ESTATE ELECTRIC LIGHTING

By

II. FENTON, A.M.I.E.E.,
(Chief Electrical Engineer, Fentons, Ltd., Ceylon)

This paper is not intended to be a Technical Article; so much as an attempt to further popularize electric lighting for the Tea and Rubber Industries.

With regard to the latter, however keenly Proprietors and Superintendents may desire electric lighting, the present conditions of the industry scarcely justify the capital expenditure involved. Another year or so may give more prosperous times. Generally speaking however, your Rubber Factory does not work at night and your electric light installation only becomes desirable (on the part of the Proprietors) or essential (on the part of the Superintendent) for the bungalows.

Possible water power is not so commonly met with (for obvious reasons) on Rubber, as on Tea Estates. With regard to Tea Estates, the last two years has seen an enormous increase in electric light installations, and present prospects induce the author to believe the increase will continue. There is, of course, no getting away from the fact that the present tea "boom" accounts for such increase, but the primary object of this paper is to prove, in general, that electric light for a tea factory is not a luxury, but a real necessity and a business proposition.

The author presumes there should be no necessity for any tea factory to work at night. If this presumption is correct any form of artificial lighting becomes unnecessary. In practice, however, every factory (more or less) requires lighting.
Whilst, as it will be shown, electric lighting for the Factory is a profitable investment, it does not follow it is a similar profitable proposition for the Superintendent's bungalow, apart from the question of personal advantage and comfort, to the Superintendent.

Costs

Based on Factories on Estates of an average of 500 acres, the cost of lighting, by means of oil, candles, etc., approximates Rs. 500.00 per annum, which figure includes depreciation of lamps, breakages, maintenance, kerosene oil, wicks, chimneys, candles, etc., and at the best of times, the interiors of Factories so illuminated are not exactly "bright and cheerful." The average cost of installing electric light, is Rs. 3,000.00. The "all-in" annual costs of lighting by electricity will therefore be Rs. 640.00. Thus money can be considered as being worth 8%. The interest is therefore Rs. 240.00. Allowing 10% (not compound) for depreciation gives a further annual charge of Rs. 300.00. Note this allowance of 10% may be objected to as being on the low side, but the author knows of many installations that have had a life of 15 years and are still "going strong." With ordinary attention and reasonable maintenance an estate electrical installation, properly erected, should have 15 years life, easily. Maintenance of a modern dynamo, is almost nil. The only wearing parts are the brushes, commutator and bearings.

With proper attention paid to brushes (the renewals of the latter being particularly inexpensive) the commutator should have the life of the dynamo. The bearings are usually ball, and can be replaced for a small sum. In practice it is found one extra set of ball bearings complete (cost about Rs. 50.00) will see the dynamo through its useful life.

The cost of repairs to the wiring is almost nil, the most expensive item being renewals of lamps. A factory of the size under consideration usually requires about 90 lights, and the allowance for lamp renewals is one third per annum, which is found ample in practice.
A total allowance of Rs. 100.00 per annum covers the whole of the maintenance and brings the total "all-in" costs to Rs. 640.00 per annum.

This is an increase of Rs. 140.00 per annum over the cost of oil-cum-candle lighting. Expressed in percentages.............Increase in "all-in" costs = 36%. Increase in available candle-power = 1,000% at least.

The increased efficiency of a factory staff (working under good lighting conditions); the increased cleanliness and the decreased "fire risk" need not be enlarged upon, as they are too obvious.

The fact that the author has made no allowance for the cost of the mechanical power, driving the dynamo, will be at once noted.

This is admitted but, if the factory engine is a "Pelton" or water turbine, such cost is nil.

Where the factory engine is steam, oil, or gas, the author has never found the introduction of electric light increase the fuel consumption. This is, of course, accounted for by the fact that all engines run most economically on full load, and this latter condition is rarely met with in a Tea Factory (the average load factor—over actual working hours—is 50% by day, and considerably less at night).

The dynamo load increases the load factor but not costs.

It should further be remembered with modern lamps one horse-power will give approximately 1,200 candle-power.

The installation considered in the preceding paras, is the simplest of all, viz., dynamo running from the factory main shaft, but such system has one big objection; which is "the dynamo (and consequently the factory engine)
must run if only one light is required." Therefore there is a tendency to run the engine specially for electric lighting, which materially increases running costs. In general, lighting is not required (except for perhaps 15 or 20 minutes) after the engine stops, and the author submits this slight increase, if any, in running costs is more than compensated for by the fact that the general working of the factory, consequent on a good light, is accomplished in a shorter period. He has, over and over again, proved (to his own satisfaction) his contention that fuel consumption is not increased.

On many tea estates, after manufacture is finished, leaf spreading is still in progress, but at such times the driers and fans are required to work, and in consequence the engine. In such cases the load factor of the engine has decreased enormously and the additional cost of running the dynamo, at the same time, is absolutely nil.

Occasionally one meets extreme cases where lighting is required when the factory engine is not running.

The only economical method of dealing with such cases is to instal a battery of accumulators.

The charging of such batteries becomes part of the every day work of the engine and the cost nil, in consequence.

The capital cost and depreciation of accumulators are unfortunately high and on the assumption that the factory, under consideration must have lighting, independent of the engine, the "all-in" costs would be increased to Rs. 1,140.00 per annum.

Unless convenience is the deciding factor the author finds, in practice, it cheaper to run the factory engine specially for electric lighting (on the few occasions independent lighting is required) than to instal accumulators. It should be remembered that these cases are extreme, and only Factory lighting is being considered.
If the factory power is water it is generally economically unsound to consider the installation of accumulators.

A general description of the standard practice adopted by the Author’s firm, for Factory Installations, may be of interest.

The dynamo is of the slow speed, ball bearing type, semi-enclosed ventilated (with fan) shunt wound; armatures former wound; and windings specially impregnated.

For factory lighting only, we prefer compound wound machines, but the lighting of the Superintendent’s bungalow generally follows the factory installation, with accumulators, and although series of short-circuiting switches can form an integral part of the dynamo, we have seen so many “reversals of polarity” that we assume all dynamos will, at some date or other, charge accumulators and we adhere to shunt windings.

The speed of such dynamos is usually between 625 and 950 r.p.m. The average factory main shaft speed is 100 r.p.m. If high speed dynamos were chosen (say running at 1,200 r.p.m.,) a machine with a 5" pulley would require a 60" pulley (or a fly-wheel) on the main shaft. The speed ratio (12 to 1) would further require a larger distance between centres of pulleys than conditions usually permit.

The solution is, of course, a countershaft, but the cost of a countershaft, plus the cost of a high speed dynamo, is no less than the cost of a slow speed dynamo. The countershaft does not add to the value of the installation, whilst the slow speed dynamo does.

Our practice is to drive direct from the factory main shaft and “slip” the belt when lighting is not required.

The countershaft, with fast and loose pulleys, is undoubtedly a more convenient method, but for a given capital expenditure
the slow speed-dynamo driven direct, is better value than the high speed machine with countershaft.

The inconvenience, with the former, is more imaginary than real. In practice, at dusk, the main shaft is slowed down, for a few seconds, whilst the belt is slipped on, and such belt is removed, next morning, as the engine starts.

We adopt a "fool-proof" type: all switches and fuses are enclosed in cast-iron boxes, with frames "earthed."

The basis of the board is teak, in two halves, back and front. Connections are all front connections and after internal wiring is completed, the two halves are screwed together and the whole board mounted directly on a wall, making it impossible for a coolie to get behind the board or, in any way, interfere with the internal wiring or connections.

Such a board is not so imposing as open switches and gear on marble or slate, but it has the merit of being perfectly "fool" and shock proof:

Dynamo double pole main switches and fuses are mounted, with volt-meter, and pilot light connected through separate single pole switch and fuse, across the "live" side of the dynamo switch. Wiring distribution boards are fitted on each factory floor and double pole main switches and fuses on the switchboard control each distribution board. Ammeters are also fitted.

We adopt either the cleat system, or lead covered, dependent on the price we obtain. The former suits the Country admirably, but has the objection of tending to become "untidy" after the lapse of time.

We find it advisable to send mechanics; a year or so after completing the work, to take up the "sag" in the wires.
Such system cannot be said to be "fire-proof," but such "risk" is small.

The system lends itself admirably to "ease in alterations"—which is a factor of importance.

Lead covered wiring is, we consider, pre-eminently the system for this country. Properly installed, bonded and "earthed," such system is absolutely fire-proof.

The cost of same, materials for materials, is no greater than the cleat system, but mechanics of this country are prone to carelessness and cannot realise the importance of efficient "bonding." Supervision and actual labour costs are therefore higher than with the cleat system, but with more experience we are convinced mechanics will be able to install lead covered without increased costs, in which case such system will be adopted (by us) throughout and the cleat system dropped.

It is an accepted axiom that where electricity is cheap, the lamps adopted should also be cheap.

Highly efficient lamps are usually comparatively expensive, and where current is free obviously the only factor economy can effect is lamp renewals.

We accept this axiom and followed it, up to a few months ago. We now find other factors require consideration. The tendency is always for increased light. Factories that, years ago, were quite content with 16 candle power lamps now require 50 candle-power, and clamour for still higher candle-powers. Further, although many local switchés are usually installed to control lights, factory staffs will not use them and the usual condition is to have all lights burning simultaneously. With a factory of 90 lights, using ordinary metal filament lamps of 50 candle-power each, the electric load becomes 7.0 h.p. and the b.h.p. nearly 9.0. Many factories, when their tea machinery load reaches "peak," cannot spare this power, and slowing up of the engine results.
It is admitted that the factory lighting, load factor (during lighting hours) should never reach 100% but the fact remains, and provision has to be made for same.

We now adopt, as standard, a high candle-power highly efficient "half-watt" type lamp (in opal glass, giving light without glare) installing a small number of such lamps, in preference to a larger number of small candle-power lamps. This enables us to reduce the size of the dynamo, wiring, and gear generally together with the number of points, keeping the capital cost approximately constant.

The power required for lighting is reduced by about 40%. The cost of lamp renewals is increased about 25% per annum. (Note.—This point may be disputed but it should be remembered that whilst half-watt type lamps are about 100% more expensive than metal filament lamps, there are considerably less lamps to re-new) and our experience is this increase is a small matter compared with the reduction of power required.

Where a factory engine can take the factory "peak" plus the lighting load, without difficulty, we adhere to cheap lamps, but we find a strong demand for the white light given by half-watt lamps.

This presents the greatest difficulty of all types of lighting. It is a simple matter to give a good light in the fair ways, by means of fixed lights, but such lighting gives no illumination between the jute hessians. Where the jute hessians are horizontal we can give fair illumination by painting the end walls of the withering lofts white and projecting lights on to such walls. It is then possible, by looking through, from the middle of each floor to form a fair idea of the condition of the tea on the various jute hessians, but if the latter are set at any angle this system fails. In such cases if good lighting is provided in the fairways and all walls and ceilings painted white, reasonable illumination, between the jute hessians, is obtained by reflection, but if local
lighting is required, portable hand lamps, connected to wall plugs, must be installed. The objection to these is coolies will not treat them properly, and breakages occur.

Further, the insulation of the wanderings leads is, in the course of time, damaged (we reduce this to a minimum by using cab tyre sheathed flexible) and such leads become a source of trouble with potential "fire risk."

It is, however, a moot point (even amongst Superintendents), whether local lighting between jute hessians is really ever required.

This can have no economical effect on the estate working, but is an obvious advantage and comfort to the staff.

Its adoption introduces several new factors. The capital cost depends entirely on (A) the distance the bungalow is from the factory and (B) the type of factory engine.

If A is too great (the author puts the commercial limit at 1 mile) it is not economical to link up with the factory plant, in which case a separate small set becomes essential. If water power exists near the bungalow a small "Pelton" can be installed and the "all-in" costs will be about the same as lighting by oil, but with, of course, very much more candle-power. With a separate engine, dynamo, and accumulators (the latter are absolutely essential in such cases) the "all-in" costs will be considerably more, for fuel has to be provided.

The cost of the latter, plus interest, depreciation, and maintenance, render such scheme prohibitive, if only economics are considered. If convenience, etc., are considered, it is, of course, another matter.

If the bungalow is within the limit given, any other system, but linking up with the factory, is economically unsound.
Where B is water power, and ample, the "Pelton", or, Turbine can be run until some given hour, at night, driving the dynamo, for a purely lighting load. Some form of friction clutch should however be provided to prevent the whole of the factory shafting and belting running unnecessarily. If water is fairly ample, with conservation, a separate small "Pelton" should be installed, taking its supply from a "tapping" from the main piping. An arrangement by which the dynamo is driven from the main shaft (by the big "Pelton") whenever the Factory is working and switched over to the small "Pelton" on other occasions, is the most satisfactory.

If the prime mover is a turbine (low fall) it probably takes its water from a river, without conservation, and a separate prime mover, for electric lighting becomes unnecessary and difficult.

If a drought period occurs, what water there is can be conserved for bungalow lighting purposes (the auxiliary engine giving factory lighting) but if insufficient for the small "Pelton" the alternative is to revert to oil lamps, during such period, or instal accumulators. The running of a big oil or gas engine (which would be available, if drought periods occur) for the sake of a few lights in the bungalow is, obviously, a most expensive matter and not to be considered, for a moment.

From this it follows if the factory prime mover be an oil or gas engine, accumulators must be installed if bungalow lighting is required.

These are best installed in the bungalow and considered as being for bungalow lighting only. They are charged during the day and the cost of such charging is nil.

The usual factory pressure is 110 volts and is, generally, a satisfactory standard. If the bungalow installation is to be at the same pressure as the factory some 55-cells would be
necessary; a somewhat expensive matter. Further if the bungalow is some considerable distance away from the factory, the overhead line would have to be of large cross-sectional area to prevent serious drop in pressure; again an expensive matter.

To surmount this difficulty and to bring costs down to a non-prohibitive point the author, some years ago, initiated the practice of reducing the bungalow working pressure to 25 or 32 volts. This reduces the number of cells in the bungalow, to 14 or 16 and allows a drop in pressure along the overhead line of some 50 to 60 volts, enabling the cross-sectional area of same to be greatly reduced, and, in consequence, the amount of copper used in same and greatly decreases the capital costs.

Accumulators of comparatively large capacity are a much more satisfactory proposition than small capacity cells. The capital cost of 55 large capacity cells, plus the cost of the heavy overhead main necessary to deal with the heavy charging current renders such schemes prohibitive. Smaller capacity cells can be installed, but the same total capacity can be obtained with a small number of large capacity cells. The adoption of (say) 16 of the latter gives a condition by which the dynamo is feeding, at the factory end, at 110 volts; and the charging pressure across the accumulators is reduced to 44 volts, giving a total drop along the line of 66 volts and allowing a high current density (in practice, this density is not allowed to reach a figure where damage, due to heating, would occur) along the copper, with a small cross-sectional area.

This drop is, of course, all "waste." We usually instal 150 amp hour cells with a normal charging current of 20 amps.

The "waste" is therefore $66 \times 20 = 1,320$ watts, or approx. 2 h.p. (the total h.p. required for charging being approx. 3.5) but compared with the size of the factory prime
mover, coupled with the fact the battery is "floating" and only charged when the factory machinery is working, the cost of this "waste" is nil, the only effect being to improve the load factor of the engine.

This system (which the author thinks is original) is now generally adopted for bungalow work on Tea Estates.

Although the accumulators are really intended for bungalow work only, it is an easy matter to "feed back" for few emergency lights in the factory. Obviously, not many can be used, as the "feed back" pressure is only 32 volts and the overhead line is small in area.

Accumulators rarely receive fair treatment on Estates, but their use is now more general than was the case three years ago, and Superintendents are getting better acquainted with their working.

When they realise regular attention must be given and plates must be kept apart, at all costs, the average life of batteries is 7 years, and after that period generally it is only the plates that require renewing—not a prohibitive or particularly costly matter, for 16 cells.

In conclusion the author would like to protest against the growing practice of installing hydro-electric lighting schemes without provision for governors on the "Peltons" or Turbines.

An alteration in the load gives an alteration in speed, and where the load is decreased the rise in voltage is a fruitful source of broken filaments of lamps.

Should a main fuse in the circuit blow, the rise in pressure (long before the "runaway" speed is reached) is sufficient to cause a damaging current to pass round the field coils and we have rewound many in consequence.
Theoretically there is supposed to be an attendant in the factory, watching a voltmeter, with his hand on the stop valve, but in practice he is, often, "not there."

A governor is the only correct practice, but same is, unfortunately, somewhat expensive. Experiments are now being made with an electrical governor (simple and inexpensive) by which, centrifugally, external electrical load is switched in, as speed rises but such gear is not yet commercial.
DISCUSSION.

8th Paper.

The Chairman: Gentlemen, the only paper to be read today is the paper on Estate Electric Lighting by Mr. H. Fenton. Unfortunately Mr. Mill's paper has arrived too late and could not be printed. There will be no discussion on it, Gentlemen, we will take Mr. Fenton's paper as read. Will any one start the discussion on the paper?

Mr. G. E. Misso.

Mr. G. E. Misso said: The author's suggestions for more efficient Estate Factory Lighting are very interesting. I agree with his suggestions regarding the use of coloured bulbs in so far as they lessen the evil of glare, but I think they hardly improve the efficiency of lighting. The polar curves of "Opal Tinted," "White Frosted," "Daylight" or "Clear" bulbs are very similar as far as distribution is concerned but they all absorb more light than the clear glass bulb. What is really required is a device for utilizing the available rays of light to the best advantage and I think the use of the appropriate type of reflector with correct lamp spacings is the most suitable arrangement for increased efficiency. Very little advantage appears to be taken of the excellent distribution reflectors now on the market.

With regard to Estate Bungalow Lighting. The average estate bungalow has a load of about 800 watts, and at the ordinary five hour discharge rate of 25 amperes, the battery recommended would be fully discharged every-
day. It would be interesting to know how long in the author's experience these batteries give useful service. I have seen batteries of this size used, but with very poor results.

The author does not provide for protection against lightning. I think it very essential that up-country bungalows with overhead lines, which are more or less always subject to static charges, should be very efficiently protected in this respect.

- The Chairman: Any other gentlemen? Well, Mr. Fenton's paper will make a very useful addition to our volume. I thank Mr. Misso for his remarks. I am sorry we did not discuss it more.

Communicated:

The Hon. Secretary,
Engineering Association of Ceylon,
P. W. D. Colombo.

Estate Electric Lighting

Dear Sir,

I thank Mr. Misso for his comments on the above and in reply I quite agree with his suggestion of obtaining better distribution of light by more scientific reflectors, but, unfortunately, the type of reflector referred to by Mr. Misso is generally prismatic glass which is extremely expensive and, for factory working, liable to breakage.

The amount of power required for lighting purposes is so comparatively small that it is a more practical proposition for tea factories to increase the candle-power, or even instal extra lights, than to instal expensive prismatic glass reflectors.

With regard to Mr. Misso's contention that the average estate bungalow has a load of about 800 watts, I think he is mistaken. I have found the average bungalow has an installation of 40 lights, of which 20 are generally in use, for an average of 3 hours per night.
The average standard lamp fixed by us consumes 20 watts and is again of the "Argenta" type. This gives a load of 400 watts or 1290 for the night.

The batteries fixed by us have a capacity of 4800 watts and in practice we find a charge is necessary, once every 3 days and this load is only exceeded when the superintendents are entertaining.

With regard to precautions against lightning, these of course are absolutely necessary and have always been taken by us. The most effective arrestors we have yet struck are the ordinary "horn type" with heavy kicking coils.

In really bad districts we frequently run earthed G.I. wire over the electric lighting mains, in addition.

Yours truly,
(Sgd.) H. Fenton.

14th Nov., 1924.
SPECIAL VISIT—SATURDAY,
28 JUNE 1924.

Visit Conducted by Mr. T. B. Stewart, Assoc.
M.Inst. C.E., M.Inst. W.E., Acting
Waterworks Engineer, Colombo
Municipality.

1. Prior to the year 1886, Colombo obtained its water supply from wells, rivers, canals, etc.

2. Mr. A. W. Burnett made a six months' tour of the districts concerned and as a result, after much discussion, a proposal to take a supply from the river Kelani was abandoned and the present works, which were designed by Mr. J. F. Bateman, a well-known Hydraulic Engineer of Westminster, were constructed by Mr. Burnett in 1886.

3. Water is obtained from Labugama Reservoir, which is situated in the Western Province, at a distance of 23½ miles from the City.

4. The Reservoir was formed by impounding the waters of the Wak-Oya, a tributary of the Kelani Ganga.

5. The catchment area which is 2,500 acres in extent covered with forest, is free from any habitation or cultivation, all the land to the summit of the water-shed having been reserved, together with a strip two chains in depth along the adjacent water-sheds. The lake scenery is very charming.

6. The area of the Reservoir at top water level is 176 acres; this lake is 360 feet above sea-level, and its greatest depth is 60 feet. The capacity of the Reservoir is 1,235 million gallons which will be increased in 1924 to 1,745 million gallons. The scheme of the Waterworks Engineer, Mr. W. M. Thyne for
raising the dam will be completed in 1924 at
a cost of Rs. 351,000. The dam will be
raised from a height of 72.50 feet to a height
of 86.25 feet and the head of water held up
will be increased by ten feet, while the
capacity of the Reservoir will be increased by
about 40 per cent.

7. The water has a very low alkalinity, and
is remarkably pure.

8. The average rainfall for the past 30
years, was 160 inches; in 1923 the highest
figure on record namely 216.81 inches was
registered.

9. Originally the water was conveyed to
Malingakande Service Reservoir in the City, by
means of a pipe line 20 inches in diameter.
This pipe line was duplicated in the year
1905, and an additional Service Reservoir was
constructed in the Northern part of the City,
at Elie House.

10. The Municipal Council assumed con-
trol over the Waterworks in the year 1908, in
accordance with Ordinance No. 18 of 1907,
under which the Council are required to pay
Government in addition to sums already paid,
the sum of Rs. 100,000 annually, till the year
1924, to meet the cost of past construction of
the works.

11. In view of the rapid increase in the
population, and of the extension of the
Municipal Limits, and the desirability of
making the water supply as pure as possible,
the Council in 1912, decided to lay a steel
main 30 inches in diameter from the source
of supply to the City, and to install a Filtra-
tion Plant. Government approved of the
Scheme, and granted a loan of three million
rupees.

12. These works were designed, and
executed by the present Waterworks
Engineer, Mr. W. M. Thyne.

13. The system of Filtration adopted, is
that known as the Mechanical or Rapid, and
the type of Filter installed, is the "Jewell
Gravity." The Filtration Works are situated
immediately below the Reservoir Dam.
14. Water from the Reservoir enters the settling basin, the capacity of which is 400,000 gallons; as the water enters this basin, a coagulant is added (Sulphate of Alumina is generally used) and the velocity of the water through the basin is checked by a series of baffle walls, so constructed as to facilitate precipitation.

15. The partially clarified water flows over a weir, and is conveyed through a concrete syphon to the Filter House.

16. The Filter House, a building 254 feet long, by 35 feet wide, contains ten filters, with a collective filtering capacity of eight million gallons per day. Three additional filters will be added in 1924, at a cost of Rs. 180,000 and the Filter House will be enlarged. The work of adding three additional filters and of extending the Filter House was commenced in 1924, in order to cope with the increase in water consumption caused by the general increase in population and more especially by the recent rapid extension of water carriage public lavatories and baths, and of water carriage drainage in private premises.

17. The water passing through the filters is conducted to a Reservoir, 800,000 gallons in capacity, and thence through the three supply mains, 85 miles in length, to the City Service Reservoirs at Maligakande, and Elie House, each of which has a capacity of eight million gallons. They are, respectively 100 feet and 95 feet above sea level.

18. The City Distribution system consists of 140 miles of mains, varying from 27 inches to 3 inches in diameter. Every inhabited public and private road in Colombo has water mains installed therein.

19. The whole system is worked by gravitation, but owing to the Service Reservoirs not being at a higher elevation, the pressure is not very satisfactory in the higher districts and buildings in the City, and is not ideal from a fire service point of view. Improvements
sanctioned in 1924 will, however, enable the two City Reservoirs to be by-passed in an emergency, the pressure in the mains thus coming direct from the Labugama Reservoir, a device which will enable the Fire Brigade to deal effectively with serious fires for which the ordinary pressure does not suffice.

20. Since the Municipality took over the Waterworks large capital expenditure has been incurred. By the end of 1924 the total will approach Rs. 5,000,000 making the total capital expenditure on the scheme about Rs. 13,000,000.

21. The Municipality makes no charge to the ratepayers for domestic water supply, over and above the consolidated rate for Municipal services; water supplied for trade purposes is metered and charged for, at rates varying from Rs. 1.30 to cents 50 per 1,000 gallons.

22. Water supplied outside Municipal Limits, i.e., to non-ratepayers (Government excepted) is charged for, at the rate of Rs. 2 per 1,000 gallons. Water supplied to shipping is charged for at the rate of Rs. 5 per 1,000 gallons.

23. The revenue derived from the sale of water, is about Rs. 750,000 per annum at present.

24. The average consumption of water in 1924 exceeds 9 million gallons per day. Venturi measuring meters will be installed in 1924 so as to provide absolutely accurate figures.

25. There are few cities anywhere which have such an ample, pure and cheap water-supply as Colombo, or a more efficient modern Waterworks equipment and organization.

May, 1924.
ANNUAL GENERAL BUSINESS MEETING,

Monday, 30th June, 1924.

Mr. M. COLE-BOWEN, B.A. (Dub.), B.A.I., M.Inst. C.E. in the Chair.

Minutes

The Honorary Secretary read the Minutes of the last Annual General Meeting, which were confirmed.

Annual Report

The following annual Report was next presented by the Honorary Secretary and was adopted.

Report for Year, 1923.

Membership

The roll of the Association has shown during the year an increase of Membership:—

1922

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\begin{align*}
\text{Honorary Members} & \quad 14 \\
\text{Paying Members} & \quad 199 \\
\end{align*}
\]

\[213\]

1923

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\begin{align*}
\text{Honorary Members} & \quad 15 \\
\text{Paying Members} & \quad 224 \\
\end{align*}
\]

\[239\]

The new members for the year totalled 30. The names of five members were removed from the list owing to retirement of service and resignation of Membership. The Association is poorer to-day by the retirement and transfer of four of its Past Presidents during the year under review, viz: Mr. A. D. Prouse, Harbour Engineer, (President 1914 and 1915); The Hon. Mr. T. H. Chapman, Director of Public Works, (President 1916 and 1917); Mr. W. C. S. Ingles, Surveyor-General, (President 1918 and 1919); who have retired from Public Service after long and distinguished
service and Mr. Harold T. Creasy, Deputy Director of Public Works, (President 1923), on his transfer to Hongkong as Director of Public Works. All these officers joined the Association at its inception and have rendered invaluable service.

Meetings and Visits

The Annual Conference and Annual General Business Meeting were held on 25, 26, 27 and 28th April, 1923. Mr. Harold T. Creasy, M.Inst. C.E., President presided. Eleven instructive and interesting papers were read and discussed. The subjects were varied and representative of the different branches of the profession. There were contributions by the Public Works, Railway, Survey and Irrigation Departments as well as two individual contributions. An easy record in the number of papers read this year has thus been established. The number of papers read during the past few years are:

<table>
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<tr>
<th>Year</th>
<th>Papers</th>
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<tbody>
<tr>
<td>1920</td>
<td>3 Paper.</td>
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<td>1921</td>
<td>5 Paper.</td>
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<td>1922</td>
<td>7 Paper.</td>
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<tr>
<td>1923</td>
<td>11 Paper.</td>
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Visits

Visits were paid to the following works:
(a) Colombo Harbour Works,
(b) New Royal College,
(c) Government Housing Scheme, Colombo,
(d) Darley Road—Asphaltic Concrete Road Paving,
(e) New Municipal Market, Kotalena,
(f) Chilaw-Puttalam Railway Extension.

Annual Volume

The Annual Volume of Transactions, the largest volume since the establishment of the Association, ran into 427 pages being nearly double the previous year's volume which contained 219 pages. The number of illustrations was double that of any previous year's volume. The volume was issued to all members early in 1924.

Complimentary copies were issued to His Excellency the Governor. The Institute of Civil Engineers, The Institute of Engineers,
India, and to others to whom complimentary copies are usually issued. Several letters were received in reply complimenting the Association on the get up and usefulness of its publications. The cost of production per volume was Rs. 9.50 this year, as compared with Rs. 6 for last year's volume.

Discussion on Papers

There has never been a lack of papers contributed to the Annual Sessions. On the other hand the discussion following the papers has always been meagre. A sure method of providing discussion is for members to prepare notes on papers most familiar to them. These notes could be read at the Meeting and they would form a backbone of what should prove a useful discussion. Many members are competent enough to prepare observations especially if given time to prepare notes but they feel diffident in speaking when their remarks have not been prepared and when they feel that their words are being reported. This diffidence will disappear if notes are prepared beforehand and members realise that they will have an opportunity of revising and approving of their observations before they are published. Members intending to ask questions, the answers to which would involve reference to text books, should give the writers of papers an opportunity to see their questions in advance so that the writer may have time to prepare replies.

Finance

A statement of Accounts is appended to this Report. Only a sum of Rs. 75 is in arrears and this amount is due from members who are away on leave. The amount will be recovered upon their return. The total income for the year including interest on Fixed Deposit, sale of papers, etc., totalled Rs. 3,335.55. Of this amount a sum of Rs. 1,912.39 was expended during the year leaving a balance of Rs. 1,422.96. But on the 31 December, 1923, there was an outstanding account of Rs. 2,106.00 for printing the Annual Volume of Transactions. This amount has since been paid partly from current funds.
It will be noted that this account could not have been met entirely from the year's revenue. This abnormal increase in expenditure is due solely to the fact that the cost of the Annual Volume of Transactions has risen by leaps and bounds. The cost of the 1923 Volume amounted to Rs. 2,854.71 as against Rs. 1,850.00 the cost of the 1922 Volume. This increase is accounted for chiefly by (a) the enhanced cost of actual printing; (b) the payment to Survey Department for reproduction of diagrams; (c) the greater number of papers contributed; (d) the increase in the length of papers; (e) the great increase in the number of diagrams reproduced. Authors in future will please note that as diagrams are so expensive their number must be limited to about a dozen per paper. At present, sometimes 30 to 40 diagrams accompany one paper.

Upon reference to the Balance Sheet, it will be noted that on 31 December 1923, the Assets amounted to Rs. 4,096.14. If from this is deducted the sum of Rs. 2,000.00 on Fixed Deposit, the balance of Rs. 2,096.14 will remain. This amount of Rs. 2,096.14 will be entirely swallowed up by the outstanding bill for printing the Annual Transactions previously referred to. It is anticipated that the Annual Volume for 1924 is likely to cost more than the 1923 Volume so that it will not be possible to meet the current year's expenditure from the year's revenue only. Consequently it will be necessary to consider the question of bringing to current account the sum of Rs. 2,000.00 now on fixed deposit so as to carry on the work of the Association. The Fixed Deposit Receipt expires at the end of December 1924 and the matter of its cancellation will then be further considered by the Standing Committee.

It is proposed to address Government with a view to granting assistance to the funds of the Association by giving free printing of diagrams and also a grant-in-aid similar to that given to the Royal Asiatic Society (Ceylon Branch).
Library

During the year under review, the following publications have been added to the Library:

(a) Proceedings of the Institute of Engineers, India.
(b) Proceedings of the Punjab Engineering Congress.
(c) Proceedings of the Bombay Engineering Congress.
(d) Proceedings of the Mysore Engineering Congress.
(e) Proceedings of the Burma Engineering Congress.
(f) Proceedings of the Engineering Association of Malaya.
(g) History of the Public Works Department, Part III, by Mr. P. M. Bingham, presented by the Hon. Mr. J. Strachan, Director of Public Works.

Copies of all past proceedings of the above institutions containing papers, a complete list of which is published in the Annual Transactions, are available for reference and will be issued to members upon request. Your Secretary has also been notified by the Honorary Secretaries of the allied Associations in India and the Federated Malay States that copies of their proceedings will be issued at cost price to members of this Association requiring copies.

Past Transactions

The value of our publication is evidenced by the fact that copies of past Transactions are continually being applied for by various Heads of Departments and others interested in the subjects dealt with therein. There is a large number of past Transactions including single copies of papers filed in the Secretary’s Office. The Standing Committee have decided that writers of papers may be allowed any number of extra copies of past papers at Rs. 1 per copy. The usual charge of old Volumes of Transactions is Rs. 10 per Volume and for copies of papers Rs. 2, but members of the Association can now purchase these (if available) at half price.
The thanks of the Association are due to Colonel T. G. Jayawardene for carrying on the duties of the Honorary Secretary during the temporary absence on leave of Mr. Woodeson last year and to Mr. R. G. Bartholomew for auditing the accounts of the Association.

Statement of Accounts

Colonel Jayewardene, the Honorary Treasurer, submitted his statement of accounts. He said, Mr. President and Gentlemen, I have pleasure in placing before you the Statement of Accounts for the year ending 31st December, 1923. You see from that statement that the first part of it deals with the Income and Expenditure for 1923, and that the balance carried forward is Rs. 1,422.96. You will note at the end of the statement a sum of Rs. 2,106 put down as cost of printing the Annual Volume; this should have been met from the year's income. But we could not pay it at the end of the year owing to the bill not having been rendered in time. The balance of Rs. 1,422.96 plus the sum of Rs. 502.96 carried forward from 1922, will go towards the cost of printing the Annual Volume, leaving a deficit of Rs. 9.86 to be paid from the current year's account. During the year under review, I will note with satisfaction I am sure, that we have had practically no arrears. Five members have not paid. These are members who were out of the Island. Their subscriptions will, I am sure, be paid on their return from leave. There is nothing else that I need draw your attention to except the regrettable part which is that the fixed deposit of Rs. 2,000 will have to be drawn upon for cost of printing the Annual Volume. It will be good if we could get Government to help us by giving a grant yearly. I trust the Director of Public Works as a
Member of the Legislative Council will urge the desirability of Government contributing a sum for an Association of this kind which is of the greatest benefit to Government, as it promotes educational facilities to the members of Government Technical Departments and it is therefore in the interest of Government to further the interests of the Association.

The Treasurer's statement of accounts was passed.

Election of Officers

The Chairman: The next thing on the Agenda is the Election of Officers for 1924-25. All officers at present in office will retire. Before leaving the Chair I should like to make one or two remarks. I have first of all to thank Mr. Woodeson our very able Honorary Secretary for the very large amount of work he has put in during the past year for this Association. The success of our meetings, you will agree, is greatly due to Mr. Woodeson. The day must come when he will go—I hope it is a very long way off, and give up the post of Honorary Secretary. The post will be filled. It is possible to get another Honorary Secretary but not possible to get such an able and energetic Honorary Secretary as Mr. Woodeson has been. I must say that Mr. Woodeson has been Secretary for 12 years and has the interests of the Association at heart. When Mr. Woodeson was away at Home Colonel Jayewardene took up dual duties of Secretary and Treasurer. He assisted me very much at the beginning of the year. The post of Treasurer is not one that any one is jumping about to get. I have also to thank the Vice-Presidents and the hard working Standing Committee. You will agree with me that success of this meeting up to a certain point was due to the presence of our Patron, His Excellency the Governor. The Governor's speech on that occasion shows the interest he takes in Public Works in Ceylon and also the interest in Engineers. My next duty is to call upon Mr. W. Brown to occupy the Chair pro tem.
Mr. Brown occupied the Chair *pro tem.*

Mr. Bowen retired amidst applause.

The Scrutineers Messrs. G. E. Misso, A. L. Freisz and J. M. Adam announced that the members’ nominees had been elected. The result of the voting was as follows:

**President:** The Hon. Mr. John Strachan.

**Vice-Presidents:** Messrs. N. M. Ingram, A. H. G. Dawson, W. Brown and E. H. Van der Straaten.

**Standing Committee:** Messrs. C. H. Kilmister, C. G. Harward, E. W. Head, A. J. Bamford.

**Hony. Treasurer:** Colonel T. G. Jayawardene.

**Hony. Secretary:** Mr. A. Woodeson.

The **Chairman:** I have to announce that Mr. C. H. Kilmister has withdrawn his name from the Standing Committee and propose that Mr. G. W. Dodds be appointed in his place.

This was agreed to.

Mr. Brown: Before vacating the chair, I have pleasure in calling upon Mr. Strachan to take the Chair. I offer him my congratulations on being elected our President. You will all feel assured that in his hands our interests during the year will be safe. They could not be in better hands.

**New President**

Mr. Strachan in taking the chair said: I thank you for the very great honour done me in electing me as President for the next year. I am afraid I cannot pretend to do the work of the Association as well as the retiring President has but I shall try to do my best. I rely on the assistance of the Vice-Presidents and the Standing Committee and our friend Mr. Woodeson. I feel depressed to think that the first thing facing me is to draw from the fixed deposit of Rs. 2,000. I hope with your assistance we will be able to get some more members. After the excellent way in which His Excellency the Governor spoke of us after attending his first meeting here, I hope his
sympathy will be extended to us in a much more practical way than expressed in his speech. I shall carry out Colonel Jayawardene’s instructions and go to the Finance Committee and try and get money. Gentlemen, I thank you very much. It is now my pleasure to convey the thanks of the Association to the Scrutineers Messrs. Adams, Freysz and Misso, to the contributors of papers and to the officers who have conducted the various visits during the session. We thank Mr. Pennman for kindly explaining Mr. Harper’s paper and taking us round the Post Office, and in addition Mr. Kennard. The thanks of the Association are conveyed to the Principal of the Government Technical Schools for allowing the Members the use of the lecture hall for Meetings. Our thanks are due to the Surveyor-General for the very valuable assistance given in printing diagrams and to Mr. R.G. Bartholomew for auditing the accounts. I propose that this Association records its thanks to the Hon. Secretary, the Hon. Treasurer and the Members of the Standing Committee during the past year.

I think these meetings have been a record. The first meeting of this session of the Association was the most largely attended that I have ever seen. I think the number of papers is a record. The volume last year was simply wonderful. Finally I want to propose a vote of thanks to Mr. M. Cole-Bowen the retiring President. I do not know really what to say about him. Mr. Cole-Bowen has conducted these meetings with the utmost care and skill. On Saturday night when in difficulty about getting people to speak he said: ‘That is the order of business.’ (Laughter.) The votes of thanks were carried unanimously.

The Retiring President

Mr. Cole-Bowen: Mr. President and Gentlemen, I thank you for the very kind things said about me. I am sure I shall always have the interest of the Association at heart, and in anything I can do I won’t be lacking in coming forward to do it. The affairs of the Association are very sound and
consequently the work of the Association will go on well. I congratulate you, Sir, on the fact that the members of the Association unanimously elected you as their President.

And now gentlemen, in conclusion I propose a hearty vote of thanks to the Chair.

Mr. Woodeson: Mr. President, Mr. Cole-Bowen and gentlemen, I wish to thank you for the honour done me and for the kind reference to the work that I have had the honour to do for this Association. The work to me has been a great pleasure. I thank you for electing me Secretary again.

The Chairman: That concludes the business of the sessions.
### THE ENGINEERING ASSOCIATION OF CEYLON

Income and Expenditure Account for the Year ending 31st December, 1923.

<table>
<thead>
<tr>
<th>Dr. 1923</th>
<th>EXPENDITURE</th>
<th>Rs.</th>
<th>Cts.</th>
<th>Cr. 1923</th>
<th>INCOME</th>
<th>Rs.</th>
<th>Cts.</th>
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<tr>
<td>December 31</td>
<td>To Printing 1923 Transactions:</td>
<td></td>
<td></td>
<td></td>
<td>December 31</td>
<td>By Subscriptions in arrears prior to 1923:</td>
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<tr>
<td></td>
<td>Printing Advance Copies of</td>
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<td>71</td>
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<td></td>
<td>Papers for Annual Conference:</td>
<td>116</td>
<td>38</td>
<td></td>
<td>45'00</td>
<td>15</td>
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<td></td>
<td>Diagrams</td>
<td>129</td>
<td>75</td>
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<td>Subscriptions for 1923:</td>
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<td></td>
<td>Stationery and Miscellaneous</td>
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<td>221 Members at Rs. 15'00</td>
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<td>Postage and Sundries</td>
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<td></td>
<td>Rs. 3,315'00</td>
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<td>Secretarial Expenses</td>
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<td>Less paid in advance:</td>
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<td></td>
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<td></td>
<td>Reporting Proceedings</td>
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<td>Less arrears:</td>
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<td>Hire of Cars</td>
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<td>Sale of Papers:</td>
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<td>Balance Carried to Balance Sheet</td>
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<td>Bank interest:</td>
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<td>Fixed Deposit:</td>
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<td></td>
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<td>Current Account:</td>
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<td>75</td>
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<td>Profit on Exchange:</td>
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<td></td>
<td></td>
<td>3,335</td>
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**BALANCE SHEET AS AT 31st DECEMBER, 1923.**

<table>
<thead>
<tr>
<th>Dr. 1923</th>
<th>LIABILITIES</th>
<th>Rs.</th>
<th>Cts.</th>
<th>Cr. 1923</th>
<th>ASSETS</th>
<th>Rs.</th>
<th>Cts.</th>
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<tr>
<td>December 31</td>
<td>To Balance from 1922:</td>
<td>502</td>
<td>96</td>
<td></td>
<td>December 31</td>
<td>By National Bank of India, Ltd.:</td>
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<td>Fixed Deposit at P. &amp; O. Banking Corporation</td>
<td>2,000</td>
<td>00</td>
<td></td>
<td>Fixed Deposit at P. &amp; O. Banking Corporation, Ltd.:</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Subscriptions Paid in Advance for 1924</td>
<td>82</td>
<td>50</td>
<td></td>
<td>Petty Cash in hand:</td>
<td>2000</td>
<td>00</td>
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<tr>
<td></td>
<td>Balance of Income and Expenditure Account for 1923</td>
<td>1,422</td>
<td>96</td>
<td></td>
<td></td>
<td>18</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4,096</td>
<td>14</td>
</tr>
</tbody>
</table>

Examin[ed and found correct.](Signed) R. J. BARTHOLOMEW, Honorary Auditor.

Colombo, 31st May, 1924.

(Signed) T. J. JAYEWARDENE, Honorary Treasurer.

ENGINEERING ASSOCIATION OF CEYLON.

Note.—On 31st December 1923 there was an outstanding account for Rs. 3,166, for Printing the 1923 annual volumes of Transactions, which has since been paid. This year's volume was nearly a record one in point of size being double the size of the previous year's volume.
Papers Read before Allied Associations.

The Committees of the PUNJAB, BOMBAY, BURMA, MALAYA and MYSORE ENGINEERING CONGRESSES have decided to issue copies of their Annual Proceedings (containing papers as per list published below) at cost price to members of the Engineering Association of Ceylon applying for copies through the Honorary Secretary.

PAPERS READ BEFORE THE
PUNJAB ENGINEERING CONGRESS, LAHORE.

1913
*Grain Elevators and their application to the Punjab Wheat Transport Problem
*The formation of Land by Rivers and Torrents in the Punjab
*Dams and Storage Reservoirs
*Concrete Work in new Loco. Shops, Lahore
*Reinforced Concrete Pipe Foundations in the West Beyne Bridge
*The Mechanical Equipment of Irrigation Works

Victor Bayley, A.M.I.C.E.
C. E. Blaker
F. W. Schone mann
J. A. Bell
E. A. C. Lister, F.C.H.
John Ashford, M.I.M.E.
A. R. Astbury, A.M.I.C.E.

1914
*The Hindustan-Tibet Road
*The Development of Canal Falls for the Production of Artificial Fertilizers
*Tube Wells

Capt. B. C. Battye, R.E
T. A. Miller Brownlie, M.I.M. & C.E., M.I.W.E.
F. W. Schone mann
Cecil A. Colyer, A.M.I.C.E.
F. Marshall Purves
A. J. Wadley
F. J. Harvey, A.M.I.C.E.
D. Macfarlane
F. B. Martin

1915
*The Construction of a Double Track Girder Bridge across the Jumna River on the North Western Railway between Kalanour and Sarsawa
*Reinforced Concrete Platforms for Carriage Washing at Lahore Station

A. J. Sleigh, A.M.I.C.E., F.C.H.
Capt E. P. Anderson, R.E.
1915 A Research and Investigation Station for the Public Works Department
Temperature Experiments at Lahore
Water Proofing Operations on the Jhang Branch of the Lower Chenab Canal during 1913-1914
Some Practical Mathematics of Canal Works
The Training Works on the Sutlej at Rupar
1916 The Testing of Bridges
Notes on Efflorescence on Buildings and Structures together with the means of combating it
River Training Works and Diversion of the Sutlej near Bahawalpur
Distributary Heads and other Canal Diversion Works
The Design of Head Regulators of Irrigation Distributaries
Distributary off-takes in relation to Soil Conditions
1917 The Absorption Losses of Punjab Irrigation Canals
Lining Irrigation Channels
The Namal Dam
Sialkot Water Supply
Surface Drainage Schemes in the Punjab
Canal Outlets
1918 The Extension of American Cotton Cultivation under Irrigation in the Western Punjab and Sindh
The Sub-Soil Water Table under the tract irrigated by the Lower Chenab Canal
Water Supply from Tube Wells
Note on Tube Wells
Exclusion of heavy silt from Channels by Vaned Pitching
Reinforced Concrete Siphons on the Lower Swat Canal
The Distribution of Canal Water with special reference to Outlets
Alignment Charts
1919 Highways in the Punjab, Past and Future
Mechanical Filter Installation at Jamum
Remodelling Inundation Canals in the Muraffargarh District
Discharge Observations
Regime Channels
C. S. Waite
A. S. Gibb, A.M.I.C.E.
F. V. Elsdon, A.M.I.C.E.
A. J. Wadley
H. W. Nicholson, B. Sc.
H. S. Sales
T. A. Curry, A.M.I.C.E.
J. Harford, A.M.I.C.E.
F. W. Schonemann
Lahna Singh, Sirdar Bahadur
E. S. Heard, B.A., B.A.I.
Amar Nath Nanda, Rai Sahib
B. P. Varma
W. Roberts, B.Sc.
C. G. May
T. A. Miller Brownlie, M.I.M. & C.E., M.I.W.E.
H. W. King.
F. H. Burkitt
J. O. Waterhouse, A.M.I.C.E.
A. C. Padday, A.M.I.C.E.
W. S. Dorman, B.A., B.E., M.I.C.E.
P. G. Dani, B.A., B.Sc., A.M.I.C.E., A.M.I.E.E.
O. W. Duthy
W. B. Harvey, B.Sc.
F. L. Lindley, B.A., A.M.I.C.E.
A Project for Providing the Punjab
with a cheap supply of Electric
Power.
Experiments on Broad Created Weirs
Water Logging.
Reinforced Concrete Tanks
An Investigation and Research Insti-
tute for the P.W.D.

1920
Liquid Fuel Installation at Kotri,
North Western Railway
Railway Water Supplies
Tube - well in Borstal Central Jail
Garden at Lahore
Shortening the Alexandra Bridge
over the Chenab River near
Wazirabad
Ferro-Concrete Well Curbs and
Roadway Slabs used on the
Chenab Bridge
Kharif Channels
The Design of Regulators for
Distributaries
Silt Valves
Wet soils and their Behaviour
under Loads
Grades and Curves on Hill Roads.
A few Aspects of the Punjab Road
Transport Problem

1921
A Description of the Erection and
Operation of Sliding forms in
grain, Elevator Construction
Drains on the Lower Chenab Canal
Water-logging from Irrigation
Canals in Alluvial Soil
The Chenab and Palkhu Road Bridges

1922
The Design and Construction of
light Suspension Bridges
Aerial Ropeways
The Supply of Road Metal in the
Punjab
Sub-soil Water in the Punjab Plains
The Electrical Equipment of the
North-Western Railway, Power
Station and Workshops at
Moghalpura.
The use of Mud in Building
Construction
Water Supply Improvements

1923
Percolation and Absorption of Water
in the Soil
Notes on Cracks in Buildings in
Dera Ghazi Khan
Notes on the Rusting of Steel in Con-
tact with Lime Mortar
Note on the Location of a Burt Main
The Application of Modules in
Irrigation
Some Problems of High Voltage Trans-
mission in the Lower Himalayas

F. L. Milne, A.M.I.E.E.
F. H. Burkitt, O.B.E.
Iqbal Hussain.
R. A. Wallace, A.M.I.C.E.
F. W. Carne, A.M.I.C.E.
N. Pearce.
C. B. Barrie.
W. S. Dorman.
F. C. Pavry
A. R. B. Armstrong.
T. M. Bostock.
W. P. Thompson.
H. W. King.
Iqbal Hussain.
A. R. B. Armstrong.
K. G. Mitchell.
Major J. K. Wyman, R.E.
W. P. Thompson
F. V. Elsdon
D. Macfarlane & W. T. Everall
A. St. G. Lyster
Major F. N. Budden, R.F.
G. T. Pound
J. H. T. Middleton
K. Preston
D. Macfarlane
W. Cathrow
B. H. Wilsdon, M.A., B.Sc., I.R.S.
J. H. Johnston, B.Sc., (Edin.),
M. INST. C.E.
A. R. Astbury, M. INST. C.E.
W. F. Buchanan, M.I., MECH. E.
E. F. Lindley
Lt. Col. B. C. Battye, D.S.O.,
1924 Tests carried out on Sand from the Sutlej River and Punjab Portland Cement... A. N. M. Robinson, B.A., B.E.
Temporary Quarters No. 1 Division Khyber Railway... Major F. P. Anderson, R.E.
Notes on the design of Girder Bridge Abutments, for Broad-gauge (5' 6") Track... N. G. Watson
Economic Railway Construction... Major F. P. Anderson, R.E.
Some aspects of Track Maintenance and Permanent way on the North Western Railway... E. Watson, B.E.
Discharge Curves and Slide Rule... E. S. Lindley, M.Inst., C.E.
Note on Aerial Photographs of Canal Works exhibited at 1924 Congress... E. S. Lindley, M.Inst., C.E.

PAPERS READ BEFORE THE BOMBAY ENGINEERING CONGRESS, BOMBAY

A Note on Road Maintenance... R. J. Kent, A.M.E.C.E.
The Jewell Filter Installation at Hubli... G. N. Gokhale, B.Sc., L.C.E.
River Training Works... N. N. Ayyangar, L.C.E.

1916 The Oil Engine and its application to Indian Agriculture... W. M. Schutte, A.M.I.M.E.
Tidal Action in the Gulf of Cambay and its effects on Coastal Lands... N. N. Ayyangar, L.C.E.
Notes on Limes and the preparation of Lime Mortar... C. B. Pooley and Rao Saheb, V.K., Chapekar.
The Willingdon Bridge at Mahuli, Satara District... H. W. Oddin Taylor, B.Sc., A.C.E.
Notes on the Relative Value of Submerged and Open Type Sluices on inundation Canals... A. Gordon, B.Sc.
Notes on Paints and Painting... G. H. Thistleton-Dyer, M.A., A.M.I.C.E.
New Engineering Laboratory of the College of Engineering, Poona... R. S. Cree Brown, B.Sc., A.M.I.C.E.
   The Power Plant of the Gokak Water Power and Manufac-
   turing Company at Gokak Falls ................................ A. N. Robinson
   Motive Power in India .............................................. F. E. Bhardwaj, A.M.I.M.E.
   Slow and Rapid Filtration of Water .............................. R. A. Collett, A.M.I.C.E.
   Light Railway Promotion .......................................... F. J. Preston, M.I.C.E.
   Note on Masonry Arches .......................................... W. G. Barnett, A.M.I.C.E.
   Note on Wells ................................................................ H. O. B. Shoubridge, M.I.C.E
   Note on Limestone, Surki Mortar .................................. A. Wilson
   Note on the Comparative Results ................................. W. L. C. French, A.M.I.C.E.
given by Kutter's and Bazin's New Formula ...................... E. M. Duggan, B.Sc., A.M.I.C.E.
   Note on the Card Index System .................................... W. G. Barnett, A.M.I.C.E.
   On handling General Correspondence ............................. W. G. Barnett, A.M.I.C.E.

1919 Mortar Testing ...................................................... R. S. Cree Brown, B.Sc., A.M.I.C.E
   Railway Electrification ............................................ W. G. Barnett, A.M.I.C.E.
   Possibilities of Reinforced Concrete Shipbuildings in In-
   dia ............................................................................ G. T. Mawson, M.S.A., Bombay
   Contour Surveying ..................................................... J. S. Malik, B.Sc., A.M.I.C.E.
   A Note on the Working cost of Steam Rolling ................ E. M. Duggan, B.Sc., A.M.I.C.E
   The Hubli Waterworks Chimney ................................... G. N. Gokhale, B.Sc., L.C.E.
   Duty of Irrigation Water in relation to the capacity of Ca-
   nals in the Deccan ..................................................... C. C. Inglis, B.A.I.
   Deflection of Rails .................................................... F. J. Preston, M. Inst. C.E.
   Use of Shahabad Stone for Litho-
   graphy ........................................................................ W. G. Barnett, A.M.I.C.E.

1919 Note on High Level Causeways ................................. R. S. Kent, A.M.I.C.E.
   Note on Water Power .................................................. B. D. Richards, B.Sc., M.I.C.E
   Mortar Testing II ....................................................... R. S. Cree Brown, B.Sc. (New Zealand), A.M.I.C.E.
   Ventilation .............................................................. J. Wallace, C.E.
   High Masonry Dams .................................................... C. T. Dalal, M.I.C.E
   Transmission of Pressure through Sand ........................ W. G. Barnett, A.M.I.C.E.
   Cold Storage ............................................................ T. S. Dawson, J.F., M.I.M.E.
   Notes on the Construction of Military Camps at Dhond .... T. G. Russell, B.Sc. (Glas.)
   A Self Acting Module ................................................. G. S. Joshi, B.E.
   Blow Lamp Experiments carried out by Messrs. Richardson
   and Cruddas, Bombay ................................................ E. G. Edgley, M.I.M.E.
   Water Supplies from Fine Sand Strata .......................... G. H. Firthwell-Dyer, M.A.,
   M.A., I.C.E.
1920 A Contribution to the Study of the Economics of Motor Design
Mortar Testing I, I, I., Brick Chimneys for Steam Boilers, Modules and Semi-modules for Irrigation, Electrical Installation Work in Bombay, Note on Reinforced Concrete Balustrade, Note on the Cost of Running a Motor Car, Some Notes on Pioneering and Hydraulics

W. Bevan Whitney, B. Sc., A.M.I.C.E.
R. S. Cree Brown, B.Sc.
Fakirji E. Bharucha, L.M.E.
C. C. Inglis, B.A.I.
R. G. Higham, A.M.I.C.E.
S. R. Perfect.
C. Graham Smith, O.B.E.
F. G. Carron, A.M.I.C.E.

1921 Jamshedpur Drainage System
Some Points in Connection with the Construction and Maintenance of Road Surfaces, A Water Storage Tank (15,000 Gallons in Reinforced Brick Work), Notes on the design of a Railway Shunting Yard, Conduit System of Tramway Construction Old and New, Some River Training Works on Alluvial Soil, Motor Testing (Paper 4), The Building Stones of Salsette, Black Cotton Soil and how to deal with it, Notes on the use of a Continuous Water Level Recorder, Jims and Gadgets

F. C. Temple
Measham Lea
D. S. Johnstone
W. G. Barnett
F. O. J. Roose
C. Graham Smith
R. S. Cree Brown
R. S. Cree Brown
A. X. Moraes
E. V. Richards
C. O. Lowsley

1922 Chlorination of Small Water Supplies

C. M. Lane.
N. N. Ayyanger.
A. A. Musto, M.Inst., C.E.
G. N. Gokhale.
G. C. Inglis, B.A.I.
F. Wright
Y. N. Gore, L.C.E.

1923 The method adopted to exclude Heavy silt from the Jamnai Canal
An example of Pre-cast Concrete Construction
Lubrication and Lubricants
An adaptation of the Standing Wave Principle to Hydraulic Testing
A study of Building Construction in Ancient Indian Manuscripts

W. Kirkpatrick
L. W. Lewis
W. Clewes Garner
C. C. Inglis
K. V. Vaze
1923  The aim and scope of the A. S. M. E. Power Test Code for Hydraulic Power Plant  
Notes and Tables for the Economic Design of Retaining Walls  
Notes on Badlapur Barrage  
Some out of the way designs in Reinforced Concrete  
Notes on details of Concrete Construction with special reference to the Report of the Bombay Reinforced Concrete Committee of 1922  
Specifications for Steam Road Rollers for use in India  
Water Divining  
"The Roadrail"  

1924  The rebuilding of the Bassin Bridge on the B. B. & C. T. Railway  
Notes on the essential Civil Engineering Equipment of Wet Docks  
The Tata Power Hydro-Electric Scheme  
The Water Turbine in India  
Notes on Experimental lengths of Ferro Concrete Road and Wharf constructed by the Bombay Port Trust  
Co-operative Development and Land Planning  
The Position of Reinforced Concrete in Structural Engineering in Bombay  
The Nasik Distillery Water Disposal Works  

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PAPERS READ BEFORE THE BURMA ENGINEERING CONGRESS, RANGOON

1915  Earth Pressure and Foundations  
Practical Considerations in the Designs of Wing Walls for Bridges  
Distribution of Pressure in an Earth Cushion  
Distribution of Pressure through a Cushion of Road Metal  
The Embanking of Rivers as a Protection from Flood Spill  
Sinking a Tube Well at Yuntaza  
Reinforced Concrete Super-passage, Yeu Canal  
90 feet Reinforced Concrete Arch Bridge at Manpwin  

A. Lennox Stanton  
N. N. Ayyanger and H. G. Thakar  
T. S. Kennedy  
P. S. Char  
M. G. Cervello  
G. H. Thistleton-Dyer & C. Holliman  
C. A. Pogson  
H. Freeland  
J. A. Jones & B. B. Haskew  
J. McClure  
N. J. Cursetjee  
E. N. Webb  
A. Hale-White  
E. M. Gilbert-Lodge  
P. S. Char  
B. L. Modak  

C. H. Wollaston  
R. S. Baker  
A. A. H. Ricketts  
W. A. Moran  
B. M. Samuelson  
G. A. Hicks  
C. C. Mackintosh  
C. E. Scovell
Roadwork on the Rangoon-Prome Road .................................................. H. L. Holman-Hunt
Assistant Engineer's Quarters at Shwebo ........................................... G. Clarke
Notes on Reinforced Concrete Work in the Northern Shan States .......... C. Innes
Caisson Foundations for Bridge Piers in a Tidal Creek ......................... J. H. Rickie and H. R. Edwards

1916 Irrigation from Streams having an Intermittent Flow during the Monsoon ................................................................. H. E. W. Martindell
The Training of some Pegu Yoma Torrents ......................................... B. M. Samuelson
The Kalaw Water Supply ...................................................................... E. P. Dove
Maintenance and Upkeep of Roads ...................................................... G. A. Grossett
Live Loads for Highway Bridges in Burma ........................................... B. B. Scott
Closing the Alguada Reef Chasm ........................................................ C. J. Homer
Hydraulic Agents in Mortars ................................................................ T. M. de Cruz
The Protection of Buildings from Lightning and some Notes on the Testing of Lightning Conductors ........................................ S. Webster

1917 Water Pumping by Compressed Air
The Reconstruction of the Mandelay Canal Headworks ....................... H. R. Aston
Improvements to Landings at Alguada Reef ......................................... C. J. Homer
Permeable Dams in the Irrawaddy River at Hanzada, 1910-1912 ............. B. M. Samuelson
Note on the Momauk Bridge at 94 Miles from Bhamo on the Mongwan Valley Road ................................................................. F. H. Sheridan
Repairs to the Abya Sluice on the Pegu Sitting Canal ............................. J. A. A. Morrison
The Construction of the Tatinguang Suspension Bridge (400 ft. span), Northern Shan States ......................................................... C. E. Whitcombe

1918 There appears to have been no meeting of this Congress during 1918

1919 The discharge or effective run-off from Catchment Areas due to Rainfall: and the Regulation of Floods by their Temporary Detention in Reservoirs ................................................................. C. H. Wollaston
Loss from Evaporation and Absorption in Tanks in the Delta District .................. W. R. Wells
The Graphic Representation of Expenditure on Works ......................... A. A. H. Ricketts
The Destruction and Reconstruction of the Heinnyetkon Weir, Yamethin District ................................................................. W. M. Hayfield
The Minye Weir and the Theory of the Flow over a Rapid 70-Acre Kadettaw Tank Project Mavmyo ......................................................... B. M. Samuelson
R. Stanley-Baker
A Brief History of the Roads in Burma showing the Development of Road Communication in the Province during the last Sixty Years
Municipal Work in Rangoon

P. F. Wickham
Lancelot P. Marshall

1920
There appears to have been no meeting of this Congress during this year

1921
There appears to have been no meeting of this Congress during this year

1922
Water Hammer
Use of Mechanical Plant for Works in Burma
Construction of Roads to meet the Requirements of the Modern Traffic in Burma
The Essential in Design of Residential Buildings for Burma
Brick Manufacture
Wiring for Domestic Electric Installations in the East
The Distribution of Pressure in Pier Foundations of Canal Syphons

1923
Power House Condensing Water Supply
The New Government Brickfields at Rangoon
Some Minor Works in the Port of Rangoon
Syphon Spillways
Discussion on Mechanical Plant

James Livesay Dyson
G. Holme, M.Sc. B. (Eng.)
J. R. Grant
J. M. B. Stuart B.A.

1924
Standard Design of Road Bridges
Mechanical Plant for working a small up-country Quarry
Foundations in Black Cotton soil
Bituminous Surfacing of Roads
Causeways
Road Problem of Rangoon

C. Innes
S. Webster
C. E. Whitecombe
F. Marshall
J. B. Nottage
A. E. Mann

PAPERS READ BEFORE THE ENGINEERING ASSOCIATION OF MALAYA, KUALA LUMPUR.

1922
The Prai Water Supply Scheme
The Penang Hills Railway
Some Notes on the Penang Water Supply, with Special Reference to the Ayer Itam Service Reservoir
Prai River Wharves
The Deterioration of Structures in Sea Water

D. W. Brisbane, A.M.I.C.E.
A. R. Johnson, A.M.I.C.E.
J. D. Fettes, A.M.I.C.E.
M. F. G. Wilson, M.I.C.E.
1923 The Pipe Line and Workings at Gopeng Consolidated, Ltd. A. G. Glenister, A.INST., M.M.
A Description of Pengkalan, Ltd., Power Station and Electric Bucket Dredge W. J. Wayte, M.I.E.E.
Notes on Road Location, Referring to Roads intended for Vehicular Traffic A. B. Potts, A.M.I.C.E.
Road Construction in the Tropics J. P. Swettenham.
Road Maintenance in the Malay Peninsula E. L. Bennett, A.M.I.C.E.
Johore Causeway D. Paterson, A.M.I.C.E.
Pulau Ubin Quarry F. L. Williams, A.M.I.C.E.

1924 Malayan Collieries, Ltd—Notes on Batu Arang Colliers James Barr, B.E., M.I.M.M. (A.), M.A.M. (M.M.E.
Some Usually Disregarded Points in Bridge Truss Design A. D. Waugh B.A. (Cantab)
A few notes on the Construction of Prai Power Station T. A. Owles, A.M.I.C.E.
The Application of the Theory of Probability to the Adjustment of Errors in Engineering Observations F. G. Coales, A.M.I.C.E.
The Field Practice of Railway location in Malaya John Leggate
The Electrical Equipment of the Penang Hills Railway and its Signalling and Telephone Systems Thomas Rogers, A.M.I.E.E.

THE MYSORE ENGINEERS’ ASSOCIATION,
BANGALORE (INDIA).

This Association issues, a quarterly Bulletin, in which the transactions of the Annual Proceedings are merged. Its Annual Subscription is Rs. 4.

1921 Notes on Surveying Field Work in the Malnad Districts of the Western Ghats with
Special Reference to the Survey Operations Connected with a Hydro-electric Project

A Brief Note on "Preparation of Estimates"

The Development of Central Industrial Workshop, Bangalore

Diversion Cut to Feed the Right Bank Low Level Canal, Krishnarajasagara Works

1922

Industrial Alcohol

Feeder Railways in Mysore

Some Features of Plant Design of the 8th Electrical Installation at Sivasamudram

Reconstruction of a Bridge in Salem-Bellary Road

Some Wants and Difficulties felt in the Maintenance and Administration of River Channels

Utilisation of the Storage of the Krishnarajasagara

Some Industrial Machinery Made in the Central Industrial Workshop, Bangalore

Construction of a Temporary Bridge Over Plus 80 Weir Channel at Krishnarajasagara

Regulation of Water from Irrigation Works across Papaghati

1923

The Mysore Distillation and Iron Works, Design and Construction

Industrial Progress in Mysore

Biochemical Factors in Modern Methods of Water Purification

Bangalore Water Supply

The Planning and Improvement of Bangalore City

Tunnelling on the Right Bank Low Level Canal Division at Krishnarajasagara

Sluices in the Krishnarajasagara Dam

Restoration of Minor Tanks and Maintenance of Restored Tanks

B. Krishna Rao, B.A., C.E.

Y. K. Ramachandra Rao, B.A., L.C.E.

B. G. Appadurai, Mudaliyar, B.A., B.Sc. (Manchester)

N. Krishna Iyengar, B.A., B.E.

S. G. Sastrı, B.A., M.S.E.

K. Srinivasa Iyengar, Asso M.E.

Inst. M.E.

N. N. Iyengar, B.A., B.S.E.

S. A. Ramaswami Iyer, B.E.C.E.

N. Subba Rao, B.A.C.E.

M. G. Rangaiya, B.A.B., E.C.E.

B. G. Appadurai Mudaliar, B.A., B.S.E.

K. R. Garudachar, B.A.B.E.

N. Krishna Iyengar, B.A., L.C.E.

J. P. Carmody, M.E., B.Sc.

P. G. D'Souza, B.A., B.L.

Gilbert J. Fowler, D.Sc., F.I.C.

J. Bhore A.M.I.C.E.

N. C. Narasinha Iyengar, L.C.E.

N. N. Krishna Iyengar B.A.B.E

C. Rangasamy Iyengar B.A.B.E

G. Sesbagin Roo, L.C.E.
THE

Engineering Association of Ceylon

RULES

Adopted at a Meeting held on the 6th January, 1906

Title.

1. The Association shall be called the Engineering Association of Ceylon.

2. The aim of the Association is to promote the acquisition and interchange of knowledge of Engineering and allied professions in Ceylon by the holding of Meetings at which papers on subjects of professional interest shall be read and discussed, and by the printing and circulation of such papers to all Members.

3: All Engineers and Surveyors holding membership, Government appointments, or appointments under any Public body in Ceylon, shall be eligible for membership on application to the Secretary.

4. Persons who are not Engineers or Surveyors, or who are Engineers or Surveyors, but not holding Government appointments or appointments under any Public body, may, on their being proposed and seconded by two Members, be elected by the Standing Committee as constituted under Rule 5. Upon such election the person so elected shall pay the annual subscription and become entitled to all the privileges of membership.

5. A Standing Committee consisting of the President, Past Presidents, four Vice-Presidents, the Secretary, and the Treasurer and four elected Members shall be appointed at the Annual General Meeting. This Committee shall deal with all matters relating to the working of the Association, which may be referred to it by the President, or the Secretary. The Standing Committee shall have
power to authorize the expenditure of any moneys, the property of the Association, for the purposes of the Association. Any three members of the Committee shall form a quorum.

6. A General Meeting shall be held in the month of January or such other time as the Standing Committee may determine in each year at which the President, Vice-Presidents, Standing Committee Members, Treasurer and Secretary for the year shall be appointed. At the General Meeting a statement of accounts shall be laid upon the table by the Treasurer.

In the event of the President being absent from the Colony, the Senior Vice-President shall be ex officio President pending the next annual election.

The Standing Committee shall have power to fill up any vacancy in such Committee or in the offices of Secretary, or Treasurer, that may occur between two General Meetings. Notice of the General Meeting shall be sent to all Members.

7. Where possible the Standing Committee may appoint a Local Representative in any Province or District who shall have power to call meetings for the reading and discussion of papers in such Province or District.

8. The subscription for the year or any part of a year shall be Fifteen Rupees, payable to the Treasurer on the 1st of January of each year, or on the date of application for membership.

Any Member who fails to pay his subscription on or before the 31st day of March in any one year shall cease to be entitled to the privileges of membership until he has paid his subscription and it has been accepted by the Standing Committee.

9. Every Member who has paid a subscription shall be entitled to all the privileges of membership of the Association and to introduce one person, not a Member, to any meeting not of a private nature.

10. Every Member shall have the right to submit papers to be read at the ordinary meetings of the Association, and to take part
in the discussion thereon. Papers shall be written on one side of foolscap paper. They shall be sent to the Secretary or to the Local Representative of the Association in the Province or District in which the Member resides or proposes to read his paper.

11. The Secretary or Local Representative shall decide whether or not such paper shall be accepted, subject to appeal to the Standing Committee and, if refused, the paper shall be returned to the Member submitting it.

The authors of all papers selected to be read or published shall forward to the Secretary or to the Local Representative the necessary small scale drawings suitable for publication.

12. The President or one of the Vice-Presidents shall preside at every Meeting if present; and in their absence, the chair shall be taken by the Local Representative. In the absence of the latter the Members present shall elect their Chairman by vote.

13. Notice of any resolution that a Member proposes to bring forward at a General Meeting shall be sent in writing to the Secretary fourteen days before the date of such Meeting.

14. The ruling of the Chairman at any Meeting on any point of order shall be final and binding on all Members present.

15. The following Rules shall govern the discussion on all papers:

(a) The Chairman shall open the Meeting by calling upon the Member or his representative who has contributed the paper to read it.

(b) Questions regarding the paper shall not be put until it has been read through, when any Member not ruled out of order by the Chair may speak on the subject under discussion.

The above Rules were adopted at a General Meeting held in the Council Chamber, Colombo, January 6th, 1906.

Francis A. Cooper,
President.
HONORARY MEMBERS.

"All past members of the Standing Committee on their permanently leaving the Island shall, upon election, be enrolled as Honorary Members with the privileges of Membership, but not be liable to pay subscriptions".—Resolution passed at General Meeting, 3-3-16 and as amended on 27-4-23.

LIST OF HONORARY MEMBERS.

Cooper, Francis Alfred, C.M.G., M. Inst. C.E. (Past President.)

Ward, Henry Thomas, Simpson, M.Inst.C.E. (Past President.)

Warren, Philip David, C.M.G., Assoc.Inst.C.E., F.R.G.S. (Past President.)

Tickell, Richard Eustace, M.Inst.C.E. (Past President.)

Templeton, Richard Stanser, Assoc. Inst. C. E., F.R.G.S. (Past Vice-President.)

Lovegrove, Charles Arthur, Assoc.M.Inst.C.E. (Past President.)

Mansergh, Ernest Lawson, M.Inst.C.E. (ElectedHonorary Member in 1907.)


Skelton, Robert, Assoc.M. Inst.C.E. (Past President.)

Waddell, George, Assoc.M. Inst.C.E. (Past Vice-President.)

Balfour, John Aylmer, Assoc.M.Inst.C.E. (Past President.)

Atkins, M. R., B.Sc., Assoc. M. Inst. C. E. (Past Member of Standing Committee.)

c/o The Crown Agents for the Colonies, 4, Millbank, London, S.W.I.

Broken Hill, Guildford Road, Woking.

Boulderwood, Mount Herman Road, Woking.

39, Kensington Square, W.

c/o The Crown Agents for the Colonies, 4, Millbank, London, S.W.I.

Castle, Wiveliscombe, Somerset.

5, Victoria Street, Westminster, London, S.W.I.

c/o the Crown Agents for the Colonies, 4, Millbank, London, S.W.I.

Do

Do

Caixa Postal 247, Lourenço Marques, Provincia de Moçambique:

Calcutta Improvement Trust, 5, Clive Street, Calcutta.


Trouce, Arthur Duncan, M.I.C.E., (Past President)

Creasy, Harold Thomas, M.I.C.E., A.M.I.Mec.E. (Past President)
Director of Public Works, Hongkong.

Ingles, Walter Culpepper Stanser, A.I.C.E., F.R.G.S., (Past President)
c/o the Crown Agents for the Colonies, 4, Millbank London, S. W. 1.
THE
Engineering Association of Ceylon.

LIST OF MEMBERS
(Corrected up to 1st October, 1924)

*The star prefix indicates contributor of one or more papers.

The addresses of retired Government Officers living in England, and officers now on leave in England unless otherwise stated may be assumed to be c/o The Crown Agents for the Colonies, 4 Millbank, Westminster, London S. W. 1.

Year of enrolment

1913  Ambler, J.  . Executive Engineer, Railway Extensions, Veyangoda.
1911  ***BAMFORD, A.J., M.C., B.A. (Cantab.), B.Sc. (London), F.R.A.5., F.R.G.S. (Member of Standing Committee)  . Superintendent, Observatory, Colombo (on leave)
1923  Bartlett, G.C.  . Assistant Irrigation Engineer, Dedru Oya Scheme, Kurnegala.
1906  Bingham, P.M., M.I.C.E.  . (Provincial Engineer, P. W. D., Retired) Executive Engineer, Board of Improvement Commissioners, Kandy.


1922  Brohier, R. L.  . . . Assistant Supt. of Surveys, Haldummulla.

1908 **BROWN, W., B.S.C., (Edin.), M.I.C.E. (Vice-President)  . . . Deputy Director of Irrigation, Trincomalee.

1923  Bryant, H. S., A.M.I.C.E.  . . . Divisional Engineer, Post & Telegraph Department, Colombo.


1906 **Caldicott, A. E.  . . . (Assistant, D. P. W. Retired),

1906  *Carson, A. de C., V.D., M.I.C.E.  . . . Provincial Engineer, P. W. D., Ceylon, (Retired)


1917  Christoffler, M. S., A.M.I.C.E.,  . . . District Engineer, P. W. D., Avisawella


1907  Clarke, A. H. F.  . . . Deputy Director of Public Works, Colombo.


1911 Coradine, W.A., M.R.S.I. ... District Engineer, P. W. D., Passara.
1915 Crow, A.S. ... District Engineer, P. W. D., Matara.

1923 Dalrymple, J., A.M.I.C.E. ... Irrigation Engineer, Ceylon (Retired)
1906 Dassanayake, S.W., F.C.H ... Acting Provincial Engineer, P. W. D., Jaffna.
1911 Davidson, A.J. ... District Engineer, Way and Works, C.G.R., Colombo.
1912 Davies, S., M.C ... Construction Engineer, P. W. D., Colombo.
1906 Dawson, A.H.G. (Vice-President) ... Deputy Surveyor General, (on leave)
1922 Dharmasena, E. D. ... Superintendent of Minor Roads, Uva, Badulla.
1917 Dias, C.W. ... District Engineer, P. W. D., Hambantota
1922 DQDSS, G.W., A.M.I.C.E. ... (Member of Standing Committee) Harbour Engineer, Colombo.
1912 Duncan, W. ... Engineer and Assistant Manager, Ceylon Wharfage Co., Ltd., Colombo.

1912 Easten, S., M.Eng. (Sheffield University) ... Acting Superintendent of Surveys, Ratnapura.
1914 *Evans, J.E., P.R.I.M.T.S. ... First Assistant Astronomer, Observatory, Colombo, (on leave).

1923 *Fenton, H., A.M.I.B.E ... Chief Electrical Engineer, Fentons, Ltd., Colombo.
1923 Ferguson, J., A.M.I.C.E ... Acting Superintendent of Surveys, Jaffna.
1924 Fernando, P.C. ... Assistant Electrical Engineer, P. W. D., Colombo.
1912 Fernando, P. Stanley ... Assistant Engineer, Buildings, Colombo Municipality.
1918 Fernando, R.C., A.M.I.C.E ... District Engineer, P. W. D., Ratnapura.
1922 Finlayson, J. J. ... District Engineer, Way and Works, C. G. R. (Retired)
1917 Fonseka, E.O. de ... Assistant Superintendent of Surveys Colombo.
1908 *Fraser, J.H., A.M.I.MECH.E ... Divisional Irrigation Engineer, Kurunegala.
1921 Fretz, A.L. ... District Engineer, P. W. D., Puttalam.
1922 Fyffe, W., A.M.I.C.E. (Late D.E., P.W.D.) ... Deputy Chief Engineer, Madras Port Trust, Madras.
1916  Gill, O.S.  Chief Engineer, Colombo Electric Tramways and Lighting Co., Ltd., Colombo.
1921  Grice, A.L.  Assistant Superintendent of Surveys, Diyalatalawa.
1921  Griffiths, G.C.  Assistant Engineer, Railway Extensions, Veyangoda.

1921  Hall, R.  Engineer, Building Department, Walker, Sons & Co., Ltd., Colombo.
1911  Harrison, H.P., F.S.I.  Supt. of Surveys, Badulla.
1906  **HARWARD, C.C., A.M.I.C.E.  (Member of Standing Committee)  Divisional Irrigation Engineer, Kolonnawa.
1907  **Henman, O.W., A.M.I.C.E.  Divisional Irrigation Engineer, Batticaloa.
1921  Hill, K.J.C., B.Sc. (Edin.)  Irrigation Engineer, Trincomalee.
1921  *Hillman, E.C., M.C., B.Sc. (Birmingham)  Irrigation Engineer, Tabbowa, via Puttalum.
1913  Hogue, A.C., A.M.I.C.E.  District Engineer, Way and Works, C.G.R., (on leave)
1906  **Human, E., A.M.I.C.E.  (Late Executive Engineer, C. L. D. S.), G. O. H., Colombo.

1906  *INGRAM, N.M., (Vice-President)  Municipal Engineer, Colombo, Municipality (on leave).
1923 Jacob, G. S. .. Officer-in-Charge of Works, Naval Office, Trincomalee
1919 Jameson, H., B.sc. .. Acting Superintendent, Observatory, Colombo.
1923 Jayaweera, E. J. .. Electrical Assistant, Government Technical Schools, Colombo.
1906 *JAYWARDENÉ, T. G. Col., v.d. (Honorary Treasurer) .. "Turret House," Turret Road, Colombo.
1914 Johnston, R. J., P.A.S.I. Acting Supt. of Surveys, Batticaloa.
1923 Johnson, S. Barker .. Engineer and Manager, Colombo Gas and Water Co., Ltd., Colombo.

1915 **Kennedy, J. S., M.C., M.A., B.sc. (Glasgow University) A.M.I.C.E. .. Irrigation Engineer, Iranamadu N.P.
1923 Keyt, E. .. Assistant Superintendent of Surveys, Bingiriya.
1921 King, G.B., B.sc. .. Assistant Supt. of Surveys, Diyatalawa.
1923 Kingston, A.T., M.A.E. .. Divisional Engineer, Post & Telegraph Department, Colombo.
1921 Koch, H. E. E. .. District Engineer, P.W.D., Chilaw.
1921 Kulatilake, H. E. de S., .. Asst. Engineer, Colombo Municipality.
1907 *Kretser, H. E. de .. Acting Provincial Engineer, P. W. D., Anuradhapura.
1919 Kretser, J. H. E. de A.M.I.C.E. .. District Engineer, Colombo.

1923 Laing, W. Allan .. Assistant Engineer, Batticaloa-Trincomalee Railway, Maho.
1911 Lambert, S.N. .. District Engineer, Way and Works, C.G.R., Anuradhapura.

1912 Mason, A.F. Executive Engineer, Railway Extensions, C. G. R., Colombo.
1923 Matthews, G. B. Executive Engineer, Batticaloa-Trincomalee Railway, Kalkudah.
1921 May, P.J., F.S.I. Superintendent of Surveys, Kurunegala.
1911 Missio, J.B. Assistant Engineer, Provincial Engineer's Office, P. W. D., Colombo.
1906 Moraes, J.A. District Engineer, P. W. D., Polmadulla.
1912 Morgan, A.H.M. Chief Assistant Harbour Engineer, Colombo.
1917 Mutummaro, T. Assistant Engineer, P. W. D., Gampola.

1914 Norris, P.M., A.M.I.C.E. District Engineer, P. W. D., Dimbulla, Talawakele.
1923 Northway, L.G. Assistant Engineer, Batticaloa-Trincomalee Railway, Trincomalee.
1921 O'Connor, J.A. Assistant Superintendent of Surveys, Hettipola.
1924 O'Kelly, A.T. Assistant Engineer, Main Line Duplication Polgahawela.
1912 Oroloff, J.O. Engineer, Board of Improvement, Kandy.
1922 Owen, C.W. Rowland Harbour Engineer's Department, Colombo.

1924 Parsons, L.D., M.B., Ch. B. (Edin.) Medical Superintendent, Lunatic Asylum Colombo.
1924 Priat, G. W. J. Assistant Postmaster General, Colombo.
1921 Peiris, T.A. Assistant Engineer, Hydro-Electric Scheme, Colombo.
1923 Penman, J., A.M.I.C.E. Assistant Chief Engineer, Post and Telegraph Department, Colombo.
1910 Peries, E.J. District Engineer, P. W. D., Matale.
1921 *Potts, J.A., A.M.I.C.E. Executive Engineer, Railway Extension Department, C.G.R., Kalkudah, (on leave).
1906 **Price, Walter C., B.A. (Trin. Col., Dub.) Provincial Engineer. P. W. D., Ceylon (Retired)

1912 Rafiel, H.C. Assistant Engineer, Colombo Municipality.
1906 Rajasooriya, S.M.S. District Engineer, P. W. D., Panadure.
1921 Ross, R.M., B.Sc. (Edin.) Irrigation Engineer, Tissa, Hambantota
1910 **Salmon, F.J., M.C., A.C.G.I., A.I.M.I., F.R.G.S., ** Supt. of Surveys, Colombo.
1923 Salmon, R.M. ** Assistant Engineer, Colombo Commercial Co., Ltd.
1922 Sanders, J.L. ** Assistant Engineer, Railway Extensions, C. G. R., Mahawelianga.
1922 Sargent, J.D., B.A., Diploma of Forestry (Oxon.) ** Conservator of Forests, Kandy.
1922 Schofield, C.H., A.M.I.E.E. ** Divisional Engineer, Post and Telegraph Department, Colombo.
1912 Schokman, C.G. ** District Engineer, P. W. D., Ratmalana.
1912 *Scott, W.G. ** District Engineer, P. W. D., Kandy.
1914 Seneviratna, R.P.W. ** Supt. of Minor Roads, D. R. C., Kegalle.
1921 *Shiliitoce, J. ** Divisional Engineer, Post and Telegraph Department, Colombo.
1913 Silva, Moses de, A.M.I.C.E. ** District Engineer, P. W. D., Colombo.
1923 Sims, N. W., F.S.I. ** Railway Extension Department, Puttalam.
1924 Skrimshire, R. T. ** Assistant Engineer, Puttalam Railway Extensions, Palavi.
1922 Sproule, F.W. ** Provincial Engineer, P. W. D., Ratnapura.
1911 Stephenson, C.C.S. ** Assistant Supt. of Surveys, (on leave)
1912 Stevens, F.G., A.M.I.C.E. ** District Engineer, P. W. D., Dandegamuwa.
1912 Stork, L.P. ** District Engineer, C. L. D. S., Colombo.
STRACHAN, J., The Hon. Mr., M. INST. C.E., M.I. ST. B., (President) ** Director of Public Works, Colombo.
1923 Swallow, L.H. ** Executive Engineer, Puttalam Railway Extensions, Chillaw.
1913 Symes, L.M. ** Assistant Supt. of Surveys, Tissamaharama
1923 Symes, G.E., A.M.I.C.E. ** Irrigation Engineer, Giants Tank, Murukan.
1906 Thornhill, W.J., A.R.T.C. (Glasgow) ** Assistant Director of Public Works, Colombo.
1916 Thuraiappa, R.A.M. ** District Engineer, P. W. D., Colombo.
1907 Thyne, W.M. ** Waterworks Engineer, Colombo Municipality, (on leave).
1908 *VAN DER STRAATEN, E.H., M.I.C.E. (Vice-President) ** Provincial Engineer, C. P. North, P. W. D., Kandy.
1919 Van der Straaten, J.J.M. ** Assistant Engineer, Railway Extensions, C. G. R., Habarana.
1908 Van Twest, J.T., A.M.I.C.E. ** District Engineer, P. W. D., Kalutara.
1920 Varey, J.A. A.M.I.C.E. ** District Engineer, P. W. D., Vavuniya.
1909 Vince, C.H., P.A.S.I. ** Supt. of Surveys, W.L., (on leave)

1913 Wavell, C. W. F., F.S.I. Assistant Supt. of Surveys, Dehiowita.
1921 White, R. M., B.A., Diploma of Forestry (Oxon.) Deputy Conservator of Forests, Kandy.
1915 Whyte, W., Lieut.-Com., R.D., R.N.R. (Retd.) Mechanical Supt., Harbour Engineer’s Dept., Colombo.

1912 Wijenathan, Hallock, B.Sc. Acting Drainage Engineer, Colombo Municipality.

1924 Wijesinghe, D. M. Electrical Assistant Engineer, P. W. D., Colombo.

1921 Williams, R. V. Assistant Works Manager, Locomotive Dept., Colombo.

1915 Williams, S. R. Acting District Engineer, P. W. D., Maho.
1921 Wilson, L. E. Assistant Supt. of Surveys, Elpitiya.

1910 Wilson, J. A., M.I.MiningE. Irrigation Engineer, Kalmunai, E. P.


1910 Zylva, W. C. de First Grade Surveyor, Elpitiya.
1915 Zylva, W. I. de Acting District Engineer, P. W. D., Pallai.