ENGINEERING DEPARTMENT.

A. W. CAMPBELL,
O.L.S., C.E., A.M.C.S., C.E.
EDITOR.

Taxes are paid for public improvement. These taxes are mostly expended through township, village, city and county authorities. In most townships the the councillors are the officials who expend the largest part of that portion of the public taxes invested in bridges. Civil engineers, unfortunately, have had but little opportunity in the past to influence the selection of improvements in the line of highway bridges. A few years ago the large majority of those in ordinary practice gave little attention to the subject of iron highway bridge designing. This was mainly because the question was a new one and because the methods of practice were so constantly changing that engineers, as a class, had no opportunity for being informed. Added to this was a lack of demand for their services on the part of pub ic officials, and it must be confessed, something of a spirit of hostility towards civil engineers on the part of the contractors.

Though, however, instances are not wanting where engineers, as superintendents, have influenced the construction of numerous first-class stone arches and iron highway bridges, yet it is the contractor—and by the term contractor I mean manufacturer and contractor combined—who has been the agent for the introduction of perhaps four-fifths of all the iron highway bridges in the province. In this introduction he has performed his full share of exertion—exertion of tongue, of mind and of muscle. He has visited the locality where a new bridge was needed; he has argued with the councillors and leading tax-payers, and pictured the advantages of a permanent bridge as against the poorly-built, old fashioned, perishable, wash-away-able structure, in which the taxes of the past had been invested. He has, at his own expense, taken officials to see iron bridges, and has given the editor of the local paper some reason to be in favor of better public improvements. He has influenced the passage of laws giving more authority to the town councillor. He has issued circulars by the ten thousand, indicating the advantages of permanent bridges and incidentally alluding to the powers and duties of municipal officials in such a way that the meaning of the law has been made manifest. He has helped carry suits into court in order to assist in making plain the intention of the statutes, and has then published the results as widely as possible. He has furnished printed blanks to guide the officials, attended their meetings, made estimates of costs without number, and has left no means untried to introduce his wares, lowering himself, it may be, nearly to the level of an ordinary peddler in his anxiety to give the public the benefit of the best modern improvements. Even if a competitor has in the end secured the coveted contract, he has captured his full share of the prize going, and has perhaps gathered quite his own proportion of the harvest.

As a matter of course he has done all this from the low motive of self-interest, and in its performance he has made many mistakes. He has been, most of the time, a pioneer in a business which has at last become well understood, but which has groped its way through a long period of peculiar uncertainties. These mistakes have sometimes been rectified at the cost of the manufacturer, but in many cases the manufacturer has dropped out of the race, his place to be taken by a more practical party offering an improvement, studied up from the failures of the past.

Engineers can best serve themselves and the public by exerting themselves to the utmost of their knowledge towards creating a demand for the best structures. All streams should be bridged in the most substantial manner possible. Whenever practicable, bridge abutments should be constructed of the best stone masonry, and we recommend iron tubes filled with concrete, iron bents, posts or piles, as ranking next to masonry. Whenever neither of these foundations can be used on account of their cost, we advise the use of red cedar, oak or spruce piles, or bents, in the order named. For bridge superstructure we advise the use of stone arches and iron bridges whenever they can be afforded, and we suggest that in order to improve our bridges, while endeavoring at the same time to improve our roads, it will be best to give very careful consideration to the economy of stone and iron bridges as against those of perishable material. It is not safe for the public to rely on receiving its money's worth without the assistance of an expert, and yet, as a matter of fact, there are on record a vast number of instances where contractors, who as a class are as good as ordinary human beings, have, when the officials were unassisted by expert talent, actually advised and carried out the very best possible expenditure of public funds at the very least margin of profit; but this should not be allowed to stand in the way of the general proposition, that the public has a right to demand of its councillors that they call to their aid, educated, impartial, competent, well-trained experts when important permanent improvements are undertaken.

This demand is founded on reason, and is, therefore, right, as a little reflection will show. The building of an important bridge is, in most places, an extraordinary event, generally coming up after the councillors are elected and it is reasonable to suppose them, in many cases, ignorant of the best way to proceed to purchase, in the legal manner, the best bridge called for by the circumstances of the case. I wish, therefore, as strongly as possible, to urge on the public to demand of their officials when building important bridges, that they purchase, and pay liberally for the services of well-trained engineers, and to insist that both sub-structure and superstructure be constructed on well known scientific principles. The more stringent the requirements of these engineers, the more probable is it that all contracts will be finally placed in the hands of contrators or manufacturers possessed of the best facilities for carrying out the most stringent specifications.

In this manner will our mutual interests be advanced, while at the same time the tax-payers' interests will be better attended to, and the councillors will be partially relieved of a responsibility which very few of them have any desire or ability to bear.

Road Metal.

The materials employed for a macadamized road should be both hard and tough. Hardness is that disposition of a solid which renders it difficult to displace its parts among themselves; thus, steel is harder than iron, and diamond almost infinitely harder than any other substance in nature. The toughness of a solid or that quality by which it will endure heavy blows without breaking, is again distinct from hardness, though often confounded with it. It consists in a certain yielding of parts with a powerful general cohesion, and is compatible with various degrees of elasticity.

Some geological knowledge is required to make a proper selection of materials. The most useful are those which are most difficult to break up. Such are the basaltic and trap rocks, particularly those in which the hornblende predominates. The greenstones are very variable in quality. Flint or quartz rocks and all pure silicious materials are improper for use, since, though hard, they are brittle and deficient in toughness. Granite is generally bad, being composed of three heterogeneous materials, quartz, felspar and mica; the first of which is brittle, the second liable to decomposition, and the third laminated. The sienitic granites, however, which contain hornblende in the place of filspar are good, and better in proportion to their darkness of color, Gneiss is still inferior to granite, and mica-slate wholly inadmissable. The argillaceous slates make a smooth road, but one which decays very rapidly when wet. The sandstones are too soft. The limestone of the carboniferous and transition formations are very good, but other limestones, though they will make a smooth road very quickly, having a peculiar readiness in "binding," are too weak for heavy roads, and wear out very rapidly. In wet weather they are liable to be slippery. It is generally better economy to bring good material from a distance than to employ an inferior article obtainable close at hand.

The whole science of artificial roadmaking consists in making a solid, dry path on the natural soil and then keeping it dry by a durable water-proof coating.