Gentlemen,—Before starting my address, I would like to read a cutting from "The Age" Special Correspondent in London:—15/3/1942.

"Sir Alexander Roger, who led an industrial mission to Australia last year, in an interview drew a glowing picture of Australia’s industrial war effort, which he described as ‘an inspiring example to the whole Empire and to the Allies.’

"Sir A. Roger has based that opinion not only on what he saw in Australia, but on information received from the Australian Director-General of Munitions, Mr. Essington Lewis, and others since his visit. ‘What Australia has achieved is a miracle of production,’ he said. ‘Some of the Empire’s greatest men, and certainly some of its greatest commercial men, are in Australia to-day. Some of these, like Mr. Lewis, formed the view that Japan was going to attack, and did their best to prepare industry, especially heavy industry, for it.

"They did what America said they could do, and what Britain said they should not do. They formed or expanded the steel, plane making, shipbuilding and ancillary industries against a good deal of opposition. I, myself, though I am the head of companies employing 70,000 people, have learned a lot from Australia, and we were able to bring back a lot of production information for use in Britain.’

"Sir A. Roger said Australia’s example of enthusiasm and sense of urgency should be used to inspire the rest of the United Nations in the race for life, and would do much good if publicised more fully in Britain. He thought Britain could have done more to help if a proper perspective had been taken earlier. Mr. Curtin’s much discussed statement in December, that Australia must look to the United States, was correct."

Within our horizon is a world war, and we engineers recognise it as an engineering war—a clash of techniques, a deadly competition in which world power will be won by those most skilful at reducing scientific facts and principles to battle practice.

When I say engineering war, I do not mean merely a war of industrial facilities, a pitting, we might say.
There is a difference between producing for war and producing for peace. In mass production plants, the machines are mostly single purpose machines, and are located to produce a certain article. If you change the product in the slightest way, a new set up is required.

Engineers moving into many kinds of munitions must school themselves to follow the ever-shifting demand of tactics. Industrial engineers must work closely with military designers and field force officers, so as to adjust their minds to military requirements at short notice. The open mind of the industrial engineer must be matched by an equally open mind on the part of the military officer.

Given the volume, the mass producers are capable of handling precision war goods.

Since most ordnance pieces are not designed for assembly lines, they doubtlessly have to undergo modification before they can be turned out in tremendous quantities. This has been met.

Material supply is another problem. Owing to shortages of many of the common materials, particularly the alloys which metallurgists developed in the past for special purposes, these have had to be replaced with procurable substitutes. With aluminium desperately needed for aircraft, other materials have had to be used to meet the demand in other ordnance requirements.

The myth that Australia was mainly an agricultural country with little possibility of developing secondary heavy industries of world standards has vanished after two years of war. The history of Australia’s munitions industry is a record of resource and tireless energy, which has worked the miracle of achieving what so many well-qualified critics had declared was unattainable.

As any nation depends on the output of her steel industries, a few words on the development of iron and steel would be of special interest.

Looking back about four thousand years, we find that the ‘Iron Age’ commenced about B.C. 1500, when iron displaced bronze in the Mediterranean world and in the East, and iron became so valuable that at one period iron bars were used as currency in England.

The industry gradually became more important—so much so that in 1558 Queen Elizabeth passed an act forbidding the use of forest timber for fuel in iron manufacture, lest insufficient should be left for naval construction. As a consequence, manufacturers then turned their attention to other forms of fuel,
and the smelting of iron was commenced with the use of coal, and in 1651 coke was used for iron smelting by Jeremiah Buck.

Steel, as we know it to-day, was not really made until about 1856, when Sir Henry Bessemer announced his method of steel conversion.

The first Siemens Open Hearth Steel was made in 1868 at Crewe on a commercial basis.

It will thus be seen that steel is really a relatively modern innovation.

The manufacture of steel in great quantities received a great fillip during the Great War of 1914-18, when in many countries plants were duplicated and production rose considerably.

As far as Australia is concerned, the first steel furnace of four tons capacity was started at Lithgow in 1900, but it was not until 1908 that serious production was commenced by Mr. G. J. Hoskins and his family. In 1915 the Broken Hill Proprietary Co. started up their own steelworks at Newcastle, and steel was produced in considerable quantities from then onwards.

You who are engineers, and have been interested in the manufacture of steel, know the strides that have been made during the last 25 years, when new plants have been erected and extensions made to existing plants.

Since the beginning of the present war, extensions to all plants have taken place, and, compared with other countries on a population basis, the production in Australia compares very favourably with anywhere else in the world.

Since 1939 steel manufacture and all heavy industries have shown remarkable progress, and are now turning out all classes of war equipment, including ships and machine tools, most of which were hitherto imported.

Fostered by war-time requirements, a universal demand for alloy steels has been created, and steel makers the world over are now manufacturing alloy steels in greater quantity than ever before.

Countries unable to import the vital alloys required in steel making have of necessity to endeavour to find ores containing these alloys within their own territory, and then, after mining the raw material, manufacture their own alloys.

With such a situation facing Australia, steps were taken to ensure that Australia’s requirements of these vital minerals would be obtainable.

Pioneering the way, the Broken Hill Proprietary Co. Ltd. tackled the problem, and as a result Australia is successfully making her own alloys, the wide range including ferrochrome, ferrosilicon, ferromanganese, ferrotitanium and tungsten.
This development makes the nation more independent industrially, and enables a substantial increase to be made in the wide range of alloy steels already being manufactured in Australia. These include all types of tool steels, plain carbon and high speed tool steels, all stainless steels, nitralloy, heat-resisting and nickel chrome molybdenum steels.

It is interesting to note in our daily press the comparison of the prices of steel through the English-speaking world. The price of steel in Australia to-day showed up most favourably. In the field of metallurgy great strides have indeed been made. Little need be said further about the steel industry. The whole story, if written, would prove to be an epic in Australian Industrial History. Apart from ferrous metallurgy, there have been many developments in the production and use of non-ferrous alloys, perhaps the most important ones being aluminium bronze and magnesium aluminium. These have proved to possess unforeseen advantages in the realm of chemical engineering. A new and important development in this sphere is also the production of metallic powders, whose uses are indispensable in the recent advances in electrical engineering.

Undoubtedly powder metallurgy, now only an infant industry, is destined to play an important role in our future industrial life. Any remarks concerning metallurgical advancement would be incomplete without reference to development in the use of reducing atmospheres in heat treatment processes, welding, brazing, carburising and annealing, can now be performed continuously in reducing gaseous furnace atmospheres, resulting in a greatly improved furnace throughput, and abolition of any subsequent treatment. This has been a factor of prime importance in the production efficiency of the materials concerned.

Some reference must be made to the effort that has been made by the iron and steel foundries to cope with the greatly increased demand for castings of all descriptions for defence purposes. They have not only been called on to supply castings to specifications not previously required under civil conditions, such as armour-piercing steel, bombs, acid-resisting iron alloys, high test steel and iron, which has called on the best brains of the metallurgist, but have had to devise many improved methods in workshop practice to increase production.

One of their greatest problems has been the shortage of skilled tradesmen, and to offset this to a certain degree recourse had to be made to the upgrading of unskilled men to machine and plate moulders. This has proved successful so far as small repetition work is concerned, but, unfortunately, it is not possible to create first class jobbing moulders by this method.
To overcome this latter problem many founders have installed large moulding machines, particularly of the Jolt Rollover type, which do the main ramming of the sand in much less time than it could be done by hand; then the jobbing moulder has only to finish the moulds.

This method, while considerably increasing output, naturally calls for large quantities of more evenly graded sand, consequently more efficient sand treatment plants have had to be installed, melting plants improved and increased, and the handling of larger tonnages of material generally has necessitated installing quite a lot of mechanical plant.

This the founders have been progressive enough to do, so far as available equipment would permit, and in consequence it is pleasing to be able to report that according to departmental information, the supply of large iron castings is well ahead of machining facilities. The output of castings, such as malleable track links, steel castings and bombs, has not yet reached the required output, but with the arrangements now in hand this position should soon be rectified.

Imagine, one steel foundry's output alone would equal Australian production before the war, single items of 2500 bombs a day being just one item that is in mass production.

An address on Australia's war effort would be incomplete without reference to the part played by technical workers, such as chemists, metallurgists, mineralogists and research workers.

With the aid of her scientists, Australia has made progress which would not have been considered possible prior to 1939. Established industries, such as the production of metals, etc., have expanded enormously, and new industries have been started. The production and fabrication of aluminium, which is of such vital importance to war industries, is one of the achievements, and the increase in production of alcohol and benzol for use in fuels is among the most obvious. The production of alkalies, also of major importance, is another established industry.

Demands made upon Australian manufacturing chemists to replace materials no longer available, or at the best difficult to obtain, have been met, a typical example being the production of an important plasticisive called dibutylphthalate, required for aircraft dopes. As one of the basic chemicals required for this is in short supply, it will not be long before it is being produced from naphthalene. One of the other ingredients, butyl alcohol, is also being made in Australia, an industry which is barely two years old. Shortage of olive oil supplies for the textile industry has been met by oils developed in Australia. Greases, cutting oils, sulphonated oils, emulsifiers, and synthetic
resins, carborite, barium nitrate, nitric acid, chlorosene, synthetic ammonia are just a few of the materials that are now being made, and in most cases have been developed in Australia since the end of 1939.

Many of the achievements of the technicians have resulted in so-called “ersatz” materials being produced, but, as is frequently found, the synthetic or “ersatz” material is in many cases superior to the original article.

T.N.T. is the most widely used explosive in modern warfare. Normally toluene derived from coal is the basic material, but, following up the success of efforts to use toluol from petroleum, to-day T.N.T. is being made from the raw material here, of which there is never likely to be a shortage for our requirements. Australia has indeed expanded in the chemical manufacturing world. To mention just a few of the products now being produced—ammonia synthesis, ammonia oxidation to nitric acid, ammonium nitrate, black powders, calcium chloride, caustic soda, dyestuffs blending, lead azide, lead nitrate, lead styphnate, nitrocellulose, refined bicarbonate of soda, soda ash, safety fuse powder, tetryl.

Back in the seventies the first munitions were made in a small building on the banks of the Maribyrnong River by the Colonial Ammunition Company, an English firm. It produced a quantity of material during the Boer War. It stepped up its production during the Great War, and was eventually acquired by the Commonwealth Government. This factory was the beginning of the vast production now operating in Australia.

About 1912 a factory was established for the manufacture of cordite. The next field in Australia’s munitions programme was at Lithgow, New South Wales, where a small arms factory was started to produce rifles only. It is rather interesting, in these days of aerial warfare, to note that the company which supplied the equipment for the Lithgow Small Arms Factory was Pratt and Whitney, of the U.S.A., now one of the largest manufacturers of aircraft engines in the world.

These factories were the main ones operating during the 1914-18 war.

In 1923 it was decided to set up the Commonwealth Munitions Organisation, and, with 1600 machines bought from widely scattered factories throughout the British Isles, the nucleus of the present vast development was started.

Figures, when they measure in millions, become vague reflections of the achievement. The production of small arms ammunition in four Government factory units alone is many millions a week; in fact, 50% above designed production.
New factories are now being built rapidly in other States. Capital expenditure alone for the munitions programme has totalled over £34,000,000. Australia produces more than 36,000,000 rounds of small arms ammunition a month, and this figure will be greatly increased in the near future.

The manufacture of shells, bombs, shell cases, fuses and primers, etc., has developed so rapidly that huge expenditure has been necessary for the expansion of production of propellants, bursting charges, detonator, fuse filling compositions. Government explosive factories and private industries operating under annexe conditions are bringing about these requirements.

A further self-contained unit for the manufacture of all types of explosives is on the point of starting to produce. This factory was built at a cost of over £7,000,000.

The Government Ammunition Factory in Victoria is being duplicated in another State to produce cartridge cases for all types of ammunition, from the two pounder to all heavy sizes. Production from this factory will be considerably greater than our Victorian one.

When one imagines that less than twenty of one type of anti-aircraft gun—a 3” 20 cwt. weapon—represented our total defence against air attack when we entered the war, and then think that we are now turning out the most modern of anti-aircraft guns—the 3.7”—in weekly batches!

Australian firms, co-operating under a major contractor, have succeeded in face of difficult problems of metallurgy and machining, and brought about the mass production of the anti-tank 2-lb. gun, which will be superseded in the very near future by a gun that will give the crews of our enemies’ tanks a very unpleasant surprise.

One of the outstanding inventions of the war is the Owen sub-machine gun. This weapon is claimed to have an all-round performance and utility equal to any similar gun used throughout the world. This gun weighs about 10 lb., and carries a clip of 30. It is shorter and lighter than the American Thompson gun, and it is expected that we will produce this weapon for about £6, compared with the £60 cost for the American gun. This gun is now in mass production, and it is confidently predicted that it will be one of the standard guns used throughout the whole of the Allied armies. But we are not stopping there; another sub-machine gun is reaching its mass production stage.

The manufacture of rifles and Vickers machine guns in the Government Small Arms Factories is now reaching an output
1. 3.7-inch Anti-aircraft Guns Nearing Completion in a Corner of an Enormous Workshop.

2. Trench Mortars Being Completed Before Leaving a Factory.

3. Grinding 3.7 A.A. Gun Jacket in Lathe, with Cutting Oils Playing their Part.


6. All Types of Bombs, from Trench Mortars to the Heaviest Type of Aerial Bomb, are filled with T.N.T. Explosive at the Commonwealth Explosives Factory. Trench Mortar Shells on the shelf at the rear; medium cases in the foreground.

7. A Skilled Operation—Cutting the Profile of the Big End of a Master-connecting Rod for Aeroplanes.
that was never dreamt of. It was these factories that the British Ministry of Supply Mission, which visited Australia, considered to be equal to any in the world.

The Bren gun was produced in Australia in a shorter time than had been required in Great Britain. This gun was in mass production six months ahead of schedule, and, when one considers the tooling up required to achieve this, we can but appreciate the co-ordination that has marked our industrial effort.

Similar co-ordination of industry has brought about the mass production of the 25-lb. gun—one of the most difficult tasks attempted by Australian industry. The barrel and breech mechanism are manufactured by the Ordnance Factory, all other parts and assembly of same being carried out by major contractors.

The trench mortars are also being produced under similar conditions, and guns for Australian naval vessels are being manufactured here.

The production of ordnance requirements covers a very wide range of products. Time will only allow me to mention a few that industry in Australia has been called on to supply, namely, flash spotting instruments, pontoon bridge equipment, pumping units and ancillary equipment, searchlights with their generators, electric cables, signalling equipment ranging from the heliograph to the most modern wireless telegraph or radio telephone gear. This latter industry has grown in such a short time that it will certainly go down in our history as a spectacular achievement.

Field telephone cables are produced to-day at the rate of hundreds of miles a week.

The last war had nearly ended before Britain and America had established satisfactorily the production of precision lenses, prisms, telescopic gun-sights, dial sights, range finders and the like. The tolerance in some of these instruments is fantastically small—in certain cases an accuracy to one millionth of an inch. Substitutes for the rarer types of optical glass have been evolved, and to-day Australia has a new industry established that has come to stay.

Before the war Australia imported most of her machine tools, and, when we were cut off from that supply, we had in Australia only two firms making suitable products. To-day over fifty firms are turning out high-grade machine tools. Copied from imported machines and original drawings, in many instances they have been modified and improved.

Every machine tool that is required to meet mass production is being made to-day in our country.

The whole programme for mechanical appliances for munitions has been manufactured in Australia. To give some idea of what these requirements included—one order for 2450 cartridge-making presses, a number of 2000 and 3000 and even 5000 ton presses, and hundreds of hydraulic presses up to 1000 tons—a number of firms co-operated in the manufacture of plant for small arms ammunition, and finished two units of 375 machines each in less than ten months.

In October last the Department of Supply delivered to the army the 1000th Universal Bren Gun Carrier assembled under mass production lines—this type having been fabricated with the new malleable bullet-proof armour plate. It was this material that aroused the interest of the British Ministry of Supply Mission, and at whose request the manufacturing formula and sample of it were sent to Britain. Quantity production has been maintained well ahead of schedule—the 250 booked for each month to keep the war output in step with military plans.

Unfortunately, the war has moved to our door, and the colossal production now asked for would have been beyond our wildest dreams two years ago. Great changes have taken place in design of this carrier, and those who have been instrumental in bringing them about have done a great service to our war effort. The major contractors producing these carriers are receiving parts from hundreds of small workshops in Australia.

Most of you will remember a visit the members of this Institute had to a carrier production shop, and I am sure you will agree with me when I say that it was an education to see the set up of the assembly lines, the jigs that had been designed and built here for the welding of the chassis, and the numerous means that have been adopted to bring about the perfect piece of war material that has stood up to the most exacting requirements on the battlefields of the Middle East.

Aircraft manufacture, the youngest of our industries, is now established on mass production lines for the building of war planes. This industry started first in New South Wales in a very small way, and it was only after the Commonwealth Aircraft Corporation Pty. Ltd. started at Fishermen's Bend that Australia took up the building of planes seriously.

Two of the most up-to-date factories were erected, one for engine building and the other for aircraft production. The "Wirraways"—that we all know so well—started to come from the assembly lines, thus establishing the fact that Australia had an aircraft industry, and would be capable of producing the necessary planes for the training of Australia’s youngest service.
10. An Australian-built Wirraway in Flight.

11. Australia has succeeded in establishing an Aircraft Industry on a mass production basis, and this impressive photograph shows Wirraways on the main assembly line.

12. The Transparent, Shatter-proof Material which this worker is fitting to the Observer's Screen of a Bristol Beaufort was developed in Australia and has won high praise.
From this nucleus at the outbreak of war, it became imperative that the industry must be expanded, and manufacture expedited. The Commonwealth Government formed an Aircraft Production Department. This department co-ordinated industry under a major contractor, and the advanced training planes were put into production, final assembly being accomplished in their own Government Annexe. As I am dealing later with the Gipsy Major Engine, the power unit used in this plane, sufficient to say that success followed in face of exceedingly difficult problems of metallurgy and machining.

I think, at this stage, I might mention a few facts about our youngest service. The story of its remarkable expansion is one of the brightest spots in Australia’s war effort.

At the outbreak of war there were 3500 men in the service. By August, 1941, there were 60,000, and over 200,000 men had applied for enlistment. In two years this young service had grown to manhood, and twice the number of recruits had been accepted than had been planned for that date. The cost to Australia by 31st March, 1943, was originally estimated at £43,462,000 for training in Australia, and £11,480,000 in Canada. The actual expenditure—due to expansion beyond our wildest dreams—is over £1,000,000 a week in Australia alone. Seven-ninths of the personnel are being wholly trained in Australia to-day, and when one considers what this means—to fit them for pilots, observers and wireless air gunners, and the training of the ground personnel, fitters and mechanics, and wireless telegraphy operators—one must appreciate what all this has entailed. Australian airmen have already an outstanding record overseas, and this branch of the services is certainly making history.

And now we must get back to our aircraft production programme. As the war moved to the Pacific it became imperative that we must build machines capable of holding their own against our enemies. The versatile “Bristol Beaufort” was considered our best weapon for defence and attack—as it can be used as a torpedo and fast bomber, and even as a fighter. Arrangements were made with Bristol Aircraft Company to supply all necessary jigs, etc., for the manufacture of this machine, but, unfortunately, this arrangement was not carried out, and the Department of Aircraft Production was faced with this prodigious job—nearly 40,000 jigs being required.

The fabrication of component parts for this plane is now in full production; Victoria, New South Wales and South Australian Annexes each supplying their respective parts, the final assembly being made in Victoria and New South Wales. The power units for this plane are being assembled in New South
Wales. Certain parts of this engine are made in Australia, and we look to the time in the not far distant future when we can claim a complete Australian-built engine. This unit is a Pratt and Whitney twin row Wasp radial 1200 h.p., its weight being 14 cwt.; 14 cylinder, 5" bore x 5" stroke. Its first test was carried out at the new aero engine factory in Sydney on 24th September. It ran for fifteen hours in what is considered to be the most elaborately equipped engine-testing room. Certainly the production of these planes on mass production is an established fact, and numbers that will be made available to our R.A.A.F. are very gratifying.

To give some idea of what has been achieved in an industrial engineering concern in its change over to total production of war material I have slides that will now be shown to illustrate in a small way their activities.

In their engineering works they have a section exclusively used for the production of the Gypsy Major engine crankcase, sump covers, and timing gear covers. The production in this section—although all machines in use are standard universal machine tools—has been astounding. There are 42 operations on the crankcase alone, each requiring individual checking with a degree of accuracy to within .004. The complete landing gear, wheels complete with brake mechanism, and also wing flap operating cylinders are all made in this section.

Munitions manufacture has been undertaken in another section of the works, and consists of the forging of 3.7" anti-aircraft and 25 pdr. shells. The shell billet is heated in a special furnace approximately 60' long, the billet being moved over the hearth by means of a hydraulic pusher. It is then forged in the Baldwin-Omes press. The production of these forgings has exceeded the output of any similar plant in the world.

Cooling is facilitated by means of a special vertical oven designed and built at their own works. They are then progressed through straight-line production from the rough turning lathes—all single purpose units which have been designed and built in their engineering section—to the base facing machines, then through the bottling furnace to the bottling press, where the nose is reduced in diameter to form the fuse hole. The furnace in use here is also their own design. They then pass to the annealing oven, which is automatic except for the operation of the press control valve. This press, by the way, was supplied from overseas to give a production rate of 60 per hour, but since drastic alterations have been effected this rate has been increased to over 300 per hour.
13. The Versatile Bristol Beaufort. These are used as a Torpedo Dropper, a Fast Bomber, on Reconnaissance Patrol, and even as a Fighter.

14. Assembly Line of Front Fuselages of Hard-hitting Bristol Beaufort Torpedo Bombers, which are now being built in Australia. Each front fuselage contains 22,000 separate parts.

After annealing the shells pass to the finishing annexe, where they again progress through the various machinery operations. All the single purpose machines in this annexe have been produced in their engineering section.

This production line, which I have tried with the aid of the slide to describe to you, is a great advancement on any line previously in operation. Special mention should also be made of the electric heating of the copper band before being forced in position by the eight-jaw hydraulic press, also the shell varnishing, which incorporates an automatic machine, and the baking of the lacquer on the interior of the shell.

The completed shell then passes to the Government Inspection, and from there they are packed and forwarded for filling.
15. Australian Mechanised Cavalry Advances Through a Cloud of Western Desert Dust. These Bren Gun Carriers are being mass produced in Australia.

All these improvements have considerably reduced the number of man hours spent in the manufacture of shell bodies, with an improvement in quality of workmanship which goes to show that the Australian industrial engineer is showing his own initiative in our war effort.

SLIDES SHOWN.
No. 1—Machining camshaft bearings—Gipsy Major Engines.  
No. 2—Machining top face crankcase for the cylinders—Gipsy Major Engines.  
No. 3—Truck load of timing gear covers between machining operations.  
No. 4—Showing all parts of brake gear, and wing flap cylinders.  
No. 5—Machining landing wheel castings—fighter aircraft.  
No. 6—Gipsy Major Engine.  
No. 7—Forging the shell with finished inside cavity.  
No. 8—Placing the hot forging in the vertical cooling oven.  
No. 9—Line of rough turning machines. These machines rough turn the shells to form, ready for bottling.
TIMBER.

Before the war the bulk of timber used in this country was imported from British Columbia, Scandinavia, the Baltic ports, and from neighbouring islands and New Zealand. Millions of feet of oregon were used in building construction, mining props, joinery and the larger constructional work. Hemlock was used extensively for case making, and Baltic timbers for flooring, weatherboard and joinery work, together with other varieties such as Californian redwood, Island timbers, and New Zealand timbers, for many varied purposes.

By Government regulation in the early period of the war to conserve dollars, timber exports were strictly licensed. These licences operated on a fast reducing scale until the point was reached whereby the material coming into our country was only a semblance of that under pre-war conditions. This had far-reaching effects on the industry as a whole, and we had to look to our own forests for the filling of our nation's requirements. As time progressed more and more demands were made on the timber industry for defence works, boat building, enormous quantities of material for munition boxes, food and transport cases, etc. This threw us entirely on our own resources for the filling of all wants, and gave the State Forests Commission an opportunity to recover and put into use the timber that was killed in the disastrous bush fires of 1939.

Salvage plans were already in operation, and millions of feet of log timber had been placed into dumps in the bush so as to conserve it from the ravages of pests. This timber was immediately put into service, and by careful manipulation was cut and graded into qualities suitable to meet every requirement, for the enormous ordnance works under construction, and everything appertaining thereto.

While the production of logs has been a comparatively easy task the sawn timber confronted many factories with difficulties owing to the nature of our timber. Most of our native woods are prone to excessive shrinkage, warp very easily, and, owing to their hardness, are very difficult to mill. In consequence, reconditioning on a commercial scale had to be carried out. Huge
quantities of timber are now being converted continually into reconditioned kiln-dried material, and used in the manufacture of munition boxes and the like. In addition to this, cases for the conveyance to the forces of tinned meat, fruits, etc., and general victualling purposes are manufactured from this material.

Very few people realise the importance of wooden cases or boxes. Countless thousands of boxes are being supplied weekly to the Defence Department. I know of one firm alone who are supplying over 60,000 per week.

Although Australian hardwoods require reconditioning, it has been found that, owing to its greater strength, box makers were enabled to cut down materially the thickness of the sections, saving approximately 30%. In this industry also a further 35% has been obtained by using the slicing machine in place of the band or circular saws.

Timber is probably the most wasteful of all enterprises. There is a tremendous field for the scientist in the study of the waste that is incurred. The Council for Scientific and Industrial Research is working on this question all the time, and it is making a valuable contribution to the industry in general—increasing manufacture of plywood is taking place, the production of wood flour plastics is becoming a valuable industry, and many other uses are being found for our waste.

As it is estimated that Australia produces 2,000,000 tons of sawdust yearly, you will see how necessary it is to try and use this waste product. The timber industry has definitely made its contribution to our war effort. The handling and processing of the potential waste of 1939 was a feat of which Victoria should be proud. The other States have provided timber from their various bushes, which at one time was classified as scrub timber, and this has been used in a way similar to that already enumerated. Tremendous advances have been made in Western Australia in producing timber for its own use, and for the less timber-favoured State of South Australia, and at the same time provided timber for the construction of railway lines both here and abroad.

All these remarkable changes have been accomplished without undue hardship to those concerned in the timber business. All branches of this trade have co-operated. Saw millers, manufacturers, and those in charge of the various organisations that are in existence have all added their share to the national effort.

This reference to timber would not be complete without some mention of the paper and pulp manufacture. This industry
has progressed far beyond the original plans, and is producing to-day many grades of paper that had been considered impossible to manufacture from Australian woods.

When war was declared the cement industry was one of the very few organisations that was found prepared. At that time not one cement plant was working to its full capacity. The companies having forecasted the natural development of Australia, and the part that cement would play, had installed the very latest equipment well in advance of requirements, so were in the position of being able to meet all demands made of them, military or otherwise.

I know that the large number of our members who visited the cement works at Geelong at the invitation of the Australian Cement Company will appreciate how true that statement is. We were given the wonderful opportunity of seeing not only what cement manufacture entailed on the mechanical side, which in itself, with its gigantic rotary kilns under perfect heat control, its crushers and all the auxiliary machinery that is required to make this essential product, but also the amount of research work that was being carried on in their laboratories, a service that it is impossible to estimate the value of to Australia to-day.

When you analyse what part cement is playing in our war effort you will realise the fact that hardly one of the essential services could be carried on without concrete. We all know how indispensable it is for the foundation of every class of machinery. However, it is not only in the workshops that uses can be found for it, particularly in meeting war requirements. Concrete buildings of all sizes and shapes are erected to-day with a rapidity which staggers the average citizen, and with the minimum of plant and labour. In most cases and localities it is only the cement that has to be transported any distance; generally the other ingredients—sand, gravel or screenings—being obtainable within easy distance.

It would be safe to say that every one of the thousands of guns placed round our coastline is erected on a concrete base. The uses of cement at aerodromes and landing fields are legion. Hangers, hanger floors, apron runways, warming up areas are concrete. It is the only material which will stand up to the heavy loadings, give smooth surfaces, withstand the effects of motor spirit and oil, etc., and can be kept clean and dustless. Concrete is the only plastic material which can be moulded into any shape or size, and take all the stresses that are set up in
foundations. It sets and hardens rapidly, and keeps on hardening as the years go by until it is one of the hardest compounds on earth.

Concrete construction is continuous at two of our important military aerodromes in this State, also at civil aviation centres, and at munition and ordnance works. When it became obvious the size and weight of aircraft that would be required in Australia to safeguard us and provide an air offence weapon, it was found necessary to construct immediately concrete runways of considerable length and width. This work necessitated a speeding up that will astound you when you have the actual figures that have been obtained. They don't speak of yards in aerodromes to-day—miles of runways are needed. Imagine 900 tons of concrete aggregates being laid and rolled in a day. This has been obtained by the use of a mechanical system not used to any great effect in Australia previously. The speed at which the concrete is being laid is one of the outstanding constructional achievements of our war development, and, like other efforts in industry, compares more than favourably with any of our Allies' endeavours.

The Commonwealth Government called on major contractors to assist in this work, and they are not by any means resting on their laurels, but anticipate that the present rate of work will be surpassed by upwards of 50%. Australia after the war will benefit greatly in all road undertaking by adopting this successful system. Fortunately, the mechanical units that are in use on this work are not a new innovation. They were in Australia before the war, and a number of undertakings had been completed under similar conditions, so all ground and experimental work had been carried out previous to the war.

Allied industries such as asbestos, cement, concrete and many other similar products have all played their part. The use of asbestos-cement has been utilised to the full, sheets and fabricated parts being in enormous demand in our ordnance building programme. The companies engaged in the manufacture of this product have been very progressive. The plants employed are of the very latest design, the systems in use having been designed and developed in Australia. A visit we had to one of the largest plants engaged in this work proved to us that the methods employed throughout the whole factory were the result of ingenuity on the part of the management in seeing the potential part this product was to play in the building of a greater Australia.

In my last Presidential Address, "Progress of the Textile Industry," I enlarged upon the development of the flax industry
in Australia, and the likelihood that it would ultimately become one of Australia’s great industries. This prediction has been largely supported by the development which has taken place during the last year.

During the coming planting season in May and June, upwards of 60,000 acres will be planted in Australia. At the present time some 33 flax mills exist in the four southern States, and the spinning and weaving of flax have developed considerably, in company with the development in the production of the fibre. The capital employed in the production of raw flax to-day is round about £1,000,000, and the product of the crop harvested at the end of last year will have an aggregate value approaching £2,000,000.

The great value that will accrue from the development of this industry will be readily appreciated when it is noted that the great vegetable fibre-producing countries of the world are the Baltic States, in German hands; Holland, Belgium and France, in German hands; Italy; the Philippine Islands, in Japanese hands; Java and Sumatra, also in Japanese hands; the only large fibre-producing countries not over-run by the enemy being East Africa and some South American States. Each of these countries produces a fibre known as sisal-hemp, which will act as a substitute in rope for Manila hemp, but the tonnage produced will not be sufficient to supply the war-time needs of the Allies. In consequence, more and more flax is going to be called for, and it is possible that in Australia the whole of the manufactured product of vegetable fibres will, of necessity, be from flax. Fortunately, this is quite a technical possibility, and the whole of the various types of standard machinery installed here can handle flax equally as well as other fibres.

In the engineering sense, considerable development has taken place, but of necessity this developmental work has had to take second place to constructional work, owing to the vast expansion which has taken place in the industry, and the shortage of man power. However, it is hoped that a stationary point has now been reached in mill and machine construction, and, should this be the case, the engineering and scientific brains of the industry will, from now on, apply themselves to work of a developmental character.

Dual harvesting, that is, the use of a harvester and a reaper and binder simultaneously to take off and clean the seed and reap the crop, has been experimented with to a considerable degree, and it appears will be an outstanding success in many Australian districts, particularly those growing large acreages
in a comparatively dry climate. This will eliminate the immense cost of handling, and will save the great wastage of straw which must follow unnecessary dealings.

The bulk of the crop is still dew retted, and my listeners will readily appreciate the cost in labour of taking up by hand and tying into bundles tens of thousands of tons of light straw. To obviate this, the co-operation of a large firm of implement manufacturers was obtained, and a machine has been developed which, with the addition of a few refinements, looks as though it will be a permanent success.

With the further object of obviating dealings, the flax mills are now being converted to use trailers and trolleys for the handling of straw. The trailers will be pulled by a tractor, and will carry straw backwards and forwards to outlying paddocks, while the trailers will run on wooden trolley lines from stacks to the treatment sheds, and will do away with the necessity to use large quantities of petrol and valuable motor trucks.

Water retting is receiving full attention. The perfect mill exists at Myrtleford, in Victoria. This mill is in an ideal setting in the valley near Mount Buffalo. It draws its water from the Buffalo River, which is perfectly pure, and you will be pleased to hear that it is already producing a grade of fibre which leads us to hope that Australia will ultimately produce flax equal to the world’s best. A water retting mill is being constructed in Western Australia; there is already one at Hagley, in Tasmania, and a further one is being constructed at Latrobe, in Tasmania, while the other Victorian water retting mill at Colac, which was destroyed by fire during the past year, is being reconstructed along modern lines.

Large quantities of flax canvas is now being made in this country, solely from Australia flax, while in addition to this Australia is being supplied with fibre hose for A.R.P. and navy and army work. Flax also plays its part in the very strong plaited goods from which an airman’s parachute harness is manufactured, and the whole of our requirements in linen threads are being made, so you will readily realise that this is an industry which has stepped into the breach, and has rendered a wonderful service to us in our time of need.

One branch of engineering that has jumped from a jobbing business to mass production scale is the manufacturing of trailers. The army authorities were slow to adopt this method of haulage, but with the infiltration of business executives into the army, the common-sense principles of haulage now prevail. Some idea of the increased demand called for can be obtained when it is remembered that the total production before the war
in Australia was two trailers daily; now it is about thirty from one factory.

Trailers are used for many purposes in the army, including portable garages, machinery workshops, laundries, sound locators, searchlights, kitchens, dressing stations, and in fact everything used in the army is gradually finding its way on to trailers. The portable steam kitchen, as built in Australia, is probably the most comprehensive kitchen used in any part of the world. Certainly it far surpasses any of the American equipment. It cooks the meals with steam, and has plenty of steam available for hot showers. The kitchen travels with the troops, and is able to cook the meals in transit and serve first class meals within a few minutes of coming to camping place. The portable refrigerator is able to give troops comforts altogether foreign to comforts enjoyed by those who went through the last war. In temperatures over 100 degrees there can always be found a cool drink. Imagine what this will mean to wounded men.

Semi-trailers, which convert a four-wheel truck into a six-wheeler, are a newcomer to the Australian army. Only eighteen months ago the army authorities could see no use for this vehicle. Now hundreds of this type of vehicle are used on the highway between Alice Springs and Birdum, a distance of six hundred miles each way. These vehicles are able to carry ten-ton loads at a petrol cost equal to less than one half that of the ordinary four-wheel truck.

Although the Australian army was slow to adopt semi-trailers, it has now been convinced of the necessity of such equipment for many other requirements. It has been proved that they are ideal for carrying bridge equipment, tanks and Bren gun carriers. The first thirty-ton tank transporter was completed a week ago, and was seen in Melbourne streets carrying the first thirty-ton Australian tank.

The Australian trailer manufacturer has proved beyond doubt that the experience gained by Australian trailer builders in commercial transport is now of great use to army authorities. It enables trailer builders to design and build in a few days trailers to carry such large objects as thirty-five-ton locomotives, power shovels, road rollers, bull dozers, large size tractors and scoops, some of which weigh as much as twenty tons.

Yes, the Australian trailer manufacturer is doing a good job, but he would do a better one if there were an army design branch to improve on practical experience.

In the modern army everything runs on wheels. There is an endless variety of trucks, tractor, and trailers required, amounting to hundreds of thousands of vehicles. All these
Yet Another Vessel is Launched at a New South Wales Dockyard under the huge shipbuilding scheme.

have had to be built, necessitating a tremendous amount of planning and ingenuity. Standard chassis have been altered where possible, but, unfortunately, many new designs of chassis have had to be fabricated—using a standard power unit—to meet the requirements of a mechanised army, so that Australia would have a highly motorised striking force.
Body building for army trucks has become a big industry, and when one sees the many designs that have been required to meet each special duty you will appreciate the effort that has been expended in this branch of our constructional engineering industry. Australian engineers played a leading part before the war in perfecting electric and oxy-welding, pioneering fabricated structures of every kind, and proving beyond doubt from our engineering and commercial angle the value of welded structure.

It is to these men who, against great opposition, we owe the success of this effort, and also the fact that we were in the fortunate position of having experts to train the thousands of operators who were needed to meet this colossal programme.

One of the most interesting developments is the manner in which concerns manufacturing relatively unessential goods have, by dint of foresight and energetic reorganisation, turned over their factories very largely to the production of materials for the Defence Department.

Perhaps one of the most outstanding examples of this reorganisation in my acquaintance is that carried out by a textile mill. This company was the largest full-fashioned hosiery manufacturing company in Australia, and also manufactured ladies’ underwear. Although a portion of their production would always have to be regarded as essential civilian clothing, quite a large portion would be considered luxury clothing, and under war conditions it would be reduced to that which was considered, after investigation by the Government, to be absolutely essential civilian clothing. The management of this company, foreseeing the possibility of considerable reduction in their normal business, made it their policy early in the war to reorganise their plant to assist in defence work as far as possible. Towards the end of 1940 the company purchased in America a complete plant of up-to-date high-speed automatic fine-weaving looms, to enable them to provide for the Defence Department a production of fine fabrics which was sorely lacking in Australia. The purchase of this plant was actually finalised in January, 1941, and by the middle of the year the plant was installed in Australia in a new air-conditioned factory building, and was then by that time operating on defence contracts for parachute fabric.

This in itself was an outstanding achievement in the establishment of an entirely new industry for defence production. The fabrics which have been produced cover a wide range, such as pure silk parachute fabric, aeroplane cloth, shirtings, flying suit material, etc. etc.

It is to the technical credit of the company that all these fabrics, particularly aircraft fabrics, which have to be produced
to very rigid specifications, have been supplied from this new
annexe, and have met with high praise, being more than com-
parable with similar overseas productions. The necessary plant
for the specialised finishing of these fabrics was also purchased
at the same time and installed alongside the weaving plant. In
addition to this special extension of their interests, the company
is producing large quantities of cut and sewn clothing, and
and-day have more than half of their female staff on this work.

If time would allow me I could give you many other instances
in the textile and other unessential industries of what has been
done by the companies themselves to further Australia’s produc-
tion of material needed by the Defence Department.

Australia has indeed co-ordinated her full resources and man
power for total war, and has, in addition to her own war needs,
filled huge commitments for the supply of munitions and
many other essential necessities for the Empire and Allied
countries. When you consider the enormous value of the
products that have been and still are being sent overseas to
fill urgent needs, you will appreciate what an industrial
revolution has taken place.

In passing, I would like to mention one firm’s activities. This
firm, previous to the war, faced world’s markets in the sale of
their implements, so when the U-boat campaign became such a
menace that Great Britain had to consider intense agriculture
as a means of saving an acute shortage of food, they were able
to supply implements on such a prodigious scale, in a short
period of time, that when the whole history is written it will
certainly be one of our engineering highlights. Besides this,
they have supplied many other vital parts for Britain’s war
machine.

When I think of one engineering firm fulfilling orders to the
value of £1,000,000 for overseas requirements alone, I realise
our great achievement. Still there is more to be done. Aus-
terian industries have laid the foundation, and they must finish
the job.

As I have had a great opportunity as your president to glean
a fair amount of firsthand knowledge of this subject, I have
tried in my own small way to give you a brief outline of Aus-
teria’s industrial war effort, and I sincerely trust that you
have gained some little benefit from my address.

And now, before concluding my address, allow me just a little
more time to express my feelings. We are a body of men belong-
ing to an Institute that has had, and still has, as its members
men who have made history in this country—men who have
been associated with every venture that has made Australia.
The engineer is generally looked upon as a necessary evil; his department is a spending department. To the business man the mill or factory manager is where his profits come from. That the business man has this idea is only your own fault. Our Institute has the power to change this outlook in our industrial world.

You, as individuals, must be active in every sphere. Increase your membership by contacting any man you think is playing, or is destined to play, a big part in our industrial world. You have just received a complete list of members. Don’t think they are someone whom you are likely to meet some day at a meeting. Look upon them as someone who is near to you. Learn to know them. Ring them and pass on to them any knowledge or experience that you think of interest to them. They, in turn, will reciprocate. By this means our Institute will become a power in the land, and the few inquiries that we now have passed on to us for advice will increase greatly.

Make the fact that you belong to the V.I.E. the hallmark of your profession.

In 58 years this Institute has built up a font of knowledge. Almost every subject has been dealt with in a practical way. Papers have been read by men who knew their subjects. All these are in our library. We have good periodicals, and papers from engineering institutes world-wide are being received constantly. We have inquiries for copies of them from other States and public libraries; yet very few of our members have availed themselves of this knowledge.

Mr. Bennie, of our Publishing Committee, who has devoted a great deal of his time in keeping all papers given before this Institute to standard, has been a worker in every sense, and the Institute owes him a debt of gratitude. Mr. Dobson, your vice-president, who collaborates with Mr. Bennie in this work, has been one of our Institute’s most valuable members. He, with the assistance of his son, catalogued our library. This alone occasioned an enormous amount of work.

To Mr. Cromwell, who has had to tender his resignation as honorary secretary, we also owe a great deal. He has been a very live wire, and it is only the men who have had the honour of being president and members of your council who can fully appreciate the work that he has done. I am sure we all hope that his eye affliction will soon be cleared up. Mr. Kneale, who has acted as secretary during Mr. Cromwell’s absence, and is now your honorary secretary, has proved, by his initiative, thoroughness and enthusiasm, that he will grace this position.
To the members of the council who have held office during my terms as your president, I wish to express my thanks. The council meetings have been fully attended, and all assistance has been given me in doing my best on your behalf. Any progress that has taken place is due to the amicable feeling that has always been present at our council meetings. If this feeling could permeate the whole of our Institute, I feel the battle for our future success would be won.