrol members also on foot. One patrol car following the chase drew abreast of one of its running crew members. He jumped on to the running board in order to save energy. He held onto the car door which was not secure. The officer, who was holding a pistol in his free hand, fell to the ground. The impact resulted in his pistol accidentally discharging, the round seriously wounding the car driver in the shoulder. He was rushed to hospital but, surgeons were unable to recover the missile. The injured driver may have felt partly recompensed by the fact that the other officers succeeded in capturing the absconding

thieves.[40]

A number of "good" arrests were made by the night patrols, including one commanded by Inspector Mackay. These were duly reported in the Sydney newspapers. Of course, not all wireless patrol arrests depended on wireless. One good capture resulted purely from the observance of a patrol detective. At one stage in the late twenties a very successful burglar operated in Sydney's eastern suburbs. He was referred to by police as the "Mystery Man". One evening, a wireless patrol car cruising eastern suburbs streets passed a man and woman walking along the footpath. Both were clad in immaculate evening dress. The patrol continued on its way and one of the crew's detectives reflected that he had seen persons in evening dress on three occasions in recent weeks. On each of the evenings the "Mystery Man" had struck. Acting on a hunch he had the vehicle turned around and as it approached the couple, the male member broke and ran. Sure enough it was the "Mystery Man". The female was his "scout".[41]

Control room equipment was Spartan, comprising only a morse key, headphones, telephone handset and, once two way communications became possible, a receiver and amplifier. Following a substantial reorganisation of the metropolitan area in 1933, control, ie, the police wireless station, moved to the police depot, Redfern, in May 1934. There, the station was provided a control room, transmitters and transmitting aerials. It had become apparent that hiring equipment was not a financial proposition; thus, the building of a police owned base station. AWA was naturally sorry to see the connexion severed but, the company's grief was no doubt assuaged by its being granted the contract to construct two receiving and transmitting aerials at the police depot. The two 120 feet towers are still operative. The control room itself was small, measuring only 12 feet

by 30 feet. In this space were accommodated the control desk, telephone desk, work bench and, the desk of the Officer in Charge (OIC). The room was expanded in 1937, when the system was converted to two-way telephony. The new system increased the section's workload substantially and extra space was needed for additional battery chargers, equipment maintenance and storage facilities, emergency power plant and a separate office for the OIC, Sergeant Walter Salmon. The depot was considered a suitable site for the police wireless station for several reasons, including: (1) the absence of high steel buildings in the vicinity, (2) facilities permitted an efficient aerial and earth system, and (3) there was availability of an adequate power supply.[42]

The main transmitter was entirely AC powered, including microphone current supply. The transmitter in question was of the multistage type, consisting of two units which included power and bias supplies utilising mercury vapor rectifiers, quartz crystal oscillator, power amplifiers and linear amplifier. The oscillator was sufficiently stable to hold the frequency constant to within 0.03 per cent of required frequency. The equipment was activated by pushing a button which energised a bank of relays in a required order. Also provided was a supervisory metering system, protecting gate switches and overload relays. Both wireless telegraphy and telephony transmission was made possible by operating a single multi contact switch designed to instantly change circuit conditions, ie, telephony or continuous wave telegraphy. The power transfer from the transmitter to the aerial was by means of a 600 ohm line extending from the transmitting room to a tuning box on the depot lawn. The radiating system itself consisted of a quarter wave aerial supported by two self supporting steel towers 480 feet apart and, built for a head pull of one ton. The earth system was buried under the depot lawn. An emergency

radiotelephony transmitter was also installed, complete with a duplicate speech amplifier, with a power rating of 100 watts unmodulated. The power rating of the main transmitter was 200 watts unmodulated for telephony and 700 watts for continuous wave telegraphy.[43]

Repairs to fixed vehicle equipment were performed outside the control room but, when it was raining, vehicles, drivers and technicians had to go to the opposite side of the depot where there was overhead cover. Mobile radio equipment in the 1930s took considerable toll of vehicle batteries. The generators of moving vehicles could only just match demand. But, as some communications were received and transmitted in the static mode batteries quickly became exhausted. Thus, battery charging and changing was a major task for Wireless Section staff.

As the system expanded, especially with the introduction of telephony, wireless monitors were installed in city and suburban police stations. They were variously AC and DC depending on local wiring. Nineteen thirty-five was a good year for the wireless patrols as several criminals were apprehended by crew members following receipt of information concerning them over the air.[44] Four wireless patrols were covering the metropolitan area 16 hours daily by the following year. A single wireless patrol officially referred to as "the metropolitan" or, more succinctly "the metro" provided coverage for the remaining eight hours. George Canacott, later to be second in command of the Police Wireless Section, sometimes worked the metropolitan patrol. At the same time, a uniformed patrol operated and traffic control vehicles were also on air.

Shortly after moving to the depot, a new transmitter was installed for long distance, including interstate, morse communications; wavelengths

of 34 and 68 meters being assigned for the purpose. The following year, the new long distance transmitter was adapted so that it could cope with local traffic should the need have arisen. With this new equipment, daily schedules with PDV were increased and, test signals were exchanged with the police department of Western Australia over a three month period.[45]

It will be remembered that during the experimental year of 1925, an observer accompanying a wireless patrol heard ship-to-shore radio traffic on the police wavelength. Eleven years later, in 1936, police radio operators liaised with their radio colleagues on board RMS Orsova. Night range tests were carried out south and west of Sydney. Police signals were reportedly received by the Orsova 3,000 miles west of Sydney.[46] PDV operators engaged in similar exercises.

A decision to return mobile wireless to telephony was made after tests in 1937[47] and vehicles were progressively refitted. There were some shortages of equipment and, for a while, six traffic vehicles and eight other cars were equipped to receive voice only. Two launches were were also converted to telephony. Some detective vehicles remained wholly on morse until the following year, when it became possible to pair all telephony receivers with transmitters.[48] There were at that time four wireless patrols, all CIB. Car 1 - eastern; car 2 - western; car 3 - northern; car 4 - far western. Patrol routes extended up to 60 miles from Sydney by this time. The decision to convert to mobile wireless telephony was based on economic grounds and the need to obviate having qualified telegraphists at every receiving point. Commercial equipment became available at a reasonable price with an upper frequency range of 1550 KHz and, which was easily convertible by Wireless Section staff to the police channel of 1700 KHz.

Part of the general expansion and updating of the wireless section in 1937 included the opening of the police wireless station in Newcastle, callsign VKG3. operating on 1700 and 1710 KHz. Vehicle transmitters, however, operated on 32.6 MHz (ultra high frequency for those days). The Newcastle equipment comprised a modulator panel and a radio frequency amplifier panel. Frequency control was by quartz crystal. The aerial system was a quarter wave type, with a buried earth and two 80 feet wooden masts. Power was carried to the aerials by a 300 feet 600 ohm line. The power rating was 200 watts unmodulated.[49] The wireless station, operated by four technicians, was accommodated in a room in the former lock up keeper's house in Georgetown Road, Waratah, until 1943.[50] In that year a new radio station was built at the rear of the lockup keeper's residence. Due to the war situation, windows were protected by brick blast deflectors.[51] The Newcastle station could communicate with cars at Gosford, Wyong and Singleton. In fact, it was possible by 1937 to maintain one way wireless telephony contact with police cars from Wollongong to Singleton. Approximately 10,000 radio messages were despatched to those vehicles during the year. Twenty-four hour telephony was established between Sydney and Newcastle the following year. Twenty-four hour communications with Melbourne were not achieved until 1942.

Despite a good deal of technical advancement over the years, patrols in both Newcastle and Sydney often experienced poor reception in certain areas. Two measures were employed to overcome the problem. According to a schedule, vehicles in poor reception areas would stop and rig a dipole aerial from convenient trees. The other method utilised a directory of locations at which reasonable communications were possible. These sites were referenced by whatever means were to hand, eg, numbered lamp posts, street intersections, culverts and buildings.

In 1938, metropolitan and country patrol cars were equipped with radio telephony receivers, as were the Commissioner's office, CIB HQ, and 18 principal stations throughout the metropolitan area. Approximately 18,000 messages were transmitted to patrols during the year.[52]

In the late 'thirties, PDNSW purchased a Chevrolet van and equipped it as a mobile workshop and base station. The vehicle proved invaluable at bush fire control centers, especially in the terrible Blue Mountains bush fires of 1944, although its primary role was to service receivers in metropolitan police stations.

As industrial development grew in the Redfern area, the level of electrical interference increased to the extent police wireless reception was seriously impaired; a nearby electric welder proving particularly disruptive to high frequency interstate communications. Eventually, it became necessary to position receivers and a reception aerial in the grounds of a police residence in Pacific Highway, Artarmon, adjacent to the police callbox. The receiving station was equipped with a number of superheterodyne receivers capable of operating on all wavelengths. Signals from the receivers travelled through a patchboard to the main wireless station at Redfern by landline.[53] One man operated the equipment, passing interstate messages on to CIB headquarters, where they were actioned. Duty at Artarmon was considered "Siberia" by some Wireless Section staff who assumed the assignment was evidence of Sergeant Salmon's displeasure.[54] By the end of the 1940s, electrical interference had also reached unacceptable levels at Artarmon and another move became necessary - this time to Middle Head.

By 1941, police depot transmitters were capable of transmitting in

both voice and morse to all wireless equipped vehicles and stations. There were 80 wireless equipped units on the road, half of which could transmit. Mobile transmitters operated on 32.6 MHz. Lack of fuel, though, greatly reduced vehicle operational time. Also, National Security Regulations required a minimum of radio traffic. These two factors led to a decrease in police wireless traffic overall in 1942.

A reserve wireless station was set up during World War II (WWII), at the rear of Petersham police station. It was intended as a back up facility in case the depot station was incapacitated by either aerial bombardment or gunfire from naval vessels. The reserve station was tested each week to ensure it was in a state of perfect readiness. This far sighted provision paid off on 1 September 1943, when fire broke out in a building adjacent to the depot wireless station, making evacuation necessary for a short period. With the electricity supply to the depot station switched off, the reserve wireless station maintained a full radio service. Another wartime measure of rather less value was the requirement that all radio technical staff report to the control center in the event of an air raid alarm. Several such alarms occurred and the radio staff duly assembled. One well placed bomb or shell could have wiped out the department's entire radio expertise, a point that did not escape the officers concerned. Eventually wisdom prevailed and the order was rescinded.

One wartime event of particular interest was the fact that police radio operators picked up Japanese submarine wireless telegraphy traffic. The signal strength indicated the submarines were not far from Sydney. This information was passed onto military authorities. The impression of members was that their information was disregarded. Shortly after, on 1

June 1942, Japanese submarines completely surprised harbor defenses with a sneak attack. Their signals were heard by police operators the day preceding the attack.[55]

In 1941, the wireless section moved from its accommodation on the north side of the depot to a much larger area which formerly accommodated the police museum, which had been located on the south side. The museum was moved to the stables loft.[56] The following year, direct wireless telegraphy communications were established with Brisbane.[57] These communications were placed on a 24 hour basis in 1943.

During WWII, close relations existed between PDNSW and Australian and American Provost units. Sometimes joint patrols were mounted and, even when they were not, Provost radio equipment was often maintained by the radio branch. In fact, four metropolitan patrol cars were equipped for joint Police-Provost patrolling. The American armed forces reciprocated by obtaining scarce spare parts. With the severe petrol rationing that operated in NSW during the war years, American Provost vehicles were sometimes the only public security vehicles on patrol, eg, in 1942, police vehicle fuel was cut by 65 per cent.[58] By 1944, there were 24 Provost vehicles available, although the number dropped to 15 the following year. By 1946, no overseas Provost vehicles were left. PDNSW wireless despatchers found the American Provostmens' accents difficult to understand over the air, especially during the excitement of pursuit. The Americans were skilled in ramming at high speeds those vehicles failing to stop on demand. Members of PDNSW radio branch were most appreciative of the cooperation afforded them by the US Army's Provost Marshal in Sydney, Colonel Burrows, and his men.[59]

Although security constraints were placed on police wireless transmissions during the war years, equipment procurement went ahead. In 1944, 22 additional police stations in the metropolitan area were fitted for wireless, making 53 in all. In addition, at that time, the wireless section was despatching messages to 60 vehicles and two marine launches.[60]

The introduction of VHF two way radio traffic for mobile units made it necessary to disperse receiving points. Water towers were popular choices due to their height. As a result, a close liaison developed PDNSW and the Metropolitan Water, Sewerage & Drainage Board. The Sydney Observatory was also utilised as a receiving point.[61]

A great advance in police radio technology was made immediately following the cessation of WWII, when Tasma introduced a range of new equipment. In particular, the company produced a transceiver, ie, a transmitter and receiver suitably connected, for police purposes operating on 1700 KHz and 32.6 MHz. This advance enabled more vehicles to be fitted for radio with more compact equipment. AWA then saw the market potential of such equipment and after a good deal of experimentation produced some good commercial models in the 80MHz band for under console mounting. This new equipment included the simplex system which merely required the pressing of a button to permit transmission. However, PDNSW did not actually introduce VHF FM mobile simplex equipment for operational use until 1956.[62] Because of the low power involved in this new technology, a number of new transmitting sites became necessary. They included Vaucluse, Carlingford and Wahroonga.

In 1946, a three ton truck was purchased and fitted out as a mobile

transmitting and receiving station, complete with portable AC power supply unit. It was capable of operating as a self contained unit anywhere in the state. The Premier also authorised the purchase of a considerable amount of portable wireless transmitting and receiving equipment for use in searches and bush fire fighting. These purchases were all part of a move to build up the police emergency service role.[63] Some of the items purchased included 11 telephony/telegraphy transmitters, two hand held portable sets for the Cliff Rescue Squad, two back pack sets and, one semi-portable control set.[64]

By 1947, the Sydney police wireless station was in two way communications with 58 vehicles, 2 prison vans, 2 launches, 1 aircraft and, 2 Australian Army Provost Corps vehicles. In addition, 53 police stations had receivers.[65]

In 1947, PDNSW added a twin engined Avro Anson aircraft, named "Nemesis", to its transport fleet. The aircraft which was employed on a range of duties from transporting detectives to distant crime scenes, through traffic surveillance to disaster relief operations, was fitted with wireless. The radio wave characteristics of the aircraft's high frequency equipment made shortrange communications difficult. Thus, a request to Mascot control for permission to cross the Sydney-Brisbane air route from a position just 15 miles north of Mascot was not received. The radio set made heavy demands on the aircraft's battery and transmissions could not be made from the ground unless the starboard engine was running. The aircraft's generator was necessary to help power the set and, the generator was coupled to the starboard engine. The aircraft lacked a VHF receiver/transmitter and visual/aural radio range equipment. These shortcomings prevented it receiving an instrument rating. Thus, the

aircraft could not be flown at night or in cloudy weather.[66]

The interstate police wireless link by 1948 included Queensland, Victoria, South Australia and Western Australia, in addition to New South Wales.[67]

Communications personnel

Early police wireless section personnel were all technicians of one sort or another. Some were specially recruited because of their telegraphic and related skills. Their common bond was a boundless enthusiasm for wireless. Their skills included those of fitter and turner, electrician, radio mechanic and carpenter. Much of the early success of NSW police radio is directly attributable to their great commitment and technical expertise. Probably, the greatest single contributor to the section's success was Bert Glasscock; whose distintive blend of engineering, radio and electronic skill was unsurpassed. Other early members to make outstanding contributions included Bert's brother, Norman Glasscock (joined 1931), Frank Cross, Hugh Farley (ex PMG operator), Cecil Light, Ray Lillie, Harry Clay, Charlie Lee (ex PMG operator), Ernie Maguire, Lew Ansell, Mick Clifford (ex ship's radio operator), Allan Furze, Jack Lumsdaine (ex RAN operator), Jack Rayner and, Walter Salmon (ex ship's radio operator, joined 1922).[68] Most of them were amateur radio enthusiasts whose spare time was spent working on the equipment in their "hamshacks". Allan Furze, in particular, had an outstanding amateur wireless station. When he joined the RAAF during WWII, PDNSW purchased most of his equipment for use in its Newcastle and interstate services.[69] At the cessation of hostilities, Furze joined QANTAS and Light joined BOAC as pilots; neither returned to police work. Walter Edwin Salmon, who was reportedly recruited by James Mitchell to start the wireless section, was

an autocratic manager who had to fight an anti-technical bias in the department throughout his period as OIC.[70]

Salmon remained OIC of the branch until 1941. That year, Jack Rayner, who had been 2ICfor many years, took command. He remained in the chair for four years to be succeeded by Bert Glasscock who thereby crowned his life's work. In 1960, Bert was succeeded by his brother Norman who remained in office until 1964, when he retired from the Force. Ray Lillie, who was the operator in the wireless car which transported the radio expert referred to earlier assumed command of the radio branch for the period 1964-1967.

In 1932, Walter Salmon became concerned with professional standards and the reputation of the branch. He decided all section personnel should possess at least second class commercial operator licences. Those members lacking such qualifications, regardless of experience, had to enrol at the Marconi School of Radio at their own expense. This turn of events was too demanding for several older members who were thereby obliged to leave the section.

Departmental finances were always limited and as many tasks as possible were performed by section members in order to economise. Equipment was rebuilt, repainted, modified and improvised thereby saving the department thousands of pounds. Even replaced valves were kept so that in the event of no replacements at all being available, the flickering remains of the discards could be used. Technical journals and books were purchased privately by members and training aids were made in their spare time.[71]

Prior to WWII, the night shift in the control wireless station was performed by one person only. Although traffic was not heavy, the member was nevertheless kept extremely busy transmitting and receiving in morse on the interstate and Newcastle networks. Telephone messages were received for broadcast to mobile units in either morse or voice. Log books had to be maintained and, quick repairs made to equipment so as to keep the mobile units on the road, including battery changes.

In the early 1930s, some wireless "experts" doubted UHF was suitable to mobile communications. As there was no commercial equipment available, section members designed their own and so proved the experts wrong. Some of the equipment they made was subsequently adopted for commercial exploitation. Similar contributions to the technical advancement of radio were made by members of other police radio sections here and overseas during the pioneering days of the medium. Of course, once early technical advances are made and consolidated, the day of the gifted individual ends and continued progress mostly lies in the hands of professionals.

By the end of the 'thirties PDNSW wireless section staff totalled 12.

The first police cadet was attached to the Wireless Section in 1935. Prior to 1942 no departmental assistance was provided those cadets wishing to study radio. But, from that year on, the department assumed responsibility for cadet radio training to the extent that radio school fees were repaid students upon completion of the course which until about 1953 had to be undertaken outside normal working hours, ie, in one's own time. In fact, three cadets attended wireless school in 1942.[72] George Canacott, Ken Bramford and, Gus Marshall were three of the cadets who

served in the 'thirties. As the number of police vehicles grew, despatching called for more and more skill. Vehicle availability boards were designed to assist despatchers. The task was made doubly difficult in the years before vehicles could hear each other. Sometimes, when not otherwise occupied, despatchers would practice interception drills on maps attached to the walls of the control center.

Police callboxes

Police callboxes, ie, miniature offices, as opposed to pillars, were apparently first used in Britain, in 1923, under the direction of the then Chief Constable of Sunderland, FJ Crawley. These boxes were used as mini-police stations-cum-patrol bases for both foot and mobile patrol officers. This pairing of motor vehicle and telephone represented yet another important combining of technologies in aid of the police function. The combination was similar to that employed in Detroit for a number of years starting in the late teens, in which mobile anti-robbery teams parked at police "booths", ie, large callboxes, awaiting tasking by telephone, as mentioned earlier. The first patrol boxes were erected in Detroit streets in 1884, when 41 were built. Crawley developed his scheme further when he subsequently became Chief Constable of Newcastle-on-Tyne. In fact, he used the callbox to decentralise his Force. He employed the strategy to the extent that no beat or point Constables made contact with a police station proper (except, one assumes, when a prisoner was taken in for charging). As a result, he was able to close five out of Newcastle's nine police stations. Substantial economies were claimed in respect of rent, staffing, cleaning, heating, painting, renovating, etc.[73] By 1930, most of the large cities in England had enthusiastically adopted police kiosks.[74]

As Inspector (Second Class) WJ Mackay reported on his return to

Australia in 1929, after studying overseas police methods, 'the patrolbox system is the product of the age in which we are living; the era of economical and rapid living, working and transport conditions.'[75] With the Great Depression in the process of descending upon New South Wales, any scheme promising the economies implicit in the callbox scheme was bound to attract government approval. Mackay submitted a detailed report, which showed he was well aware of Crawley's pioneering efforts, advocating savings, suggesting locations and outlining implications for motor patrols. This persuasive document was clearly successful as indicated by its rapid acceptance by police authorities. In fact, authorisation was given the same year, although it was another two years before funds became available for their construction. The boxes were located in Sydney at:

(1) King's Cross, (2) Stanley and Riley Streets, (3) Bayswater and Barcom Avenues, (4) Bourke and Fitzroy Streets, (5) Devonshire and Crown Streets, and (6) Campbell and Riley Streets. At the same time the old police stations at Bourke and Cathedral Streets were closed and converted to callboxes.[76]

The following year, in 1932, the Chief Secretary approved 47 extensions to the callbox system, in support of the divisional reorganisation attempted that year. The Commissioner of Police claimed the boxes to be a success because:

* they provided police protection in areas where police stations were not established
* they saved the time normally spent by patrolmen in walking to their beats from the stationhouse and vice versa at commencement and termination of shift as well as before and after meal breaks
* they afforded telephonic communications direct to the nearest police station at a time when there were very few telephones in the poorer neighborhoods

* first aid kits were available at each box in addition to the telephone.[77]

In addition, patrolling police were able to report and receive complaints using the box telephones. By 1930, there were 18 divisional PD cars patrolling the metropolitan area.[78] They were not fitted for wireless and the additional telephones provided in the boxes would have been of great utility to the crews. The year 1933 saw the 47 callboxes (approved by the Chief Secretary in 1932) erected in Sydney and suburbs, which figure included another four buildings vacated and converted to callboxes. As a result, considerable savings in rent were realised. The convenience of foot patrolmen being able to report urgent matters to their stations without leaving their beat was great. It was also considered callboxes were responsible for reduced police attendance time to calls for assistance.[79] Stools were supplied to boxes in 1933,[80] a useful adjunct as police employees were in some cases required to take their mealbreaks in them. However, just when things were going well the Sydney City Council received a complaint from a businessman who claimed a police callbox obscured his display window and, as a result, he incurred loss of business. The Council reneged on its previous approval to the police department to erect the boxes within the council's jurisdiction on the grounds that the boxes obstructed pedestrian traffic and obscured the vision of drivers and asked that they all be removed and erected beyond building lines.[81] Consternation ensued as Police Commissioner Walter Henry Childs was quick to appreciate that relocation costs would be prohibitive and so, in the city area at least, the callbox scheme was in jeopardy.[82] Crown law advice was sought and all the vast resources of government were brought into play. After a good deal of Minute writing between various officials, the city council was thwarted by amending the Police Regulation Act 1899 so as to empower police to authorise the

erection of police callboxes in a manner similar to the power granted the Post Master General to erect postal pillars.[83]

Further telephonic effectiveness was achieved in 1934, when police in inner divisions were permitted to use Fire Brigade callboxes for official purposes. This arrangement made it necessary to provide direct telephone lines between a number of larger police stations and local fire stations.[84]

By 1935, it was claimed callboxes were proving useful in providing emergency services to persons requiring same.[85] Early fears that boxes would be badly vandalised or the first aid kits stolen were not realised. The only case recorded of severe damage being inflicted on a police call box occurred in Surry Hills, when one was tumbled off its foundation in 1933.[86]

Two large callboxes were installed in Orange in 1938, in addition to several smaller boxes in the metropolitan area.[87] Few extensions were made in the next few years due to shortage of funds. A box was erected at Coogee Beach in 1940[88] and another at Kensington in 1941.[89] By that time there were 42 police callboxes in operation.[90]

The growth of new suburbs along the Tempe-East Hills railway line necessitated the siting of a large police callbox at Kingsgrove. It opened for business on 30 August 1943, staffed by two Constables equipped with a motor cycle.[91] The situation again remained static for several years until 1947 when a callbox was opened at Wynyard Station.[92] Six more boxes were opened in 1948, in addition to the provision of a room in lieu at Town Hall subway station.[93]

Callboxes proved most successful operationally, although their intended substitution for brick stationhouses in the Newcastle-on-Tyne style was never realised to any significant degree. For a while, beat and traffic point police were required to report on and off duty at the boxes as well as eat their sandwiches there during meal breaks. In such cases the lack of toilet facilities, winter heating and summer cooling were points of employee complaint. Cramped facilities made meal breaks an uncomfortable experience and as inner city call boxes were close to station houses anyway, there seemed no good reason why meal breaks should not be taken in the greater comfort and privacy of the latter structures.

In fact, for several years in the mid 'thirties the issue was a regular cause of complaint raised by the Police Association to the police administration. By that time, the callbox scheme instigator, WJ Mackay, had become Commissioner of Police. He clearly resented employee criticisms at a time when he was trying to squeeze every possible minute's work out of an undermanned department. Alterations were made to some of the offending callboxes which reduced the level of complaint.

Conclusion

The foregoing comments comprise a highly selective account of the early development of electronic communications in the police department of New South Wales. Apart from a brief comparative introduction, the principal framework of analysis is confined to the department and its immediate environment.

Given that rapid dissemination of information to field personnel has always been a central requirement of police operational effectiveness, it seems strange PDNSW did not enter the field of telephonic communications earlier and more effectively, eg, through the introduction of pillars.

Police adoption of the telephone some eight years after it became publicly available no doubt reflected several factors. Lack of funds doubtless played a role as did the relatively low status of the department within the public service of New South Wales. The Commissioner of Police was subordinate to the Chief Secretary and normally was required to approach him through the Under Secretary of the Chief Secretary's Department. Police priorities would not have rated highly under such a system. Within the police department, resistance to change by elderly police officers nurtured in the horse and buggy era may also have been a factor. No publicly available data are available to ascertain the point with clarity but, the fact that the department was slow to adopt such an important technological innovation remains evident.

PDNSW was even slower to adopt radio telephony. Indeed, it was the initiative of Victorian police officers which led to experimentation with the medium in New South Wales. Even then, had it not been for the relatively progressiveness of Commissioner James Mitchell, it is doubtful the wireless medium would have been resorted to for another one half decade or so.

With Mitchell's support an experimental period showed not only that radio telephony was inadequate for police purposes at that time but, that wireless was nevertheless an excellent aid to police operations. Thus, serious attempts were made to establish a police base radio in support of a small fleet of wireless cars. These cars were principally employed on detective patrols in the early years, revolutionising urban police work in the process. It was not until much later that wireless was employed for point to point communication.

The entire police wireless enterprise was conducted on a shoestring budget. Only the intense commitment of its earliest members and the firmness and wisdom of its first chief, enabled the branch to grow and command respect within PDNSW.

During the period reviewed here, ie, early twenties until 1948, equipment was relatively simple and in short supply. Self sufficiency, the enthusiasm of members and a growing combination of operational demands placed on PDNSW, saw the Wireless branch spread both territorally and functionally, until by the end of WWII it comprised a major communication system within the department.

Mobile traffic and general duty personnel closely followed the lead of detectives in the use of mobile communications and, indeed, the growth of wireless closely paralleled the utilisation of motor vehicles in the department for many years.

By the time WWII erupted police radio was back to telephony and used widely for command and control purposes. The control and direction of numerous foreign military personnel in the Sydney area during the war years was closely associated with police radio which cooperated with American and British Provost units.

All the while intense economy was practised and at times, it seems fair to say, it was only the willingness of wireless branch personnel to experiment, use their own materials and devise economies that kept the branch fully operable. It is that individual commitment that typified the branch in its developmental years.

With the advent of peace came increasing complexity of technology and growth. These characteristics led to a quantum change in the style and operation of the branch. More personnel, dispersed more widely, operating more complex equipment led to the end of the golden era of electronic communication - an era in which technicians set and maintained the pace of development.

The department's utilisation of the telephone did not achieve any great operational significance until the volatile and dynamic William John MacKay sold the government on the idea of police call boxes following a world study trip undertaken by him. MacKay's rapid promotion in the department enabled him to support and encourage the implementation of police call boxes throughout the remainder of his career.

In an agency perpetually short of personnel, MacKay was quick to appreciate the tremendous savings in manpower made possible by the utilisation of call boxes. However, resistance by rank and file police employees concerned with the lack of convenience occasioned by the boxes meant that they were rarely utilised as originally intended, ie, replace police stations, although they served a useful purpose in new suburbs lacking established police stations. It is to James Mitchell and William John MacKay that the credit must go for initiating these two important modes of communication in PDNSW. However, the development of PDNSWs wireless branch from a small band of enthusiasts to the largest and most sophisticated police communications branch in the Federation, lies essentially with those early members who contributed so much and who (apart from a sense of personal satisfaction) received so little in return.

1. The telegraph did not start in a high state of development and improved greatly over the years. Also, telegraph was totally dependent on wires being laid (or strung) and the availability of trained operators.

2. 1956. BROWNE DG. The Rise Of Scotland Yard. London: Harrap, p 132.

3. 1878. PDNSWAR, p 2.

4. 1890. PDNSWAR, p 2.

5. 1974. TOBIAS MW. Police Communications. Springfield, IL: CC Thomas, p 8.

6. Ibid, p 7.

7. 1890. PDNSWAR, p 2.

8. 1962. HOBAN LE. New South Wales Police Force 1862-1962. Sydney: Government Printer, p 43.

9. 1911. PDNSWAR, p 3.

10. 1933. PDNSWAR, p 6.

11. 1934. PDNSWAR, p 8.

12. 1911. PDNSWAR, p 3.

13. 1970. LEONARD VA. Police Communications System. Springfield, IL: CC Thomas, p 11.

14. TOBIAS, op cit, p 11.

15. Ibid, p 10.

16. 1926. Police News, v6 #3 (7 Mar): 4-5.

17. 1929. MOYLAN John. Scotland Yard And The Metropolitan Police. London: Putnam, p 133.

18. 1979. DOWER Alan. Deadline. Melbourne: Hutchinson, pp 57-58.

19. 1967. CRITCHLEY TA. A History Of Police In England And Wales 900-1966. London: Constable, p 211.

20. LEONARD, op cit, p 12.

21. 1981. LEONARD VA. 'August Vollmer, Dean Of American Chiefs Of Police.' Police Chief, v48 #2 (Feb), p 68.

22. TOBIAS, op cit, p 12.

23. 1934. PDNSWAR, p 8.

24. 1930. MACKAY WJ. Uses Of Teletype & Teleprinter (5 Jun).

25. 1980. Personal communication ex Superintendent Gus Marshall (RL) (3 Nov).

26. 1927. Michigan State Trooper (Mar). The assistance of Dr VA Leonard in providing this reference is acknowledged.

27. 1926. Police News, v6 #3 (7 Mar): 5.

28. 1930. PARSONS TWS. 'Wireless Telegraphy For Police Purposes: British Columbia Practice.' Police Journal, v3 #1 (Jan): 103-110.

29. 1957. MACKAY IK. Broadcasting In Australia. Melbourne: Melbourne University Press, p 16.

30. The medium would certainly have been adopted in PDNSW following a report submitted in 1929 by Insp 2/C WJ Mackay advocating its expanded use.

31. 1980. Police In Victoria 1836-1980. Melbourne: Government Printer, pp 57-58.

32. 1924. PDNSWAR, p 4.

33. 1926. WATTS AW. 'The Wireless Patrol.' Police News, v6 #4 (7 Apr): 10-13.

34. 1980. Personal communication ex Sergeant (First Class) Norm Glasscock (RL) (3 Nov); 1930. Sydney Morning Herald (4 Sep): 9.

35. MARSHALL, op cit.

36. 1980. Personal communication ex Executive Chief Superintendent DR Williams (4 Nov).

37. Ibid.

38. 1933. Police News, v13 #8 (1 Aug): 45.

39. 1930. Sydney Morning Herald (4 Aug): 10.

40. 1930. Sydney Morning Herald (3 Apr): 11.

41. 1930. Sydney Morning Herald (14 Jun): 16.

42. 1933. Police News, v13 #1 (2 Jan): 5.

43. 1938. Police News, v18 #12 (1 Dec): 12-13.

44. 1935. PDNSWAR, p 9.

45. Ibid.

46. 1936. PDNSWAR, p 11.

47. 1937. PDNSWAR, pp 12-13.

48. 1938. PDNSWAR, p 14.

49. 1938. Police News, v18 #12 (1 Dec): 14.

50. 1980. Personal communication ex Superintendent George Canacott (RL) (4 Nov).

51 1981. Personal communication ex Superintendent Gus Marshall (RL) (12 May).

52. 1938. PDNSWAR, p 14.

53. 1936. PDNSWAR, p 11.

54. CANACOTT, op cit.

55. WILLIAMS, op cit.

56. 1941. PDNSWAR, p 3.

57. 1942. PDNSWAR, pp 10-11.

58. Ibid.

59. MARSHALL, op cit.

60. 1943. PDNSWAR, pp 8-9.

61. CANACOTT, op cit.

62. MARSHALL, op cit.

63. 1946. PDNSWAR, p 5.

64. Ibid.

65. 1947. PDNSWAR, p 6.

66. CANACOTT, op cit.

67. 1948. PDNSWAR, p 8.

68. GLASSCOCK, op cit.

69. CANACOTT, op cit.

70. WILLIAMS, op cit.

71. CANACOTT, op cit.

72. 1942. PDNSWAR, p 5.

73. 1928. CRAWLEY FJ. 'Decentralization & The Police Box System.' Police Journal, v1 #1 (Jan), p 119.

74. 1930. Sydney Morning Herald (4 Jan): 15.

75. 1929. MACKAY WJ. Report #5 to A/COP (28 May).

76. 1929. PDNSWAR, p 5.

77. 1932. PDNSWAR, pp 5-6.

78. 1930. PDNSW file S2805/282 (29 Apr).

79. 1933. PDNSWAR, p 6.

80. 1934. Police News, v14 #13 (1 Nov): 4.

81. 1933. Letter ex Town Clerk to COP (22 Nov).

82. 1934. Letter ex COP to US, Chief Secretary's Department (12 Apr).

83. S.37 Post & Telegraph Act 1901 (as amended)

84. 1934. PDNSWAR, p 8.

85. 1935. PDNSWAR, p 9.

86. 1933. Police News, v13 #1 (2 Jan): 5.

87. 1938. PDNSWAR, p 14.

88. 1940. PDNSWAR, pp 19-20.

89. 1941. PDNSWAR, p 5.

90. 1942. PDNSWAR, p 19.

91. 1943. PDNSWAR, p 18.

92. 1947. PDNSWAR, p 9.

93. 1948. PDNSWAR, p 13.

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