DISCUSSION.

Mr. Hector Kidd, stated that the Author's remark that non-automatic generators were the most satisfactory, is borne out by Mr. Fowler's, paper read at the Institute of Civil Engineers, wherein it was stated that they were undoubtedly the safest forms to use, and which recommended that each generator should have an apparatus attached for drying and purifying the gas. He would like to know if the Author had found this necessary, and would also like information as to the safety and cost of Acetylene for generating power, it having been pointed out by Messrs, Ravel, and L. Meyers. that there was danger in such use, the special characteristics of this gas being, (1) great rapidity of transmission of flame.—(2) low ignition temperature—(3) high explosive temperature—and (4) extraordinary energy of explosion.

In Mr. Fowler's paper the horse power hours per pound of carbide was given as 2.189, which equalled 4903 horse-power hours per ton . Professor Lewis stated that only .3lb. of picked carbide could be depended on per E.H.P. which was 7500 H.P. hours per ton. At Geneva, 1 H.P. gave .306 carbide, or 7320 H.P. hours per ton. In the prospectus of the Liverpool Acetylene Company, Mr. Ravonl Peclet guaranteed 1 ton carbide with 2000 E.H.P. There was a great discrepancy in these figures.

Dealing with the generation of electricity necessary, Mr. Kidd, suggested that steam might be used

instead of water-power, and much economy effected by utilising the waste heat in the exhaust steam for evaporation. In a quintuple effect of modern design one lb. exhaust steam at a pressure of 5 or 6lb. per sq. in, should evaporate 4¼lb. water, and return the condensed steam from the first vessel direct to the boiler at a temperature of about 225 deg. F. By thus evaporating salt water, the salt produced would cover much of the cost of the whole operation, and reduce the cost of the carbide.

Mr. Norman Selfe pointed out the great scope for inventive genius in the devising of a satisfactory automatic generator, and suggested feeding in the carbide in a powdered form as desired by a little motor worked by the gas. The deficiency of natural water power in Australia prevented any great prospect of a carbide factory being established amongst them, but Mr. Kidd's, idea of obtaining salt as a by-product put a different aspect on the case. He thought the waste heat from other large power installations might be so used also, and if electrical engineers found they could make salt thus, they would get before the carbide industry. Acetylene had no doubt a great future before it in country districts, and he was much relieved by the statements made by Mr. Tyree as to its safety.

Mr. O. W. Brain, expressed the thanks of the members of the Electrical Association for the opportunity of hearing and discussing this paper. Acetylene gas, he said, was receiving a good deal of attention from electrical men for two reasons—firstly, because we were being continually assured of its being a dangerous rival of the electric light, and secondly because the manufacture of calcium carbide promised to lead to an enormous consumption of electrical energy. Every addition to our practical and com-

mercial knowledge of the subject, however, adds further proof that the latter consideration will be realised without the properly recognized field of electric lighting being seriously encroached on. An essential feature that distinguished acetylene lighting from electric was the absence of any requirements in the way of a load factor. The former might therefore be used in special cases, such as small isolated installations, where the very low load factor of electric lighting would render the cost prohibitive. It was a problem how to charge for electric lighting in very small towns, for instance. The meter system meant a fair price per unit, but a small output, and consequently small revenue, while the light loading of the machinery for most of the time rendered it inefficient, and therefore raised the cost of production. The system of an annual charge per lamp necessitated a heavy charge to the consumer in order to provide for an unlimited consumption, and of course leads to a universally extravagant use of current, for which the actual receipts per unit were very low indeed. Everything went to show that the solution of the small central station problems was the adoption of the meter charge and the installation of a direct current plant re-inforced by a judicious expenditure on a modern storage battery to take the inevitable "peaks" of the load curve, and to supply current during hours of light load; in this field Acetylene might prove a serious competitor. Mr. Brain discussed the commercial production of acetylene, and pointed out that if Mr. Tyree's hope of retailing carbide at 2d. per lb. which would be equivalent in lighting cost to coal gas at 1/6 to 2/- per thousand feet, on his showing, was realised, it would appear to dispose of all rivals at once, but such figures could not be received without reservation. The fact which the auther pointed out,

that steam factories had always failed, added additional testimony to the unreliability of the figures presented, for there would be ample room for carbide in the big towns at 3d. a lb. even, if it was equivalent to coal gas at 3/-. He asked for an explanation of an exposion which he had just read in an English paper, in the use of an apparatus which the author had referred to as safe. He remarked on the difficulty of securing the exact pressure at the burners, to which the author gives such importance, owing to the varying flow and friction in the pipes, as the number of lights in use varied; and asked how it was that when carbide was at £5 per ton, that was practically ½d per lb., we did not hear of acetylene making any progress as a source of power.

In conclusion, he remarked that the electrical industry was not resting, and that future developements of acetylene or coal gas lighting might have to compete with the Nernst lamp, which already promised to provide electric lighting at less than 40 per cent of the present cost of current.

Mr. J. S. Fitzmaurice read then some remarks by Mr. Webb, president of the Electrical Association of New South Wales, who dealt with the commercial aspect of acetylene lighting. The author hoped to bring down the price of carbide to 2d. per lb, as if that was a very low figure, but taking 5 cub. feet of gas as the product of 1lb. carbide (the author only guarantees 4.6) and assuming a consumption of ½ cub. feet, per hour in a 25 c.p. burner, this was equal to a cost for carbide alone of .2d. per hour. A 25 c.p. electric glow lamp would use .0875 B. of T. units per hour, and the actual cost of generation, including fuel, wages, and stores, in Sydney, was under 2d. per unit, making the cost of current per hour for a 25 c.p. lamp not more than .175d. and as a matter of fact, for a fairly large

paper pointed out some discrepancies in the comparison made between Acetylene and coal gas. On concluding his reading, Mr. Fitzmaurice referred to the explosive mentioned by Mr. Brain, which was, he believed, another case of "didn't know it was loaded." It was due to the careless use of a light during repairs, and the same result would have occurred with coal gas. So far as electricity was concerned, there were many instances of explosions in tunnels and conduits through leakage of coal gas therein. It seemed to be the irony of fate that electricity should be called on to generate the new illuminant.

Mr. Howarth read some remarks quoting from Mr. Fowler's paper at the Inst. of Civ. Engineers referred to by a former speaker, and calling attention to the danger of explosion. Inside two years there had been eleven fatal cases of explosion with acetylene. The Home Office had placed calcium carbide under Petroleum Act, by order of the Council, February 26, 1897. The order enacts—moisture to be kept away from the carbide — good ventilation of the carbide store—insistance on the carbide being pure—prohibition of the use of copper—use of suitable and safe apparatus—employment of competent men—and safe disposal of the residue. In November, 1897, an additional order was made, that acetylene gas compressed beyond 100 inches water pressure, whether compressed alone or mixed with oil gas, came under the Explosives Act, unless a special exemption was obtained from the Secretary of State. The experiments of Berthelet and Vielle described in Proc. Inst. Civ. Eng., Vol. 127, go to show that when compressed to two atmospheres, acetylene could be fired by an electric spark or glowing wire with explosive results.

The speaker had carefully examined the results of 27 recorded experiments on the illuminating power of

acetylene, in burners consuming from .54 to 5 cubic feet per hour, at various water pressures. These appeared to indicate that the photometric value of small burners is at a maximum when about two inches pressure is used, and the best result was 26½ candle power, with a consumption of 1 cubic feet, very different from the author's reference to 25 c.p. for ½ cub. feet. The burners used were apparently similar to those used by Mr. Tyree, and the speaker would like to know whether he was mistaken or not in assuming that ten of the ½ foot 25 c.p. burners would give 5 per cent. more light than one of the 5 feet 240 c.p. burners which gave the best result recorded by Professor Lewis. He calculated that the cost of the gas, with carbide at 2d a lb., works out to about 36s. per 1000 feet, including maintenance and depreciation of plant, and at the present price in Sydney of £30 a ton, the total price in the holder would be 57s 2d per 1000. In the most favorable instance, that of the 240 c.p. burner of Professor Lewis, the relative values of acetylene and coal gas photometrically are as 13.9 to 1, but with the small 25 c.p. burners only 7¾ to 1, taking coal gas as up to the Board of Trade standard of 17¼ c.p. per 5 foot burner per hour. Therefore, carbide would need to be sold at £16 5s per ton to enable it to produce in small burners as much light for the same price as coal gas at 4s per 1000 cubic feet. He referred to acetylene gas engines, and Ravel's experiments, as stated in Proc. Ins. Civ. Eng., Vol. 127. Cycle motors are built in Italy which use a charge of 15 parts air to 1 of acetylene and develope .8 of 1 brake horse power. The use of acetylene as an enricher of coal gas is not encouraging. At present the best records seem to indicate that an addition of one per cent. acetylene gives an enrichment of only one candle. This is too poor to warrant the use of calcium carbide even at

the low price of 2d per lb. Probably we shall get better results when the inventive genius neglects the generator, and directs his energies to the evolution of a burner capable of neutralising the great difference of the combustive temperatures of the two gases when mixed in varying proportions and pressures.

Mr. Stowe asked the author how he overcame the leakage of gas at the water seal of the non automatic generator he recommends, as the gas has the feature of penetrating the water to a serious degree—how he overcame the varying weight of the bell owing to more or less immersion, when it is so necessary to maintain an exact pressure in the system; how the water in the generator is replaced, as in some parts it would cost almost as much as the carbide for carting or pumping; is there any way of preventing it's consumption? how the solid residue which falls to the bottom is got rid of by opening a cock only? and various questions re cost of acetylene and comparison with coal gas, directing attention to the use of incandescent mantles with coal gas, and Professor Lewis' experiments on the photometry of the subject referred to by the last speaker.

Mr. Coward, as a gas man of some experience, did not look on acetylene as a rival to coal gas. Gas men were forced with electric competition some years ago, but it only made them turn their attention to the improvement of gas, and more than ever was now being used. The introduction of acetylene will bring forward more inventive power. He showed that we got 25 c.p. from one cubic foot of coal gas per hour by the use of the Welsbach mantle, and the latter was being continually improved.

Mr. Tyree replied to the questions, and pointed out to Mr. Selfe that he had shown several arrangements for automatically feeding the carbide at the last meeting.