rollers are the modern inventions necessary to satisfactory and economical road construction and repair. Two good men with two teams can build or repair more road in one day with a roller and road machine than many times that number can with picks, shovels, scoops and plows, and do it more uniformly and thoroughly.

One of the best ways to prevent the formation of ruts and to keep roads in repair is by the use of wide tires on all wagons carrying heavy burdens. In most foreign countries they not only use from 4 to 6-inch tires on market wagons, but on many of the four-wheel wagons, in addition to wide tires, the rear axles are made 14 inches longer than the front ones, so that the hind wheels will not track and form ruts. Water and narrow tires aid one another in destroying the roads, while on the other hand wide tires are roadmakers. They roll and harden the surface. and every loaded wagon becomes, in effect, a road roller. The difference between the action of a narrow tire and a wide one is about the same as the difference between a crowbar and a tamper; the one tears up and the other packs down. By using wide tires on heavy wagons the cost of keeping roads in repair would be greatly reduced. The introduction in recent years of wide, metal tires, which can be placed on the wheels of any narrow-tired vehicle at a nominal cost, has removed a very serious objection to the proposed substitution of broad tires for the narrow ones now in use. The formation of deep ruts has been prevented on some of the toll roads of Pennsylvania by lengthening the doubletrees on wagons and by hitching the horses so that they will walk directly in front of the wheels, a device worthy of consideration.—Municipal World.

DEVELOPMENTS IN ACETYLENE.*

There is probably no subject so worthy of the attention of progressive engineers and architects at the present day, as the development of acetylene lighting. There is no question that the tendency even of professional men, of late years, has been to accept at the outset what is heralded by the press as new and wonderful in human invention, at a valuation far above what may ultimately be proved to be its worth. The trouble is that while members of the technical professions in due time come to place upon every invention its just value, the public at large, misled in the beginning, is slower to realize mistakes, and hence the prevalence of false views among the laity as to the value of many modern inventions. Concerning nothing is there so much error prevalent as in regard to electric lighting. Electricity is an attractive mystery to the man on the street. "Electric light" has a euphonious suggestive sound, and the phrase has been worked to death by hotel advertisers, unscientific writers of cheap fiction, promoters, etc., until it conveys an entirely false idea, only possible of correction by placing this light where it must defend its laurels against the competition of a really good illuminant. People who suppose that with the statement that such and such a building has "electric light," the last word has been said, would be more than surprised if they could see in the same building, by means say of combination fixtures, the much vaunted electric light placed in fair competition with acetylene, which in its purified form is undoubtedly the light of the future. It is for this reason that I have commenced this paper with the statement that acetylene lighting demands the earnest attention of every up-to-date engineer and architect; in fact, it may yet turn out that not the least of the benefits that modern electrical development has conferred on mankind has been the rendering possible the production of calcium carbide in commercial quantity, thus opening the way to the general use of acetylene for purposes of illumination, etc., seeing that before the day of the electric furnace both calcium carbide and acetylene were chemical curiosities.

The discoverer of acetylene was Edmund Davy, professor of chemistry to the Royal Dublin Society. In March, 1836, just sixty-seven years ago, he described some of the properties of a gas he called "bi-carburet of hydrogen," and later, at a meeting of the British Association, said: "From the brilliancy with which the gas burns in contact with the atmosphere, it is in my opinion admirably adapted for the purpose of artificial light, if it can be produced at a cheap rate." The name "acetylene," however, was given to the new gas by Berthelot, a French chemist, in 1860. Carbide of calcium, from which acetylene is commercially produced now, was discovered by Wöhler. in 1862, who found that carbon acted upon an alloy of zinc and calcium at high temperatures, and resulted in the production of calcium carbide, which name he himself gave it. He found also that water reacted upon it to produce acetylene. It was not, however, until Mr. T. L. Willson accidentally discovered, in 1892, a process of making carbide on a commercial scale, that acetylene became possible as an illuminant for general use. He was endeavoring to obtain the metal calcium by reducing lime with finely powdered charcoal, in an electric furnace, when he found that an interaction took place which resulted in the evolution of carbon monoxide, and left behind a fused mass, which upon subsequent test was found to be calcium carbide. Another version of the accident is that Willson's workmen omitted the iron ore from a charge of the furnace where carbon and lime were to be employed as a flux in an experiment in electric smelting, and that he coming along, noticed the ore lying on one side, and stopped the work, having the furnace emptied. The fused mass thrown out was dumped on a damp spot, and soon burst into flame. This led to investigation, and it turned out to be calcium carbide. Carbide at this date (1892), and as late as 1895, was an expensive material, costing $2,000 per ton. To-day, in Canada, it is selling for $65 a ton, and for $70 in the United States. The cost of producing, however, is very much less than this, and is variously estimated at from $20 to $40 per ton.

The Shawinigan Carbide Company, in its prospectus, gives the cost of making at from $30 to $35 per ton, while a plant of 5,000 tons per annum capacity, and the details of the cost are as follows: Labor, $8.50; carbon, $2.10; repairs, 50c.; expenses, 50c.; oil waste, 5c.; tar, 5c.; power, $8.18; tax, 10c.; legal expenses, 10c.; cans, 20 per ton, $4.60; lime, $2.50; coke, $4; royalty, $2.50; total, $33.58. The Canadian production at present is said to be 1,000 tons per annum at the Willson Carbide Works, St. Catharines, Ont., and 4,000 tons per annum at the Ottawa Carbide Works, Ottawa, Ont.

When carbide was first used for trade purposes, the gas generated was compressed to a liquid form, under a pressure of from 500 to 600 lbs. per square inch, and so shipped for consumption in cylinders, which were of course subject to varying pressures owing to changes of temperature. The danger was great and the public got the idea that calcium itself was a risky substance to handle. Nothing could be further from the fact, however. Carbide of calcium comes packed in steel drums, air-tight, and strong. Two hundred and forty of them went through a fire at the G. W. Knox Express Storage Warehouse, at Washington, D.C., and two hundred and thirty-nine came through safe and sound, when everything else in the warehouse was a total loss. The fire occurred through communication to the roof of the building from adjoining premises, and carloads of general goods. stoves, furniture, etc., all were consumed, and eighteen of the drums of carbide were broken open by falling brick from the walls (which had to be torn down eventually). Nevertheless, the carbide was gathered up, and 239 cans out of the 240 (twelve tons), saved in good condition. Nothing could display more utter ignorance of the matter in hand than the idea that drums of calcium carbide stored on premises add to the fire hazard. A ton of coal is a far greater danger, and yet insurance companies make no limitations as to the amount of coal one may put in for the winter. Carbide of calcium is absolutely incombustible and inexplosive, and a lump of it may be held in the flames or put in the stove with perfect safety. It will simply refuse to burn like a piece of asbestos. Again, when the danger of liquid acetylene was recognized, efforts were made to provide machines to generate the gas as used. This was first attempted on the principle of dropping small quantities of water upon bodies of carbide, but it was found that the carbide acted like a sponge, and soon soaked enough water to go on generating without

* A paper read before the Engineers' Club of Toronto by J. H. Chewett, C.E.