so as to gravitate to the sludge drying-beds. It was, therefore, necessary to provide some means of lifting it to the desired level, without, if possible, incurring the cost of pumping. This was accomplished by utilizing the head of the water in the tanks for the purpose of forcing the resultant sludge to the drying-beds, and to assist in this object an apparatus known as Fidler's revolving scraper was placed in each sedimentation tank.

The Fidler scraper arrangement is intended to facilitate the removal of sludge without interfering with the continuous working of the sedimentation tanks and to deliver the sludge at a level only a few inches below the top water level of the tank. The scraper, by means of which the sludge is directed to a sump in the bottom of the sedimentation tanks, is helical in form; it is attached to and supported from a lattice girder, and is rotated by gearing fixed at the side of the tank adjacent to a sludge discharge chamber so as to give opportunity for careful regulation of the discharge. When it is desired to remove the sludge the scraper is revolved and the sludge directed into the central sump, from the bottom of which it is forced to the sludge drying-beds. Valves are provided on the several pipes to regulate and control the flow.

The sludge drying-beds are four in number, each 25 ft. long by 10 ft. by 6 ft. deep; they are constructed of brickwork, backed on the outer side with concrete; the floors are made of concrete, laid with proper falls in the direction of the drains. Each bed is provided with doors, constructed in sections, extending the full width of the bed at the lower end, which can be raised or lowered at will as the material in the beds increases or decreases. Cross walls are formed of perforated boards laid in grooves so as to be easily adjusted.

When the sludge is about to be emptied from the sedimentation tanks, a layer of straw, litter, dried weeds or the like is first laid in each tank or compartment in such a manner that the whole surface of the bed is covered; the litter is also drawn slightly up the sides of the beds or compartments, as well as round the vertical perforated pipes or shafts. These perforated vertical pipes are about 6 in. in diameter, in lengths of about 2 ft., provided with sockets and spigots, so that they can be built up in continuous shafts from the floor to the top of the bed as it is being filled. A layer of sludge, to the depth of 4 in. to 6 in., is then run on to the litter, which acts as a filter, the litter allowing the liquid to filter through and find its way to the perforated pipes, which in turn are connected to drains laid on the floor of the beds. This operation of filling the beds alternately with litter and sludge is repeated until the bed or compartment is filled, when operations are transferred to the next bed. The liquor draining from the sludge beds is conveyed to a well, and is then pumped, by the oil engine and pump previously referred to, into the feed channel of the tanks for re-treatment. As the beds are being filled the increasing weight compresses the sludge and litter, thus forming, after proper settlement, a firm bed of manure, which is easily handled and is very portable. A layer of litter is always placed on the top of a layer of sludge to obviate any nuisance from smell, which one usually expects to arise from open sludge beds or lagoons.

The authors were assisted by the Surveyor to the Penrith Urban District Council, Mr. J. J. Knewstubb (member), who acted as resident engineer throughout the construction of the sewerage works, and who has supplied, for the purpose of this paper, the following information:—

Population dealt with in the scheme, 8,000.

Daily dry-weather flow per twenty-four hours, 290,000 gallons.

Quantity of wet sludge passed on to the beds per day, 2½ tons average.

Quantity of dried sludge taken out of the beds per day, 16 cwt. average.

Quantity of dried sludge removed from the beds and sold per annum, about 300 tons, average.

Quantity of litter used in the beds per year, 70 tons.

Length of time occupied in drying the wet sludge; this varies according to the season, but averages about six weeks.

Length of time occupied in filling one bed, about four weeks. This again varies according to the time of the year and atmospheric conditions.

Rate of consolidation varies according to depth of bed.

Length of time required for the dried sludge to attain its most beneficial condition as manure after removal from the beds, twelve months.

The sludge is sold by open tender every year, and the average price per cart load realized has been 1s. 9d. per load. The authors are informed that the manure removed from the sludge beds after treatment under this system is most beneficial for use on land growing turnips and mangolds, and also gives good results for clover and seed grass at any time and under almost any conditions. It has also been found to be an excellent material for ploughing into land of a light character.

No additional expense is placed upon the Council in dealing with the sludge, as the operation of filling the beds is performed by one of the regular men employed on the farm, and occupies but an infinitesimal portion of his time. The emptying of the beds is undertaken by, and at the expense of, the purchaser of the dried sludge, who also provides and brings to the beds part of the litter required; this, of course, being a consideration of the purchase price. So far as Penrith is concerned the sludge problem has been solved; the authors have, however, up to now hesitated to supply any description of the system, as they were desirous it should have a fair and ample trial before doing so.

This description is given purely from an engineer's point of view, apart from that of the chemist. There is, however, the practical side of the question in that the farmers of the district are competitors for the dried material. The works were completed in the latter part of 1907, were formally opened on, and have been in continuous operation since, the 19th of March, 1908.

CANADA'S COOPERAGE INDUSTRY.

Seven million two hundred and ninety-three thousand oak staves were imported into Canada during 1911, while only 2,768,000 were cut in the Dominion. These figures which show that Canada is fast losing her possibilities as a producer of tight cooperage, are contained in a bulletin issued by the forestry branch of the department of the interior.

In the manufacture of slack cooperage, used for the dry rough commodities such as lime, potatoes, apples, dry fish, flour, cereals, etc., which predominate in Canada's products, elm is the principal wood employed, forming over 50 per cent. of the total consumption. Spruce is rapidly coming into more general use as a source of stave supply, eleven million more spruce staves and nine million fewer elm staves having been used in 1911 than in 1910. When elm is exhausted birch will probably take its place, being comparatively flexible and available in great quantity.

The total value of the materials used in the slack cooperage industry in Canada for the past year was $1,465,702. In 1910 it was $1,595,119 or some $130,000 more. Imports and exports of materials and finished product were, respectively, $329,992 and $135,463, an excess of imports over exports of $194,529.