

## AMMUNITION FACTORIES.

Forray, Hendon, Finsbury, Rutherford, Rocklea, Walshpool, Derwent Park, Albany, Broken Hill, Clare, Goulburn, Hay, Kalgoorlie, Kapunda, Mildura, Moonta, Mount Gambier, Murray Bridge, Port Pirie, Tanworth, Wagga Wagga.

As long ago as the early 1880's, there were people associated with the Armies of the Australian Colonies who were concerned about their dependence upon the factories of England for the supply of ammunition for use with the English-made 0.45" Martini Henry rifles with which the Colonial Armies were equipped. The Royal Commission on Defence held in Sydney in 1881 had, in fact, reported that "... steps should be taken for the purpose of making up small-arms ammunition" locally.

One of these forward-looking Australians was Major Frederick T. Sargood, an officer of the Victorian Volunteers and a Melbourne businessman, who in 1882 arranged for plans and specifications to be supplied by the War Office, London, of the plant and materials necessary for the manufacture of the ammunition for those rifles.

Two years later -- in his capacity then of Minister for Defence in the Victorian Government -- he sought the views of the other Colonial Governments as to the possibility of creating a central factory to make the 0.45" calibre ammunition not only for the Victorian Army but also for the Armies of the other Colonies -- and of New Zealand.

Although there was ready agreement regarding the desirability of becoming self-sufficient in this vital munition of war, excuses were not lacking for deferring decisions and introducing irrelevant side-issues. This continued procrastination convinced the Victorian authorities that, if they wanted locally-made small-arms ammunition for the Victorian Forces, they would have to take action independently of the other Colonies.

New Zealand, incidentally, already had factories making small-arms ammunition and coarse gun-powder but the records do not disclose whether the managements of those factories made any attempt to sell their products to the Australian Colonies or whether the Military authorities of those Colonies would have been receptive to any such approach.

By 1886, the Victorian Government let it be known that it was hopeful that a small-arms ammunition factory would be established "... at no very distant date", that there was no intention of establishing a Government factory for the manufacture of such war-like material, and that it was prepared "... to give a bonus to any private Company which <sup>first</sup> manufactured a certain amount of rifle ball

cartridges of approved quality in the Colony".

To encourage action by private enterprise, it was made known also that the quantities of cartridges "consumed" during the year 1885-86 were:-

Ball cartridges	3,100,000
Blank "	300,000
Carbine "	200,000

and that it was expected that future consumption would be considerably greater.

Initial reaction by interested parties in England was to endeavour during the early months of 1887 to better the inducements offered by the Victorian Government urging, in particular, a larger subsidy than the £2,500 suggested as a possibility, plus relief from Customs duties and an assurance regarding orders for substantially larger quantities of ammunition than indicated above.

Of these overseas groups, that most persistent was G. Kynoch & Co., leading ammunition manufacturers in England at that time and the owners of the ammunition factory already operating in New Zealand. That Company submitted the proposal which proved to be the origin of what became the Commonwealth Government Ammunition Factory at Footscray (Vic.) — the first munitions factory to be established in Australia.

The Company's proposition was that, provided that -

- (a) the Governments of the four principal Australian Colonies would participate in a joint loan of £15,000 towards the capital costs;
- (b) joint orders for 10,000,000 cartridges annually would be assured;
- (c) a bonus of £10,000 would be granted; and that
- (d) the plant would be admitted into Victoria free of Customs charges;

the Company would build and operate a factory on a site to be agreed upon.

Under date July 21, 1887, the Company advised that Greenwood & Batley Ltd. of Leeds, England — "manufacturers of all the Woolwich Arsenal cartridge machinery" — and certain other unnamed interests would form a private Company for the production in Victoria of small-arms ammunition "... and possibly later on of war stores generally".

Further correspondence led to an invitation in February 1888 for Captain John Whitney of the Kynoch Company's New Zealand factory to visit Victoria, virtually to select a site for the proposed factory.

By this time, the Company had registered the Colonial Ammunition Company Limited, with the Registrar of Joint Stock Companies in England — the Company's Certificate of Incorporation was dated January 30, 1888.

The Company suggested to the Victorian Government that a contract should

be negotiated providing for :-

- (a) supply of 3,000,000 or more cartridges annually for 25 years;
- (b) a site on the Saltwater (now Maribyrnong) River, at Footscray (Vic.);
- (c) Supply of gunpowder by the Government on a repayment basis;
- (d) a subsidy of £5,000;
- (e) an allowance of £2,000 towards Customs duties;
- (f) supply of locally-made cartridges to the Government at prices based on current English prices, plus carriage, insurance, etc.; and
- (g) representations by the Victorian Government to endeavour to induce the New South Wales Government to purchase its ammunition from the Company.

The Victorian Government had, in fact, been trying for years to win the support of the N.S.W. Government for a factory to make ammunition for all the Colonies but without success — with opposition, in fact, to support for a factory to be located in Melbourne.

Albury, Echuca or "... a convenient point of the three Colonies of South Australia, Victoria and New South Wales .." were suggested as alternative localities for the factory by the Premier of New South Wales and, subject to agreement on these lines, he offered to recommend N.S.W. support for the venture. The Colonial Ammunition Company, however, was opposed to any location other than one in "... close proximity to a dense population to supply junior hands for the manufactory".

Impatient over the continued procrastination by the N.S.W. authorities — who had not responded favorably even to the Victorian Government proposal that the factory be located in Sydney with an assurance that Victorian requirements of ammunition would be ordered from the suggested Sydney factory — the Company on May 22, 1888 submitted to the Victorian authorities a revised proposition which led to the decision to go ahead.

Plans of the proposed site for the factory at Footscray (Vic.), of the proposed factory buildings and of the associated range for testing the ammunition were presented by the Company for consideration, together with requests for :-

- .. a grant of three acres for the initial factory set-up;
- .. an option to purchase 30 to 50 acres additional for possible future extensions;
- .. a subsidy of £5,000; and
- .. a contract that the Victorian Government would purchase all future requirements from the factory.

The Company's "contract letter" also provided that the price of cartridges would not exceed English prices plus landing charges, that gunpowder would be

supplied by the Government and that deliveries of ammunition would commence within 12 months.

By May, 1889, all preliminary formalities between the Victorian Government and the Company had been completed and an assurance of support had been given also by the Governments of South Australia and of Tasmania.

Five acres of land at Footscray were made available on a peppercorn rental basis. Conditions of supply of ammunition during the ensuing 25 years and the basis for calculating the price to be paid were agreed. Deliveries were to commence within 12 months (and they did) and the subsidy of £5,000 was agreed. It was agreed also that the supply contracts would be so framed that they would expire periodically -- at 5-year periods or otherwise as agreed -- and would have to be renewed rather than committing both parties to contracts extending over long terms of years.

The contract papers were signed in England on August 1, 1889, and on November 4, 1889, the Victorian Government formally ratified the document.

The Company built the Factory in two sections. The Case and Bullet Shop, loading and assembly sections, proof ranges and packing room - known later as No. 1 Small-Arms Ammunition Factory - <sup>were</sup> located on the river flats. The "upper" factory, located adjacent to Gordon Street comprised the boiler house, electric generating plant and cap factory and a rolling mill was added later. The "lower" factory was almost entirely of timber construction and, because of oil saturation since it was erected in the later years of the 19th century, the risk of fire and the problems that would have arisen if it were destroyed <sup>eventually</sup> led to the decision to replace it by a new factory built just to the north of the old one. The change-over was made in the early part of the 1939-45 war with hardly any loss of production.

Manufacture of the 0.45" Martini Henry ammunition proceeded successfully with some exceptions. There was, for instance, the deputation of employees which waited on the Minister for Defence (Sir Frederick Sargood) in October 1892 to complain about the cessation of operations at the factory following the arrival in Australia of 1,000,000 rounds of ammunition ordered in England some time previously. The depression of the early 'nineties was then at its "height".

Negotiations between the Company and the Victorian Government following this incident resulted in the revision of the Agreement in December 1893 to provide for --

- .. compensation of £1,450 for the loss of the order;
- .. annual orders for 1,500,000 cartridges for the next five years; and
- .. in default of orders, compensation to the Company in the form of cash payments

as well as clarifying the meaning and intentions of various clauses of the earlier contract which had been the subject of dispute.

Concurrently with these revised agreement conditions, regulations were gazetted by the Victorian Government covering the matter of safety in the handling of explosives at the Company's works. Four years later -- in September 1897 -- three female employees died following an explosion. The exhaustive professional investigation which followed -- conducted by G. Napier Hake, Chief Inspector of Explosives of the Victorian Department of Trade and Customs, who was subsequently closely identified with the development of Australian munitions production -- led to the conclusion by the Coroner that the Company had been lax in regard to safety precautions. Closer supervision by the Government Explosives authorities followed this unfortunate incident.

During the early 'nineties, also, the War Office in England decided to replace gunpowder by "smokeless powder" and cordite was adopted as the propellant for small-arms ammunition. This change to a more powerful propellant resulted in the reduction in the diameter of the projectile (the bullet) for the rifles then in use from 0.45" to 0.303".

This advance in the explosives field was initially reflected in the conversion of the Martini-Henry rifles to function with the smaller calibre ammunition but it also speeded up the decision to introduce a new rifle -- the 0.303" calibre Short Magazine Lee Enfield -- both in England and, in due course, as recorded elsewhere, in Australia.

Arrangements with the Colonial Ammunition Company were adjusted to provide for production of the 0.303" ammunition also. It appears that, despite the earlier lack of official support from the New South Wales Government for the establishment of a small-arms ammunition factory in Victoria, that Colony's military authorities were obtaining some, at least, of their supplies from the Victorian factory.

In fact, in October 1897, the N.S.W. Military Commandant complained that the supply of ammunition by the Company was unsatisfactory. He urged that his Government should arrange for the manufacture of the ammunition needed by the N.S.W. Forces in a factory to be established by the Government on a site at Goat

Island in Sydney Harbour.

The subject was considered at a Premier's Conference from March 7 to 10, 1898 and it was agreed generally that the N.S.W. Government could proceed with a factory for production of ammunition loaded with cordite if the Victorian Government did not elect within three months to establish a Government Small-Arms Ammunition Factory.

Victoria did not support that decision, however, pointing out that its agreement with the Colonial Ammunition Company would prevent Victorian orders going to any new factory "... for the next 10 years".

The proposal apparently lapsed - possibly because Federation of the Australian Colonies was then being discussed - as some three months later - on July 1, 1898 - the Victorian Government arranged that the Company's contract would include production of 0.303" ammunition loaded with cordite as well as any other kind of small-arms ammunition required for military purposes. Cordite was to be provided from Government stocks, although the Company had offered to make the cordite locally.

Victoria's decision to continue to support the Colonial Ammunition Company was influenced by the fact that the Victorian Military Forces by that time had a combined demand for some 4,000,000 rounds of small-arms ammunition annually - approximately half the possible out-put of the factory. Furthermore the Company had suggested that it would instal a rolling mill suitable for rolling metal for small-arms ammunition and would use it for commercial work also - the annual amount needed for military ammunition could be rolled in one week!

It is interesting to note that, at that time, the owners of the Colonial Ammunition Company offered to sell their property to the Government for £60,000 cash or bonds or to lease it to the Government for an annual rental of 5 per cent. based on that figure. Annual profits averaging nearly £3,000 were reported by the Company's auditors as having been achieved since the Company commenced operations. No action was taken by the Government.

On April 23, 1901, the area of land leased by the Company was increased to 40 acres to enable the Company to extend its factory buildings, despite the fact that the Military Commandants in the various States were still urging that the manufacture of small-arms ammunition was a Government matter and that the Company's supplies should be limited to the Victorian requirements instead of extending over the Commonwealth "... the monopoly now held by a private contractor in Victoria".

The Secretary for Defence accepted the logic of the Military arguments in favor of conducting a Government ammunition factory but opposed action to establish such a factory at that time for financial reasons - the capital expenditure /involved and

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the operating costs — when adequate facilities already existed at Footscray.

Continued association with the Company for a further five years was approved in 1902 by the Prime Minister, conditional upon the Company's undertaking to maintain reserve stocks of metal equivalent to 10,000,000 cartridges and to provide machinery for making percussion caps.

By June, 1906, the Commonwealth had agreed to maintain the reserve stocks of metal as a Government responsibility with the Company having the right to draw on these stocks from time to time, if necessary, but subject to replacement as soon as new stocks could be procured.

Four years later — in an Agreement gasetted on June 11, 1910 — the Company undertook to erect metal-rolling mills on land at Footscray, together with the necessary brass foundry — both of which were brought into operation in 1912 — and also to provide machinery for the manufacture of caps and paper wads. This ensured that 0.303" small-arms ammunition was being made almost wholly in Australia before the outbreak of the 1914-18 War — production of suitable cordite had by that time been successfully established at the Government Cordite Factory, Maribyrnong, (Vic.).

By 1915, the factory's capacity for brass cups to be drawn into 0.303" cartridge cases was so productive that, in addition to meeting the greatly increased local demands, it was possible to export some millions to cartridge manufacturers in England.

During 1914, the Company was still importing —

- .. percussion caps;
- .. cupro-nickel cups for bullet envelopes;
- .. glazed board discs; and
- .. leather-board for cartridge clips

but steps were taken in August of that year to instal plant for production of the caps with fulminate of mercury supplied by the Government Cordite Factory.

After February 1916, percussion caps were being exported to other Dominions but imports of cupro-nickel cups continued until the end of 1916 and success could not be attained with the production locally of discs or of leatherboard.

Early in 1915, the Company encountered difficulty with its bankers regarding the financing of supplies of raw materials to be imported to enable it to assure war-time deliveries of 2,000,000 rounds of ammunition weekly for two years ahead. As a possible alternative to the provision of finance by the Government, consideration was given to the question of whether or not the

Government should purchase the Company's assets. The Company, however, was reluctant to suggest a price and the subject was not pressed as bank finance was arranged. In fact, finance was made available to enable the Company to purchase also additional manufacturing plant which increased its efficiency.

While the factory's output was being stepped up to meet the war-time needs, some ammunition had to be obtained from U.S.A. and from England. Deliveries from the Footscray factory in 1915 were 62 per cent. greater than for 1914, 140 per cent. greater in 1916 and 209 per cent. greater in 1917, by which time all needs were being met. During that year also, all factory production — 2,000,000 rounds weekly — was of the pointed-bullet Mark VII ammunition, an improvement upon the initial factory product.

During August 1916, the question of purchase of the Company's works by the Government was again raised with the Company in the context of the planning then in hand for the establishment of a Central Arsenal, including a Small-Arms Ammunition Factory. The Company proposed that the business could be taken over for £350,000, plus —

- .. all new capital issued after 31st December 1915;
- .. all capital expenditure since that date;
- .. all stores and materials in hand and on order; and
- .. partly-manufactured goods at cost price plus 100 per cent. on the wages for establishment charges.

Cabinet, however, decided that no action would be taken at that time and the Company was so informed on August 23, 1916. The Arsenal concept was destined to be abandoned at the end of the 1914-18 War.

The proposed nationalisation of the Factory was revived again during the initial stages of the post-War recession when the Company informed the Government that, because of the paucity of orders for 0.303" rifle ammunition, it would be unable to maintain production without appropriate Government assistance.

As the continued operation of the factory was regarded as an important element of the national Defence policy, the Commonwealth agreed to lease it from the Company and took over responsibility for its activities as from January 1, 1921 under a 7-year lease, at an annual rental of £20,000 plus rates, insurance and the like and with the Company's Manager (G.A. Cartright) continuing to manage the works for the Commonwealth.

This arrangement was, however, terminated in 1927 when the Commonwealth purchased the factory as a going concern for £150,000 to be paid in instalments



spread over 10 years, including interest of 5 per cent. per annum on the outstanding balance as from January 1, 1927 -- a total payment of £191,152.12.0d.

The funds available for maintaining the seven Government Factories then operating were limited in the 1922-23 Estimates to £192,200. The policy of "nucleus production", which had to be introduced during this depression period to ensure retention of essential skills, directly affected the Footscray works in that the ammunition production programme there largely determined the quantity of cordite to be produced at the Government Cordite Factory.

It was consequently decided that the nucleus out-put would be 3,000,000 rounds annually of 0.303" ammunition, involving the retrenchment in two years of 633 of the 810 persons employed at June 30, 1921, when production was at the annual rate of approximately 40,000,000. The Military Board agreed to this reduced programme on the condition that the Factory would be capable of attaining full production again within six weeks.

During 1921, at the request of the Military Board, the initial steps were taken for the manufacture of 0.455" ammunition for the Webley pistol and experimental work commenced on special 0.303" ammunition (known as "Red Label") to be used with machine-guns mounted in aircraft.

Other work undertaken at this time included production of tools and gauges for the gun-ammunition project entrusted to the Factory as a new phase of its development, construction of plant for the new High Explosives Factory and reconditioning of second-hand munitions plant acquired under "disposals" conditions from the British Government when war-time factories in England were closed down.

By June 30, 1925, pistol ammunition was being delivered as well as 0.303" drill cartridges. Experimental work was proceeding on 0.303" tracer ammunition to be fired from aircraft. Special alloy strip was being rolled for the Air Board and radiator tubes for aero engines were manufactured for the first time in Australia. Production of detonators and of primer percussion caps for artillery had also been successfully established.

The acquisition by the Commonwealth of the Company's interests as from January 1, 1927 was followed by a merger, effective from July 1, 1928, with the new Gun Ammunition Factory, still under construction on adjoining land at Footscray.

Ten years earlier, as part of the planning for the Central Arsenal project, two Queensland University engineering graduates -- J.H. Wrigley and W.H.R. Fowler

W.H.R. Fowler

were in England studying the technique of manufacture of the brass components of ammunition for the guns of the Field Artillery.

On their return to Australia, they were given the task of planning appropriate capacity for this purpose and bringing it into production. By 1921, the requisite manufacturing plant was built up from various sources, including plant surplus from British war-time factories. The intention at that time was to concentrate on the ammunition for the quick-firing guns - 4.5" howitzer and 18-pdr. field-gun -- in service with the Field Artillery Corps.

The "Development Programme" of 1922 included provision for making the metal components of gun ammunition -- other than the steel projectiles of shrapnel and high-explosive shell -- in a Gun Ammunition Factory to cost £199,100, comprising:-

.. Buildings and Works	£26,800	
.. Machinery and Plant	70,600	
.. Gauges and Tools	<u>12,600</u>	£140,000
.. Machinery and plant already in hand		<u>59,100</u>
		£199,100

which was to be built on Commonwealth land at Footscray.

Plans for this new Factory, prepared by Engineer-in-Charge Wrigley, were ready in August 1923, covering the Cartridge Case Building, the Fuse and Primer Building, and a new Rolling Mill and Foundry as the major units but with supporting offices, stores, mess-rooms, roadways and fences to round out the construction programme.

While the site selected for this new project was adjacent to that occupied by the works of the Colonial Ammunition Company, the latter site was on the "river flats", except for the foundry, rolling mill and percussion cap sections which were on the higher land fronting Gordon Street. The new Government Factory was built adjacent to the works on this latter site.

During 1925, despite restricted availability of finance, the Cartridge Case plant had been advanced to the stage where experimental production of 18-pdr. brass cartridge cases was in hand and by 1927 these cases were in full production. Reconditioning of already-fired cartridge cases returned by the Services was also being carried out.

After the combining of the two Factories in 1928, Cartright resigned and Wrigley was appointed Manager of the "Commonwealth Government Ammunition Factory" as it was then named, with Fowler later appointed as Assistant Manager (in March 1932.)

By this time - July 1, 1928 - the Commonwealth investment in military ammunition production amounted to £561,426. The Factory work-force totalled 289. The range of Factory products had been widened greatly beyond that in hand in 1925 and now included --

- .. duany cartridges;
- .. special proof ammunition;
- .. experimental manufacture of fuses;
- .. 18-pdr. Q.F. cartridges;
- .. reconditioning of 3-pdr., 18-pdr., and 4.5" cartridge cases;
- .. components of 20-lb. aircraft bombs;
- .. firing apparatus for Naval depth charges;
- .. copper rings for driving bands of high-explosive shell;
- .. copper rings for manufacture of percussion tubes;
- .. brass and nickel-silver sheet and strip;
- .. tin-foil of .00195 inch thickness; and
- .. tools and gauges

with orders accepted from the Governments of New Zealand, Fiji and New Guinea as well as from the Australian Services.

The last of the new Factory buildings had been completed and brought into service, the new rolling mills and foundry having adequate capacity to meet all known requirements of non-ferrous sheet and strip as well as the brass sheet needed for the production of cartridge cases while still leaving a margin of spare capacity. The old rolling mill and foundry acquired by the purchase of the works of the Colonial Ammunition Company were retained as reserve capacity for emergency.

From 1930 onwards, despite the initial sharp decline in the Factory work-load following the onset of the Great Depression, there was a moderate increase in orders from the Services, mostly for the types of ammunition already in production but also for 0.32" pistol ammunition. Preliminary work was undertaken on 0.303" armour-piercing ammunition and on 0.22" rim-firing cartridges but production of the latter store ceased in the mid-1930's as ample capacity for that ammunition was provided by I.C.I.A.N.Z. as part of its commercial activities.

Other new tasks were the production of --

- .. parts for aircraft bombs;
- .. metal-belt links for air-pattern Vickers machine-guns;-

- .. wireless apparatus;
- .. percussion primers;
- .. percussion fuses;
- .. powder-train time fuses;
- .. fuse-hole plugs; and
- .. aluminium cylinders for illuminating cartridges.

The manufacture of wooden boxes and other timber-fabrication production activities were, however, transferred with the Factory's wood-working plant to the Ordnance Factory at Maribyrnong.

Some orders were accepted from the P.M.G.'s Department for telephone and switchboard components but the inter-Departmental Committee which examined the question of whether or not the Factory should undertake the production of all the Commonwealth Government's requirements of telephone equipment reported that it was impracticable for the Commonwealth to enter into that business on a profitable basis. Questions of patent rights were only one aspect of the proposal which were regarded as introducing major problems.

Throughout the early depression years, while Service orders were still restricted, commercial orders — particularly for brass sheet and strip and other non-ferrous products from which substantial profits were earned — attained increasing significance as is apparent from the following figures :-

Year	Total Orders	Commercial Orders
1929-30	£59,094	£2,144
1930-31	38,146	6,697
1931-32 (anticipated)	62,245	24,000

By 1934-35, however, the total value of orders placed by the Services for the products of the Munitions Factories increased greatly and the works at Footscray shared in this upsurge. For the three years prior to the commencement of the 1939-45 War the Factory's production was valued at —

1936-37	£311,186
1937-38	362,536
1938-39	496,900

For the 11 years 1927-28 to 1938-39, the commercial orders handled by the Factory had a total value of £1,635,398, one very interesting task being production — to a total of 4,113,336 — of lipstick containers, for the production of which the Factory's cartridge-making machines were ideal.

At June 30, 1939, by which time 1916 persons, including 487 females, were employed, the Factory's assets were valued at £1,299,983, including -

Land	£17,706
Buildings	314,292
Plant	167,216
Stock and work in progress	386,631

Although the financial restrictions during the depression years of the 'thirties had slowed down plans for increasing the Australian-made content of the supplies for the Services, it was still found to be possible during 1933-34 to finance the building and equipping of a tool-room at the Ammunition Factory capable of production and maintenance of all the tools, gauges and manufacturing equipment needed by the ammunition plants, as well as assisting with the needs of the Maribyrnong Factories.

This section of the project was an advance stage of the programme for "Modernisation" of the Factory generally which was included in the Munitions Developmental Programme 1937-41 at an estimated cost of £111,065 — £64,265 for replacement of the original Factory buildings and works and £46,800 for purchase of plant and tools to replace or supplement the original manufacturing plant. By February 1938, when more precise estimates were available, the project cost had been increased to £140,533 — the Buildings and Works element was now estimated to cost £99,500.

Following the Munich crisis of September 1938, urgent instructions were received to revise the Munitions Developmental Programme of 1937-41, including a direction to provide for duplication of small-arms ammunition production to increase the out-put to 80,000,000 rounds annually. At that time, the old Ammunition Factory was still the only source in Australia for supplies of small-arms ammunition and gun ammunition components.

The 1937-41 Programme also included funds totalling £131,000 as the estimated cost of bringing up-to-date the Gun Ammunition section of the Footscray Factory and of extending it for production of the long brass cartridge-cases used in production of anti-aircraft ammunition and ammunition for guns mounted in Naval vessels, up to 5.5" calibre. Additional capacity was provided also in the Fuse & Primer Section.

In February, 1939, as the Services were demanding several types of 0.303" ammunition following the deterioration of international relationships in Europe, it was arranged that the .303" Mark VII Ball type — for which the demand was by far the greatest — and Tracer types, together with 9 mm. Ball Ammunition would be made in the former Colonial Ammunition Company's factory with a new main building, with the miscellaneous types — incendiary,

armour-piercing, stream-lined bullet, as well as ball, etc. -- allotted to the new section known as S.A.A. No. 2, in which production commenced in 1940.

By this time, it had been approved that a new Factory should be erected on a site at Menden in South Australia, with Fowler as the first Manager. Production in the first of the two Factory units -- each of which was planned for an output of 110,000,000 rounds annually, exceeding Australia's annual output of small-arms ammunition pre-war -- was proceeding in 1940. Production of all the cupro-nickel cups for bullet manufacture and of all the brass (copper/zinc) cartridge case manufacture was, however, retained at Footscray for all the Factories engaged during the War in production of ammunition.

On February 1, 1939, instructions were issued for the Factories engaged in production of ammunition to be placed upon a war footing, to be continued until deficiencies in stocks were overcome. This involved introduction of second-shift working as soon as the industrial questions involved could be worked out with the Unions and appropriately qualified additional labour recruited.

Following the actual outbreak of war, very large orders were accepted from the United Kingdom on January 18, 1940, for a wide variety of ammunition supplies, ranging from 50,000,000 rounds of 0.303" Mark VII Red Label ammunition to hundreds of thousands of rounds of complete high-explosive shell, subject to the Government direction that no deliveries would be allowed until the needs of the Australian Forces had been taken care of.

After the British reverses at Dunkirk, however, large supplies - including 35,000,000 rounds of 0.303" rifle cartridges from Army reserve stocks -- were immediately shipped, with replacement from current Australian production. By June, 1941, 100,000,000 rounds had been delivered.

Orders were accepted also from New Zealand for 0.303" ammunition and for ammunition components to be completed in that country, for ammunition for Fiji and other countries in the Pacific as well as for supplies to the Netherlands East Indies and to Malaya before the Japanese advance into those areas in early 1942.

Total requirements of small-arms ammunition to meet the need of the A.I.F. and the A.M.F. as estimated in June 1940 were 411,000,000 rounds -- by February 1941, the new programmes had increased the total forecast requirement to 656,000,000. One-fourth of the weekly production at that time of this ammunition was being allocated to the British Government, to be shipped to destinations nominated, such as Singapore and Malaya, through the Eastern Group Supply Council.

In a review in June 1940 of the capital expenditure likely to be involved in increasing manufacturing facilities to meet the Army's revised programme of future requirements of ammunition -- estimated to cost £1,980,000, without taking account of likely additional requirements for the Navy and the R.A.A.F. -- immediate expenditure of £220,000 was contemplated "... to provide additions to existing factories for another 100,000,000 rounds of 0.303" ammunition ..." by "... extending existing factories, principally at Adelaide". That amount was increased by War Cabinet three months later to £350,000 including £150,000 for buildings and works.

On February 27, 1941, War Cabinet approved the setting up of an additional ammunition factory, at Brisbane, at a cost of £450,000, followed by approval of expenditure of £30,000 for extensions at the Small-Arms Ammunition Factory at Hendon (S.A.) and of £500,000 for extensions and additional factories for the manufacture of small-arms ammunition in Victoria and Western Australia.

By April 1941, there were 7,399 employees at the Ammunition Factory at Footscray, including 2,399 females. The quantity of small-arms ammunition included in the Consolidated Programme of the Services' Requirements had by now increased to 1,000,000,000 rounds.

Because of this tremendous increase, the number of new factories and the scale of activities generally as planned in 1940 was seen to be completely inadequate for the task and the expansion programme had by 1942 been spread Australia-wide to include :-

- .. At Hendon (S.A.), two units each capable of producing 110,000,000 rounds of .303" ammunition, using cordite and percussion caps from Salisbury Explosives Factory and metal strip from the Finsbury rolling mills, together with extensions to permit production annually of 40,000,000 .303" incendiary cartridges and, later, of 9 mm. ammunition for sub-machine guns.
- .. At Finsbury (E.A.), in addition to foundry and rolling mills for non-ferrous metals, capacity was provided for the production annually of:-

Fuses and primers	..	1,000,000 of each
25-pdr. cartridge cases	..	4,000,000
40 mm. AA cartridge cases	..	1,000,000
3.7" AA cartridge cases	..	600,000
Reforming of cartridge cases	..	1,000,000

The range of activities was extended later to include also production of :-

- .303" Brass cups
- .303" gilding metal cups
- .303" percussion caps
- Assembled bombs
- Copper bands for 25-pdr. shell

together with the derusting and revarnishing of 3" mortar-bombs and the degreasing, annealing and pickling of practice bombs.

.. At Rutherford, near Newcastle (N.S.W.), foundry and rolling mills were not needed because of the industrial capacity available in N.S.W., but the Factory programme provided for the annual production of :-

6-pdr. cartridge cases	500,000
4" cartridge cases	300,000
4.7" cartridge cases	12,200
4" H.E. shell	300,000
3.7" H.E. shell	300,000

.. At Rocklea, near Brisbane (Q'land), the capacity provided comprised latest design equipment for production of small-arms and gun ammunition, including foundry, rolling mills and a smoke-shell unit, adequate for the production annually of :-

.303" small-arms ammunition	..	220,000,000 rounds
.455" " " "	..	2,000,000 "
.380" " " "	..	9,000,000 "
25-pdr. cartridge cases	..	3,000,000 "
25-pdr. smoke shell	..	600,000 "

After production of small-arms ammunition and cartridge cases had been successfully established, the revised -- and reduced -- Services' requirements of ammunition announced in 1943 resulted in cessation of production at Rocklea in October 1943 and the transfer of the Factory to the Department of Aircraft Production for use as a large-scale overhaul workshop for handling the large numbers of engines requiring overhaul from the United States Air Force squadrons operating in the Australian region. The Rocklea Factory's programme for production of 25-pdr. smoke shell at the annual rate of 600,000 was transferred to Rutherford and reduced to 200,000 rounds in 1944 when that Factory's programme was also reduced in other ways.



At Welshpool, near Perth (W.A.), production of small-arms ammunition -- using non-ferrous metal from Finsbury -- and fuses was planned at the annual rate of :-

.303" small-arms ammunition	..	110,000,000 rounds
Fuses	..	1,000,000

and production of tracers and igniters was added later.

.. At Derwent Park, near Hobart (Tas.), rolling mills and a foundry were provided to support an output of 2,000,000 cartridge cases annually, commencing with plant for making 6-pdr. and 40-mm cases but modified later for production of 8" mortar-bombs plus limited quantities of 40-mm and 20-mm cartridge cases.

The setting up of a number of lesser Factories was also proceeding, as follows:-

State	Location	Product	Annual Production Rate
Vic.	Mildura	Primers	1,250,000
S. A.	Port Pirie	Shell -- 25-pdr.	750,000
W. A.	Kalgoorlie	Shell - 40-mm AA Bofors	1,000,000
N. S. W.	Broken Hill	Fuses	650,000
	Goulburn	Fuses Shot -- 6-pdr.	650,000 750,000
	Albury	Fuses	650,000
	Wagga Wagga	Fuses	650,000
	Tamworth	Primers	2,350,000

While authority had been given also for appropriate units to be located at Moonta, Clare, Kapunda, Murray Bridge and Mount Gambier in South Australia and at Hay in New South Wales.

It will be noted that some of these establishments were allotted the machining of shell in addition to fuses and primers for gun ammunition, the administrative arrangements being handled by the Ammunition group on behalf of the Ordnance group.

Units for the machining of 25-pdr. shell at the rate of 235,000 annually were planned for Hamilton, Horsham, Stawell and Swan Hill in Victoria with the shell forgings supplied by Ordnance Factory, Maribyrnong, but the reduced programme in 1943 made it unnecessary to proceed with the Hamilton and Swan Hill planning for assistance to the Ammunition Factory at Footscray. The Stawell

reduced

unit ceased production at Christmas, 1944, and was transferred to the Department of <sup>Supply</sup> Supply & Shipping. At the Horsham Factory machining 25-pdr. shell bodies commenced in September 1943 but, six months later, the shell task was replaced by the machining of 3" trench mortar-bombs and during June 1945 of 6-pdr. shell Q.F.H.E.

The 1943 review of requirements was followed by changes in the Ammunition feeder factories in addition to the release of the Rocklea Factory, as follows :-

.. Production of primers at Tamworth ceased in November 1943 and the Factory was taken over by the Department of Commerce and Agriculture for dehydration purposes.

.. Production of fuses ceased at Albury and Wagga Wagga in February 1944 and the Factories were made available through the Department of Supply & Shipping for commercial industry to produce tinware products and waterproof garments respectively.

Further progressive restriction of production to the larger establishments continued, with the result that, at June 30, 1944, the "parent" Factories at Footscray (Vic.) and Hendon and Finsbury (S.A.) had the continuing support only of the "feeder" factories at :-

Horsham (Vic.);

Goulburn and Broken Hill (N.S.W.);

Clare, Moonta and Port Pirie (S.A.); and

Walahpool and Kalgoorlie (W.A.)

By June 1946, ammunition production had been restricted to the factory at Footscray, although the rolling mill section at Finsbury was kept in operation on a commercial basis until early 1952 to assist in the increasing industrial activity in South Australia.

Activity at Footscray included the continued production of .303" ammunition at a relatively nominal rate, together with substantial numbers of 20 mm., 40 mm. and 4.5" cartridge cases, primer and fuse components and .303" percussion caps by the million -- one order from New Zealand was for 10,000,000 caps.

New types of fuses for Navy and Army were added, including electronic (V.T.) and time-mechanical (clockwork) fuses and the fuse for the Navy's Squid mortar. Installation of the latest types of multi-spindle automatic lathes facilitated production of the larger components for these new types of fuses. Development and production of a number of the electronic components for the new fuses was

entrusted to industry. Special watch-making machines imported from Switzerland were installed for the production of the clockwork mechanisms for the mechanical time fuses. Fuses are, in fact, so important an element in modern ammunition that some descriptive detail will help those who have never had to grapple with the problems of fuse manufacture to understand why the introduction of a new type of fuse into the Footscray Factory's programme involves exceptionally careful planning, the highest standards of precision in machining the component parts -- and considerable time.

A 25-pdr. shell of a field-artillery gun, for instance, could be fitted with any one of five types of fuses, depending upon the performance planned before the gun is fired. These are :-

- .. direct-action or percussion fuse, to detonate the shell on direct impact on its target;
- .. direct-action and graze fuse to detonate the shell on oblique impact on its target;
- .. powder-burning time fuse to ensure explosion after a pre-determined time has elapsed;
- .. clockwork time and percussion fuse to detonate the shell after a predetermined time from firing or on impact on the target; and
- .. variable time fuse to detonate the shell when it is at a point in relatively close proximity to the target.

The last-mentioned type - the variable-time (V.T.) fuse - incorporates a miniature radio transmitter and receiver complete with aerial, battery, mechanism for detonation and auxiliary safety devices, all of which must be small enough to be mounted in the nose of a high-explosive projectile. After the gun is fired, the fuse transmits a continuous radio signal which, as the projectile approaches its target, is reflected back to the receiver element and the detonation of the explosive filling follows.

As expressed above, such a sequence of actions does not appear to be anything out of the ordinary when the other achievements in the electronics field are recalled. With the V.T. fuse, as with earlier types, however, there are special factors involved. The complete unit, for instance, must be extremely small in size and restricted in weight.

At the same time, every component built into it must be sufficiently robust in design to withstand the physical shocks of being fired from a gun at 20,000

times the acceleration of gravity without affecting its performance when approaching the target. Furthermore, while en route to the target, every component must also withstand considerable variations in temperature and altitude as well as the centrifugal and vibrational forces produced by rotation of the shell at 20,000 revolutions a minute.

For bombs, the design of V.T. fuses is simpler - the fuses are not subjected to the same initial acceleration forces as are involved with projectiles fired from guns.

By the early 1950's attention was being given to the planning for the conversion of the small-arms ammunition section of the Factory for the production of ammunition for the 7.62 mm F.N. rifle then under consideration as the long-overdue replacement of the Lee Enfield .303" rifle introduced into the British Services shortly after the Australian Colonies were Federated in 1901.

Initial batches of the new ammunition were being made by 1958, more or less in parallel with the commencement of deliveries of the new F.N. weapons from the Small-Arms Factory. Successful large-scale production of the 7.62 mm. ammunition was assured by the installation of the latest automatic plant developed in France for the purpose and the provision of appropriate supporting plant and machinery.