lations as .441 of a penny, and with steam installations .418 of a penny. The whole position was summed up clearly when he showed that the gas engine was only working at economical conditions at full load, and that the consumption of gas was increased by nearly 40 per cent, at half load. Consequently a gas engine which did not run continually at full load could never show the guaranteed minimum fuel consumption: whereas the steam engine suffered much less in economy through such a reduction in load. Of course if gas producer plants replaced old-fashioned and out-of-date steam plants an economy could be shown, but it could be clearly demonstrated that, by using an up-to-date water-tube boiler, superheated steam and a compound engine—not necessarily condensing—and taking into consideration the advantages of safety, reliability. and flexibility, let alone economy, the steam plant still held the day.

The "Electrical Times," which published every week the works costs of the 300 Electric Light Stations at Home in accordance with the returns required by Act of Parliament, furnished a striking example of the success of steam plants as against gas plants in economy. There were only four gas engine installations, and these showed a marked increase in the working costs as compared with most of the steam plants, and cost three times more for maintenance than Mr. Forkels estimate.

So that the theoretical estimate of .41 of a penny for suction gas plants per H.P. could not be relied upon, unless under exceptional conditions favorable to a gas plant, and considering the cost of labor and repairs in the Colonies. he (the speaker) should be more inclined to place this figure at 1d. per H.P. per hour as more reliable. It had come under his knowledge that several suction gas plants had been discarded for steam,

principally owing to frequent breakdowns. To sum up, although the suction gas plant had its sphere to a limited extent, it by no means threatened to displace the modern steam plant.

Mr. E. Kilburn Scott,—(Visitor) said he spoke with some diffidence on the subject because he felt that he was likely to be in disagreement with the gentlemen who were interested in the steam boiler industry. We were on the eve of a very important change in prime movers, and he could not help thinking that indications were all in favor of the increasing use of gas engines working with producer gas. Last year he was asked to report to a Syndicate in England, on the use of large gas engines for driving electric plant on the continent. The enquiry was in connection with a large Power Station, it was proposed to erect at Philadelphia in Durham for the purpose of supplying electric energy to about ten of the pits of the Lambton Colliery Co., and three of the Hetton Coal Co., besides others. and certain Electric Tramways, on the construction of which he was advising. About 16 miles of tramways are already in operation supplied with electric current from a Gas driven station working with producer gas, and the equipments for the extended Power Station to cost £92,000 and for the Electric Motors etc, for the Lambton Colliery Co., to cost £26,000 are now in hand.

He had visited several of the largest Iron and Steel works in Germany and Belgium, besides the Engine works of Messrs. Korting of Hanover, and Messrs. Cockerill, of Seraing who were making gas engines of 1000, 1500, and 2000 horse-power. One of the points he was specially interested in was whether such large gas engines working with poor gas would drive Alternators in parallel. He came away quite convinced on that point. The engines he saw were all double acting, and the fly wheels were of course exceedingly

heavy, so that the variation per revolution was about the same as for a high class horizontal steam engine, indeed the engines and engine rooms etc., resembled to a remarkable degree a steam driven station. The number of men in attendance seemed to be about the same as in a steam station, except that of course there were no firemen. We went there without giving more notice than post a letter the day before, that we were coming, and am convinced we saw the engines working under normal conditions. The Power Station of the Ilseder Iron and Steel Works, on the line between Hanover, and Leipsig, is the finest he had ever seen. There were four blast furnaces each turning out 220 tons of pig iron daily, and the waste gases from the blast furnaces would develope 15,000 horse power. When he was there, about 6000 of it was already being used in gas engines. A remarkable feature of this station was that they were generating electricity at 10,000 volts, and transmitting it four miles away to th same Company's rolling mills at Peine, where eventually there would be 12,000 horse power in electric motors.

Of course in any paper such as the one before us which practically describes one type of Gas Producer, one had to weigh the statements with a good deal of care, but even if the author's figures were toned down considerably there was still a good case for Suction Producer Plants. At Guernsey, in the Channel Islands there was a very interesting station in which a steam plant and a gas producer plant of about the same size, were working side by side. The particulars had been given in a paper by Mr. Campbell read last year at the Leeds University. The steam plant with 180 H.P. engine, piping, auxiliaries, dynamo, switchboard etc., cost £3,642, and the suction gas plant with 180 H.P. engine etc., cost £3,200.

The works costs, that was fuel, oil, waste, water, stores, wages of workmen, repairs, and maintenance had been taken out each month, and one given in detail in the paper. In the case of the steam plant the works cost per unit sold was over a penny and up was as much as 1½d. In the Gas Producer Plant, it was .89d, .77d., .76d, .83d, and .72d, or roughly ¾d. Now these figures had been widely distributed and so far as he knew no one had shown that they could not be substantiated.

The points that he thought were favorable to the Suction Gas Producers were.—

(a) The producer could be so easily shut down by merely stopping access of air, and when so shut down there was no likelihood of an explosion, or the various things which happen to a steam boiler.

(b) The smoke nuisance was completely solved by the Gas Producer. When the general public knew that there was a method of producing power which did not require a chimney then he thought presure of public opinion would help the coming of the Gas Producer.

(c) In any steam station the chimney was a large item in the initial expenditure, thus in the case of the Central Supply Company's Station at St. John's Wood, London, there were six chimneys, and each of these chimneys cost £10,000. That was to say interest and depreciation had to be found on £60.000, which would not appear if the station were gas driven.

(d) With the Gas Porducer Plant the producer need not be near the engine, but in a steam plant the engin must be near the boiler or there would be losses by condensation. In the Gas Producer there is no condensation of

the gas, only a slight cooling and this as a matter of fact was an advantage.

As at present constructed the fault of the Gas Producer was that it was so unpleasant for the attendant to break up the clinker. Even a small quantity of Carbon Monoxide gas was dangerous. In some producers the top had to be opened and the clinker broken up by driving a long crowbar down into it; this necessitated the attendant standing right over, where the gas was coming out, and it was a most unpleasant business. The firms who were interested in Gas Producers must certainly develop some means of agitating the coke or fuel of producers so as to do away with the work of braking up the clinker by hand. He understand that such producers had been made. Of course it was also necessary that the fire should always be solid or otherwise the air would have a clean blow through, and poor gas would result.

Referring to the Deutz Gas Producer as shown by the author, he (the speaker) noticed that it was constructed on he same principle as the Mason Producer which had been made in Manchester for some years. The taking of the raw gas from the top of the fuel and passing it then through the incandescent portion of the fire, and finally drawing it off from just this incandescent area was one of the greatest improvements ever made in gas producers. and it would be interesting if the author could say who it was who first thought of it, or patented it.

He noticed to-day in the Gas Lighting Journal, article on a producer for wood gas. The plant described gave 447 electric horse power, and it was working at a copper mine in Mexico. Coke was required for starting the fire, but afterwards only wood billets were used, and the consumption was 2.6lbs. of wood and .11lbs. of coke per horse-power hour. Until he

read this article he did not know that so large a plant as 450 Electric H.P. was already at work especially in such an outlandish place as Mexico. The wood was special kind of oak, and it was fed in billets about 3 feet long.

In his remarks Mr. Arnot, mentioned that the efficiency of the steam boiler was about 80 per cent. Mr. Dugald Clerk, who was a recognised authority on gas engines said that in a particular gas producer plant he got 89 per cent. Some members might have noticed an article which appeared in the Melbourne "Argus" a few days ago giving statements of what was being proposed in Victoria in the direction of making Mond Gas from lignite and coal. He heard a good deal about this scheme before he left London. and was afraid that some of the statements in the "Argus" had been provided by some over sanguine Company promoters. At the same time there was no doubt going to be a development along these lines in Victoria. Many of the low grade or lignite coals contained a great deal of volatile matter and is all the better for making sulphate of ammonia and other bye products. From this point of view it was superior to pure carbon coals, and the previously despised brown coal deposits were likely to increase in value.

It might be interesting to mention that at the Brunner Mond Works at Northwich, a Mond Gas Plant had been in use for some years, and instead of sending the poor gas which was made out into the atmosphere some of it was sold to the Northwich Electric Lighting Co., and the price they paid for it was 2d. a 1000 cubic feet.

Mr. J. W. Fell, considered that the authors paper on the Suction Gas Producer, its development and economical application, was worthy of deep consideration, and one that he was in accord with. as far as

the general principal was concerned, although differing with him in detail, as to the modus operandi.

Numerous were the designs for the production of producer gas of which every inventor claimed superiority. However, they all found a common level at the finish. Some plants presented features for facility in feeding non clinkering, removal of ash, purifying of gas etc., but the principal was still the same. In the course of time and experience, a perfect plant would be evolved. from the many designs that had seen the light of day, just as the present type of Water Tube Boiler, had been perfected from the designs of our grandfathers.

Gas, unlike steam, carried impurities, which had to be removed by filtration, or washing of the vapors, to prevent complications arising in the combustion chamber. In the combustion chamber was centered the whole question on which the success of the internal combustion engine depended. To his mind the "Deutz" system was deficient in this all important subject. Whether the gas was produced by suction or pressure, it had come to play a highly efficient and economical method of utilising more fully the calorific power of all classes of fuel; and allowing for the march of progress that had been made by the steam boiler and engine within the last thirty years. it was reasonable to assume that similar progress would be made by producer gas and gas engines.

The field for expansion in producer gas was much larger than steam, entering as it did into all forms wherein heat and power was required. We, in this country, who lacked the associations of the older world were timid in embracing the newer methods, preferring to await the experiences of others; but the day would come when the bulk of our smelting and power generat-

ing would be done by the producer gas and its accessories.

Mr. S. O. Roberts said that in looking over the author's diagram of efficiency, the first thing that attracted the engineer's attention was extremely high efficiency of the generator and the subsequent heavy losses that occured in the waste gases and cooling water amounting as they did to 64 per cent, of the total heat of the fuel. And it seemed strange that the gas engineer, had not yet found a suitable means of diminishing these losses. It was true that in some designs of gas producer plant, attempts had been made to utilize the waste heat of the exhaust. by using it to heat the air supply to the generator. The exhaust gases were made to pass along an annular space round the air pipe, being baffled on its way by a unmber of gills fastened to the latter. But as the amount of heating surface would have to be very large, and cleaning operations therefore troublesome, it would be interesting to know if the attempt had met with success.

Another method used by Captaine, in his marine suction gas plant, was to utilize the heat of the waste gases in evaporating the water for the generator; and after mixing the vapour with the requisite amount of air to again superheat the mixture by the heat of the produced gases from the generator. There appeared a distinct advantage in this superheating, as thereby a gas more nearly approaching water gas, in composition (and consequently with a higher heat value) was thus produced, and one would not expect the generated gas to have a higher temperature.

Mechanical difficulties would again. most likely present themselves, such as the fouling of vaporizer tubes and the burning down of the firebars through the superheat.

Did any one know whether the regenerative furnace principle, had ever been applied to save the heat of the waste gases, to heat the air supply.

As regarded the waste heat in the cooling water he had heard of no method of saving this, except perhaps using a certain per cent. of the water for the vaporiser. It was this difficulty of utilising the waste gases of the suction producer plant, that prohibit its use in many factories where steam and hot water are largely required in the processes of manufacture. In the case of the steam engine, nothing could be more economical and handy than, to use the exhaust steam for this purpose.

One would like to know how the efficiency of the suction producer plant, varied with the varying loads. It was known that the quality of the gas did not keep constant, different degrees of "waters" occuring under different loads. The gas engine itself rapidly diminished in efficiency as the load fell. If the generator decreased to the same extent it had little hope of competing with an up-to-date steam plant, whose efficiency varied little with decreasing load. Besides, a steam engine could usually take a large overload, that a gas engine could not. In the case of stoppage, could the author tell us how long a (say 200 H.P.) generator would keep alight without the use of the auxiliary fan and petrol motor.

He believed under light loads, a means had been devised whereby all the air was drawn through an outside annular section of the fuel thus keeping the outer part alight and preventing the inner centre from cooling off, by radiation below its working point. With two or more motors running off the same generator, some such method would be necessary in case of any of them being thrown out of running.

A steady pull on the generator seemed to be a factor for efficiency; 10 per cent. having been gained through so doing by some makers, who fixed a regulator between the motor and generator, thereby causing a steady suction. This offered the further advantage of allowing men to clean the ash-pit without the gas coming back on them.

On the question of cleaning, how long would the suction plant run without the necessity of stopping to clean the fires. If this interval did not extend to a week it would prove a big obstacle to the introduction of such plants for continuous running from week to week end. There were, he knew, so-called self-cleaning grates, but had they proved successful?

There was no doubt that under a steady load the suction gas plant would prove a dangerous rival to the steam engine; yet in one case ,viz., for marine work, where the load showed little fluctuation for very long intervals, the suction gas plant had made little headway. This was, perhaps, due more to the motor; no suitable gas engines for marine work of large h.p. having yet been designed. Yet the advantages that a suction gas plant offered in this sphere seemed to be many. Being generally a steady load, it should attain its highest efficiency. Compared with a steam plant, only half the amount of coal bunker space would be necessary. or twice the distance travelled, without re-coaling. The room occupied by the gas plant would be less; especially so if that cumbersome part of the plant, viz., the coke scrubber, could be eliminated and a smaller mechasical device for cleaning and cooling, substituted. However, it had its drawbacks; the greatest one of which was, perhaps, the difficulty of always obtaining the same class of fuel. For it seemed that every generator had to be constructed to suit its own

particular class of fuel. This also applied to a land plant, and would create difficulties in case of a strike.

The difficulty in the use of sea water. and the rise of the density in vaporizer had been got over by captains by maintaining a continuous flow through the vaporizer of sea water, and which was warmed on its way by coming in contact with the outflowing hot water, absorbing its heat, and thereby causing little loss.

The author, in his paper, made a comparison between a gas and steam engine, based on what he called local conditions. But he (the speaker) thought that he erred on the side of the "local" steam engine, when he debited it with a consumption of only 12.1lb. of steam per I.H.P., but more than made up for his generosity when he allowed the boiler to evaporate under 7lb. of water per lb. of coal. costing the excessive price of 13s. a ton. The majority, he thought, would agree with him when he said that coal at between 7s. and 8s. a ton could be easily obtained, which would evaporate at least 9lb. of water. In attendance, he again overstepped the mark, as a modern high speed, self-lubricating steam engine required a driver's attention, for only a few hours a day at a cost of a few shillings. Surely, also, the sinking fund (which. he presumed, included maintenance), was rather low in the case of the gas plant, viz., 10 per cent. For the destructive action of the ammonia and sulphuretted hydrogen generally present, must soon shorten the life of the generator and its accessories, making the maintenance bill very high. No account seemed to be taken of the ill-effects produced on the health of the attendant.

Mr. J. S. Fitzmaurice said the subject of the paper was highly interesting, and one that was absorbing a good deal of attention at the hands of engineers. The trouble referred to by the previous speakers in con-