"COLOMBO'S GAS SUPPLY"

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With the scientific utilisation of coal, the prosperity of industry must be wrapped up. The art of coal gas manufacture dates back roughly 135 years, the credit for the first use of Gas as a public service being due to William Murdoch, a Scotsman, who first lighted his house in Corunwall with coal gas in 1792.

The Colombo Gas & Water Co., Ltd., was formed towards the close of 1868 and by an indenture dated 21st January 1869, the Municipal Council of Colombo entered into certain covenants with the Company in relation to the supply of gas to the Town of Colombo.

The work of erecting the gas installation at the Gas Works was duly begun, and Colombo was first lighted by gas on 10th August 1872, nearly 55 years ago.

The science underlying the manufacture of gas from coal depends on what products in the form of gas, tar, ammonia, solid fuels, etc., give the best financial results.

I do not propose to outline in this paper the exact *modus operandi* in respect of ordinary gas plant detail, as same is briefly set out in the Souvenir booklet which the members of this Association will receive when they visit the Gas Works this week. I merely wish now to touch firstly (and broadly) on gas matters, and secondly (and more particularly) on the principal Engineering work that has
been quietly and surely going on; by this Company the past 3 or 4 years—work brought about in the keeping pace with the rapid rise in the consumption of Town's Gas.

Coal was first carbonised to obtain illuminating gas, but little attention was paid to tars and oils, and ammonia was looked upon as a nuisance. The resultant solid fuel (coke) was also regarded as of little value.

Now-a-days the whole question of gas manufacture and carbonisation of coal has entirely altered. The incandescent gas mantle, invented by Baron Von Welsbach in 1887 has made it possible to obtain light efficiently with gas having little or no illuminating value, and we now only require to supply gas with heating, or calorific value. The so-called illuminating gas only contained 4 per cent. of actual illuminating constituents, the remaining 96 per cent. of the gas being non-illuminant, but in the old days to maintain this 4 per cent., carbonisation was made an inefficient business and prevented the best heat value being obtained from the coal.

The present day carbonisation of coal therefore results broadly in gas, tar, ammonia and coke. Tar can be split up into an almost endless number of constituents, as can be seen in glancing at the genealogical table given in the appendix herein. The quantity and quality of all these products of coal carbonisation vary with the raw coal and the methods employed for carbonisation as may be gathered from the table given herein which sets out in broad indicative lines the results obtained. From the Board of Trade Return for the year 1925 (the latest results obtainable) it is shown that the quantity of coal carbonised by the authorised gas undertakings of Great Britain was over 17 million tons, so that one cannot help but realise the all importance that the gas industry—even in Britain alone—is to-day, and as each Works or each locality differs from another, so must the type of plant differ in carbonising this really huge tonnage.
Whenever any paper or discussion on Gas is published, the average layman generally falls to the conclusion that the gist of such a paper is "Gas versus Electricity," Gas being the winner. But this, in so far as I am concerned is quite wrong. There is no good sense resulting in referring in a depreciatory way of a rival. Certainly no two industries could have had origins more widely different. Gas making in the old days was for the half-naked-man-with-the-shovel; electricity was the product of the study elegantly dressed by the mathematical instrument maker. In supplying gas we are selling a material—potential energy, whilst in supplying electricity it is a force—kinetic energy.

Turning now to Colombo's gas requirements, the Company, starting 55 years ago has passed through many trials, not the least of which were during the long war years, and it is not too far distant to remember when, by reason of the impossibility of obtaining coal supplies, the gas supply on the Town was to all intents and purposes cut off at 9 p.m. each evening. Matters gradually improved and outputs began to pick up from 1919 onwards due to varying reasons. In 1918 the output of gas showed a decrease on 1917 of 21 per cent.; in 1919 this decreased output was converted into an increase of 15.6 per cent. over 1918, and in 1920 a still further rise of 21 per cent. in sales was recorded over and above 1919; so that towards the close of 1920 it was becoming evident that extensions to both the manufacturing and distribution (storage) plant were matters for early decision.

In 1921 and 1922, the output continued to show goodly percentage increases, so much so that for the 4 years 1919-22 the total gas manufactured had risen by some 56 per cent. While the manufacturing plant could be relied upon to deal with the total gas required for a year or so, the storage capacity (Gasholders) was becoming dangerously
insufficient, and as the Wellawattee area was fast voting for "Gas," it was becoming impossible for us to supply this outlying and growing suburb at adequate pressures.

In 1922 it was definitely decided to erect a Gasholder on land which we had purchased six years previous in Havelock Town (Greenlands Road). This scheme was to serve the dual purpose of (a) storage and (b) pressures.

Erection commenced early in 1923. The plant comprises a 200,000 cubic feet gasholder (2 lift spiral guided), an engine house containing a gas driven booster, and governing apparatus. Briefly, gas is drawn from the Town's mains by the booster after 12 midnight each night and the holder is filled up in a few hours time ready for the next day's output.

The area of the Depot is just over 1 acre and the sub-soil is entirely sand and firm. Accordingly it was thought quite sufficient to make the foundation a reinforced raft of 2' 6" concrete and the reinforcement was effected by 2 layers (one top and one bottom) of 3" expanded metal placed 3 inches from the surfaces. The diameter of the tank was 78' 6" and the raft was made 79' 6" the concrete mixture being 4 stone (14 in. metal) 2 river sand, 1 English cement. The concrete was mixed mechanically and gangs of coolies worked day and night till the raft was finished. The bottom of the raft was fixed at 5 feet below ground level. The total weight on this raft, of holder and tank when latter was filled with water was 3,500 tons, equivalent to ¾ ton per square foot. The foundation proved all that was desired and no subsidence has occurred at all,

The first rivet was put in the tank at the end of January and the holder was operating on the Town at the end of July, resulting in 186 working days.

In all such jobs the sheets for tank and lifts are sent out drilled so that except for a few final joints, etc., the work consists purely
The tank plates vary in thickness from 1⁄2" downwards, and the lift sheets from 4⁄8" downwards.

No set backs occurred in the erection and the holder passed all tests from the start, and has been working daily ever since.

The scheme as before stated increased our storage capacity by 200,000 cubic feet, and also enabled us to supply gas at the necessary satisfactory pressures to the south of the Town, and afterwards for the 2 districts outside the Colombo limits, viz., Dehiwala and Mt. Lavinia.

Having made ourselves so far safe in the matter of "Storage supply"—and the total of such at Works and Greenlands was then 310,000 cubic feet equivalent to roughly 20 hours' normal needs)—we embarked on increasing the manufacturing plant at the Gas Works itself the following year (1924). The total carbonising plant then was equivalent to 800,000 cubic feet per 24 hours, and the daily output was approximately 600,000 cubic feet, so we had little or no reserve plant to fall back on.

The new carbonising plant and general alterations to the method of handling the coal, were put in hand in March, 1924, and were concluded in December that year and provided for an additional manufacture of 700,000 cubic feet per diem.

This scheme completely altered the method of gas manufacture at Colombo, but was most difficult to carry out considering the lack of ground space at our disposal and the fact that we were adding to and coupling up, new plant with old.

The main retort house which contained the old retort benches (hand charged) was extended by the 3 new beds noted above, and the entire old retort house brick building and roof was pulled down and in its stead a higher and wider steel structured building was erected. These alterations were necessary so
as to allow for the new mechanically driven "charger-discharger," coal elevator, storage hopper, etc. Four plates showing different aspects of the new house are given in the appendix. The span of the new building was 55' 2" and the overall length 136' 4".

Owing to the marshy slimey nature of the subsoil great care had to be taken with all foundation work, the concrete mixture used throughout being 4 parts metal (1 1/4" cube)- 2 river sand and 1 Portland cement.

The raft for the 3 new settings was reinforced with expanded metal at the bottom and old railway lines, 1 foot from top surface, the latter bonding into the old setting foundations. The raft was made 3 feet in thickness, but for the chimney it was necessary to excavate down 8'.

On reference to the drawings it will be seen that 14 roof principals are employed, and 37 concrete blocks necessary for the 37. 12" x 6" R.S. stanchions, and these blocks were made 4 feet square, reinforced.

The pit accommodating the coal crushing plant on the south side, and known as the "Breaker Pit" was sunk 16' below stage floor level and gave us great difficulty in excavating, pumps working day and night. A 3 foot foundation was laid and then a cast iron tank 10' x 11' x 6' deep was bolted and fixed in position and has proved of the utmost value in keeping water out of the elevator machinery. The elevator consists of buckets attached to an endless chain, the coal in passing through the 4 roll breaker feeds direct into the buckets and is then taken up to the top of the building into the 50-ton storage hopper—which holds about 36 hours' supply.

The coal, which is so broken, can then be fed into the machine hopper. The charging machine travels up and down the house on rails, receiving electric current from overhead wires, and has 3 motors, one for hoisting and one for travelling (both 7 1/2 H.P) and one-
for charging—discharging (15½ H.P.). A visit to the Works will show members exactly how this machine works, the coal being fed into the retorts by 4 pushing operations, and in respect of "discharging" the coke is pushed out in one operation only.

Despite heavy monsoon weather the foundations and roofing were in due time completed, and no interrupted supply on the Town arose.

A power house was erected to generate electric current for the several motors and consisted of 1.30 K.W. gas driven National generating set with switchboard, regulators, etc., compound wound interpole dynamo 30 K.W. 500/550 volts, 60 amps. 230 r.p.m. Apart from such, Town’s electric supply is coupled up to the switchboard. The foundation for the engine was made 6’ in depth.

The new plant has been in constant use since 16th December, 1924 and has revolutionised our records. The scheme has been a means really of increasing our manufacturing outturn by almost 100 per cent, with little or no encroachment on ground area—and this latter point is a very important one with us.

On the completion of the scheme just noted, the output of gas continued to show phenomenal rises. The early months of 1925 indicated that towards 1926/27 our output would so increase that we should need to consider "storage" accommodation again, but this time at the Works, for the District was being well served by the Greenlands Holder, and it was subsequently decided to reconstruct our smallest (50-year old) holder at the Works, converting it from a single lift 60,000 cubic feet holder to a double-lift spirally guided holder of 125,000 cubic feet, utilising of course the same W.T. tank.

This was agreed upon towards the close of 1925, plans were drawn up and actual work was begun in May, 1926, the scheme being completed on 10th November that year.
This work of taking out an old holder lift and guide columns, and fitting in a new spiral holder to a tank that was out of plumb and not round, entailed far more responsible work than either of the 2 schemes given above.

The tank was first emptied of water and a sump holes sunk near the "in and out" pipes to take the underground water pressure off the emptied tank bottom. A certain risk was taken in respect of whether the tank, which had been in use for so long would be found water tight and serviceable after the water had been emptied. It was true the outside of the tank "appeared" AI, but it sometimes happens after years of use, that when a tank is emptied and cleaned out, flaws assert themselves, but only just one or two merest leaks were noticeable, and after cleaning and painting the tank presented the appearance of new.

The 10 old latticed columns and cross girders which were attached to the former telescopic holder were taken down to tank top level, and the lift (or bell) was cut out into big sheets by an oxy-acetylene plant. This took one month and we were then held up one month for material on account of the coal strike in England, manufacturers being rationed on fuel. After one month's waiting material arrived and work was then started on the erection of the new lifts and no other set-backs occurred. The old inlet and outlet gas pipes were fixed too near the tank sides to permit of the 2 lifts clearing, and so special arrangements has to be devised to allow these main pipes to be brought nearer the centre.

Erection proceeded according to plan, a chequer plate platform was bolted to the tank top angle to ensure greater stability, and the 10 roller carriages guiding the outer lift were specially made for different centres (as the tank was not truly circular) and specially bolted through the tank platform to the column pedestals, for it is on these 10 carriages and pedestals that
the whole of the thrust is borne when the holder is in commission, for with this old holder the columns were not attached in any way to the tank.

A great deal of drilling on this job arose and a portable electric drill was used. The work gradually assumed completion, the tank again filled with water (475,000 gallons) and with a few minor adjustments the holder went up at the start without the slightest hitch.

With the conclusion of this extension, our storage capacity was brought up to 375,000 cubic feet on the Works and 200,000 cubic feet on the District, the total being some 19 hours' supply which brought us almost to the same pitch as we were in 1923, 3 years ago, despite the fact that at the close of 1926 outputs had risen by nearly 45 per cent. over 1923. We were therefore—with growing outputs—merely keeping pace, and in anticipation of continued rise in gas sales, we have now decided to convert the remaining old single lift holder of 90,000 cubic feet into an up-to-date 3 lift spiral holder of 285,000 cubic feet capacity going upon similar lines to the one already described, and this scheme is estimated to be completed by October.

The 3 projects referred to above are the largest and most important of the engineering works that have been carried out at the Gas Works since 1905,—over 20 years ago. In the year just mentioned, a complete new holder in steel tank (74' dia. by 23' deep) was erected at the Gas Works. The holder is column not spiral guided and the foundation weight is over 1,000 tons. The foundation was built on running sand and necessitated having recourse to a sheet piling apron about 150' long (curved to the radius of the tank) by 30' deep to prevent the sand being pumped away during subsequent, drainage operations in the road adjacent to the Works. The capacity of this holder is 160,000 cubic feet.
From the foregoing one will realise that a fair amount of scheming in the real sense of the word, and looking ahead, has been underlying the Company's local administration. And on a Gas Works one never seems to be finished. There is always something new to be done, some improvement to be made; and so the work becomes of great personal interest.

At the outset I stated that gas manufacture dated back 135 years, and indeed it is one of the oldest industrial processes, but even so we have only in recent years realised the improvements that can be attained. The war certainly broadened ideas and in England, greater freedom has been given by the authorities; yet much remains to be done.

When the great poet Goethe lay dying, it is said that he kept uttering the words "More light, more light." This in a multitude of directions and with every variety of meaning is the great cry of the present day—"More Light." It is our function to provide men with light—physical, artificial light and we strive to do the best we can.

In order to do this we should diffuse among ourselves such intellectual light as we may possess, sharing freely with members of this and other associations, whatever new light we may gain to aid us in the industry which we serve, and which in turn serves us.
## VARIOUS METHODS OF CARBONIZATION

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<th>AMMONIA</th>
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<tr>
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<td>cu. ft</td>
<td>Cal. Value</td>
<td>Therms</td>
<td>lbs. of Sulphate</td>
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<td>1.—Old-fashioned Horizontal Retorts</td>
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<td>60</td>
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<td>370</td>
<td>166</td>
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DISCUSSION.

3rd Paper

THE PRESIDENT.—It is an extremely useful and interesting paper. This is not a subject on which I personally can offer much comment, but possibly some members of the Association would discuss it.

Mr. D. J. WIMALASURENDRAS.—As a confirmed advocate of the use of electricity, I think everybody will expect me to say something on the subject of this paper. It is very interesting to note that this Company is so enterprising in their line of business in the manner indicated in this little pamphlet. They have thought out and planned out everything to spread their tentacles right throughout Colombo. In spite of the fact that a cheap hydro-electric supply will be introduced into Colombo at an early date, the policy of this Company laying out so much capital in extending its gas supply system is to be appreciated and admired. Undoubtedly there is room for both electricity and gas. Even in the most advanced centres of Europe, take for instance the very heart of London, the use of gas is extending just as rapidly as electricity, but one important fact should be noted in this connection. In Europe electricity is produced with the use of coal and there is a limit to the cost of production. In Ceylon the current will be generated with water power and necessarily very much cheaper. There is no reason however to fear that gas would be wiped off altogether. There is room for both. In certain ways gas has its uses where electricity cannot compete. For instance, in heating and cooking gas is undoubtedly at the present day a very keen rival of electricity. Of course electricity is used for cooking largely as most of our friends who have visited some of
the restaurants in London will not have failed to see. At present there is, as I say, ample room for the existence of both these rivals in Colombo. One unfortunate thing I notice in gas especially, is that it cannot be used very economically for power production. In Europe, especially in some Belgian and German Towns, I found gas largely used in engines for power production. I believe in these towns the composition of it is so adjusted that it can be used both for lighting and power production economically. From what I understand gas used in Ceylon is specially produced for lighting and it is made rich in certain constituents to serve that purpose well with the result that it cannot be supplied cheap for producing power. One of the first things I did when I was looking for means of introducing a cheap supply of electricity for Colombo was to approach the Gas Company to find if it were practical to obtain gas for the purpose of running gas engines for generating electricity as cheaply as it would be by the use of steam. I had such a scheme in view at the time, but found from data collected the cost was prohibitive and so had no other means for generating power. Of course gas has its undoubted uses, but the greater drawback is that gas produced, say in Colombo, cannot be transmitted to distant places like Ambalangoda, Galle or Negombo. It is necessary to put up a local installation in each case. But an electric supply generated at one station can be transmitted to supply any distance if only sufficient demand can be found with great economy. In this respect electricity scores over gas, especially in regard to power production at distant centres. It is clear that gas cannot compete with electricity to any degree unless a special system such as that obtaining in the Continent is initiated. Even our author does not hesitate to give electricity its due importance when he states that he is using an electric generating plant for the construction of gas holders and not gas. That shows the free and ready manner in which you could use electricity as a great ally to all manufactures. My personal opinion, however,
is that gas will ever be a rival to electricity in certain forms at least. When Goethe cried out "more light, more light" I am perfectly certain, that especially in a country like Germany, he meant electric light.

Mr. S. W. DASSANAIKE.—I should like to ask what use is made of the waste products of coal in the manufacture of gas in Colombo.

Mr. E. W. HEAD.—The Author opens his very interesting contribution to this Association by pointing out that "with the scientific utilisation of coal the prosperity of industry must be wrapped up." We have only to look back but a very short time to value and appreciate how closely the prosperity of a country depends upon its coal supply. It is therefore of paramount importance as indicated by the Author that the best use should be made of it in obtaining heat and light. In this connection I would like to ask the Author if he would explain how from such poor illuminating power we get such high efficiency in lighting. Another point on which I would like to have a little more information is in regard to the Greenlands Depot, for instance, after midnight gas is drawn from the mains into their holders ready for next day's work. May I ask why such a step was decided upon instead of boosting from their own works. The question which I was going to raise about the endless constituents in tar that we see in daily use has already been asked by my friend on the right.

Mr. BARKER JOHNSON.—I think the first question raised was on the point that Town's gas in Colombo was not satisfactory for use with gas engines (for power). This is quite wrong for the gas we supply and deliver on the street mains can be used for lighting, cooking, heating and power. There are about 100 engines in Colombo running daily on our Town's gas. There is practically no difference in the composition of Colombo's gas to that of any other Town's gas except in such places where water gas is made and mixed with the coal gas. Another point mentioned was that we used electric motors, etc. This is true and shows that we are not bigoted in any way and I trust it also shews the broad-
mindedness of the local management. Replying to Mr. Head's remarks, it does perhaps seem paradoxical to state that high lighting results are obtained from Town's gas having of itself little or no real illuminating power, but having a calorific or heating value, yet such is the case, not however with an ordinary flat flame burner but with the incandescent mantle, which invention completely revolutionised gas lighting. The fabric of the mantle is during the process of manufacture dipped in a bath containing 99% of thorium and 1% of ceria. The former is an extremely bad radiator of heat, and, therefore, capable of attaining a very high temperature. It possesses, however, only poor light giving properties, so that practically the whole of the incandescence is due to the ceria. The high illuminating value of the mantle can be explained by what is known as "selective radiation" of the flame gases at the temperature of the Bunsen burner. Since the substance of the mantle emits but little red lights or ultra red rays and thus gives off little energy in the form of heat the mantle can completely absorb the high temperature of the gas flame and consequently emit a relatively larger proportion of light. As regards the distribution station at Greenland's Road, I know of a number of similar schemes where the holder is filled by boosting from the works itself as Mr. Head suggests, but in our case the Town's mains are quite large enough to permit of sucking or drawing on them after midnight. Whichever method is employed, exhausting or boosting plant is required so that this expense is common to both. If the gas were boosted it would have meant laying a special high pressure main to this Depot, some five miles away from the works, which would have been most expensive. Referring to the question of putting the several products derived from tar and ammonia to commercial use locally opens up a point of interest. In respect of the chief ammonia product, sulphate (of which there is some 7,000 tons annually imported, mostly coming from the United Kingdom), the high cost of importing the necessary acid alone makes the idea impracticable. Even from the Indian ports the cost of acid to make a ton of salt is very nearly
the same as you can buy a ton of sulphate itself locally. In addition to the acid, gas, liquor and steam, lime is required, also labour as well as the expensive plant, and so the chances of making local sulphate with any profit at all are very remote. Excepting for dehydrating tar and so putting on the local market a Road Board Tar, there is peculiarly enough no outlet at all for the several tar distillation products. The Customs Returns show that practically little or no naphtha, light oil or creosotes are imported and the Island's requirements for pitch appears to be only about ten tons per annum, which is negligible. A complete tar distillation plant would therefore be of little value to us, but we are shortly erecting a dehydrating plant to refine our crude tar and so be able to put a Road Board Tar on the local market.