

members who are working the very hardest for the welfare of engineering who, I am convinced, will find the least fault with me for strenuously pointing out wherein there appears to be room for improvement, and no one, I hope, will doubt the sincerity of my motives.

Much of what I have said will doubtless be regarded by you as obvious, but is it not so often the most obvious things that we regularly fail to properly observe? I find it somewhat difficult to crystallise the conditions most essential to the success of engineering associations, but if asked what I would, from my somewhat limited experience, suggest as the attributes each member should bring to bear upon their work, I would say:—

(1) Each member should consistently regard his profession as a fraternity, and act fully upon this idea in his capacity as a member of an Association.

(2) He should remember always that he is deeply indebted to the profession for knowledge generously placed on record by pioneers and contemporaries, and, consequently, he should share in supporting societies created for mutual professional benefit, and contribute, whenever possible, from his own store of knowledge.

(3) He should jealously guard the dignity of the profession by bringing to bear a constant personal desire to see it held in the highest esteem, both within the Associations and without, and he should hold close the ideal that his mission is not personal gain, but public good, and the strength and security of the country.

### **Brief Review of the Position of the Engineering Industry.**

The war has forcibly reminded us that a nation, to be reasonably secure, must aim to be self-contained. It has also shown us more clearly what our resources are. So far as primary products are concerned, we are fortunately

situated, but in engineering we are far from it, and no engineer in Australia can have any doubts as to the loss, the delay and the inconvenience which has been caused to Australian industries by their inability to procure from outside the country during the war numberless articles of vitally necessary importance. We could have been of vastly greater help to the Empire if we had been able to produce certain engineering products instead of actually being somewhat of a drag. There has always been a strongly-voiced sentiment that, because Australia is a great primary producer, it was impossible at the same time that she should develop any great manufacturing industry. Whether in national politics that statement has any weight, I am unable to discuss, but that it is essential to our progress, if not our safety, as a nation, to build up and maintain a great and profitable engineering industry, I do not think will be gainsaid by any one. Let this outstanding fact, then, be borne strongly upon us, and the means to meet it will be found. We have seen that battles are not won entirely by fighting men, but almost equally as much by fighting industries. Preparedness for war is very little more dependent upon the training of men than it is upon the training or organisation of all the sources from which spring the munitions of war, and of these engineering is essential and predominant. Indeed, as we should all now know, it is in well-prepared machinery for war appears to lie the greatest safeguard against it, and in the unfortunate event of war it proves the greatest means of saving precious life.

But quite apart from the question of the bearing the engineering industry has upon the capacity of a country for war, there is surely room for development along peace lines of a flourishing industry in a young and growing country already producing, or demonstrably capable of producing, practically all of the base metals, and certainly all of the fuel necessary for such. One still very frequently

hears the statement that Australia is merely a huge repair shop, and this argument has been used to explain away our inability to rise to the occasion when certain schemes for construction locally have been proposed. I feel strongly that we should vigorously combat that argument. So far as I am able to judge, it appears evident that, with the rapid development of every strong nation, there has been coincidentally phenomenal growth of its engineering industry. Think of America, Germany, Japan, and of our own mother country, Great Britain, from whom, latterly, the younger nations were rapidly whittling away her former pre-eminence in the industry. Engineering for centuries flourished in Great Britain, but her very pupils were fast displacing her when war overtook us. We have yet to learn whether, by the casting aside of many traditional habits of thought, the building up of huge additional manufacturing plants and the forced outstretching of the hand of the manufacturer to the scientifically-trained assistant, she will return to her place of pride. The difficulties that hinder the building up of industries in Australia are certainly greatly discouraging, but they must not be accepted as insuperable—they must be met and overcome. Such, indeed, is the spirit of engineering. We exalt our soldiers because of their exceptional resourcefulness and general fighting qualities. We cannot believe, then, that the bulk of those left behind to carry on the business of the country are without many of the same qualities. It is a question of turning these qualities to profitable account. Every day there is growing up a greater necessity for engineers to enter into consideration of the scientific use of labor. It is dawning, perhaps too slowly, upon those who are directing our industries, that it is not enough for them to be up to date in developments of a technical character only, but they must be wide awake to the fast moving changes in economics and administrative affairs. For years past the cry has been

general all over the British Empire that we had lost the ability to organise industry. That we were, in many respects, indeed, suffering from the want of organisation, has been only too obvious, but that the capacity for organisation was absent has been sufficiently disproved to still the voice of the greatest pessimist. It would be futile to dwell upon the abundant evidence of the magnificent organising ability displayed in so many directions in Great Britain during the past few years.

But what I am more directly concerned about to-night is the organisation of engineering here in Australia. The opportunities for its development are very great, and, fortunately, there is ample evidence to show that even prior to the war, but now inspired to greater effort by its lessons, very striking progress was being made. I would refer you to Table II.

It would be impossible for me to attempt, in this short address, a broad retrospect, but I propose to briefly outline a few of the outstanding features of engineering developments during the last few years, because I believe they provide both encouragement and inspiration.

Quietly, but surely, is there growing up in this country a powerful steel industry, which may, sooner or later, have an effect on other markets than our own. The air of romance surrounding the development of Lithgow iron and steel has always laid firm hold of our imaginations, and now we see it a growing business, and, together with the great Broken Hill Proprietary works at Newcastle, establishing a record of the very first importance to Australia. Not only is it expected that these firms will henceforth provide the whole of Australia's requirements of steel rails, but the time is not far distant when export may be possible, and, if there is anything certain, it is that rails will be in tremendous demand after the war. The manufacture of steel sections and plates is, I believe, only a matter of time.

TABLE II.

DEVELOPMENT OF ENGINEERING INDUSTRIES  
 — FROM 1909 - 1914 —

	ENGINEERING, IRONWORKS, AND FOUNDRIES	INCREASE %	RAILWAY AND TRAMWAY WORKSHOPS	INCREASE %	ENGINEERING, IRONWORKS, FOUNDRIES, RAILWAY AND TRAMWAY WORKSHOPS, & AGRICULTURAL IMPLEMENT WORKS	INCREASE %
NUMBER OF FACTORIES	164 — 950	24	68 — 715	10	980 — 1,179	20
" " EMPLOYEES	17,862 — 25,776	44	13,176 — 21,745	65	35,139 — 51,376	45
ACTUAL HORSE-POWER OF ENGINES USED	11,000 — 33,000	100	10,700 — 11,000	3	24,000 — 47,500	95
APPROX. VALUE OF PLANT & MACHINERY	£1,450,000 — £2,900,000	100	£1,300,000 — £2,050,000	58	£2,900,000 — £5,400,000	86
TOTAL AMOUNT OF WAGES PAID	£1,700,000 — £3,150,000	85	£1,650,000 — £3,100,000	90	£3,100,000 — £6,160,000	80
VALUE OF FINAL OUTPUT	£4,800,000 — £8,900,000	85	£3,250,000 — £6,150,000	90	£9,300,000 — £16,500,000	77
" " ADDED IN PROCESS OF MANUFACTURE	£2,150,000 — £4,920,000	79	£1,800,000 — £3,640,000	102	£4,400,000 — £9,200,000	108
POPULATION					4,320,000 — 4,940,000	15

The rolling of iron and steel bars is being extended by several firms in the larger cities of the Commonwealth, and there is no reason why, a few years hence, we should go outside the country for any of these things. The manufacture of rolling stock wheel tyres, forged from the solid, of steel of a tensile strength of 55 to 60 tons per square inch, and delivered at the rate of 60 per week, is typical work which could not have been undertaken at the present time if the local steel works had not been able to supply the special blooms.

Of yellow and white metal alloys, it is interesting to note the development along sound lines of the manufacture of rolled manganese, phosphor and other bars, and this difficult business has not been undertaken without due recognition of the necessity for maintaining a laboratory for the scientific control of the processes. The manufacture of solid drawn copper tubes is now being carried out successfully, and the rolling of copper sheets is approaching fulfilment. These are portentous happenings in the engineering history of the Commonwealth. In our foundries, very considerable improvement is taking place everywhere in the extension and addition of modern equipment, the capacity of which, for large iron castings, is now practically unlimited. For the more difficult work of steel casting there is also a most noticeable improvement, and the increasing number of plants in which attention is being confined entirely to this class of foundry work indicates a realisation of the fact that highly specialised experience is required to successfully turn out good steel castings.

The casting of steel rolling stock wheels is gradually developing to a satisfactory stage, and it is generally understood that the establishment of another modern plant on extensive lines is contemplated in the near future at Newcastle, which is rapidly becoming, as is natural with a deep-water coal port, a great manufacturing centre. When

it is remembered that there are now approximately 20,000 miles of railways in operation in Australia, only 4,000 less than in the United Kingdom, it will be realised what possibilities there are for the local manufacture of rolling stock material. When we turn to the manufacture of finished machinery there is, I think, much to strengthen the contention that we have long since passed the state of being repairers of plant only. Twenty years ago, practically the whole of Australia's locomotives were imported. Now each State is making its own, some of them all of their requirements, and it is certainly very doubtful whether locomotives will ever again be imported into Australia. Not only are the State Governments making locomotives in their own shops, but private establishments are participating in this work. It is to be sincerely hoped that this state of affairs will continue, for if manufacture in private establishments is stopped the result will certainly not be beneficial as far as the cost is concerned, and the stifling of private enterprise would be fatal to the country. One private establishment in Queensland, which is practically the pioneer in locomotive construction in Australia—that is, on extensive lines—has now made nearly three hundred locomotives, and some years ago were turning out one complete loco. per week, supplying quite a number of Southern States. As we are all proud to know, a private establishment in New South Wales is now proceeding with the contract for 300 locomotives, but, unfortunately, is grievously hindered in its work by the want of raw material. In fact, Australia will never be the machinery manufacturing nation it should be until it produces everything from the raw pig to the finished article, until it has mills which can roll all sizes of steel plates and sections, and until it turns out all sizes of copper and brass plates, tubes and rods. The figures quoted above mean that repetition work on a large scale is being carried out, and you will realise what this means to any

establishment. One of the great troubles confronting Australian manufacture is the necessity for, and the difficulty of, specialising. His market is restricted unless we can manufacture from our base metals so efficiently as to export. Practically every business, engineering or otherwise, must have some speciality which, under fair conditions, will keep it reasonably busy in manufacturing the whole year round.

Perhaps no better example of high-class workmanship could be quoted than the manufacture of modern high-speed steam engines, and these are now being very successfully made in several Australian workshops. For example, the 800 H.P. triple expansion engine shown in figure. In the manufacture and export of agricultural machinery, harvesters particularly, quite a striking success has been achieved, and the export of a considerable quantity to the Argentine and elsewhere indicates what can be done by organisation and specialised manufacture. The imperative call of the man on the land for a cheap and handy form of power to supplant hand or horse has given the manufacture of internal combustion engines a great impetus. Before the war, perhaps 10 per cent. of the supply only was made in Australia and 90 per cent. imported. Let's hope that in ten years' time the percentage will be reversed. Oil engines from a half H.P. of the farm unit type up to a semi-Diesel marine engine of 150 H.P. are now being made. Pumping machinery is of such a varied character that standardisation or specialisation is difficult, but there is such abundant evidence of the capacity of Australian works to turn out the very highest class of plant, either centrifugal or reciprocating, that I need not stress the point. It is encouraging, however, to know that it was estimated that, whereas ten years ago only 15 per cent. of the centrifugal pumps used were made locally, this figure is now believed to be fifty per cent. Refrigerating plant has, for many years, been made in Australia, but it is worth noting that the



largest compressor so far made here was recently completed by a local firm. In machine tools, wood-working machinery, rail and road tractors and cars, tin-making machinery, electric motors, capstans, boilers of every class, including water-tube, we have further reminders that Australian engineers are broadening Australia's resources, and, given reasonably stable economic conditions, they would prove themselves well able to maintain the reputation Australians are given for resourcefulness. Much is being done, but one cannot help reflecting upon what might have been done had the Australian Governments more determinedly fostered or encouraged the production of what may be called the raw materials. As it is, we are, metaphorically, wringing our hands and crying out for materials that, under efficient exploitation, are available in illimitable quantities within our borders. To give a concrete instance: Steam boilers, which, before the war, could be manufactured and sold for approximately £32 to £40 per ton complete, are now costing £70 to £100 per ton, due almost wholly to the fact that boiler plates are only procurable through import sources at from £50 to £80 per ton, whereas a modern steel plate rolling mill establishment at one of our large coal and iron centres could be producing and selling them under present conditions at £14 per ton. Let us not forget, too, that our engineering industry has long since proved its ability to manufacture every class of mining machinery, and to carry out works of large proportions, as witness some of our great railway undertakings, the complete meat, sugar and other factories, the sawmills and mining plant. The prophet in Australia has had, I am afraid, a no more cordial reception than his fellow prophets in other young countries, and it has consequently been an uphill fight for many Australian industries to obtain honor from the Australian consumer, but the lessons of the war should surely serve to instill in every mind the determination to do what

each one reasonably can to strengthen Australia's hand in the endeavour to increase, not only her natural resources, but the utilitarian value of her people as a whole. Conservatism will certainly not enable us to successfully meet the conditions that are to come. It should not be necessary to repeat that every country has had to buy its experience, and if we are at times inclined to criticise too harshly the productions of our local industries, let us remember that they are part of the price of experience, without which we cannot expect manufacturers to get that practice which makes perfect. The manufacturer must, at the same time, be always ready to listen to and benefit by the criticism of the user.

It is with feelings of regret that I refer to the manufacture of shell cases here last year, but I do so because I have so often heard very harsh criticism of the work done by several of the firms, who so patriotically entered into the business, and which has proved so thankless, and, from an important point of view, very unprofitable to them. From men who have had experience, both here and in Great Britain, I have learned that beyond doubt the work done in the workshops here was quite as good in every way as that in both the British and American made shells. The technical periodicals of both these countries have referred very fully to the many failures of well-established works to come up to requirements when the work was commenced. The failure of that sorry business was not largely attributable to any incapacity on the part of Australian workshops, and even though the productive result was disappointing, there is no doubt that the repetition work to accurate measurements and rigid inspection had a beneficial effect upon many of the establishments that undertook the work. What steps will be taken by the Commonwealth Government to ensure the successful manufacture of such munitions in the future will be watched with much interest.

by Australian engineers. With the experience of the past few years to build upon, we can surely expect that a sound scheme in keeping with the defence of the country should be easily devised.

I do not, however, wish to dwell further upon preparedness for war, but rather upon the more wholesome thought of preparedness for peace, although, as it seems clear that the strength and importance of any nation is determined more by its capacity for manufacturing iron and steel than perhaps by any other factor, one cannot very easily separate the necessities of either set of conditions. Coal, iron and steel are the three greatest sinews of any nation, whether used for peace or for war. Having the first two in abundance, our position is safe with regard to their child, steel, if the industry is allowed to properly develop.

Whatever its bearing may be from the point of view of trade balances, there is surely the greatest significance in the fact that, whereas, in 1913, Australia exported £13,000,000 worth of unmanufactured metals, she imported over £16,000,000 worth of manufactured metals and machinery. From the nature of most of the metals exported, it is obvious that we could not profitably turn the greater proportion of them into manufactured metals and machinery, but that there is very ample room for development in this direction there is no doubt. Let it be remembered that with all the copper, the tin, the zinc and the lead Australia produces, until about a year ago not a brass or copper sheet was rolled, not a pipe drawn in the country. Do we, as engineers, really appreciate the fact that in certain respects in the production of basic metals Australia leads the world, and yet from these very metals we have not, as has been recently pointed out, so much as rolled the necessary sheet brass to make our cartridge cases for defence purposes. But now that the product of these mining and metal industries has been saved from our enemy's

claws, let us hope that an attempt will be made by the Governments and the captains of our manufacturing industries to ensure a fuller use of them within the Commonwealth by working up a reasonable proportion into manufactured articles for the large local requirements at least. Let us realise, too, that much the larger percentage of our imported manufactured metals and machinery is of steel and iron, and yet we have known for very many years of the widely distributed deposits of iron in the Commonwealth awaiting development. There is opened up a vista of great possibilities for the conversion of these deposits into marketable commodities. I have referred above to the creditable work of private firms in developing our raw material, and it is certainly worth recording that the Queensland Government recently appointed a commission to consider the establishment of State Iron and Steel Works, and the recommendation of the commission was that a small pig iron furnace be established at a cost of approximately £5000. While this undertaking will not in all probability be of any practical utility for some considerable time to come, it is a move in the right direction, and one that will meet with the approval of engineers generally.

It is generally accepted that by a country's capacity to turn its own raw materials into commodities is largely measured its prosperity and self-containment. If, then, our safety in war and our prosperity in peace are so dependent upon the development of our iron and steel industries, there should be needed no stronger call for the whole of the community, and the engineers in particular, to endeavour by every means at their disposal to support and encourage it. The Engineering Associations of this State, in which are situated important branches of this industry, have a special interest in this matter, and it is, in the popular phraseology, "up to us" to give our vigilant attention to every means whereby we can aid in increasing the efficiency

of manufacture, both insofar as the appliances required are concerned, and in the application to the best use of the materials produced. In this way we can take part in helping to organise upon a national basis. Organised national production can be the only true foundation for a truly economic system. By this I do not necessarily mean State control or ownership, but that each member of the community should consider the welfare of national industries a matter of personal concern.

Two directions of national importance and in which great developments appear to be possible, and certainly desirable, are, first, labour-saving machinery for agriculture, and cheap and rapid transport of the products therefrom, and secondly, in shipbuilding. Referring to the first-mentioned, there appears to be a big opportunity available for the manufacture in the Commonwealth of agricultural machinery, and particularly with regard to tractors, or, as they are called in Great Britain, agri-motors. The growth in the use of these in every part of the world is enormous, and even with the retarding effect of expensive "oil, there is certain to be great developments here. We have not only to remember the aim to save the cost of labor (I believe, the most expensive in the world), but to provide against shortage by greatly reducing the number of hands required. It will often prove ultimately profitable to instal machinery where, in the first estimate, an actual money saving cannot be shown. Nowadays, every good-sized farm is more or less a factory and every man who owns a farm owns a manufacturing potentiality. The old idea that the farmer could manage horse power so long as it was in the shape of flesh, and not in the mechanical equivalent, is being rapidly dissipated, for every modern farm has its machinery, and most farmers nowadays have to be either handy men themselves or employ skilled mechanics. How remarkably well there has been demonstrated the development of mechanical

knowledge in the farm community during the recent upheaval when the countrymen came to the city, and very many of them took on winch and other machinery driving with comparative ease. The conditions in America and Canada, where, perhaps, 60,000 farm tractors are now in use, are, in many respects, similar to those in our own vast country, where even now some 15,000,000 acres are under crops. The hauling of our wheat and wool over long and sometimes waterless distances, and the cultivation of the land in a trying climate, suggests so many ways in which the mechanical horse would be more suitable.

The demonstrations taking place everywhere certainly seem to herald the horseless age for commercial purposes. It might interest members to know that towards solving the great problem of mechanically harvesting the sugar cane of the world, and of which some 2½ million tons are annually grown in Australia, definite progress has been made, and a film recently exhibited privately showed that two workers, Messrs. Luce and Cockerill, of America, have each produced machines that appear to be capable of performing many of the operations necessary, but with what degree of perfection it is impossible yet to state.

To refer at all exhaustively to the question of ship-building would, of course, take too much time; but, as the matter has recently been before the public, and this Association for discussion, and it is even now, perhaps, one of the most acute problems of the war, I intend to briefly refer to it again, if only to express regret that, for reasons which appear too obvious to permit of any but the one construction, Australia is to again be left standing at the barrier, whilst other nations have long ago jumped into their strides towards helping the Empire in a crisis, and at the same time established permanently on a firm footing a national industry. Crossing the harbour daily it has often struck me that even in the carrying of some £2,000,000

worth of timber alone to this country, quite a large fleet of auxiliary sailing vessels have come into being, and, although we are the customers who pay for the timber, and consequently largely support the business, and we have at the same time all of the facilities locally for constructing such ships ourselves, so far nothing whatever has been done in this direction.

It is a somewhat remarkable thing that in this huge sea-girt land of ours, endowed with all the materials required for the construction of ships, and upon the shores of which are the sixth and eighth ports of the Empire, the annual construction of commercial floating craft has, on an average, only been some sixty small vessels, of a total net tonnage of between two and three thousand. If it were not for the building of small coasting vessels, ferry steamers, and dredges, from which one can abstract some satisfaction, the record would be a very disappointing one. The main reason will, no doubt, be found in the explanation that could be given for our lack of progress in many other directions, and if, in the time of war, when we have seen the birth and re-birth of many things which were difficult of accomplishment before, we have failed to kindle truer national sentiment, what is the prospect of success afterwards? Who would deny the need for ships? It has not come upon us as a shock, but for the last two and a half years we have practically seen what was coming, and throughout the intermediate stages that which was a coming need grew into a pressing one, and now is almost crushing. And so far, it has been impossible for us to make up our many-sided mind. In time of peace, quick decision, action, is more often than not successful; in war it is essential, for although the line taken may not be the most direct, the object is usually achieved in the quickest time. One leader who is able to use his forces promptly is worth in an emergency a

score more able men who cannot agree. Our Government told us that they were going to build ships; our experts agreed upon the practicability of doing so; some of our craftsmen were ready to forego some of their so-called rights in order to see help rendered the Empire in what has been stated to be her supreme crisis, but yet precious time flies on, and still our many-sided mind is not made up. Gentlemen, we talk liberally enough of the union of science and industry; we talk of research as though it were a discovery since the world-storm broke; we talk of industrial organisation as though it were invested with some new and mysterious power, yet evidence of all these things is here in our midst, amply demonstrated but undeveloped. And why? Surely because those who have the energy and ability to develop industry cannot be sure of the efficient support of that other arm which is necessary to carry on any business. Everyone of us is concerned that the Commonwealth should be industrially successful. Whatever the faults may be at present, it will probably be admitted they are, to a great extent, characteristic, and have to be outgrown or driven out by education. Each one of us has to realise that there are no underlying principles that will meet any case.

It is with much diffidence that I refer at all to the question of labour, for so many abler minds are concentrating upon this all-important question. If, however, I have a true conception of the functions of this Association, I take it that we must accept some responsibility in helping to elucidate the great problem of bringing Australian labour to a higher state of efficiency. It is not an exaggeration to say that our whole economic future is bound up with the question of labour economy. We must remember that we are in a unique position; our membership list contains a large number of engineers, each one a link which, welded by the warmth of association, provides a chain of thought,



reaching from the centres of scientific education, and many of the highest Government and private executive offices, down through every branch and grade of engineering practice, to our young representatives commencing upon their careers, and for the first time in their lives in close touch with the so-called men of the world. We should, therefore, play an important part in moulding the character of many of the future leaders in our industrial life, and we must pay due regard to their training so that they may be fitted in after years to manage and direct those whom they will have to control. Every industrial concern wants, or at least should have, its engineer, and, if well trained in the business work, there are many high executive positions awaiting the man with ability in this respect, reinforced with skilful engineering experience. The word "commercialism," in its relation to engineering, has taken on a far too mercenary meaning of late years, and, although our ideals will always hover around about the more scientific work of the Association, and from which progress will come, if the majority of us look for the reason of our professional being, we will find a commercial business standing at the back of it. The history of the past few years has shown that it is possible that we may have to reconsider our relations, as a scientific association, to many things at the present time considered outside our scope. There can surely be little doubt that we should endeavour to take a leading part in assisting the fortunes of the industries many of us in some measure represent, and in which we are all interested, and it seems increasingly difficult to do so without entering into active discussion of economic reforms. I offer no decided opinion at the present time, but I think it would be as well for members to keep this matter closely in mind, so that if it should come up for definite debate in the near future, they will be prepared to discuss it with clear ideas as to the objects aimed at. We must remember that, in common with many of the older

societies, our Memorandum of Association was framed nearly half a century ago, and the developments of industry in the meantime have taken many turns that could not possibly have been foreseen at that time. Particularly must we keep prominent the consideration of the training of our young engineers, but I cannot possibly detain you longer to hear any opinions of mine in this respect to-night, as I may have already said much that has tired you, although, if I have succeeded in turning anyone's thoughts in the direction of realising the bigger part that he, as a member of an Association of Engineers, may play in the development of engineering, I will be amply repaid. Personal service is the most essential characteristic required, for it must be plain that nothing, however beneficent it may be potentially, is of any value until it is appropriated and set to work. Let each one realise that, by co-operating, his efforts will more quickly become stable achievements.

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