Culverts.

The following excerpt from the 1923 annual report of the Chief of the Bureau of Public Roads in the United States, with regard to experiments on the smaller and more common forms of pipe culverts, is interesting :—

"The results with concrete, vitrified clay, and corrugated-metal pipe culverts, 30 ft. long, with straight end-wall entrances, and varying in diameter from 12 in. to 30 in., show that a 12 in. vitrified-clay-pipe culvert with bevelled lips up-stream will carry about 65 per cent., an 18 in. clay-pipe culvert about 50 per cent., a 24 in. clay pipe culvert about 40 per cent., and a 30 in. clay-pipe culvert about 30 per cent. more water than corrugated-metal-pipe culverts of similar sizes; while a 12 in. concrete pipe with bevelled lip end up-stream will carry about 49 per cent., a 24 in. concrete pipe about 36 per cent., and a 30 in. concrete pipe about 32 per cent. more water than corrugated-metal pipes of the respective sizes.

"By merely rounding the entrance to a 24 in. vitrified-clay-pipe culvert the capacity may be increased approximately 13 per cent. over that obtained in a square entrance. By increasing the area of the cross-section of the outlet end of an 18 in. vitrified-clay-pipe culvert so that the area is about double and the angle of divergence about 10°, the discharge of the culvert, when the outlet is submerged, may be increased 40 per cent. over that obtained in the same culvert having a uniform bore throughout.

"The utilization of the data obtained in culvert design enables an engineer to increase the carrying-capacity of culverts 40 to 50 per cent. over former standard practice with a comparatively small increase in cost."

Subgrade.

A pavement depends upon the subgrade for support, and this support is exceedingly non-uniform in character. The supporting-power of a subgrade depends on the type of soil, its capillarity, the proximity of the ground-water, the amount of sustained rainfall, and the extent of freezing and thawing.

In the construction of modern pavements more and more attention is being given to the preparation of the subgrade. The statement is often made that the drainage and preparation of the foundation have more effect on the life of a pavement than the traffic. Altogether too little care has been used in the preparation of the subgrades in the past in New Zealand. It is just as important to have a smooth uniform surface true to cross-section on the subgrade as it is to have it on the pavement. It is much cheaper to fill up minor depressions with suitable earth than to allow an extra thickness of metal, concrete, or other surfacing to compensate for those depressions. The extreme importance with which the preparation of the subgrade is regarded in America can be gathered most satisfactorily by referring to the extract from the latest specification of the California Highway Commission, forming Enclosure A to this report.

Gravel Roads.

Gravel for many years will be our most important and cheapest roadmaking material. While it is only fit for taking light loads, nevertheless a good gravel road from the point of view of the motorist is better than a good macadam road. Careful study of the behaviour of gravelled roads is therefore warranted, and improved methods of construction can and should be evolved. The following points show the direction in which improvements are being made in America :—

(1.) The gravel should be passed through a crusher, particularly if there are numbers of fragments over 3 in. in diameter.

(2.) The gravel should be laid in two courses, the lower course consisting of material passing a screen with circular openings of not more than 2 in. (preferably 1½ in.) retained on a screen having openings of 1 in. or ⅞ in. diameter; the upper course consisting of all material passing the smaller screen.

(3.) No single course should be greater in depth than 5 in.

(4.) During and for some time after construction the road should be constantly dragged, and if necessary dampened.

(5.) The use of light rollers is advisable.

Water-bound Macadam.

This type of pavement is too well known to warrant a detailed description. There are certain features of accepted good practice, however, which could be observed more frequently to great advantage in this country: for example—

(1.) The better preparation of the subgrade as regards shape, drainage, and consolidation.

(2.) The segregation of the stone into three sizes, for the bottom course, top course, and binder.

(3.) The greater use of water in binding the road-surface, and the more frequent use of rollers.

(4.) More attention to the provision of lateral support for the surfacing.

With regard to No. 4, the use of any form of kerb is generally prohibitive in cost, but a good substitute can be constructed at moderate cost by treating the outer 12 in. on each side of the macadam with bitumen applied by the penetration method, using 1 U.S. gallon per square yard on the base course, and the same amount per square yard on the upper course. This method is particularly suitable when it is intended to treat the surface of the water-bound road.