The President (Mr. A. C. Mountain, M.Inst.C.E.), addressed the meeting in the following terms:

I am called on, in accordance with the custom of this Institution, to make some remarks on matters of interest to Engineers before vacating that chair to which I was elected some twelve months since; and before doing so, would take this opportunity of thanking the members of the Victorian Institute of Engineers for the courtesy and consideration that they have at all times extended to me during my year of office as president. This has tended to lighten the duties of my office, and will serve to render its memory one of pleasant regret. In selecting my subject on this occasion, however, I experience much difficulty. The customary review of the principal engineering work of the year would, if necessary, be but little more than a repetition of the rapid but comprehensive sketch of the advances made in engineering science during 1894 (which was read by my immediate predecessor last year), seeing how barren of engineering enterprise the year just past has been in Australia; whilst, so far as the particular branch of the profession on which I am myself at present engaged, viz., Municipal and Sanitary engineering, I have so recently described what has been recently done in Melbourne in that direction, that I feel this also must be a closed subject to-night. Being thus, by force of circumstances, obliged to abandon the beaten track of the usual Presidential address, I will make a departure by considering—(1) The prospects afforded by the Australian colonies to the Engineer: and (2) I will make brief reference to one or two of the more remarkable developments of mechanical and engineering science in various parts of the world, which were either completed in, or were in course of construction during the year 1895.

(1) THE PROSPECTS OF THE CIVIL ENGINEERS IN AUSTRALIA.

Whilst every encouragement is being afforded in most of the Australian colonies for the training and proper education of young men destined for the engineering profession, it must at the same time be apparent to an observer that the scope and opportunities of the practising engineer in the Australian colonies are much more restricted than in the countries of the old world. Nor is this difficult to account for. Apart from the disparity in population, there stands the fact that so many of the large enterprises which are carried out in England by private Engineers, are executed in Australia by the State. These include Railways, Docks, Breakwaters, River Navigation, Water Supply and Irrigation, and (in a large measure) Roads and Bridges. Not only, therefore, is the Engineer in private practice unable to hope for anything like the income that is realized by many of the leading men at Westminster, but he has, too often, to eke out a living by arbitration, or by combining the duties of Architect or Surveyor with the work of his regular profession. Failing this, if he possesses sufficient commercial instinct, and enough capital or credit, he may abandon the more purely scientific side of his calling and develop into a contractor. It may, therefore, be freely admitted that the present prospects for private Engineers are not encouraging. It will, no doubt, be said that if work is to be done Engineers will be needed, and the State will give them employment. There is something in this contention, but it opens up a very debatable ground as to the extent to which State-employ offers inducements to the most capable men to enter its service. One thing is very evident—that it reduces the number of actually responsible Engineers to a comparatively few Chiefs of departments. As for the remainder, the best that can be said is
that they are afforded a chance of obtaining steady employments, very similar in status and remuneration to that of a successful clerk, policeman or corresponding functionary—excellent and suitable men, no doubt, but not possessing the special education and training that is necessary to the production of a competent Civil or Mechanical Engineer; nor can any alteration be expected, until a very large increase in our population is obtained. Whether that is likely to occur in Victoria other than by the natural rate of increase under our present methods is not for me to say. The fact remains that a large development of commercial and mechanical enterprise can only exist in populous countries, that no country ever attained greatness without population, and that Victoria in now languishing for want of both. But even as matters now stand, it must be admitted that—directly the present temporary cloud of depression passes from us—there will be fair prospects in Australia for the engineer. It is only: by comparison that one can actually realize what a virgin country this still is, and how much has yet to be done in it. When it is remembered that the United Kingdom (which is practically only the size of our own colony), supports a population of about 38,000,000 people who use 29,300 miles of railways, 3,814 miles of canals, together with numberless ports, docks, wharves, mines, factories, ships, etc., there would seem to be room for more than the one and a quarter million souls which comprise our total population at the present time; nor can it be long before the additional wealth and strength which a larger population means, will be ours; and with it will come the desire—nay the necessity—for the development of commercial and constructive works of various kinds.

For most amongst these, I am inclined to place the Mining industry, especially so far as Victoria is concerned. The substitution of well designed economical machinery, boilers, pumps, etc., for existing inefficient plants, would make the difference in many a mine between it being a call-paying and a dividend-paying property; there will be large scope here for the Mechanical Engineer. Also, the application of electricity in lieu of steam power in mines and other works is desirable wherever the conditions are favourable to the conservation of water under proper conditions, to drive the motive power for the generators; and this is an opportunity for the Engineering Surveyor and Hydraulic Engineer. One or two schemes have been designed with this object, one of which (situated on the Guayra River, near Armidale, N.S.W.), is intended to supply power to the hydraulic mines, and is now, I understand, in profitable operation. A bolder enterprise now in contemplation is the proposal to construct a high concrete dam to impound the waters of the Thompson and Abergeldie Rivers, from which to obtain power to work dynamos (by means of turbines), for the supply of electricity to work the mines and to light the town of Wallace. This dam, which will be of rubble masonry set in concrete, and which has been most carefully calculated and designed by Mr. J. B. Mackenzie, M.Inst.C.E., will probably exceed in height (viz., 110 feet) any similar structure in Australia, and if as successful financially as there is every reason to believe it will be from an engineering standpoint, should be the pioneer of many other dams in connection with hydro-electric schemes. It is designed to impound 1468 million gallons of water at a height of 85 ft., working three turbines of the Jonval type, which will drive the dynamos employed to generate the electric current. I understand that a very desirable amendment in the present law is being proposed, whereby the Government will have power (which at present does not exist), to grant permission for the erection of pole and electric wires over Crown lands, in connection with enterprises such as the one just referred to. This is highly necessary, as it will tend to encourage works which are of tangible and permanent benefit to the community, by removing an element of delay that now too often occurs in granting concessions; delay which often proves fatal to the success of the undertaking.

Another field for the Engineer will undoubtedly be in connection with Irrigation, and the development of inland navigation and the conservation of water in the parched interior, including locking rivers and constructing weirs and embankments across streams and catchment areas. When the area and form of the continent of Australia is considered, and when the cheapness of water-carriage is borne in mind, the almost entire absence of anything approaching to canalization or inland waterways is remarkable. France, which is a country that in compactness and unbroken coast-
line, somewhat resembles some of our colonies, possesses no less than 7,700 miles of inland navigation, of which 2,648 miles were of canals sufficiently large to carry barges of 300 tons burden. Up to the year 1891, about £55,000,000 had been spent by the State on these works, which were prospering, although the cost of carriage was as low as from 1d. to 1½d. per ton per mile. Laws have also been passed insisting on uniformity in the size and depth of different locks, which are of great service to those using the canals. There can be no doubt that there will also be ample scope in the future for the Electrical Engineer, both for the development of power and for lighting purposes. One gratifying reflection is the knowledge that as regards the opportunities for acquiring the scientific training which forms the basis of the profession of a Civil Engineer, and of obtaining a practical field experience which is so calculated to develop the self-reliance and originality of a man, the young Australian student is probably as fortunately placed as any pupil in other countries; and as he certainly possesses as much average ability and energy as his neighbours, there is no reason to feel that what works are required in the future need be entrusted to outside Engineers, but that there is capacity and knowledge enough within our own community to deal in a thoroughly satisfactory manner with all problems that are likely to arise. I have already referred to the necessity of population to a country. That, added to enterprise, means the starting of works which will need the advice of the skilful designer and supervisor; and the chief hope to the Engineer must be that, wherever progress and development is, there will his services be needed.

I am now entering on the 10th year of my residence in Victoria, and when I reflect on what has taken place within that decade, I still feel hope for the future. In Melbourne itself the development from 1886 to 1896 is startling. Within that period great sanitary measure of underground water carriage sewerage, electric city and private lighting, hydraulic power, refrigerating machinery; whilst pneumatic tubes for the conveyance of telegrams, and desiccating machinery for treating slaughtered house refuse, were unknown here in 1886. Neither Prince's nor Queen's Bridges were built, nor the river in their neighbourhood deepened, widened, or improved. St. Kilda road was so bad that I have seen cabs bogged near the entrance to Government House; the Cooburn Canal was only just opened; the West Melbourne Dock was not in existence, nor was the railway viaduct which connects Spencer and Flinders street stations. No control of explosives was then exercised, and the extent of paved carriage ways, storm-water drains, and macadamized streets was much less than is now the case. Taking the entire colony for the corresponding time, we find that during the decade ending 30th June, 1896, 1,427 miles of railway were constructed; and the rolling stock increased by 183 engines, 627 carriages and vans, and 3715 trucks. The amount (exclusive of rolling stock) has been £12,430,913, and on rolling stock, £2,576,845; new workshops, running shed, bridges, viaducts, and station buildings have been constructed, and the permanent way maintained and renewed at a cost of £3,590,783. The last decade has also witnessed most of the more important works of the Victorian water supply, principally the construction (at a cost of £447,483) of the Goulburn Weir and its dependent system of works; of the Laanecoorie Weir over the Loddon, designed to impound 8,812,900,000 gallons of water, and erected—of concrete masonry—with automatic tilting gates, at a cost of £67,560; of the Kow Swamp National Works, designed to convert the swamp into a reservoir holding 1,450,000,000 gallons, available for irrigating some 180,000 acres of land in the lower part of the Loddon Valley, and costing £170,000; together with the creation of more than 24 waterworks trusts for purposes of water supply and irrigation. The Mildura Irrigation Colony is also belonging to this period of time, as does also the opening up and development of the large and promising coal-fields of Gippsland; indeed space will not enable me to even recapitulate the numberless ways in which the colony has been advanced during the past ten years by the aid of the Engineer. I find, last but not least, that (under the direction of the Inspector General of Public Works) important river and harbour improvements have been affected at Port Fairy, Portland and Warrnambool; whilst a practical entrance, accessible at all times to vessels of 10 ft. draught, has been created at the mouth of the Gippsland Lakes. A new lighthouse has been constructed at Spit Point; and an extension of the Melbourne Water Supply (by the construction of the Silver Creek Aqueduct
and the Maroondah scheme) has added about 31,000,000 gallons to the average daily flow into the city and suburbs, at a cost of about £708,000. In connection with water supply must be noted the introduction of wrought iron for water mains, about 47 miles of which are laid of 30 in. and upwards in diameter. No less than 7 intercolonial bridges have spanned the Murray at the joint cost of the two colonies of New South Wales and Victoria; whilst the erection of the Princes’ and Queen’s Bridges in this city have already been alluded to. In this resume of some of the Engineering works that have been undertaken in Victoria during the past decade, I trust enough has been said to justify my belief in the future prospects of this country (notwithstanding the present period of gloom and depression), in view of the wonderful strides she has made. If this be so, there need be no doubt but that its Engineers will be largely instrumental in promoting its future progress and development, even as in the Old Country both Civil, Mechanical, Mining and Electrical Engineers have taken a principal part in effecting the social and commercial revolution which has characterized the reign of Her Most Gracious Majesty.

(2) SOME RECENT REMARKABLE ENGINEERING WORKS

Before entering upon the second portion of my paper, I wish to disclaim at the outset any intention of doing more than to refer—in the briefest way possible—to a few of the more recent engineering enterprises (either just completed or now in course of construction) which, in my humble judgment, are remarkable; either on account of their magnitude, or as exhibiting some originality in treatment, which places them outside of the category of ordinary engineering. It is needless to say that, to give other than a general reference to any of these works would require more time than I have at my disposal. Even as it is, I feel that I must omit reference to many structures which certainly could be included in the above definition, and to which I would have wished to direct your attention, did time permit.

THE TOWER BRIDGE.

This structure (though now open for traffic for some time) naturally passes under review as fulfilling the above-named conditions; first of all in the size of its lifting bascules, which exceed anything previously executed in that direction; and, secondly, because it is one of the few examples where an attempt has been made to recognise the fact that Utilitarianism may be made to walk hand in hand with grace and beauty of form, and that it is not because a structure is strong and well designed for its purpose that it must, of necessity, be hideous! In the case of the Tower Bridge, the first impression produced on the mind of the beholder appears to be a grateful appreciation of the essentially artistic feeling which is shown by the happy combination of the medieval and the modern on such a site; and afterwards a further admiration of its splendid mechanism and structural design. There can be no doubt that the bridge (whatever may be objected to on the score of the unusual blending of architectural masonry and engineering ironwork) forms a characteristic and magnificent monument to the greatness of London, at the same time that it is a great convenience to thousands of her citizens. The design of the Tower Bridge is familiar to most of you; it provides a central span of 200 feet (which opens to admit vessels by means of 2 leaves with counterpoises, each weighing 950 tons) and two side spans of 270 ft. With approaches, the total length of the bridge is 2640 feet, and the roadway is 60 feet wide, except at the lifting span, where it is 50 feet. When the leaves (or Bascules) are opened, a clear headway is afforded of 1394 feet above high water mark to the overhead footways, which enable pedestrians (by means of hydraulic lifts and staircases in the piers at either side of the central span) to continue their journeys whilst the bridge is open for river traffic. In all, about 15,000 tons of iron and steel were used in this work. It may be of interest to remark in this connection that the engineer (Mr. J. Wolfe Barry) received £12,000 from the London County Council as extra payment, consequent on the work taking longer time and involving more anxiety than was originally anticipated, brains not being valued at a maximum of £500 a year by that body, evidently! The piers, which support the weight of the masonry towers and two platforms (amounting to a load of about 70,000 tons) are said to be about the largest of their kind in the world.
This is, however, in part due to the safe sustaining load of the London clay on which they are built, being limited to only 4 tons. The cost of this great civic work approaches £90,000. Since writing the above, my attention has been directed to the effect produced on Alphonse Daudet by this bridge during his last year's visit to London. That eloquent and artistic Frenchman after terming the bridge "a colossal symbol of the British genius" goes on to say: "Like that genius, the bridge struck me as built on lines of severe simplicity and harmonious balance. Its very audacies are all reasonable, and the whole structure subserves its end with that clearness which is the hallmark of everything English."

"Throw this bridge across the Seine or the Loire, and it would spoil the view like a false note of colour. But here, on the contrary, its effect is prodigiously imposing. Look at its two towers! How square and massive they are! It is like the gate of some strong town of the middle ages; the structure rises above the river like some massive efflorescence of the past. But look again and the impression becomes more complex. Light and airy, even as the face of an iron footbridge joins the two towers across the abyss. Another, lower down on the level of the river banks, lifts up to let the big ships pass, as under some triumphal arch. And herein there bursts forth all the audacity of the modern architect—destined to create the works of the future, suspended on the solid foundations of the past. But with so much measure and proportion within, that nothing offends in this medley of archaism and modernity. There are few countries able to carry off such contrasts. But this country adjusts itself to them in perfection. It is because its people know how to unite with the same harmonies and the cult of tradition and the love of progress, and insatiable passion for the future! These are stirring words; the more so that they come from a man who admittedly started on his (only) trip to England with a decided bias against that country. Whilst on the subject of artistic perception in bridge designing, I would like to direct attention to the elegant outline of a proposed stiffened suspension bridge over the Danube, where the treatment of the abutment towers shows both taste and originality. As a contrast to this, and as an illustration of effect produced simply by "mass" without any decorative accessory, I also have brought a photograph of the famous Forth Bridge, which as yet stands unrivalled as a type of the perfection of framing, and obtains dignity and power from that fact alone, thereby impressing on the beholder, be he layman or critic, the feeling that the stability and proportion of the structure is perfect, and that the entire gigantic mass is one complete and solid whole.

TUNNELS, WITH SHIELD AND COMPRESSED AIR.

In view of the exceptionally difficult ground through which the Engineers of the Metropolitan Board of Works have had to carry some of their principal sewers (full descriptions of which will, I trust, be given before long to this Institute by some of our members who are engaged in the work), it may be of interest to note the fact that the shield—so necessary an instrument to the successful completion of such undertakings—has only been known to Engineers as a complete and self-contained machine moving forward with the tunnel, since the year 1869 when it was first introduced by Mr. J. H. Greathead, M. Inst. C.E., on the work of driving the Tower Subway; it was of cast iron, and only 7 ft. 11 in. in diameter. From this work, which was chiefly through clay and which presented no special difficulties—and omitting all intermediate drives, in the carrying out of which much experience was gained and many improvements in the machine affected—I will pass on to a brief mention of the construction of the St. Clair tunnel, between Lakes Huron and Erie, U.S.A. This was started in 1888, is 21 ft. in diameter, and lined with cast iron. In this case, owing to the nature of the ground, it was found necessary to use compressed air in conjunction with the shield. The greatest pressure was 23 lbs. per square-inch above ordinary atmospheric pressure, the ground was soft clay alternating with wet sandy gravel, and the work was carried on from each end of the river simultaneously. Each shield, on an average, executed 12 ft. per day of 24 hours; the tunnel being opened in 1890. Although compressed air had previously been used in a 10 ft. tunnel under the River Hudson, before the St. Clair tunnel was built, I understand it was not worked in conjunction with a shield (at all events at the start of the work), nor
has this tunnel ever been finished; so that the St. Clair tunnel may be fairly regarded as the first instance in which the shield and compressed air were worked together on a large scale. But though this was a sufficiently important work, it has been eclipsed in size by the Blackwall tunnel under the Thames, just completed; which at the present time stands forth as the largest work of the kind extant, having an external diameter of 27 ft., lined with cast iron segments and finished off internally with white bricks. It is 3083 feet long under the river; and, with approaches, is 6200 feet between the entrances. A central carriage way of 16 ft. and two side walks, 3 ft. wide, are provided. Under the roadway is a spacious subway for water, gas and other pipes. The cost of the work is nearly £900,000, and altogether it is noteworthy as an Engineering feat, for it was only after several practical men had pronounced the work to be impossible, that the London County Council decided to abide by the advice of Sir Benjamin Baker (the newly elected President of the Institute of Civil Engineers) and Mr. Greathead, and proceed with the undertaking. Of course the work would have become impossible without the shield and the use of compressed air, seeing that it was driven for most of the distance through the Thames ballast, and was, in places, within 6 ft. of the river bed with a pressure equal to a head of 50 ft. of water to contend with. In a paper such as the present, it is impossible to do more than glance in the most superficial manner at this great work. The greatest air-pressure in driving the tunnel was 28 lb. per sq. in., though in bottoming one of the shafts as much as 35 lbs. had to be employed. Where the ballast was in direct contact with the river, a bed of clay, from 9 ft. to 10 ft. thick, was tipped along the line of the extended tunnel; this effectually answered the purpose for which it was intended, of preventing the air from blowing out, and of stopping up any hole that might be caused in the event of a "blow" occurring. As a matter of fact, three bursts did take place, but (consequent on the precautions taken) without being attended with serious consequences. The shield, fitted with a cast steel cutting edge, was moved forward as the building of the tunnel proceeded, in the usual way, by 24 hydraulic rams thrusting against the C.I. tunnel lining with an aggregate pressure of 3000 tons. Attached to the back of the shield were the hydraulic segment-lifting machines, which lifted and placed into position ready for bolting together the cast iron segments which formed the outer skin of the tunnel. The working chamber of the shield was fitted with the usual air-lock, and was divided into four working levels or twelve chambers in all, each provided with necessary shoots passing through the diaphragms for the excavated material, which was received on a travelling stage at the rear. In the immediate neighbourhood of the shield a safety diaphragm of wood and iron was fitted across the upper half of the section of the tunnel, and made air-tight. Through this diaphragm an air-lock and doors (approached by means of steps) was fixed as a means of escape in the event of the water finding its way behind the shield.

**MOUNTAIN TUNNELLING.**

If the development of Engineering science has been evidenced—as above described—in the power to pierce through water-logged ground, there are no less interesting advances to record in the matter of boring through the rocks of huge mountain ranges. Of this class of work probably the most remarkable example is that of the scheme, recently approved by the Swiss Government at a cost of about £3,000,000, to take a railway line through the Pennine Alps under the celebrated Simplon Pass, the summit of the road of that name made in 1801 by Napoleon to enable him more conveniently to reach Italy. The project is indeed stupendous, for it means 12½ miles of tunnel bored through the range at a depth of 7000 feet below its summit, in consequence of which it is estimated that, in places, the temperature of the tunnel will be no less than 104 deg. Fahr. Special arrangements to deal with this difficulty, and also to properly ventilate the drive are being designed, that will be worked by hydraulic power, obtained from the Rhone (from which water sufficient to afford 1180 h.p. is taken) at the north end of the tunnel; and from a stream called the Cairasca at the south end, which latter will contribute a power equal to 2250 horses. One peculiarity of this scheme is that it will consist of two single-line tunnels driven parallel at a distance of 56 feet apart. The maximum width of each tunnel in the
clear is 16 5', and about the centre of the tunnel it widens to 30ft, to enable a siding for passing trains to be formed. In order to be prepared for the varying pressures likely to be met with whilst driving through different strata, five types of sections have been designed for the tunnel, and the construction can be modified as the work proceeds, wherever the same is found to be necessary. As compared with other mountain tunnels in Europe, viz., the Arlberg Tunnel, about 64 miles long; Mount Cenis Tunnel, nearly 8 miles long; St. Gothard Tunnel, about 9 ½ miles long; the Simplon Tunnel of about 12 ½ miles, will easily take premier place.

WATER POWER.

A start has at last been made with what will undoubtedly prove to be the most gigantic undertaking of its kind ever attempted, in the scheme for utilizing the power contained in the great Falls of Niagra, for the generation of electricity to be conveyed by cables over an enormous area, where it will be sold as motive power (at such a cost as to displace steam or gas engines), and for street and house lighting. The Niagara River, which connects Lakes Erie and Ontario and thereby receives the drainage of some 250,000 sq. miles, has an available drop of 160 feet at the falls, with a total discharging volume of quite 5,000,000 horse-power. The scheme to execute projects to capture and convert to practical use some portion of this now wasted energy; and as a beginning, buildings and works sufficient to deal with 50,000 h.p., have already been constructed, and a tail-race of a capacity to deliver waste water from twenty turbines, each of 5000 h.p., has been driven from the power-house, discharging 200 feet below the level of the city of Niagara Falls. This tunnel is 6,700 feet long, and is laid with a fall of about 1 in 143. As it is built to carry an enormous volume of water, travelling at a speed of about 17 miles per hour, special measures were adopted to strengthen the outlet or portal, which discharges into the river in a gorge some distance below the American Falls. This outlet, for a length of nearly one hundred feet, is framed along the sides and floor of the tunnel with angle-irons well crossbraced and stiffened, lined with ½ steel plates. Concrete is filled into the whole of the framing to make it thoroughly solid. The turbines are of the type known as Fourneyron's, and are calculated to pass 28,800 lbs. of water per second when going at 250 revolutions per minute. This, from a working head of 136 feet, is equal to about 6,600 theoretical horse power. So that if they, in practice, work up to 5,000 h.p. as they are guaranteed to do, it will be equivalent to an efficiency of 75 per cent. These are the largest turbines yet made, and have been specially designed to withstand the enormous load (87 tons of water alone) to which they are subjected. Apparently the only part of the scheme as to which any uncertainty exists, is as to the distance to which the electric current can be profitably transmitted. The chairman of the company is sanguine of being able to supply at 320 miles, and there is even talk of going 600 miles; but, so far, that has not been proved by actual practice.

NEW LOCOMOTION.

Within the past few years a silent, but none the less powerful, change has been taking place amongst the people—not only of England, America and Australia, but of every civilised nation on the face of the globe—in regard to their habits, and it has all been caused by the continued improvements which have been effected by a piece of mechanism resulting in the conversion of what was originally designed as a toy or means of mere amusement, into a machine which is rapidly becoming so universally used both for business, pleasure and health, that it may almost be considered as a necessary of life. I am aware that, strictly speaking, the bicycle is a triumph of mechanical skill and workmanship rather than an engineering work; but all the same I am emboldened to make reference to the],&amp;quot; of the late Mr. Alfred Giles, past President Inst. C.E., who thought the matter sufficiently important to refer to in his address in 1893) not only because of the interest that is naturally aroused in watching any considerable departure from the prevailing habits of a nation, but also because this change is but the precursor of others more immediately associated with our profession. I refer to the Horseless Road Carriage, which is now beyond the experimental stage, and will soon be as useful in its own way as...
the bicycle. Improvements are not stopping there, for a revival in the Traction Engine is taking place, and improvements are being effected to such an extent that it will soon become a formidable competitor to the horse and bullock waggons on country roads. All this will tend to a higher standard of road construction, which will not necessarily mean greater cost, because the new types of vehicles will not destroy the macadam as much as do the feet of draught animals. Regarding the horseless carriage, it would appear from French, English and American tests that those propelled by mineral oil will be preferred to those worked either by steam or electricity; and, provided the oil used be a petroleum product, there would seem to be no objection to its use on the score of danger. I observe that during a test in Chicago last Nov., the successful competing carriage (Duryea’s) developed 4 horse power, and attained a speed of 16 miles an hour on good roads. It carries enough gasoline for 100 miles, and weighs 1000 lbs. The application of a small 2-cylinder gasoline engine to a bicycle enabled “straight-away” run of 1 mile to be made in 58 seconds. In June, 1895, the test trial between Paris and Bordeaux and back (a distance of 750 miles) was done by one petroleum-driven carriage at an average speed of 15½ miles an hour, including stoppages. [Some photos of several types of these carriages are shown on the screen for members’ information.]

REFRIGERATION AND TRANSPORT OF PERISHABLE PRODUCTS.

Time will not permit me to dwell on this fascinating subject, which could be made to read like romance, so wonderfully sudden has its progress been. When it is remembered that in 1881, the first shipment of frozen meat left Australia for London, and that now annually more than a quarter of a million carcases are exported to England, one begins to realize the development of an industry that is destined to work a wonderful change in the conditions of all thickly populated countries. During last year alone the “Linde” Refrigerating Company sold no less than 322 Ice-making and Refrigerating Machines; and, in all, quite 2400 such machines (equivalent in refrigerating capacity to the melting of 60 thousand tons of ice in 24 hours) have been disposed of since the formation of the Company. Cold storage equal to 14,000 tons has been provided during the past year by ‘Haslam’s” dry air and ammonia machines for steamers alone, in addition to large storage plants ashore; whilst Messrs. J. and E. Hall have fitted up over 30 vessels and 14 shore plants with their carbonic anhydride machines. These three firms probably are the most prominent in the several methods of refrigeration adopted by them, viz., the ammonia; dry air; and the carbonic anhydride processes; but there are other manufacturers who are also busily engaged in supplying the constantly increasing demand for cooling and freezing machinery, which is now found necessary in numberless industries connected with food supply; chemicals, explosives, etc.

THE BALTIC CANAL

Recently opened by the German emperor, is a rather interesting work, being 8½ miles long, with a width at bottom of 72 feet, and on water surface of 206 feet, and a depth of nowhere less than about 30 feet, so as to afford passage to any ship of 10,000 tons displacement. Four railway bridges (two being swing-bridges) span the canal. The two fixed bridges have a clear span of 511 feet, with a headway of 137 feet above water level. Where the canal crosses main roads, powerful steam forries are provided. The two locks placed side by side at either end of this canal are the largest in the world, being 492 feet long, 82 feet wide, and 31 feet deep. The work was carried out in less than eight years, at a cost of 7½ millions sterling. Though neither so costly nor so intricate in detail as the Manchester Ship Canal, as a very important undertaking it is worthy of reference here.

THE PERIYAR DAM

Opened last October by Lord Wenlock, (and irrigation works in connection therewith) is designed to irrigate (ultimately) 100,000 acres in the Madura district of Madras, India, and cost 87½ lakhs of rupees (£787,000). It is expected to give a return of 6 per cent, on this outlay; for, in addition to the irrigation supply, a comprehensive scheme of electro-hydraulics has been devised for the transmission of the electric current to Madras and other towns, to be utilized (as in the case of Niagara) for lighting and power purposes.
CONCLUSION.

In conclusion, I thank you for having endured so lengthy a paper, with such exemplary patience, and shall feel amply repaid for what little labour has been spent on its preparation, can I but feel that it has had the effect of making my hearers realize (even to a small extent) how essential to the progress and improvement of the world are the labours of that man whose function in life is (to quote the well known words of Telford, the founder in England of our profession) "In promoting the acquisition of that species of knowledge which constitutes the profession of a Civil Engineer, being the art of directing the great sources of power in Nature for the use and convenience of man."