covered with large bubbles which explode on the application of a lighted match.

The equation (1) quoted by Mr. Phelps, may be perfectly true for certain laboratory experiments, but it does not represent what takes place in the production of electrolytic hypochlorite in the apparatus described by Messrs. Digby and Shenton.

On page 67, Mr. Phelps speaks of "the obvious impossibility that a reaction can produce at one and the same time nascent hydrogen and a strong oxidizing agent"; yet, on the next page, gives the equation showing simultaneously the liberation of nascent hydrogen and nascent chlorine to express the "complete reaction in the cell before the recombination of the hydroxides and the chlorine."

Exception must be taken to the statement that "the oxidizing power from the available chlorine as ordinarily determined of the products of reaction (1) is equivalent to twice the chlorine of the hypochlorite, or to the total chlorine present," which is incorrect and misleading, inasmuch as it might induce non-chemical readers to suppose even that the chlorine existing as chloride were capable of exerting an oxidizing influence.

The oxidizing power of sodium hypochlorite is dependent on the liberation of its oxygen atom in a nascent condition, and there is not any confusion or misconception as to the meaning of the term "available chlorine" beyond that which Mr. Phelps has introduced. It is, and has long been, a matter of common knowledge that for each univalent atom of chlorine existing as hypochlorite, one bivalent atom of oxygen is set at liberty under suitable conditions, but this does not warrant Mr. Phelps' statement.

Again, Mr. Phelps' equation (1)—

$$2NaOH + 2o1 = NaOCl + Na\ Cl + H_2O.$$

is said to make manifest the fact that if it were carried out completely a product would be yielded containing 100 per cent. of the available chlorine initially present. Now, that is manifestly impossible, because the equation shows that half the chlorine liberated as a result of the electrolysis reverts to the state of chloride, and Mr. Digby's equation (2)—

$$NaOH + Cl = NaOCl + H.$$

does not indicate that the yield of available chlorine would be twice the amount allowed by the law of electro-chemical equivalents. It would be interesting to have Mr. Phelps' explanation of this matter.

Elementary Electricity—Continued from page 378

voltage acting from **a** to **b** through the generator is **ev** positive, and **bw** negative. The resultant is, therefore, **(ev-bw)** = **(oe + hv)** = E_1. The voltage between **b** and **c** is **(bw-cx)** = E_2; between **c** and **d** it is **(cx-dy)** = E_3, and between **d** and **a** it is **(dy-o)** = E_4. If R_1, R_2, R_3 and R_4 represent respectively the resistance of the conductors between these points, then

$$I = \frac{E_1}{R_1} = \frac{E_2}{R_2} = \frac{E_3}{R_3} = \frac{E_4}{R_4}$$

Since the net change of potential around the whole circuit is zero, the total voltage is equal to the e.m.f. of the generator, which is represented by **ev**. But **ev** = $E_1 + E_2 + E_3 + E_4$; therefore,

$$I = \frac{E_1 + E_2 + E_3 + E_4}{R_1 + R_2 + R_3 + R_4}.$$

This equation may be used either to determine the current which will flow through a conductor of given resistance to determine the resistance of a given conductor by measuring the current and the voltage between its terminals.

ROAD SUPERVISION.*

W. A. McLean, Provincial Engineer of Highways.

"Supervision" is the foundation stone on which road-building reform in Ontario must be placed. Lack of management has been the cause of an enormous amount of waste in road expenditure. The outlay on township roads in Ontario, in statute labor and money, exceeds two millions annually. This is steadily increasing. Statute labor in pioneer days was the right thing in the right place. To-day it is more than undoing the good done in former years. Not only is statute labor of to-day inefficient in itself, but cash expenditure is largely made in conjunction with statute labor, by pathmasters, on the statute labor basis, so that it places a two-fold handicap on road improvement. If this large outlay were handled in such a way as to give good roads, the misfortune would not be so great; but with statute labor squandered, and a considerable cash expenditure in its train, we still have the evil of bad roads. County road systems with Provincial aid are undeniably beneficial, but while increased outlay is needed the greatest good can come from such an awakening on the part of the ratepayers as will lead to the skilful direction of all expenditure now being made in the rural districts.

The remedy is not simply the abolition of statute labor. That is a minor part. The important feature is—the system adopted in place of statute labor. Not only must that system be thoroughly efficient and practical, but it must be carried out with energy and good judgment. No system, however thorough, can be of use if left to itself—it will not be automatic. What is required is an active working out of an efficient system by the men upon whom its administration falls, backed up by a clean-cut and healthy public opinion.

Road-building, as with any other constructive work, has two parts—the theoretical and the practical. The one pertains to the engineer; the other to the contractor or foreman. The one includes the knowledge of what the completed road should be as regards materials, form, drainage, and the application of scientific principles to the design of a road; the other involves the direction of labor so as to produce maximum results at minimum cost.

How do pathmasters trying to build roads with statute labor serve these conditions? Without over-estimating the scientific ability necessary to build roads, it is safe to say that in no township can one or two hundred men be found who, as pathmasters, can qualify as road engineers; while to expect them as foremen to efficiently manage statute labor as well, is a travesty on the art of roadmaking.

No two pathmasters can agree as to what a road should be as to width, crown, grade, drainage, quality of material,—yet it is only by the skilful treatment of such details that a good road can be cheaply and durably designed. A defect in one particular may readily mean the undoing of the entire work. In teaming material, which is one of the great factors of cost, the size and number of loads per day often does not amount to one-third or one-quarter what a contractor or good foreman would exact. This means in effect that, for a given quantity of material, the cost of teaming is three or four times what is should have been. In many townships a rate of $3 or $4 per day for man and team is nominally paid, yet it really amounts to $12 or $16 for a full day's work. This is the rigid economy being practised on the township roads of Ontario—as their condition fully testifies.

*Read before the Ontario Good Roads' Association.