11TH NOVEMBER, 1886.

A. C. Mountain, President, in the Chair.

The PRESIDENT announced that the Council had appointed Messrs. L. Hargrave and W. E. H. Nicolle as librarian and secretary respectively.

The PRESIDENT presented a number of valuable books on engineering and scientific subjects, as awards of encouragement to those apprentices who had prepared and exhibited drawings, models, &c., at the society's late exhibition.

Mr. A. C. MOUNTAIN then addressed the meeting in the following terms, on the occasion of taking the chair at the first meeting, after his election as president:—

GENTLEMEN,—It devolves upon me, on taking the chair for the first time as President of the Engineering Association of New South Wales, to deliver a few remarks on subjects that are likely to prove of interest to members; although, with the exception of last year, when the Past President instituted the practice of delivering an address—it has not hitherto been the custom with this Association: but the fact that it is invariably done in all scientific or professional societies justifies the introduction of the practice here; whilst the opportunity thus afforded to refer in general terms to a variety of subjects bearing upon engineering work, and which are likely, more or less directly, to affect the welfare of this association, appears to my mind to be one which should be availed of—not only in the present instance, but on all future similar occasions. At the same time, I am sensible that to attempt the task of merely alluding in a very cursory manner to some of the works in our profession which mark the steady development of our country, or of touching on the still more delicate subject of the present position and probable prospects for professional men in New South Wales, is to self-impose a not light burden, and one from which I would

feel inclined to shrink, did I not have the consciousness that my audience is kindly and ready to make allowance for my shortcomings.

In the first place, it is quite impossible in a new and comparatively undeveloped country to give any narrative of great engineering feats that surprise and delight the world by their originality of conception and novelty of design, as is the case in the old world, where—year after year—the records of difficulties overcome, of fresh mastery of the powers of nature, of new discoveries in the world of science, or of the additional achievements, for the benefit and advantage of the human race, are dwelt upon by the chiefs of the great engineering societies of England, Europe and America, to the delight and instruction of their audiences. Rather is ours the case of a nation, young, vigorous and impulsive, throwing its whole energies into the actual work which has to be done, and in doing which it finds no time to waste in the quiet contemplation of patient thought so necessary for developing the faculty of invention, thus of necessity causing its work to be largely the outcome of the best and ripest experience of the old world masters. That this should be so at our present stage of growth is inevitable, and not at all to be deplored; but, as the fever heat of youth passes away, and the calm and repose of maturity begins to appear, there can be no doubt that Australia will produce her inventors and men of genius and originality in the various branches of our common profession, even as—in the course of time, and under the influences of the fostering conditions of leisure, technical culture, and opportunity—the countries of the old world have produced their great engineers and mechanics.

I propose, in a brief way, to refer to the more noticeable works in New South Wales, thus giving a general idea of the strides she is taking in the race of progress; after which I would wish to make a few remarks on the state of the engineering profession in the colony at the present time, the prospects and inducements for men to follow the profession in the future, and the advantages and opportunities that are afforded to those desirous of entering upon that career.

In the first instance it is well to remember that the peculiar conditions of Australia were such as to render it inevitable that, for many years at all events, the most important engineering works of almost every description, should be carried out by the State; thus *Roads*, closely followed by *Railways*, were constructed in order to open up the country and afford facilities to the inhabitants to dispose of their produce in its different markets; *Bridges* to span the rivers and streams, thereby shortening and rendering safe such means of communication; *Breakwaters and Jetties* to form safe havens for our shipping, and *Docks* to repair same; *Dredging* and other *River Improvements* to render our larger steamers subservient to the needs of commerce; the *Electric Telegraph* to transmit our message, literally "with lightning speed" were soon undertaken by the Government; whilst following in their wake, and continuing up to the present time, are the various works commenced for *Water-Supply* and *Sewerage* (rendered necessary by the growth of population in our larger cities and towns); *Fortifications*, *Hydraulic Cranes*, and other appliances for shipping coal; and now, in all probability, *Irrigation*, all of which have been, and are being, executed under the direction and control of engineers employed by the State, or by some local public body, instead of being, as is the case in older and more populous communities, largely carried out by private enterprise. It will thus be seen that the scope for private engineers is, comparatively speaking, very limited, whether considered from the standpoint of a civil or mechanical speciality.

This natural disadvantage has been increased during the past few years by the severe depression in all branches of commerce and industry under which this colony has laboured, a depression primarily due to the trying seasons to which it has been subjected, and also to the universal stagnation in trade which has been reported from other countries. Whether the evils thus caused have been aggravated or lessened by the policy of our legislators—whether prudence wisdom and true patriotism are the motives which guide their deliberations—are questions on which I will not venture to express an opinion in this place; but will content

myself with remarking, with deep regret, that the present condition of engineers of all grades and classes in this community, outside of those holding public or official positions, is distressing in the extreme, from whatever cause arrising; and that probably, at no period of our history has there been a larger number of men connected with engineering work (either as professional men, designers, or operatives) unable to obtain employment. It is also a significant fact that all our private engineering firms are compelled to reduce the number of their hands to a minimum, and are doing very little business; whilst in the case of those professional men who have secured engagements, many have been forced to accept a rate of remuneration that would be refused by a labourer! We can only hope that under more favourable auspices—with better seasons, and a general improvement in commerce and manufactures—we may soon find prosperity replace the present anxious period of depression.

I now propose, in the briefest possible manner, to refer to some of the principal works in the Colony, naturally commencing first with—

RAILWAYS.—Probably everyone here present is aware that the first railway in Australia (Sydney to Parramatta, a length of 14 miles) was opened in 1855, and that the construction of our present railway system was slowly carried on until in 1876 there were 509 miles open for traffic. That 21 years should have elapsed whilst executing this work was due to many other reasons than engineering ones; although, as this work included the crossing of the Blue Mountain Range, in the case of the both Southern, Western, and Northern Lines, and involved the construction of the famous Zig-Zag, and the driving of several long tunnels, there was sufficient difficulty to render the work both formidable and tedious. During the past ten years the extensions have been much more rapid, there being, at the present time, about 1,790 miles of railway open in the colony, and through communication established between Sydney, Melbourne, and Adelaide; whilst Brisbane will, in the course, probably of one or two years, be also linked to Sydney with the "iron band." Undoubtedly

the most interesting feature in connection with our railway works will be the new bridge now being erected across the Hawkesbury River, by the Union Bridge Company of New York, under the direction of the Engineer in Chief for Railways of New South Wales. This bridge is designed of seven openings, each of 415 feet, resting on steel piers, each of which forms a single caisson 52ft. x 24ft. at base, with flat sides and rounded ends, on which a pair of cylinders are to be built above water level to carry the girders.

The especial interest attaching to this bridge will, of course, be the successful sinking of the caissons, which, in some instances, may have to be sunk as deep as 170 feet below water level, in order to ensure a good foundation, and the accomplishment of which feat will be watched with interest by all engineers,—in view of the fact that in this particular (viz.: the depth to which the caissons will have to be sunk in order to obtain a sound bottom) the bridge will be *unique*. It is designed to carry a double line, and will be the longest bridge in the Southern Hemisphere, being over 2,900 feet in length. The girders are to be of the usual American lattice type, with pin fastenings for eye-bars and struts, rivets elsewhere.

An illustration of the American whipple truss, with pin fastenings is also to be seen in the new iron bridge over Iron Cove Creek (between Petersham and Summer Hill) which was completed a few days since by sliding the half width of the bridge intended for the up-line, from a temporary framing on which the traffic had been carried whilst portion of the old stone viaduct was being demolished into its permanent position on the new brick piers. As we are to have a paper on this very well executed alteration (which was only about five hours in execution, and which it was my privilege to witness) I shall not here do more than say that the bridge was designed by Mr. Max Thomson, A.M. Inst., C.E., under the supervision of Mr. Cowdery, Engineer for Existing Lines; whilst Mr. Kendall, Assistant Engineer, superintended its erection and subsequent change of position.

Roads and Bridges.—I quote from Prof. Warren, A.M.I.C.E., the following remarks on a bridge now being erected over the

Paterson River, from an official report of an inspection made by him of the superstructure in the yard of the contractors, Messrs. D. and W. Robertson, of this city, as illustrating probably the best type of bridge yet designed by this large and important department, both as regards economy of material and suitability of construction. "The bridge consists of two lattice main girders, continuous over three openings of 91 feet, 119 feet, and 91 feet respectively, placed 23 feet apart from centre to centre, and each forming a continuous girder 303 feet long, resting on masonry abutments and extending over two intermediate cylinder piers. These girders are 8 feet in depth and parallel throughout their length excepting at the ends where they are curved to the form of an ellipse; they are fixed to the S.E. abutment, and rest upon expansion bearings upon the other abutments, as well as over the two intermediate piers. The booms are trough-shaped and connected with double lattice web; the bottom booms being connected together with horizontal wind-bracing. * * * The workmanship is equal to the best imported bridge work. The dead load in the deck and cross-girders is 25 cwt. per foot run; the weight of main girder is 8 cwt. per foot run. The bridge has been designed to carry a live load of 84lbs. per superficial foot, as well as the dead load. The superstructure weighs 0·75 tons per foot run; the total weight of iron work in superstructure and piers being about 300 tons, whilst the total cost amounts to £31 7s. per foot run of bridge. The bridge is very light for the loads it is calculated to carry. At the same time its lateral strength to resist wind, pressure and vibrations due to rolling loads, as well as its vertical carrying strength, is fully up to the heaviest traffic that may ever be expected to pass over it. The expansion arrangements are worthy of special notice, for it is well knownthat the provisions in this respect in most of the bridges both in England and the colonies are, to say the least, defective and uncertain. As the stress produced by non-expansion may in many cases exceed those due to the heaviest traffic, it is most important to interfere as little as possible with the free expansion of the bridge. In this case the expansion is reduced to a certainty, as the rollers are 2 feet in diameter, and the load per lineal inch does

not exceed 13 cwt. This arrangement is the invention of Mr. J. Alex. Macdonald, A.M.I.C.E., M.I.M.E., who has also designed the bridge under the supervision of Mr. Wm. C. Bennett, M. Inst., C.E., Engineer-in-Chief for Roads and Bridges"

This report is especially of interest as being made on a bridge that has been both designed and manufactured in the colony; and which after being subjected to the critical inspection of our engineering profession, passed through the ordeal in so satisfactory a manner.

METROPOLITAN SEWERAGE.—In connection with the Roads and Bridges Department, the construction of a sewerage system to deal with the drainage of the greater portion of the city and suburbs is being carried out, and is now approaching completion. As the chief aim of this work will be to intercept, as far as practicable, the sewage which now discharges into and pollutes the harbour, by sending portion of it out to the ocean and utilizing a part for the purpose of forming a sewage farm below Cook's River, it will effect a much needed improvement in the sanitary condition of the metropolis.

The trunk sewer, designed to drain the northern district, extends from the centre of the city easterly to the coast line at Bondi, being a length of $4\frac{1}{4}$ miles: this is chiefly driven through solid rock, except near the coast, where drift sand and water (requiring much ingenuity in overcoming) were encountered. This sewer is now completed, and the construction of several branch intercepting sewers is being proceeded with. The southern and south-western district will be drained by a main sewer starting in Surry Hills, and running southerly across Cook's River (crossed by means of an inverted syphon) on to a sandy tract of land, now being laid out as a sewage farm. The main sewer is now finished, and the syphon is nearly so, although the execution of this work presented more than ordinary difficulties (owing to the bad bottom in part of the river bed), which delayed the works considerably. There will still be a great deal of work to do in gradually connecting the existing sewers of the city with the new scheme, and many knotty questions to settle; but there is little doubt but that the greater half of the work is now completed.

WATER SUPPLY.—The very extensive scheme for the supply of water to the metropolitan area is also one which has occasioned a considerable amount of public attention, both from the magnitude of the works and the necessarily lengthy duration of the contracts into which it is divided. As the temporary supply scheme, constructed by Messrs. Hudson Brothers for the Government, has already tapped the permanent works near Guildford, and delivered water to the city, it may be said (in a measure) that this large scheme is now approaching completion.

Commencing at the Pheasant's Nest (a point about 63 miles from Sydney by the line of the conduit), the water is carried through tunnels and open masonry channels to the storage reservoir now in course of construction at Prospect, which will be undoubtedly the largest artificial lake in Australia, covering, as it will when full, about two square miles, and calculated to contain (*vide* Report of Commission on Water Supply) an available storage of about 7,000 million gallons, at a level of 195 feet above sea-level. From this reservoir it is intended to bring the water, partly by wrought and partly by cast-iron pipes, into the Crown Street Reservoir, supplying, *en route*, the new Circular Service Reservoir just completed at Petersham. The whole of this essentially national undertaking has been carried out under the direction of Mr. E. O. Moriarty, M. Inst., C.E., engineer in chief for harbours and rivers; who is, in addition, providing schemes of water supply for several of our inland towns (particularly Newcastle and Maitland, where very complete pumping engines are erected with this object). The new graving dock at Cockatoo Island, and various works of harbour improvement, also the very excellent hydraulic cranes at Bullock Island, for the speedy shipment of coal, should not be omitted when dealing with the important work entrusted to this department.

With reference to the maintenance and extension of water mains and sewers under the control of the municipality of the city, I find from the report of the City Engineer that, of water mains nearly 20 miles were laid during the last year in the way of extensions; and that the sewers of the city, large and small, comprise a length of 60 miles.

ELECTRIC TELEGRAPH.—Mr. E. C. Cracknell, M.I.C.E., informs me that the extension of telegraphic communication has been such that there are now no less than 19,864 miles of wire in use, and 2,625,992 messages transmitted last year. With regard to electric lighting, installations are now running at the Railway Station, Parliament Houses, Randwick Tram Shed, and at both Circular Quay and Cowper Wharf.

As it is not long since the members of this association listened to a paper descriptive of the improvements that had been effected in paving the main thorough-fares of this city with wood, and also with basaltic stone, no further reference to this subject is needed here, beyond the remark that there are now about 207,000 square yards of carriage-ways paved with wood, and 45,000 square yards of cube-sett paving now completed; whilst money has been voted for at least half as much more as the area already finished: also, that after 6 years' experience of the Colonial hard-wood, its durability is undoubted, as the cost of maintaining the wood roads during that period has not exceeded one-half per cent. per annum on the prime cost. The slipperiness of the wood during wet or greasy weather is counteracted by spreading sand over the road, which is now being partly done by means of Garratt's "sand distributers," an ingenious invention imported from London, which will soon entirely supersede the manual work both in point of efficiency and cost.

The grave question of disposal of house refuse, etc., which affects the sanitary condition of a city so much, has not yet been finally dealt with, although some exhaustive reports on the subject have been submitted to the authorities in favour of treatment by fire, somewhat similar in character to the processes adopted in Leeds, London, and other English cities. It cannot be long before some such system will have to be introduced in Sydney, as at the present time it is becoming a serious question to know what to do with all the various and offensive "waste products" of a populous city.

GAS WORKS.—I should not omit to mention the very fine works recently constructed by Mr. T. J. Bush, the engineer to the Aus-