PART II.

PAPERS.

10TH NOVEMBER, 1887.

ADDRESS BY THE PRESIDENT.

W. D. CRUICKSHANK, M.I.M.E.

IT is my privilege on the present occasion to have this opportunity of expressing my high appreciation of the compliment paid me in electing me your President for the present year.

Being the Centenary of the Colony enhances the honor, and it is exceptionally gratifying to know you consider me worthy of filling a position of which any engineer would feel justly proud.

As one of the original members, who took an active interest in its formation, any time I have devoted to its affairs (which was to me congenial employment) has been more than amply repaid by the success and progression we have made in the attainment of the objects for which the Society was founded.

It is now seventeen years since its inauguration, and although in the early part of its existence it had many trials and difficulties to overcome, still, like many other things in life, the greatest pleasure was in the struggle, and our present position is such, that we may with fair justification assume the foundation to have been well and truly laid, and that those who in a few years will fill our places, can have no reason to be ashamed of our labours.

In accepting office it is as well to remember that both members and management have duties to perform. It is true our positions are purely honorary, still they carry certain responsibilities, because the public look to us as the representatives of a profession, upon whose knowledge and experience the successful and economical development of the resources of this country to a great extent depend.

Engineering is only another word for civilisation, and in studying our history during the last century, every one must be struck with the fact, that the extraordinary progress made by Australasia in power, wealth, numbers and influence, has been to a great extent rendered possible by and through the labours of the Engineer.

It is, therefore, well we should realize, and recognise, how much depends upon us, for in this busy, high pressure age, this age of keenest competition, this continuous struggle for "mechanical supremacy," we must see to it that we are not left behind in the race, for it appears to me that the "survival of the fittest" may, in the near future, have practical application to many things, scarcely dreamt of at the present time.

The work done by the Society during the past session has been highly satisfactory ; both papers and discussions have been above the average, embracing a variety of subjects of considerable interest and importance to the Colony.

There is every indication that the present year will be equally successful, and I confidently rely on the advice of the Council and the hearty support of the members to make the year worthy of our one-hundredth birthday.

It is scarcely necessary to particularise the various papers brought before the Society, as the Annual Report gives all needful information on that head, but it is, I think, very desirable to refer to the effect of our periodical excursions which have been so conducive to the development of social and friendly feeling, for besides being instructive and pleasant, they are the best lubricant for reducing, and in fact removing, that professional friction which as a natural consequence must exist amongst men who are in active competition with each other.

Another great and important advantage of such meetings is, as Engineering is divided into so many sections, and as it takes a man all his time to keep himself up to the mark in his own department, they are invaluable in giving the members an excellent opportunity of seeing what is being done in other branches, resulting in an extension of our general knowledge in such a pleasant and instructive manner, as to commend itself to all concerned.

It should, therefore, be our aim to promote and encourage those excursions by every possible means, knowing that by so doing we are studying the best interests of the Association.

During the last few years it has been the custom of past Presidents to follow the example of kindred societies in the old country, by delivering an address on Engineering, and if the present attempt (which is made with considerable diffidence) does not come up to the standard of expectation, I must claim your patience and indulgence on the plea of its being a sincere and conscientious effort.

Respecting the various and most important works which are being carried out in the colony—such as the Hawkesbury Bridge, Sydney Water Supply, the comprehensive sanitary measures taken for the disposal of sewage, the extension of our railways, the realization of the importance of water conservation, our improved buildings and streets, &c.; it appears to me that to enter into any detailed account of them would be a mere repetition of what you already know. Many of the works we have had the pleasure and the privilege of examining, besides which they have been minutely described in the public press.

The same holds respecting the principal works in the old country—such as the Severn Tunnel (just completed), the Manchester Ship Canal, the Forth and Tay Bridges, the various improvements in mechanical appliances, in electrical and other machinery, in gas and steam engines,—not forgetting to credit Australia with the success of the Brennan Torpedo. All these, with many others, have been fully detailed in the scientific papers, and anything but a glance at them would probably represent so much time wasted.

There is one thing, however, to which I think special attention should be directed, and that is, our utter helplessness to prevent this fair city or Sydney and its harbour from being daily enveloped in volumes of dense smoke. Every particle of smoke represents so much heat wasted, so much unconsumed carbon, a black, tangible proof of how little we really know; and a proof also of our ignorance and extravagance in wasting the capital with which nature has so liberally endowed this colony.

This public nuisance—for it is nothing else—is increasing in a very rapid ratio, and although its prevention and cure have hitherto puzzled our best men, still the difficulty should only act as an incentive towards solving a problem whose solution would be a public benefit.

With your permission, therefore, my remarks will apply to our profession in a general, or rather, a universal sense, glancing at the past and present, and concluding with a reference to the present depression.

Man is naturally curious: the spirit of inquiry is strong within him. His mind is so constituted that, in all time, he has developed a strong desire to know the reason of things.

Many of the best men the world has produced have devoted their lives in attempting to fathom and understand natural laws, and the best method of applying them for the use, comfort, and convenience of life.

It was only after hundreds of years, and after numberless failures, that he began to understand the true method; and it was only when fable, fancy, and metaphysical assumption gave place to practical experience and observation that real progress began, and this progression has now given us a safe and reliable guide which has enabled us to perceive and understand in its truest sense the phenomena of the physical world.

Many of our best men's lives have been devoted to this object, and we, who live in such an advanced age, are now reaping the benefit of their labours.

In this colony we are exceptionally fortunate, having many privileges and advantages, but, like many other things, we are so accustomed to them that they are scarcely appreciated at their true value.

For our present position we are indebted in a material degree to the spread of education, and, as a community, have reason for congratulation, inasmuch as the Government of this colony have inaugurated a complete system of technical training as will compare very favourably with any other country.

In connection with the establishment of technical schools this Association may justly claim a fair share of credit, for it was principally by our efforts that their importance and necessity was demonstrated; and in fact it was because we felt the want so much that caused this Association to be founded.

At that time we had many so-called "mechanics' institutes," but they were all, or nearly all, mere circulating libraries, and utterly failed to serve the class for which they were originally intended, and it was only when we began to feel our inferiority as regards technical knowledge that the awakening came.

Our method of teaching, as at present established, is on the most liberal scale, for it makes ample provision for all professions and trades whereby any young men can, at a nominal rate, acquire a thorough knowledge of "first principles," and there is every encouragement and facility given to induce such a resulting harmony between theory and practice as will beneficially affect the future destinies of our manufacturing and mechanical industries.

Again, the setting up of a certain standard of efficiency, and the granting certificates only to those who reach it, is one of the most suggestive features of modern education. This, in the opinion of some, is being carried too far, and in some cases, perhaps, it is; but the principle is sound, and might, with advantage, be applied to our social life.

In all professions and trades—in theology, law, medicine, commerce, and engineering, everybody admits and clearly understands the importance and necessity of having to undergo a severe training, extending in most cases over a term of years, before they can attain that degree of efficiency which will enable them to earn a profitable livelihood.

That this system of compulsory qualification is right and just will be generally admitted; it affects both men and women in almost all the relations of life, except one, and that one—the most important of all. I have often thought that if the framers of our educational code had given due consideration to the future comfort and happiness of this community, they would have insisted on the future wives and mothers of New South Wales attaining the same proficiency in domestic economy and household management as in other branches, and if we could only turn the present fashion upside down, and put the practical and useful before the ornamental, it would not only remove an almost incalculable load of extravagance and mismanagement, but would have the most beneficial effect in developing the beauty and purity of that "home life," which in all time has been the mainspring of true happiness.

While on the subject of education it is very desirable to direct the special attention of our young engineers to the almost supreme importance af having a knowledge of chemistry.

This grand science stands out very prominently as one imperatively necessary before we can expect anything like an economical utilization of those rich, natural stores of which we are always boasting. The loss this colony has sustained (especially in mining) through a want of chemical knowledge we can never know, but it must amount to millions of pounds, besides, in many instances, having a tendency to introduce an element of distrust in estimating the true value of our varied resources, and especially of our mineral wealth.

This, however, should only be the means of stimulating those who have the opportunity of undergoing a training, and acquiring a knowledge which in their professional career through life, they will find acting as a lever, whose power is multiplied many times, and always to their advantage.

STEAM AND STEAM NAVIGATION.

It is now a little over 2000 years since Hero applied the elastic force of steam to move his engine, but whatever ingenuity was developed in its construction and application was kept secret by a cruel and bigoted priesthood, who used it only to prey on the superstition and ignorance of the people, and it is a most curious and remarkable fact that this mighty power lay dormant and unknown for nearly 1,900 years. (Hero's engine made 130 B.C.)

The first engine that really did any work—and did it badly—was Savery's, in 1698. Then comes Newcomen, Smeaton, and Hornblower, bringing us down to 1782, and even then all the engines made were empirical in design, crude in construction, and wasteful in working. It was not until Watt took hold of it that its mechanical and financial relationship began to harmonise, and the date of its recognition as a successful and economical motive power is scarcely so old as the foundation of this colony.

The world's age is a disputed point, some reckoning by thousands, others by millions of years, but however that may be, there is nothing in its history that does not sink into insignificance when compared with the stupendous and unprecedented bound of progression which has taken place almost within the memory of living men, affording ample food for reflection and having an important bearing on our present and future prospects which will be referred to further on.

Referring to the early efforts made to get at the real amount of work done by an engine—the first reliable attempt was made by Smeaton, in 1774, who from a series of experiments found it took from ten to twelve pounds of coal to generate as much steam as would be equal to one horse-power. Watt, by his improvements, practically halved it, and so it went on till the introduction of the compound engine, about 1870, which, with improved design and superior workmanship, has reduced the price paid for a horse-power to two pounds of coal.

It is, however, since 1881 that the progress has been so exceptionally great. This decided advance is principally due to the labours of Mr. Kirk, who undoubtedly deserves the credit of demonstrating the economy and success of the Triple Expansion Engine, and it is interesting to note that it was by the successful voyages made by the "Aberdeen" between London and Sydney that has caused such a revolution in marine engineering. This vessel works at the *now* moderate pressure of 125 lb. sq. inch, her average consumption being 1·7 lb. per 1 H.P.

With the present pressures—160 lb. and triple expansion engines—the consumption has been reduced twenty-five per cent., comparing it with the ordinary compound working at 70 to 80 lb., and this has been beaten by Messrs. Rankin and Blackmore, who, with 180 lb. pressure and quadruple expansion engines, claim to have brought down the consumption to 1·25 lb. of coal as the price of a horse-power, that is to say: in Smeaton's time it took from 10 to 12 lb. of coal to develop a horse-power; now we can do the same work—raise the same weight—with $1\frac{1}{4}$ lb.

These high pressures have, in exceptional instances, been considerably increased, but always with questionable safety and doubtful economy, as it is generally admitted that we have nearly reached the limit where the temperature of the steam itself requires consideration as being so high as to affect the strength of the material.

This rapid and permanent advance in the possible working pressure is mainly due to the general introduction of steel, and it is this great mechanical invention that has caused such a revolution in constructive art.

The successful manipulation of this grand material is intimately connected with the names of Bessemer and Siemens, for in it we have moderate cost, a tensional strength equal to twice that of iron, having no grain or fibre, is equally strong in all directions, can be regulated to any required degree of ductility, approaching, as Siemens himself said, "the hardness of the diamond on the one hand and the toughness of leather on the other."

It is only simple justice to say that the names of Bessemer and Siemens will always be intimately connected with one of the most important eras in the world's history, for their labours will distinctly mark what is now universally recognised as the age of steel.

This steel is invaluable in the construction of high pressure boilers, and although far from perfect in design, still the proportion, material, and workmanship, is of such excellence as to make them quite as reliable and equally safe, if not more so, than others working at one tenth the pressure.

Another radical change which is likely to come into general use before long is the application of forced draught and mechanical stoking.

Respecting the first we have had little or no experience here as yet, and even at home it has scarcely passed the experimental stage. So far as economy is concerned, a simple comparison will illustrate its importance.

With a natural draught we now burn about 16 lb. of coal per hour on every square foot of fire-grate, but on a locomotive we consume about 70lb. on the same amount of grate-surface, and as the power developed should be in direct ratio to the coal consumed, it simply means that if the forced draught can be successfully, economically, and safely applied, we shall get the same amount of steam with one-fourth the boiler-power; and, even if not carried to such an extent, if we burn 32 lb. instead of 16, all engines would do the same work, and develop as much power, with one boiler as they now do with two.

With specially designed boilers, having proportional heating surface, there may be no reason why they should not succeed, more especially as they would be exceptionally adapted for burning those inferior brands of coal which, with a natural draught, are practically useless. But there is another side of the question which requires to be carefully and cautiously considered.

In boilers carrying high steam—say 160 lb.—engineers now realise the importance and necessity of keeping the internal surfaces quite clean; and their practical working has taught us that a thickness of scale which would be harmless at 80 lb. will overheat the plates at 160, and (in my opinion) for this reason. Heat from the furnace plates to the water will pass through them quickest when the surfaces are quite clean, the water perfectly pure, and no pressure on them. When the pressure is raised the tendency is to press or compress the particles of water into closer contact, thereby retarding the velocity of transmission, lessening the water-absorbing power, and increasing the liability to overheat the plates.

Special provision is always made in triple-expansion engines for "making up" the loss by leakage, radiation, and condensation, by having an ample supply of pure fresh water, and which amounts on our Orient liners, when everything is perfectly tight, to about fifteen tons of fresh water in twenty-four hours.

Now, with forced draught and taking an extreme case, if we burn four times as much coal in the same sized furnace, we generate four times as much heat, and we therefore tax the absorbing power of the water in the proportion of four to one, that is to say, the water would have to do four times as much work as it does with a natural draught.

In a letter recently received from an eminent engineer in London he states that at the trial of one of the Isle of Man boats, which attained a speed of 22 knots, the temperature of the furnaces with forced draught was reported to be 3,500 deg. Faht., which he considered "very risky" unless the circulation was wonderfully good, and even if so, thought it very apt to boil the water off the plates in places.

When it is considered that the temperature of an ordinary furnace is from 2000 deg. to 2,500 deg. Faht., and that this forcing has increased it to 3,500 deg., we naturally want to know if anybody has any definite knowledge or evidence to guide them as to the limit of the absorbing power of water, which I think is very doubtful.

We all know there must be a limit to the temperature of the furnace, and also to the power of the water to absorb the heat as fast as it is generated. Knowing this, it is only taking a common sense view of this forced draught to say that it is possible and even probable we may get too near a temperature which would leave us an indefinite and perhaps fractional margin of strength.

At all events, in dealing with this question there is every reason for the exercise of care and caution, and the element of safety must be clearly and practically demonstrated before its general adoption with confidence becomes possible.

As regards mechanical stoking, it is bound to make its way, and on many large works it has been successfully applied. Many of the members present had the pleasure of seeing this mechanical wonder at the Mortlake Gasworks, where we saw furnaces charged, cleared, and re-charged in a manner which, for speed, precision, and work done in a specified time, is unattainable by human hands.