Another great stride which has taken place in steam marine is the increase in power and speed. When the "Austral" first arrived in Sydney she was justly considered a wonderful vessel, and on a trial trip (after being sunk and raised), she obtained a speed of 17 knots and developed 6,000 h.p. Although this took place only four years ago, it is now a comparatively poor effort judging by what other vessels are doing at the present time.

Torpedo boats have attained a railway speed of thirty miles per hour. They have English coasting steamers travelling at twenty-six miles per hour. The home liners practically bridge the Atlantic in six days at the rate of twenty-three miles per hour, while vessels of the "Ormuz" class have brought the world's antipodes within thirty days of each other.

The time is not far distant when, with vessels such as the "Victoria" and "Prince of Wales," the steaming time between Sydney and Melbourne will be reduced to 24 hours, and vessels of equal power will run from Sydney to Newcastle in 3 hours.

As a suggestive indication as to what is being done, and what we may expect in the near future,—there is now being constructed at Naples, under English supervision but with Italian labour, a vessel which is to develop 22,800 horse-power. She will have 60 distinct engines, 90 cylinders, and her piston speed will be 1,020 feet per minute.

This is a new departure with a vengeance, but changes come quickly in our time. What is the wonder and novelty of to-day is in a few months commonplace, and looked upon as a matter of course.

Respecting this mighty power of steam, which is in all cases confined for the use and convenience of man, it is interesting to have some definite idea of its actual force.

In Fairbairn's "Useful Information for Engineers" will be found a calculation where an ordinary locomotive engine, working at 100lb. pressure, has a pent-up force within it equal to 60,000 tons; but this sinks into insignificance when compared to the vessel referred to. She has 18 boilers, 78 furnaces, and 160 lb. of steam, and the amount of surface exposed to that pressure is equal to 720,000 tons.

It is when such calculations are reduced to simple figures that we truly realise our responsibility in designing and constructing suitable and safe prisons to confine this monster. We must leave no loop-hole for escape, for although as a servant its energy its ceaseless and untiring, as a master it means destruction and death.

In speaking of the great things we have done with steam, it is well to remember we are only bunglers after all. With all our science and knowledge we can only utilise about 15 per cent. of the total heat that is in the coal, the other 85 per cent. being wasted.

The knowledge of this fact should teach us humility, for we are only on the threshold of economy, and have much to learn.

Reflecting on the present mania for excessive speed, this hot, feverish haste and hurry, we will find it is not by any means confined to the application of steam power; it is prominently seen in nearly all our professional and business relations, and the question naturally suggests itself: Is all this necessary or judicious? Is it healthy or conducive to happiness that we should be in such a confounded hurry to get through life? The question is easily answered: We have no choice, for competition's stern experience makes it compulsory, if we would retain our position; and, whatever we may think, we cannot stem the tide, and must, therefore, go with it.

With regard to its effect on health, its tendency is certainly injurious, as I shall endeavour to show.

As engineers we pride ourselves, when designing machinery, in making every part exactly proportional to the strain it has to bear, and if one machine is made to work at 60 and another at 120 lbs., they are both made equally strong for their respective purposes, and the margin of strength is the same in both cases. Not so with us, for the continuous excitement and bustle of our present life seems to have increased most materially the mental strain which professional and business men have to bear, and we forget that the human brain is a constant quantity, where original strength cannot be augmented, and yet we continue to increase

its mental load to such a degree that the human factor of safety is like a spring strung to its utmost tension, and liable to snap at any moment.

How all this will end no man can say; but in all departments of life—in the parliament, in the press, in the counting-house, and the workshop—the statement will be endorsed that the human machine is out of proportion, overloaded in fact, and that the mental strain is, in many instances, too heavy for the structure.

So far as we are professionally concerned, this is mentioned for the purpose of showing that, in our anxiety to make satisfactory machinery for other people, we often forget and injure our own.

Another wonderful feature in the present standard practice of engineering is the greatest development of specialties.

It is now an inevitable and foregone conclusion that financial success, not only in engineering but in manufactures generally, can only be attained by a combination of special men working special tools, and although in most instances the finished work is highly creditable, cheap, and admirably suited for the purpose intended, still the system has a deteriorating influence on the average scope and skill of the workman.

This, of course, has scarcely been felt here yet, but at home there are hundreds of thousands of men who work at the one thing and nothing else all the year ronnd, and, in a mechanical sense, I fear the result will end in generating a feeling of monotonous indifference, cramping and confining their intellectual powers, lessening their independence, and, worst of all, will have a strong tendency to make the production of "good all-round men" an unknown quantity. If you ask how this is to be rectified, I frankly and freely admit my inability to even suggest anything that would remove this evil

This special method of working is intimately connected with the present hard, keen competition, which has produced such great changes in the relative positions of the various countries, a competition which is now seriously affecting the most vital interests of all English speaking countries.

Let us look for a moment at our present position. It is not so many years ago, in fact within the memory of many of the members here to-night, that the home country had a complete monopoly, so far as engineering is concerned. Less than half-a-century ago, the most advanced countries such as France, Germany, Italy, Russia, and America produced only sufficient for their own wants, and almost everything in the shape of machinery was made by Englishmen. No locomotives or marine engines, no rails, no steamships, no spinning machinery, iron bridges, and I might add very little iron or coal could be made or supplied out of England. In a few years what a change!

It was after the Exhibition of 1851 that this competition began to be felt and even then the cloud was no bigger than a man's hand, but it has so increased that it now bids fair to assume the proportions of a mighty avalanche, threatening (as an eminent writer puts it) "to sweep the English trade off the face of the earth."

When serving my apprenticeship, thirty-five years ago, it was a subject of common remark that in such shops as Stephenson's, Hawthorn's, Sir William Armstrong's, and others, a large per centage of the premium apprentices were foreigners, who, though very good fellows, were looked upon as being very much inferior to the average Englishman, and never at all likely to affect the profession in any way. There we made a great mistake, and now we are making the still greater discovery that these were the men who, being well educated and practically trained in British workshops, went back to their respective countries, and by their energy and enterprise, their patience and thrifty habits, by study and close attention, are now not only independent of their teachers, but have to all intents and purposes turned our best customers into our most powerful competitors.

Thirty years ago English, and I think I may say Scotch, engineers were to be found in almost every country holding prominent positions and having almost sole control of European machinery, on the railway, in the arsenal, afloat and ashore, whenever and wherever the work to be done required special mechanical

skill and experience, it had to be carried out under their management and supervision.

Now their occupation is gone, their services are no longer required, the pupil is as wise as his teacher, and his engineering education is completed. He is now in a position not only to supply his local wants, not only to compete with us in the markets of the world, but he is strong enough to tackle us on our own grounds, and in many instances successfully. Numerous cases might be cited, but a few will be sufficient.

Many of our ship and engine builders get their steel castings (used in marine and other heavy work) from abroad. They are made in Antwerp and delivered in London or any English works at some £3 per ton cheaper than can be supplied by English makers. The cement used in the construction of the Rochester Bridge came from Germany, being equal in quality, and much cheaper than our own people could supply, although their works were situated close alongside the bridge.

Then we have again the bounty-fed sugar to contend against —a system which has, to a great extent, crippled the industry in Australia—both as regards its production and in the construction of machinery.

Coming nearer home, we see in Sydney Harbour splendid lines of foreign steamers (built by Englishmen to compete with them) which are subsidised to double and treble the extent of our own vessels, enabling them to run under such conditions that what would be a loss to us would be a profit to them.

Then, in America we have another rival who, as a competitor, has both brains and tools to do almost anything that can be done in England or anywhere else. In railway construction, in locomotive building, in bridge work, in electricity, and many other branches they are equal to us, and in some instances surpass us. Take watchmaking as an example: a few years ago an English-made watch was allowed to be the personification of mechanical skill and accurate time-keeping; now it is practically dead—killed by the establishment of a system (which we cannot but admire) so complete that, although paying higher wages, they

can produce a better article at a cheaper rate, pay freight and all other expenses, and then undersell us on our own ground to such an extent as to justify the statements just quoted, viz.,—that English watchmaking is a dead industry.

How all this is to end; how it will or can be adjusted, is a question which is forcing itself prominently forward, and at no distant date must be faced, and it is devoutly to be wished its solution may be satisfactory to all concerned.

Following close after specialities and competition, and intimately connected with them, comes the question of the general depression.

The scarcity of gold—the depreciation of silver—over production—under consumption—strikes—competition, and many other things have been assigned as reasons, and no doubt have more or less to do with it; but during the last twelve or eighteen months the conviction has slowly but surely forced itself on my mind that if we look nearer home we will find that the mechanical engineer has a great deal more to do with this depression than is generally supposed.

For many years the brain and intellect of our best men have been directed and devoted to the invention, design, construction and application of labour-saving machinery; and any engineer making a machine capable of doing the work of ten, twenty or one hundred men, and of doing it quicker and cheaper than by manual labour was, and is, looked upon as conferring a benefit on his kind.

English engineers have always taken a pride in the construction of labour-saving tools, and although for many years a source of profit to the makers,—principally through sending them to foreign countries—the seed sown so freely and extensively is now ripe, and, in a mechanical sense, the harvest is very much to our disadvantage.

In designing such machines it has always been the aim—in fact, the highest ambition—of the engineer to so construct them that their successful working and commercial value would be judged by the amount of manual labour that could be dispensed with.

In this we have succeeded to such a degree as to almost justify the statement of having made a rod for our own back.

In all trades, and in all branches of trade—on the farm, in the mine, on the wharf, in the warehouse, anywhere, everywhere—labour-saving machinery is the paramount object where work has to be done.

Consider for a moment what has been accomplished. First of all, we have that prince of mechanics, Joseph Whitworth, making lace machines, which are now working in Nottingham, and one of which is capable of doing the work of 8,000 women. Then we have in railway construction the steam navvy, each capable of doing the work of 80 to 120 men. In the cotton trade such is the perfection of their machinery, they run their spindles at from 8,000 to 10,000 revolutions per minute, and although producing four times as much as they did in 1850, yet, machinery has superseded manual labour to such an extent, that only one is employed to do the work that required two thirty years ago.

In the shipping trade the same thing holds; the work that took three men in 1850 is now done by one; besides, the number of hands has only increased 36 per cent., while the tonnage has increased 360 per cent.

Again, taking a calculation made in 1881, we find that if the additional work done by machinery now had to be done by the appliances of 1850, the increased number of artisans required would equal the total population of Glasgow, Liverpool, Manchester, and Birmingham, a number closely approaching the total inhabitants of the Australian colonies.

If we go over any modern engine-shop, we find shearing, multiple punching and drilling, steam and hydraulic rivetting, shaping, rolling, stamping, flanging, and many other machines capable of doing almost anything, and every one specially designed to economise labour.

The same holds in wood-working, in brick and bread-making, in printing, in gas-making, boot and shoe making—in fact, in everything we see the most complete appliances for doing the maximum of work with the minimum of labour.

In a previous part of this address reference was made to the stupendous progression (unprecedented in history) which has taken place almost in a lifetime, and we are advancing so fast now, that the following question has often occurred to me: If, in the future we advance in a greater ratio, or even at the same rate, is it conceivable—is it possible that the present depression is an indication that with the aid and assistance of labour-saving machinery, the world's works and the world's wants can be supplied, and more than supplied, and yet leave half the population unemployed.

I know and appreciate what machinery has done for the comfort, convenience, and happiness of the race. I know it employs a large number of men to make it, look after, repair, and renew it. I know it cheapens production, that it increases the purchasing power of wages, that through it the necessaries of life are better and cheaper, and that to all who have money, fixed incomes, or constant employment, it is a benefit every way; but it is of little use pointing out these advantages to hundreds and thousands of men who have and can get neither work nor wages, and whose number, not in any particular country, but in all, seems to be an ever increasing quantity.

The annual increase in population must be met, or rather, should be met, by a corresponding increase in production, but the present proportion between the two is bad, one-sided, and out of joint. Production is represented by a whole number, and increased requirements by a fraction, and it is this unequal balance that has thrown the world out of gear, presenting a problem which transcends all others.

How is the equilibrium to be restored? Can it be done? Who is to do it? Or must it, like troubled water, be left to itself to find its own level? Few, if any, can answer such questions. We have had Royal Commissions and Reports enough, but all to no purpose. Our very complete system of education will not help us. On the contrary, its invariable tendency is to increase mechanical and decrease manual labour. In fact everybody admits the necessity for action, but nobody seems to know what should be done.

In thinking and reflecting over this matter, I would ask your careful consideration to the question. Looking at the present and future prospects of trade, it is possible that the human intellect has attained, or rather, may attain, such a stage of development as to make it a matter of serious consideration whether the ingenuity and inventive ability of the Engineer should not to some extent be restricted, in order to keep the people employed?

In attempting to give expression to such opinions on the present depression, I am well aware they will be freely criticised. I have certainly no pretentions to speak with authority on such a subject, and probably in the opinion of many, what has been said, may only have its sincerity to commend it, but right or wrong, in either case some good may result, if it be only in directing the attention of those who are much better qualified to deal with what appears to be the question of the day, viz.—How are the people to be employed?

In conclusion let me thank you for your patient hearing, and let me repeat that important changes come quickly in our day, and the present indications are such that we may be called upon before long to deal with matters affecting our most vital interests, and which in all probability will result in our having to exercise a large amount of self-denial, in having to work harder, possibly longer certainly cheaper; we may have to curtail our expenses, pocket our pride, and practice habits of economy and thrift; but whatever we may have to do, and notwithstanding present troubles, I have every confidence in the energy and courage of the race from which we have sprung, and that we will come out of the present struggle with credit to ourselves, and to the profession to which we are all proud to belong.