method of working renders the contact beds self-cleansing, so that they retain their purifying power unimpaired.

Automatic Alternating Gear.

The alternate filling and emptying of the contact beds is effected automatically by means of the alternating gear, known as the Central-Basin Four-Filter Gear. As soon as bed 1 is filled, a small quantity of filtered effluent overflows from its discharge well into a float chamber, lifting the float, at the same time opening the admission valve and closing the discharge valve of bed 2. When bed 2 is filled, this operation is repeated, the flow of tank effluent diverted into bed 3, and the discharge valve of bed 1 is opened and its contents built upon a cast-iron bed plate and enclosed in a small chamber to protect it from the weather and from interference.

The works being automatic throughout, and the working of the contact beds being controlled by apparatus of proved reliability, there is no risk of temporary breakdowns such as occur where the working of an installation is dependent upon the fidelity and vigilance of an attendant.

The small plant south of the hotel has a capacity of 5,000 gallons daily, and consists of one septic tank and three aerobic bacterial contact beds. The septic tank is 17 feet long, 6 feet wide, and an average depth of 5 feet below the water level. It is covered with a reinforced concrete roof.

Contact Beds.

There are three contact beds averaging 15 feet long, 7 feet 6 inches wide, and all filled to a depth of 4 feet with slag.

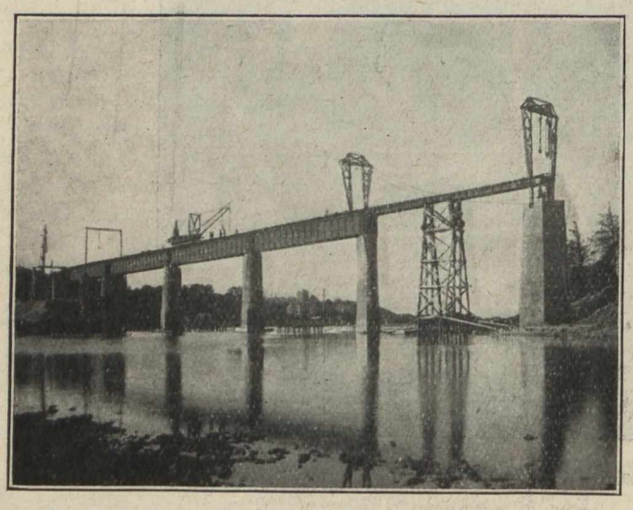
The method of operation is practically the same as already described for the larger plant, excepting that a Three-Filter Alternating Gear is used instead of the Central-Basin Four-Filter Gear, above described.

Both plants have now been in operation two seasons and are giving entire satisfaction.

THE GUELPH AND GODERICH RAILWAY.

By J. Grant MacGregor, C.E.

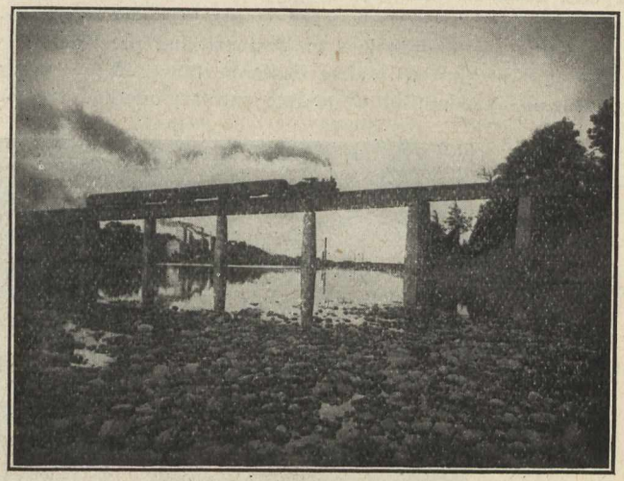
The Guelph and Goderich Branch of the Canadian Pacific Railway was formally opened for traffic on the 12th inst., exactly three years from the date of turning the first sod. As this may seem an unusually long time in which to build 80 miles of railway, the permanent character of the work must be considered, together with the severe winter, and the extensive work on the Goderich end where the line crosses the valley of the Maitland River. This portion of the work alone consisted of 10,450 cubic yards of concrete in bridges and retaining walls, and 265,000 cubic yards of earthwork in



The Maitland River Bridge, nearing completion.

embankments. The distance from Guelph to Goderich is 80 miles, and with the exception of 20 miles at the Goderich end the work of location presented but few difficult engineering problems. The location of the last 20 miles, however, was repeatedly revised, leaving no doubt whatever as to the final location being the most favourable one.

The limits of grade and curvature were fixed by rules and diagrams issued by the Canadian Pacific Railway for the use of velocity grades wherever practicable, such limitations being based on experiments made on an extensive scale by the Northern Pacific Railway, and from which the diagrams referred to had been prepared. The application of the diagrams to the original grade profiles eliminated much heavy work and established on an economic basis a virtual 0.60 per cent. profile for eastbound traffic, for a minimum speed of 10 miles per hour with a train load of 1,630 tons. In extreme



The Completed Bridge.

cases the above limitations may have been exceeded, depending perhaps on an increased acceleration to overcome some of the higher summits.

In order that the effect of such acceleration could be determined the experimental diagram had to be dispensed with and the usual theoretical rule substituted. This necessitated a comparison to be made of the data obtained by experiment with results obtained by theory, in expectation of effecting a change in the 0.60 per cent. and 10 mile per hour requirement to embrace the new conditions, but it was impossible to do so with the class of locomotion expected to be put in operation on the division.

The requirement had therefore to be departed from in some cases, reducing the speed at summits to 6 miles per hour and even lower. The velocity heads given on speed diagrams were substantially those given in Table 118 of Wellington Railway Location, and are derived from the formula for finding force of gravity in falling bodies, $h = \frac{v^2}{2g}$ to which is added 6.14 per cent. for the rotative energy stored in the wheels.

The work of construction on the first 60 miles from Guelph was comparatively of a light character, such as is usually encountered in undulating country; the average quantity of earthwork per mile being 18,300 cubic yards. The work on the last 20 miles was much heavier, the average quantity per mile being 42,000 cubic yards. No rock had been encountered throughout the whole line. The classifications specified were "solid rock," "loose rock," and "common excavation," the latter embracing all materials which could not be classed as loose rock.

To avoid disputes and simplify questions arising from the calculation of overhaul, the usual clause was annulled and a fixed amount included in contractor's tender to cover all overhaul, such amount being previously determined by the extra cost of removing from line excavation the quantity in gullets of sufficient width to permit of the extra widening being done by steam shovel and train haul.

The structures are absolutely of a permanent character, and are built entirely of concrete, the only exception being the upstream faces of cutwater piers, which are faced with cut stones. The proportions of concrete used were for piers and abutments one, four, seven, and for arch culverts and foundations under water one, three, five. The standard designs of the Canadian Pacific Railway were adhered to as closely as circumstances would permit. The graceful form of the piers of the larger structures evolved from the appli-