13ft. 4in. depth of hold; displacement with passengers on board, 420 tons; co-efficient of block, .3, which indicates that the vessel has very fine lines. She is to be propelled by triple compound engines of 800 I.H.P.; cylinders 16ft 25ft 41ft, supplied with steam from two boilers of the navy type, 9ft. 9in. diameter x 18ft. long; heating surface, 2607 sq. ft.; steam pressure, 160 lbs. per sq. in. The estimated speed on trial is 15½ knots, and on ordinary running service 13 knots. The vessel is to be equipped with all the latest improvements, and is to be thoroughly up to date. The speed of 13 knots, or 15 miles per hour, in ordinary service is a considerable advance on the average speeds of the past, and there is little doubt but that these speeds will be further increased when the demand is made for a high speed suburban steam water service. What has been attained in this direction in America may be gathered from the description of a high speed service about to be commenced there. The proposed vessels are to be built of steel throughout:—Length, 150ft.; beam, 15ft.; draught, 4ft. 6in. The estimated speed is 35 miles per hour. The propelling machinery will consist of twin quadruple expansion engines of 4000 horse-power. The designer of these boats has already turned out similar craft, which has attained the high speed of 35 miles per hour, and one of them is expected to reach the high speed of 46 miles per hour.

Repairing Accommodation.—The progress made in providing accommodation for fitting and effecting repairs is represented by four (4) graving docks, one of which is in course of construction for Mort's Dock and Engineering Company at Woolwich, on the Parramatta River; five (5) floating docks, and five (5) patent slips, two of which are at Newcastle. There are also several small graving docks under construction on the northern rivers, to accommodate the floating plant used by the Government in the construction of the harbour works and breakwaters on the northern rivers.

The new graving dock now under construction at Woolwich is to have the following dimensions when completed:—Length, 775ft.; width, 84ft.; depth of water over sill, 32ft. It will, therefore, be able to take in the largest class of steamer trading to Sydney.

The principal docks and slipways in Sydney, with their loading dimensions and the size of vessels they will accommodate, are as follows:—

Name of Dock.	Where Situated.	Length ft.	Breadth ft.	Depth water over sill, ft.	Berthing capacity, tons
Graving Docks under construction, Woolwich	Woolwich	775	83	32	
Mort's	Balmain	641	69	20	
Sutherland (Govt.) ...	Cockatoo Island	600	84	32	
Fitzroy (Govt.) ...	Cockatoo Island	450	59	21ft. 6in.	
FLOATING DOCKS—					
Rowntree's	Waterview Bay	160	42	12	475
Woolwich (Mort's) ...	Woolwich	242	73	14	1500
Jubilee (Mort's) ...	Johnstone's Bay	317	55	15	1500
Johnstone's Bay (ort's)	Johnstone's Bay	100	23	7ft. 3in.	300
Drake's	White Bay	150	60	7ft. 6in.	300
PATENT SLIPS—					
Morts' No. 1	Balmain	270	30	11ft. ford. 17ft. aft.	2000
Morts' No. 2	Balmain	200	25	10ft. ford. 16ft. aft.	1000
Morts' No. 3	Balmain	80	13ft. 8in.	5ft. 3in.	40

The progress made in berthing accommodation is represented by the following figures:—

In Port Jackson the Government control about 17,500 feet of wharves, and private owners about 19,000 feet. The depth of water is ample for ships of the largest tonnage.

In Newcastle there is about 14,500 lineal feet of wharves, and it is estimated that the shipping capacity is equal to 25,000 tons of coal per day.

The crane or lifting capacity on wharves in Sydney is represented by three (3) ten-ton steam cranes, one (1) set of shear legs at Mort's Dock capable of lifting 80 tons, and one (1) set of shear legs at Garden Island capable of lifting 120 tons.

The engineering equipment of Sydney Harbour seems fairly equal to meeting the requirements of the largest steamer trading to this port.

Electrical Engineering.—The progress made in the State in the application of electricity to lighting purposes may be gathered from the following figures:—Number of generation stations in use, 34; indicated horse-power employed, 3500; value of machinery, about £100,000. It can hardly be said that the progress indicated by these figures is satisfactory, and it is to be hoped that the brilliant and extensive display of electric lighting shown in illuminating the public and other buildings, and in the lighting of our streets and parks, during the Commonwealth celebrations, will be an object lesson to the citizens in the advantage of electric lighting, and cause them to bring pressure to bear on the City Council, so that they will take steps to bring into existence at an early date a central generating station for lighting up the streets and public parks, and also for supplying current to householders at moderate cost. There are so many successful examples of municipal electric lighting plants in existence, that the City Council need have no misgivings as to the commercial success of the undertaking, provided they obtain proper advice.

Electric Traction.—The close of the nineteenth century has seen the beginning of the end of the steam tram service, which has for the last 20 years been the principal means of carrying passengers from the city to the suburbs. Few will, I think, deny that the conversion from steam to electric traction is a great improvement, and has already had the effect of increasing the number of passengers travelling. The Railway Commissioners' report for 1900 gives the number of miles of tram line operated by electric traction as nearly 20.

The current for the Rose Bay line is supplied from the Rushcutter's Bay cable tramway power-house by two Multi-Polar belt-driven generators. The output of each generator is 150 kilowatts, viz., 270 amperes at 550 volts. These generators also supply the power for working the air compressor pumps of the Double Bay sewerage.

The Harris-street Power-house.—The power plant at present installed consists of four sets of Reynolds-Corliss horizontal cross compound engines, each direct coupled to the generator. The generators are of the multipolar type, designed to be operated at a speed of 100 revolutions per minute, and to give an output of 850 kilowatts. Each generator is capable of delivering 1545 amperes at 600 volts, and to carry an overload of 50 per cent. for a short time. The output available at the generating station at present is equal to 4556 horse-power, but as the Railway Commissioners have decided to convert the whole of the steam tram service into electric traction, they wisely selected the Harris-street site with a view of installing a plant of 20,000 horse-power, and there can be but little doubt but that the city will require at least about 30,000 or 40,000 horse-power to meet all the requirements of an extensive system of tramways in the future, and to supply power to work the city railway, for there is little doubt but that this system of traction will be used, more especially as it will be free from the smoke and smuts which accompany the steam locomotives. A large amount of power should also be required in connection with the railway works, and the receiving and discharging depots for goods.

Water Power Generating Station.—Up to the present the progress made in utilising water for generating power has been confined to the Hillgrove power generating station, situated about seven miles from the mining town of Hillgrove, on Baker's Creek. The impounding reservoir for storing the water is formed by an embankment 500ft. long across the Gera River. The storage capacity of the reservoir when the water is level with the overflow is 300,000,000 gallons. The watershed area of the Gera River is of considerable extent, and would allow of a much larger impounding reservoir being built, if this be found necessary in the future. The embankment is constructed on a plan proposed by Mr. Cotton, M.P., and consists of a timber frame or crib work, built of round logs laid longitudinally the whole

length of the embankment, bonded and secured by bolt and spike fastenings to similar logs laid transversely. The spaces between the timbers are hand-packed with suitable stones, and the interstices of the stones are packed and well rammed with suitable material found near the site. I visited the works in August, 1900, the reservoir being then full, but subsequently the embankment was partly washed away by a very heavy flood; it has been re-built, but the rainfall has not been sufficient to fill the reservoir.

The water is conveyed from the reservoir to the penstock at the head of the creek by a flume one and a half mile long, 4ft. x 2ft., built of Oregon pine, having independent tongues fitted between the planks. The direction of the flume follows the contour of the ground, where practicable, but a considerable length of it is carried on trestle work, which in some parts reaches to a height of 40ft. From the penstock the water is conveyed to the generating station by a W.I. pipe 18in. diameter and 850ft. long. The water pressure available for driving the Pelton wheels is 206 lbs. per sq. ft., so that the depth of the generating station below the level of the Penstick is about 475 feet.

The generating plant consists of three Pelton wheels, each of 270 H.P., belted on to continuous current generators of 160 kilowatts capacity, viz., 100 amperes at 1660 volts; and two smaller Pelton wheels of 50 H.P. each, belted to two alternating current dynamos of 25 kilowatts capacity, for lighting purposes.

There is one 75 H.P. and one 25 H.P. motor running the batteries and vanners at the Sunlight mine at Baker's Creek. There are also installed two 50 H.P. motors at Baker's Creek mine. The distance from the generating station to the mines is about 4½ miles, and the motors run at a pressure of 1500 volts.

The lighting of the township of Hillgrove from the alternating current dynamos is done through transformers, which reduce the pressure from 2000 volts to 100 volts.

Technical Education.—The question of technical education is one to which this and kindred associations in the State should give their best attention, for there seems to be a consesus of opinion amongst the great majority of engineers that it is only by a more systematic training in scientific and technical subjects, as well as in business methods and in workshop management, that any country can hope to keep pace with the marvellous engineering and industrial progress of the world.

The industrial and engineering progress of the State at the close of the nineteenth century can at most be called moderate, but as we may with good reason hope that the inauguration of the Commonwealth of Australia will give a strong impetus to the development of its vast industrial and engineering resources, we may briefly refer to the institutions now in existence at which a scientific and technical training may be obtained to qualfy our designers, supervisors, managers, and directors to guide and control the industrial and engineering enterprises which, let us hope, will soon be greatly increased.

The Engineering School of the Sydney University stands first as the institution where the highest branches of technical education are taught. The course extends over three years, and consists of lectures on all scientific subjects which form the foundation on which the engineering profession is based. There is in connection with the school an engineering laboratory fitted with several types of testing machines, by means of which the students are able to determine the elasticity and strength of materials. There is also an experimental steam engine and boiler to enable the students to study the working and economy of the steam engine. In the year 1896 Sir P. N. Russel donated the sum of £50,000 for the endowment of the engineering department of the University. Under this gift the Senate has determined, with the donor'c approval, to award one scholarship annually for the encouragement of the higher education in mechanical engineering. At this school students or engineering apprentices, who pass the prescribed examinations and fulfil the conditions for entrance, may

continue their studies in the higher branches of mechanical engineering. For a more complete account of the various subjects taught at the Engineering School of the University, I beg to refer you to the University Calendar. I may, however, say that the scientific and technical training to be obtained there and the degree of engineering granted to successful students are considered equal to those of the Engineering Schools of the British Universities.

Sydney Technical College.—The foundation of this institution dates back as far as 1875, when a few of the members of this Association—including two past Presidents—wtih the assistance of other gentlemen, who took an interest in educational matters, started a Technical School with the object of improving the scientific knowledge of the Australian artisan. From 1873 to 1878 the work was carried on by these gentlemen. In 1883 a Board was appointed by the Government to take over the management, and the College became a State Institution. In 1889 the Board was dissolved, and the Technical College passed to the direct control of the Minister for Education, and is now under the control of a Superintendent appointed by the Minister. The College was first opened in1893; five years later the number of students was in excess of the accommodation, and at the present time, according to the daily papers, there are no less than 1000 applicants who cannot get admission to the classes for want of accommodation. I have a personal knowledge of one case where an application was made for admission to the Electrical Engineering Class nearly five years ago, and the reply came about a fortnight since to say that there was a vacancy. There is no doubt that the accommodation for students at the Technical College in Harris-street, and branch schools in the suburbs and other centres of population, is too small, and it is to be hoped the Government will take immediate steps to increase the building accommodation and the number of teachers, so that there may be ample opportunity for apprentices and other students to acquire the technical knowledge they are in search of in connection with their occupations.

An examination of the syllabus of the Department of Engineering at the Technical College shows that there are four classes of persons for whom the classes are intended, viz.:—

1st. Youths who intend entering the engineering profession.

2nd. Those who are engaged in drawing office duties, and wish to learn the manipulation of machine and other engineering tools.

3rd and 4th. Those who are engaged in various trades, but desire instruction in the use and practice of machine and other tools.

The course of instruction outlined in the syllabus for mechanical engineering seems suitable for the class of students for which it is intended; and there is little doubt that the apprentices to mechanical engineering who attend the full course of lectures and receive the diploma in mechanical engineering will appreciate the advantage it confers in giving them a clearer insight into the principles and construction of the work on which they may be engaged in the various workshops. It is scarcely necessary for me to point out to the gentlemen present that it is just after the youth has finished his apprenticeship that he begins to realise the great necessity for technical education if he wishes to succeed in attaining a responsible position in his walk of life. And it is just in this connection that the Technical College seems to fail in providing the opportunity for young men to continue their studies after they have finished their apprenticeship; and it is to be hoped that when the Minister for Education is looking into the matter of extending the accommodation for the junior students, he will give this matter consideration and arrange for a series of lectures, for advanced students of the College and others, on the higher branches of mechanical engineering and other industrial subjects, for there is no doubt that an advanced system of scientific or technical education is necessary if we are to aspire to keep in line with the industrial progress of the world. It should, however, be pointed out that technical education is of little value

unless accompanied by practical experience and sound judgment, for, although education will do much, it will not endow a man with common sense, and therefore the aim of the College should be to arrange the various subjects taught to produce the best possible results. The scope of the College is becoming so extensive that the Minister for Education should consider the advisability of appointing an advisory board, to consist of the leading professional men in the city, to confer with the Superintendent of Technical Education, so that the course of instruction and the work of the College may be kept up to date.

The brief reference made to the engineering works completed and in progress in the State at the close of the nineteenth century may serve to remind us that we have scarcely begun the great work of developing the resources of Australia for the use and convenience of the people, and there can be little doubt that the inauguration of the Commonwealth will cause a great demand to be made for engineering works of considerable magnitude during the next decade.

The works which seem to me to be most required are as under:—

(1) An extensive system of water conservation and irrigation, for it will be mainly by engineering works of this kind that the agricultural resources of the country can be fully developed.

(2) The building of light or pioneer railways, the regrading of existing lines, and the building of locomotives of the most powerful type, with a view to reduce the cost of transport, for it is mainly on the railway system of the State that we must depend for the transport of the agricultural and pastoral products of the land to the seaboards.

(3) An extension of the electric tramway system to the various suburbs, with an increase of the number of lines passing through the city.

(4) The building of a new Central Station at Redfern and the extension of the railway into the city.

The system of traction for the city portion will no doubt be electric, as this system seems to be gaining favour in Europe and America.

(5) An overhead electric tramway for passenger traffic along the wharves of the harbour, built on similar lines to the system in use in Liverpool, England.

(6) The erection of the long-promised North Shore Bridge and the lighting of the streets and parks of the city by electricity.

These are only a few of the engineering works which must receive attention at an early date, and when we consider the prospective development of the agricuiltural, pastoral, mining, and manufacturing industries of Australia, there seems to be plenty of scope for the employment of civil and mechanical engineers for many years to come.

Before closing these brief remarks, I should like to call the attention of members to the desirability of increasing the usefulness of the Association. Your Council have had under consideration the best means of doing this, and have decided, as you have heard to-night, to recommend that the number of members of Council be increased from six to nine (I hope that the number may be increased to twelve), so that we may have on the Council some of the younger members to assist in carrying on the work. The progress and usefulness of your Association greatly depends on the members assisting the President and Council, by the reading of papers, by their regular attendance at meetings, and by their taking part in the discussion. I hope, therefore, during the session which we have just opened, that those members who have papers to read will be good enough to notify the Secretary, who will be pleased to arrange for their being read at one of the meetings. Those members who have nothing they consider of sufficient importance to bring before the Association may have any question discussed if they will be good enough to formulate same and send it to the Secretary, who will have any question printed and circulated among the members.

Many of you are doubtless aware of the reputation of the American Society of Mechanical Engineers as an engineering and scientific society, and it may interest the members if I mention some of the subjects which are brought before it for discussion under the head of "Topical Questions and Interchange of Data":—

1. Has anyone ever tried to standardise sizes for keys? If so, what are his sizes?
2. Have you had any experience in outdoor work at night in wind and storm with portabel apparatus for light in large quantities, other than electric light?
3. What is the best design for line shafting transmitting over 50 H.P., permitting them to be stopped and started on any floor without interfering with the motor or other shafting?
4. In arranging chimney stacks for a battery of boilers, is it best to use one for each boiler, or pair of boilers, or to use one large chimney for the entire battery?
5. Why should anyone cut a half inch belt with twelve threads to the inch? Is there any objection to the U.S. standard of thirteen threads?
6. Have you had any experience with systems for purification of bad feed water before it gets into the steam boiler, either by precipitation or otherwise?
7. Is it better to have the lead increased with the load in high speed automatic engines, and, if so, why?

I have enumerated these questions at length, so that members may have an idea of the kind of subjects that are formulated for discussion in the American Society of Mechanical Engineering, and I need scarcely add that our Association may, with much profit to its members, introduce the same practice, for it will be the means of enabling the members to have any subject on which they wish a discussion brought before the Association, provided, of course, the subject submitted for discussion has the approval of the Council. The subject of smoke

prevention is one that will soon have to be seriously handled by all steam users in this city, for I notice by the daily paper that the Mayor of Sydney has called attention to the Act prohibiting the nuisance, and states that it is to be enforced at an early date. I hope some of our members may be able to read a paper dealing with this subject, or bring it on for discussion by formulating a question on the combustion of coal and the prevention of smoke.

In conclusion, I would point out that if we are to make satisfactory progress as an Association, we must recognise the advantage to be gained by attending our meetings, in order to exchange past experiences, to discuss difficult problems awaiting solution, and to cultivate personal friendships. I consider it the duty of every engineer to become a member of some Engineering Society, so that he may, by subscribing to its funds and by reading papers, help to carry on the work of putting on record the engineering experience of that part of the world in which he is located. If we desire to keep abreast of the rapid march of progress, which characterises the present age, an engineer's education must never cease so long as he continues in actual practice, and there seems no better way of educating oneself than by becoming an active member of some Engineering Society. I hope that the inauguration of the Commonwealth of Australia will give a great impetus to civil and mechanical engineering, for there is little doubt that the importance of a country greatly depends on the development of its civil, mechanical, and chemical engineering industries.