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THE SCIENCE OF ROADMAKING.

Roadmaking is a science, a branch of engineering, the difficulties of which are not usually appreciated. It is a common expression that "anyone can make a road," which merely indicates that the average man knows so little about road construction that he does not realize how much there is to know. If it is true that anyone can make a road, it is also true that anyone can build a house, a bridge, or a steamship. "Anyone" can do these things, but in most cases at a great waste of money and labor, and with very inferior results. For centuries in England it was left for anyone to make the roads. It was not until McAdam and Telford appeared, but one century ago, that the people in England became convinced that "anyone" could not build a road. This work was then placed in the hands of expert road-builders and the transformation has been nothing short of wonderful.

In too many townships of Ontario "statute labor" means that once a year the ratepayers gather to make roads under the direction of "anyone." They plow and scrape the mud and pile on a ridge of gravel. After violating every rule and principle laid down by Macadam, after doing everything Macadam told the people of England not to do, the result of this statute labor is called a macadamized road.

Among the earliest roads of which we have definite information were those built by the Romans chiefly as military highways, leading east and west to the remote provinces, from which arose the proverb, "All roads lead to Rome." So substantially were these roads built, of layer upon layer of stone and concrete, three and four feet in thickness, that many of them still remain, and are commonly believed by the peasantry of Spain and of other countries of Southern Europe to be of supernatural origin. These roads were built at an enormous waste of money and labor, and while of the greatest durability, they lack the first essential of modern construction—a properly balanced union of economy and efficiency.

For several centuries after the downfall of Rome, roadmaking became a forgotten art. In France, during the eighteenth century, under the engineer Tresauguet, road construction was revived, but on very different principles from those followed by the Romans. The type of road built by the French engineer was that introduced into England by Telford, and consisted of a foundation of large stones, laid on edge and carefully shaped, upon which was placed a coating of finer broken stone. Early in the nineteenth century McAdam advocated and constructed in England a still more economical design, in which the foundation of large stone was omitted, but greater care was given to drainage and roadbed. McAdam's system is that most commonly followed to-day, with a number of important alterations consequent upon the introduction of roadmaking machinery.

In the time of McAdam the best method obtainable was to break stone by hand, which was then placed loose on the roadway and left for traffic to consolidate. The process of consolidation was slow, during which a considerable amount of the stone was forced into and mixed with the earth subsoil, injuring the consistency of the road. Under present methods, by means of a crusher, stone is broken much more cheaply than it could be done by hand.

Stone dust and chips (screenings) are created in the process of crushing, which are used to fill the voids, instead of waiting for this to be produced by traffic, or allowing the clay or loam from beneath to be forced up among the stones. With a road roller the road metal is made thoroughly compact, forming a strong, waterproof covering over a firm subsoil. The result is that more perfect work is done in a few days and at less cost than the methods of McAdam or Telford would accomplish in several months. The main features of present day roadmaking, which are of recent introduction, are :

(a) The use of grading machines for forming the earth subgrade and open drains.

(b) The thorough drainage of the soil underlying the road so as to make a strong foundation.

(c) The use of a roller to consolidate both the earth foundation and the surface layer of stone or gravel.

(d) Where broken stone is employed, the use of a crusher to prepare the metal, instead of breaking the stone by hand.

(e) The screening of broken stone so as to grade it, for application to the road in layers according to size.

HIGHWAY BRIDGES

The use of concrete does not cease with tile and small span arch culverts, but may extend to arches of considerable span, while for abutments and piers it is the most satisfactory material available.

Concrete bridges have been commonly built with spans of thirty and forty feet. Last year an arch of thirty foot span and fourteen foot roadway was erected on the townline between the townships of Downie and South Easthope, at a cost of $635. The thickness of the floor is only fourteen inches, and the abutments at each end are three and a-half feet thick at the base, and two and a-half feet at the top, is almost wholly of concrete, but the flooring is reinforced to some extent with metal. The method of construction was to first construct a wooden substructure between the abutments. On this was placed four inches of concrete, in which was imbedded steel rods of one and three-quarters inches diameter, running lengthwise, and ten inches apart. Three inches of concrete was laid on this, then a layer of woven wire stretched from end to end of the bridge. On this a coating of concrete was laid, then another layer of wire ; and so on, making a total thickness of fourteen inches at the centre of the bridge. A concrete parapet wall takes the place of a railing. This is also strengthened with wire, heavy bolts run downward and are fastened in the floor so that the wall adds to the strength of the bridge.

Highway bridges of longer span are now being commonly constructed with steel superstructures and concrete or stone masonry abutments. When timber of the best quality was more plentiful and cheaper than now, wooden bridges were no doubt more economical, but with the growing scarcity of lumber, increased price, and poorer quality obtainable, the more durable if more expensive materials will, after a term of years, be found the cheaper.