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MISSING

The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

THE NEW EASTERN ENTRANCE TO THE CANADIAN NATIONAL EXHIBITION

DETAILED ACCOUNT OF METHODS EMPLOYED TO CARRY OUT THIS WORK WITHOUT INTERFERENCE WITH TRAFFIC.

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THE Canadian National Exhibition at Toronto is perhaps the best-known yearly event in Canada. Founded in 1879, it has grown by leaps and bounds. In 1883 the attendance had grown to 171,765, and in 1913, the biggest year on record, the attendance was 1,009,000, while the attendance on one single day in 1913 nearly equalled the total attendance of 1883, being 153,000.

A review of the traffic facilities of this great Fair will be of special interest at this time. In 1879, when the fair was opened, people could go to the exhibition in three different ways—by boat, by steam railway, and by horse-car to King Street and Strachan Avenue, thence by foot to the eastern gate, known as Strachan Avenue entrance. In 1884 the exhibition built an electric street railway line from the foot of Strachan Avenue into the grounds; this shortened the long walk from King Street and Strachan Avenue. It is interesting to note that this electric line was the first electric car line in America and the second in the world. This line easily paid for itself; at the time it was considered one of the "big" features. The ferries did not run much after 1884, the weather being so uncertain it did not pay. In 1892 the Toronto Street Railway electrified its lines and extended the King Street line out to Dufferin Street and down Dufferin Street to the Dufferin Street entrance, making this the main entrance. The exhibition discontinued its line at this time. Up to 1911, when the Grand Trunk Railway eliminated the grade crossing at the Dufferin Street gate, this entrance was used for both vehicles and pedestrians, but after 1911 only pedestrians were admitted at Dufferin Street, the vehicles being admitted at Strachan Avenue or by way of Dunn Avenue and Dominion Avenue. Away back in 1904, on account of the poor facilities for handling the crowds at the Dufferin Street entrance, an agitation was started to procure another street railway entrance, and this year the dream of the exhibition authorities will be realized. To anyone who has had to fight his way to a car after the evening entertainment no argument is necessary as to the need of another street railway terminus. It may be interesting to mention the fact that between 25,000 and 75,000 people have to be handled inside of an hour any evening of exhibition. The only facility for handling this traffic was a double-track line on Dufferin Street with a loop at the end. Needless to say, many people either did not go to the exhibition or else walked home to avoid the crush.

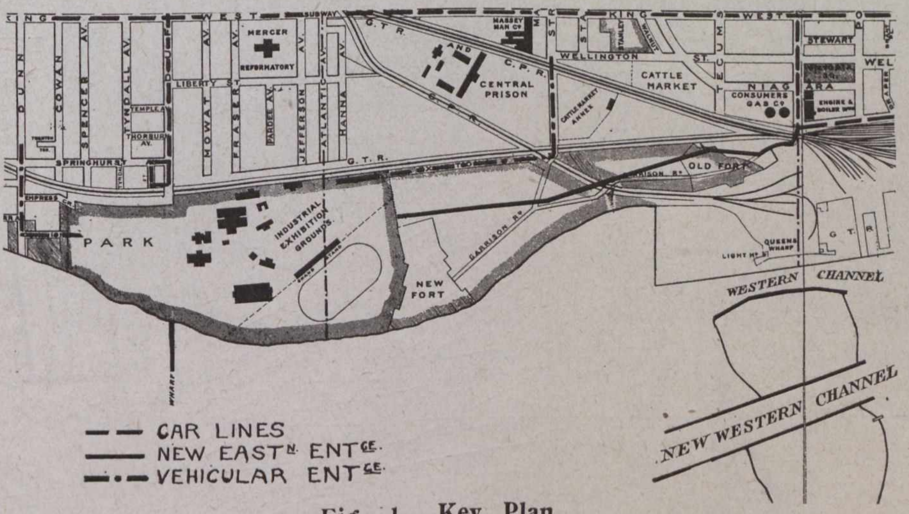

Fig. 1.—Key Plan.

The aim of this article will be to describe shortly some of the engineering features of the construction of this new eastern entrance. A glance at the map (Fig. 1) will show the different entrances as they exist to date, *i.e.*, the main entrance at the foot of Dufferin Street, the vehicular entrances down Dunn and Strachan Avenues, the wharf where the ferries used to land, the steam railways, who have a fine loading platform for out-of-town excursions, and the new eastern entrance from Bathurst and Front Streets.

The eastern entrance to the exhibition, starting at the corner of Front and Bathurst Streets, is carried over a 202-ft. 6-in. through truss span, then down a 195-ft. timber trestle, then along the north side of the north embankment of the Old Fort on a 256-ft. sidehill timber trestle, then cutting through the parapet of the Old Fort is carried on the Old Fort grounds behind the barracks for a distance of 400 ft., then, cutting through the parapet again, it runs about 950 ft. over the Garrison Commons to a 344-ft. timber trestle over the Canadian Pacific Railway Queen's Wharf line, and from here it runs over the Common for about 1,900 ft. to the terminal loop at the exhibition grounds. The steel bridge and the 195-ft. timber trestle are designed to carry both street railway and vehicular traffic, and the rest of the line for street railway traffic only. The vehicular traffic, when it leaves the 195-ft. trestle, goes over the Old Fort Road to the exhibition. The total distance from the north end of the bridge to the end of the loop is 4,475 lin. ft.

The most interesting part of the work from the engineering point of view is the layout of the work at both ends of the steel bridge. The work from the south end of the steel span is intended as temporary work only, the final plan calling for Bathurst Street to be produced straight south and the car line to travel on the new area to be created by the harbor commissioners. To do this, it will be necessary to demolish the large building of the Matthews-Blackwell Company, shown in Fig. 5.

The steelwork, concrete abutments and everything else had to be designed with this future arrangement in mind. Part of the east end of the final north abutment is built to act as a pier for the east truss, and the pier to support the north end of the west truss was so designed that it will become part of the wing wall of the abutment as finally built. A temporary back-wall was built. This wall bears on the abutment of the old bridge and cantilevers out over the northwest pier. When the bridge is to be swung around into its final position, steel beams resting on the northwest pier and on the new abutment (to be built) will provide a sliding surface. At the south end concrete piers were built to carry the truss in its temporary position. These, of course, will be of no use in the future arrangement. All concrete piers and abutments bear on bed rock, which is about 14 to 20 feet below base of rail.

The layout of the special trackwork at the corner of Front and Bathurst Streets required special study. It is so designed that a minimum of new special work will be required when the bridge is swung to its final position. All curves are laid out to permit of two cars passing on any part of the curve when going in opposite directions.

At the south end, access had to be provided to Queen's Wharf, to the Matthews-Blackwell plant and to the railway yard. On account of the increased length of the new bridge over the old bridge and also the increase in headroom over the Grand Trunk Railway called for by the Railway Board, the grade of the road in front of Matthews-Blackwell's had to be raised 7 feet. Also, on account of the length of the new bridge and the steep grade of 6 per cent. existing on the Queen's Wharf Road, it was necessary to bring Queen's Wharf Road under the timber trestle in front of Matthews-Blackwell's and then rise up to the south end of the trestle

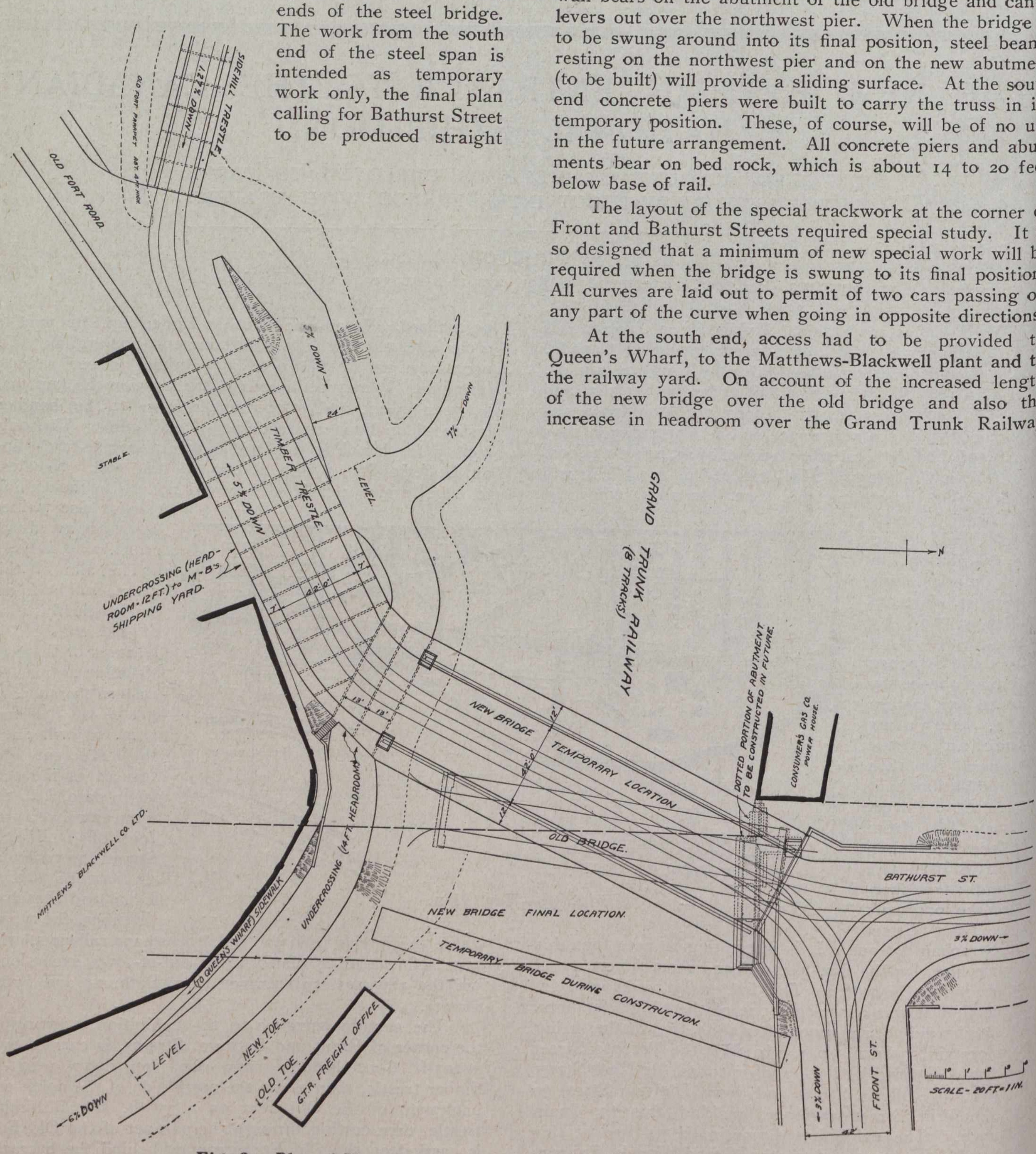

Fig. 2.—Plan of New Bathurst Street Bridge, Showing South Approaches.

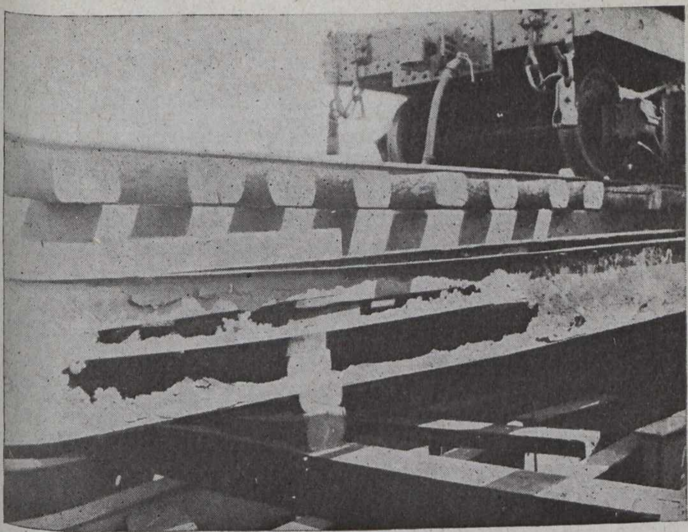

Fig. 3.—Corrosion of Steel on Old Bridge. Wrecking Crane in Background.

on a 5 per cent. grade. This arrangement provides an undercrossing into Matthews-Blackwell's yard with a headroom of 12 feet, and a ramp is to be built, leading down to the Grand Trunk Railway yard. To take care of Matthews-Blackwell's office entrance, a stairway is provided from the bridge floor to the level of the office floor, and to maintain this level, which is 11 feet above the level of the new undercrossing of Queen's Wharf Road, a retaining wall of reinforced concrete is built. Pedestrian traffic to Queen's Wharf will use this stairway also. All these various arrangements can be easily followed on Fig. 2. The grades used are as follows: Bathurst and Front Street approaches, 3 per cent.; south approaches to bridge, 5 per cent.; sidehill trestle, 1.27 per cent.; C.P.R. trestle, 5 per cent.; all other grades are nearly level.

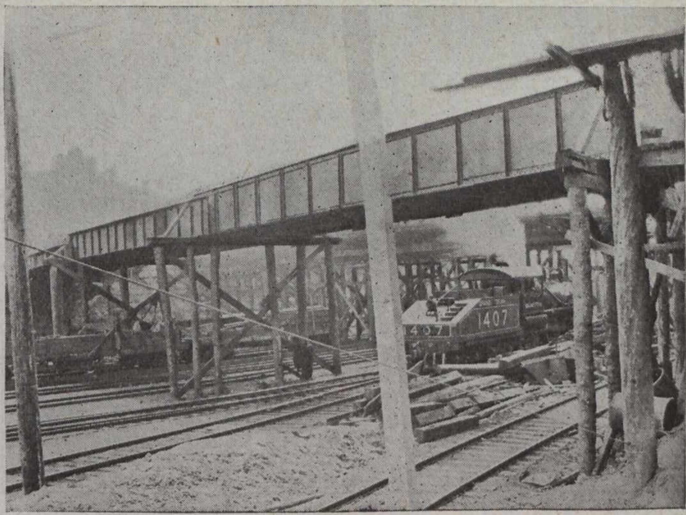

Fig. 4.—Temporary Bridge During Construction.

The steel trusses are the trusses released from the Humber River crossing when the G.T.R. raised the grade at that point in 1911. This was a double-track bridge, 202 ft. 6 in. centre to centre of bearings, and by putting in a new system of bracing, new floor beams,

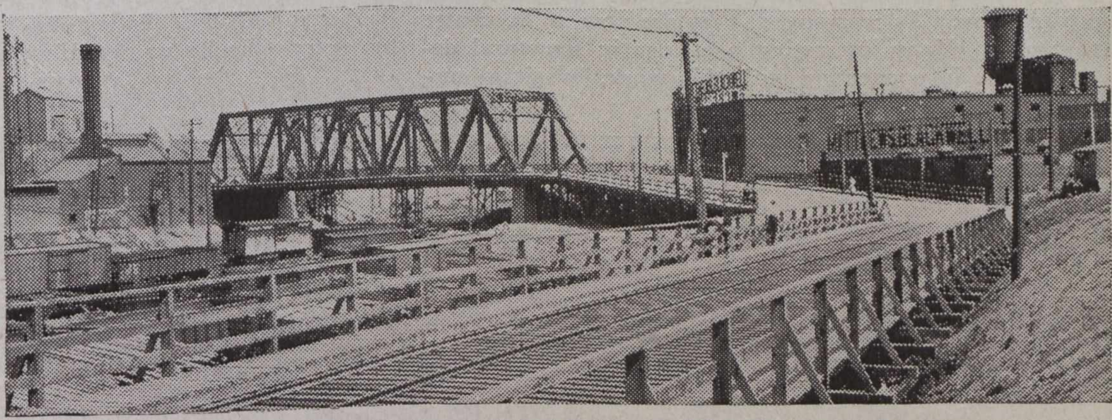

Fig. 5.—New Bathurst Street Bridge and South Approach.

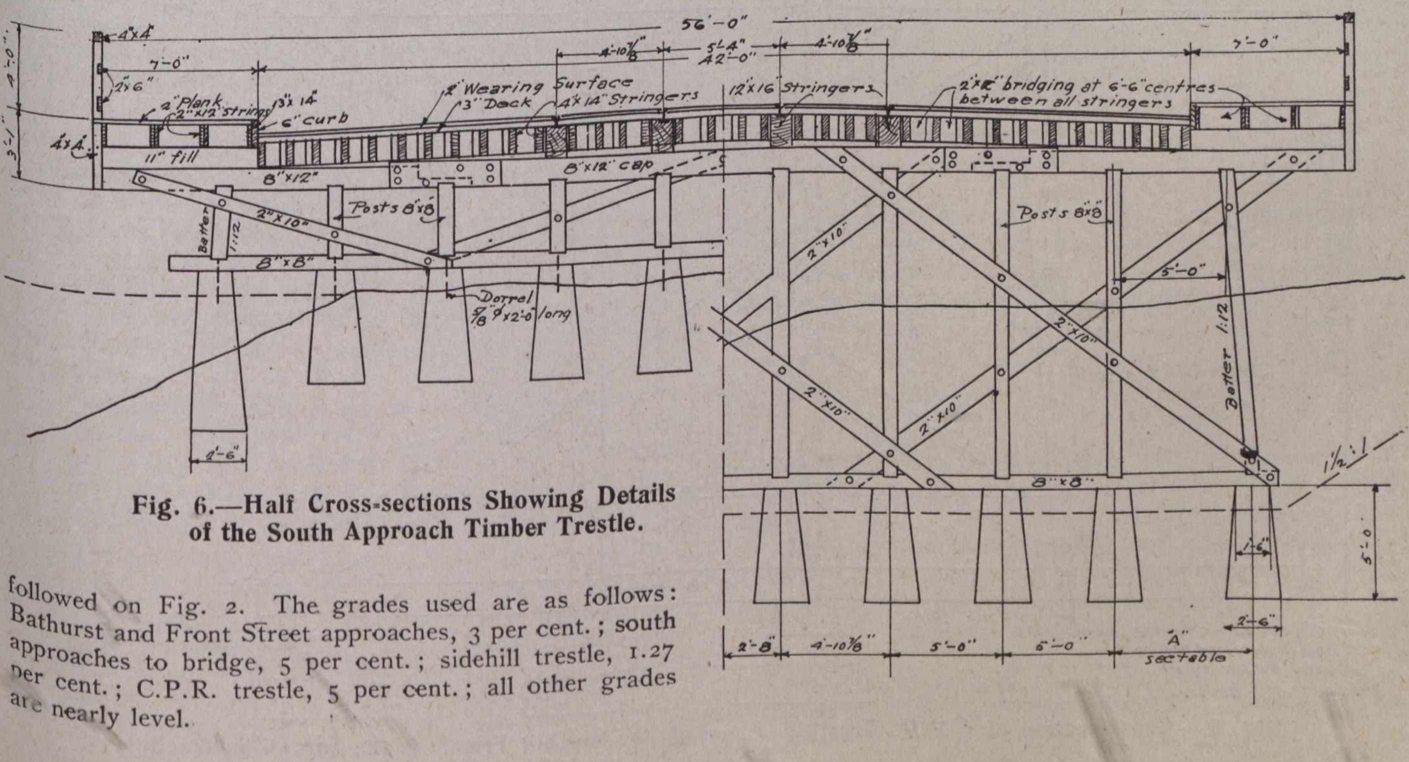

Fig. 6.—Half Cross-sections Showing Details of the South Approach Timber Trestle.

Fig. 7.—Sidehill Trestle. Old Fort Buildings in Rear. No buildings of the Old Fort were altered, the only disturbances were two cuts through the earth parapet, one of which is shown at the far end of the trestle.

stringers and sidewalk steel it made a very suitable structure for this purpose. The trusses were originally 31 ft. centre to centre and are in a very good state of preservation. As rearranged, they are now 46 ft. centre to centre. Many interesting questions in structural details arose in connection with this work, but it is surprising how easily the changes were made. The floor of the bridge is concrete, which is thoroughly waterproofed, the paving being creosoted wood block.

The erection of the new bridge and the wrecking of the old bridge without interfering with the railway and highway traffic entailed some forethought. A temporary bridge was built to the east of the old bridge to carry the highway traffic and the falsework for erection and wrecking was put in between the different tracks. This temporary bridge is constructed of old railway girders supported on pile bents, as shown in Fig. 4. By forbidding trainmen from going on the tops of cars in the yard the railway company were able to build this temporary bridge with a headroom of only 19 ft., otherwise the approaching grades would have been very steep. The wrecking of the old bridge was done with a travelling crane running on tracks supported on falsework. Fig. 3 shows two of the sidewalk stringers of the old bridge and gives a fairly good idea of the need for a new bridge. The track in this view is the one on which the wrecking crane runs. The erection of the new bridge was carried out with this same wrecking crane on a track laid on falsework in line with the new bridge.

Fig. 6 shows a cross-section of the timber trestle of the south approach. An interesting problem in this trestle is the fact that it is on a horizontal curve; the floor is on a vertical curve, and it was impossible to place the bents radially. By careful work in the field and office every difficulty was readily overcome.

Fig. 8 shows a cross-section of the street railway

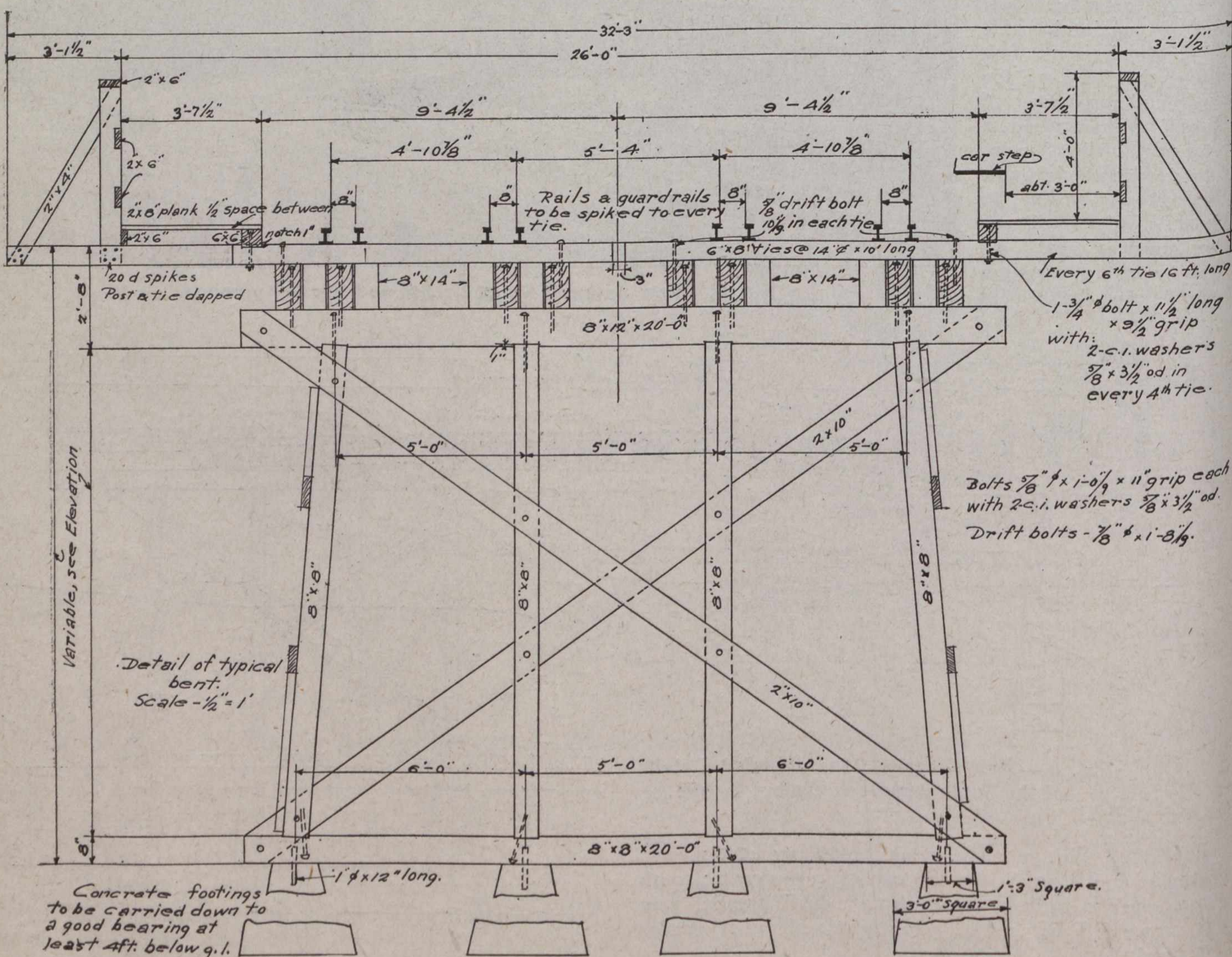

Fig. 8.—Cross-section of C.P.R. Trestle; Floor of the Sidehill Trestle is the Same Construction.

trestles on the sidehill and over the C.P.R. The sidewalks are placed on these trestles to act as emergency outlets to the passengers on the street cars should the cars become stalled on the trestle. The walk and railing also serve as a safety guard to anyone who might possibly fall off the crowded cars. All the trestle footings are of concrete carried down below frost level and to a good bearing. Fig. 7 shows a view of sidehill trestle.

The exhibition terminus of this line is shown in Fig. 9. Cars coming to the exhibition run up to the 80-ft. x 500-ft. platform, discharge and load, then around the loop and back to the city. If desired, the cars can be stored on the inside loop ready for the big crowd. By this arrangement it will be possible to have 28 cars standing ready to receive their load. This means that over 3,000 people can be taken away in one lift. When one compares this with the existing arrangements on Dufferin Street, where six or eight cars are all that can stand and

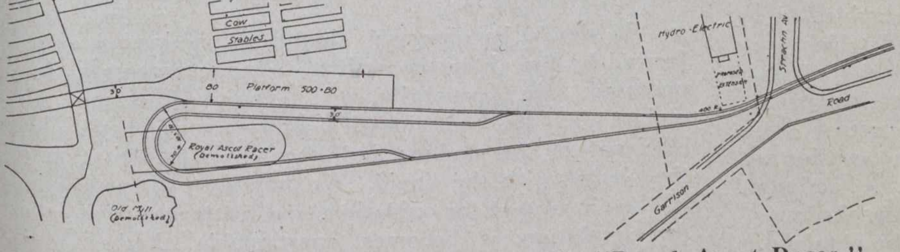

Fig. 9.—Plan of Exhibition Terminal Loop. The "Royal Ascot Racer," a Midway Amusement, was taken down to make room for this loop. The Grand Stand is 1,000 feet west of the loop.

load, it is readily seen that a great relief in traffic congestion will be effected. The platforms and turnstiles will be of a temporary nature, being all built of wood.

The rail, except on the steel bridge and the 195-ft. trestle, which is a 7-in. girder groove rail, is standard 60-lb. rail. The line is ballasted with gravel. On the steel bridge the rails are laid on 5-in. x 8-in. x 2-ft. oak blocks at 2-ft. centres, and are fastened to same by screw spikes.

The work is being done entirely by day labor. The city's share of the work was the concrete piers for the steel bridge, paving, grading at south approach, track and overhead electrical construction, platforms and terminal facilities. The G.T.R.'s share was the erection of the steel bridge and a temporary crossing, the abutment, retaining walls and grading at Front and Bathurst Streets. The Toronto Street Railway's share was the trackwork at Front and Bathurst Streets.

The work was started about the first of April of this year, and was ready for the opening of exhibition. When one considers the difficulty of getting material and labor this year, the progress in five months has been remarkable.

It was very interesting from an historical viewpoint to watch the excavations near the Old Fort. An old corduroy road had to be cut through, and the palisades of the Old Fort were encountered in several places. This Old Fort is the Fort York of history that figured in the war of 1812.

The engineering has been done jointly by the city and G.T.R. for the Bathurst Street bridge, and for the rest of the work by the city. The city's work has all been done under the supervision of Mr. G. A. McCarthy, engineer of railways and bridges of the Works Department of the city of Toronto, of which Mr. R. C. Harris is commissioner of works.

EXPERIMENTAL WORK WITH REFERENCE TO THE PURIFICATION OF SEWAGE BY AERATION, ACTIVATED SLUDGE, ETC.*

By John Haworth, F.C.S.,
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THESE experiments, carried on at Sheffield, are by no means complete, and have been retarded on account of shortage of staff and pressure of work due to the war.

While the primary effluents from the contact beds are usually incapable of putrefaction, at times colloidal solids separate out on standing, and they are particularly liable to this effect on account of the large volume of trade wastes, containing iron and other metallic salts, hydroxides and mineral acids discharged into the sewers and present in the sewage at the outfall works. Experiments were, therefore, commenced about four years ago in order to determine the most suitable and economical methods by which these primary effluents from the contact beds might be rendered at all times satisfactory. The experimental plant consists of tanks, pump, motor, etc.

Aeration.—It was found that, on standing in contact with air, opalescent and cloudy effluents became quite clear after about twenty-four hours. Experiments were, therefore, made to bring about, if possible, the rapid deposition of colloidal and other solid matters with subsequent clarification. These experiments consisted of (1) Aeration by jets of air. (2) Aeration by forcing air through porous substances, such as land tiles and silica bricks. (3) Aeration by causing the liquids to fall in sprays. (4) Aeration by rapid treatment on percolating filters of varying depths. (5) Sand filtration. (6) Precipitation by chemicals. All these methods produced the effects desired to a greater or less extent, but by means of the percolating filter effluents of high purity, clear and free from colloidal matters, were obtained. Primary effluents have been regularly treated in this manner at the rapid rate of 800 to 900 gallons per day per cubic yard of material with satisfactory results over a period of at least four years.

The following chemical results may be taken as typical:—

	Parts per 100,000. Sprinkler effluent.
Oxygen absorbed, four hours' test*	0.68
Nitric nitrogen	0.72
Dissolved oxygen test. Oxygen absorbed in five days at 18.3 deg. Cent.	0.63
Suspended solids	Traces only.

* Liquid treated, 2.51.

The effluent, when diluted with tap water in the proportion of four effluent plus five tap water and the mixture aerated at 14.5 deg. Cent. (equal to two parts dissolved oxygen per 100,000) and then incubated for five days at 18.3 deg. Cent. invariably absorbed less than two parts of oxygen per 100,000, and were, therefore, well within the Royal Commission standard.

*Abstract of paper read at the meeting of the Association of Managers of Sewage Disposal Works, at Sheffield, July 8th.

Whilst the early experiments which were made by forcing air through porous substances, such as land tiles and silica bricks, did not yield such hopeful results, there was an incentive to continue the experiments, inasmuch as attention had then been drawn to the use of activated sludge in combination with aeration. Consequently, it was thought that useful information might be obtained by applying activated sludge to the treatment of primary effluents. In two of the experimental tanks, fitted with diffusers, sludge was activated by the usual method. In one tank primary effluents and mixtures of these effluents with settled sewage were dealt with, and in the other settled sewage was treated. The results have proved both interesting and instructive. In the case of the tank treating primary effluents with settled sewage, deposition of colloidal matters is obtained, but bearing in mind the large volumes of this liquid which can be dealt with on the percolating filter and the greater simplicity of the process, no advantage would be gained by adopting the former.

Briefly, the following are the results arrived at: (1) Well-clarified effluents are usually obtained which are within the commonly accepted limits of impurity allowable. (2) It is found that discharges of acid trade wastes, such as occur in the Sheffield sewage, destroy the efficiency of the sludge for a time. On one occasion a particularly strong discharge resulted in the activity being destroyed, and aeration for several weeks was required before clarified effluents could again be obtained. This inhibitory action is more or less pronounced, and, consequently, great care is necessary to render such abnormal discharges neutral in character and to equalize their flow so as to render such sewage amenable to purification by this process. A still more important point must be considered, namely, the effects of discharges of trade effluents containing and consisting essentially of chemical solids of heterogeneous composition upon the activated sludge. (3) The porous tiles became choked after a few months' use, owing to dust and grease in the compressed air, and also by bacterial masses growing through the pores of the tiles. This latter fact has also been proved in connection with the Pasteur-Chamberland porous porcelain tube filter. (4) Uneven aeration occurs by reason of unequal porosity of the tiles. (5) Tiles have cracked, with the result that the air escapes at one place, and the tank has had to be stopped for repairs. This unsatisfactory feature in the use of porous tiles requires serious consideration. These unsatisfactory features lead one to the conclusion that, while sewage may be purified by means of activated sludge the mode of application leaves room for much investigation and improvement before its practical utility is proved. Experiments have, therefore, been made in connection with devices for the aeration of liquids without the use of porous media, and in this direction some of the latest experiments will now be described.

During a discussion on this question with Mr. F. Scudder, F.I.C., F.C.S., of Manchester, he described to me a series of experiments on the aeration of crude sewage which was made by him in 1881, in collaboration with the late Dr. Angus Smith, and called my attention to an apparatus designed for the oxidation of oils, etc., devised in the year 1880 by Dr. Storer, and which was used in Angus Smith's experiments. As a result of this, and with the aid of valuable suggestions by Mr. Scudder, apparatus has been constructed which promises satisfactory results, of which several small types may be seen in operation. The apparatus consists essentially of a narrow cylindrical tube placed vertically and fitted with a central spindle, bearing either an archimedean screw or a series of suitably shaped propeller blades. A number of the blades are within and others projecting below the lower end of the tube. The top of the cylindrical tube is placed at a suitable depth beneath the surface of the liquid to be aerated. On rotating the spindle at a rapid rate the liquid is merely circulated down the cylindrical tube, but on the insertion of a small air pipe within the edge of the cylindrical tube a large volume of air is sucked in and distributed into the liquid at the lower end of the cylinder. The mixed water and air rise up on the outer side of the tube ready to flow in again, and thus the aeration is continuous. The apparatus is at present experimental in character, but, as a mechanical means for circulating the sludge and at the same time giving abundant aeration, has so far proved to be simple and effective without many of the disadvantages to which aeration by forcing of compressed air through porous slabs, etc., is liable.

It should be observed that two functions are performed by the air in the activated sludge process as now operated, viz., primarily, the supply of oxygen for maintaining the bacteriological and chemical action and efficiency of the sludge; and, secondly, the agitation of the sludge with the liquid. As only a small proportion of the air is used for oxidation, and the larger proportion for circulation, it becomes questionable whether it is economical to use compressed air for purposes of agitation, or if mechanical agitation, which would carry in probably the minimum amount of air necessary, would work as efficiently as the more expensive compressed air plant.

With this aim two further experiments were devised: (1) A series of perforated ordinary steam pipes was laid at the bottom of a small tank and connected to the compressed air supply. Over the pipes, approximately two feet of clean clinker or slag, broken into approximately ¾-in. cubes was laid. The tank was then filled with settled sewage and air bubbled through for about five hours. The resulting effluent was found to be clarified, non-putrescible, and in all respects a satisfactory one. A partially septic and black tank liquor treated by this method becomes bright and clear after one hour's aeration, and after four to five hours is amply purified. One of the tanks has been in daily operation for about nine months and continues to give good results.

	Parts per 100,000. Effluent.
Oxygen absorbed, four hours' test*	0.92
Nitric nitrogen	1.15
Dissolved oxygen test. Oxygen absorbed in five days at 18.3 deg. Cent.	1.89
Suspended solids	Too small to estimate in 250 c.c. of liquid.

*Liquid treated, 4.97.

The effluents when diluted with tap water in the proportion of four effluent to five tap water aerated at 14.5 deg. Cent. and then incubated for five days at 18.3 deg. Cent., with a few exceptions, absorbed less than two parts of oxygen per 100,000, thus being within the Royal Commission standard.

(2) The second experiment consisted of a small iron tank having a semi-circular section at the bottom. A

shaft was fixed lengthwise through the tank, and to it were attached two hollow paddles of special shape, so arranged that in the lowest position the paddle nearly touches the bottom of the tank, and in the upper position it is approximately at the top of the tank. The tank was charged with humus washed from material taken from a contact bed together with sewage, the proportionate volume of humus being 25 per cent. of the sewage. When the paddle is rotated the blades leave the liquid at the surface and trap a small volume of air, which is carried into the liquid and discharged therein. Thus the mixture of humus and sewage is kept continuously in motion and a definite quantity of air is discharged into it by each revolution of the paddle. The paddle is revolved fifteen times per minute. After several weeks' operation the humus was found to become fully activated, and during the last six months crude sewage has been treated daily with satisfactory results, as the analytical table indicates:—

	Parts per 100,000. Effluent.
Oxygen absorbed, four hours' test*	1.17
Nitric nitrogen	0.66
Dissolved oxygen test. Oxygen absorbed in five days at 18.3 deg. Cent.	0.57
Suspended solids	Too small to estimate in 250 c.c. of liquid.

*Liquid treated, 4.81.

The effluents, when diluted with tap water in the proportion of four effluent to five tap water, aerated at 14.5 deg. Cent., and then incubated for five days at 18.3 deg. Cent., invariably absorbed less than two parts of oxygen per 100,000, thus being within the Royal Commission standard.

The results of these two experiments show that the aeration by minute bubbles of air, such as through porous tiles, is unnecessary, and that the mechanical circulation, combined with minimum aeration, is efficient. Both these experiments are still in operation.

The general conclusions drawn from the experiments which have been described may be summarized thus: (1) That a normal sewage may be purified by the activated sludge process. (2) That trade wastes may interfere seriously with the process. (3) That further investigation is needed with respect to modes of application of the sludge to the sewage, periodical removal of the surplus sludge and the effect of such removal on the continuing results of purification methods of aeration, costs of plant and upkeep, before older plants and methods can be abandoned. (4) That skilled control of the process will be essential. (5) That while the resulting sludge is undoubtedly richer in nitrogenous organic matter than ordinary sewage sludge, it remains to be proved by actual agricultural trials that such nitrogen is in a form suitable for the ready assimilation by plant life, and that as a fertilizer its superiority over humus can be established, as up to the present humus sludge derived from sprinkler filters, which is also richer in nitrogenous organic matter than ordinary sewage sludge, has not been appreciated by the agriculturist as a fertilizer, in spite of its availability in large quantities at many sewage works in this country during recent years. I desire to acknowledge the kindness of the chairman and members of the Sewage Disposal Sub-Committee in consenting to my giving the information presented in this paper.

GREAT BRITAIN'S BLACKLIST

Various portions of Great Britain's blacklist have already appeared in *The Canadian Engineer*. Below we print the list for Bolivia, Chile, Colombia, Cuba, Ecuador, Paraguay and Peru. In previous issues appeared the lists for the United States, Argentina, Uruguay and Brazil. All persons and firms in the United Kingdom are forbidden to trade or deal in any way with these firms and individuals. These lists are complete, official and correct. They were transmitted to *The Canadian Engineer* by mail from London, England.

BOLIVIA.

Banco Aleman Transatlantico (Deutsche Ueberseeische Bank).
Barber, Alfred W., & Company, Cochabamba.
Bickenbach & Company, Oruro.
Colsman Boehme & Company, La Paz & Oruro.
Dauelsberg & Company, La Paz.
Dohrmann, Dahse & Company, Oruro & Potosi.
Elsner, Juan & Co., Santa Cruz.
Emmel, Hermanos, La Paz.
Eulert, F. G., La Paz.
Fricke, Jerman, & Company, Oruro.
Gundlach, C. F., Oruro.
Gunther, Ernest, Sorata.
Hinke, Gustave & Company, La Paz & Oruro.
Hirschmann & Company, La Paz & Oruro.
Morales, Bertram & Company, Potosi & Sucre.
Quidde & Gatermann, Cochabamba & Sucre.
Reinecke Findel & Company, Oruro.
Schubert, H. G., Oruro.
Schweitzer, Felipe, Santa Cruz.
Stofen, Schnack, Muller & Company, Santa Cruz.
Zeller, Villinger & Company, Santa Cruz, Trinidad and Yacuiba.

CHILE.

Arrigoriaga, Saturnino, Valparaiso & Santiago.
Banco Aleman Transatlantico (Deutsche Ueberseeische Bank).
Banco de Chile y Alemania, (Banco fur Chile und Deutschland), Antofagasta; Santiago; Valparaiso; Concepcion; Temuco & Valdivia.
Banco Germanico de la America del Sud (Deutsche Sud-Amerikanische Bank).
Canelo, Nemesio, (of Gildemeister & Company), Iquique.
Cia Salitrera Constancia, Iquique.
Compania Salitrera Alemana, Taltal.
Compania Salitrera, H. B. Sloman & Company.
Curtze, Walter, Punta Arenas.
Daube & Company, Prat, 12, Valparaiso; Santiago; Concepcion; and Latorre-Baquedano & Antofagasta.
Dauelsberg & Company, Antofagasta.
Folsch & Company, Casilla, 16a, Valparaiso.
Fonck, Carlos, & Company, Calle Brasil 126, Valparaiso; Calle Puente 571, Santiago.
Gildemeister & Company.
Gleisner, Mauricio & Company, Santiago; Valparaiso & Talcahuano.
Hagnauer & Company, Valparaiso.
Hardt, E. and W., & Company.
Lange & Company, Casilla, 953, Valparaiso.
Luck, Winkelhagen & Company, Valparaiso.
Manns, Ernesto, Punta Arenas.
Parman & Krebs, Valparaiso.
Reitze, Leopold, & Company, Valparaiso.
Salpeterwerke Gildemeister Atkien Gesellschaft.
Schultz, Ricardo, and Company, 8, Coquimbo, Concepcion, Valparaiso.
Siemens Schuckert Limited, Blanco 366, Valparaiso; & Santiago.
Sloman, H. B., & Company, Tocopilla.
Stubenrauch & Company, Punta Arenas.
Stubenrauch, R., Punta Arenas.
Timmermann & Company, Valparaiso & Santiago.
Trede, H., Punta Arenas.
Trillo, Victor, Antofagasta.
Ureta, Oscar, Punta Arenas.
Vorwerk & Company, Prat, 231-239, Valparaiso.
Wagner Klein & Company, Valparaiso and Santiago.
Weber & Company, Santiago and Valparaiso.

COLOMBIA.

Banco Aleman Antioqueno.

CUBA.

Barba, Vicente, Havana and Porto Rico.
Berndes, J. F., & Company, Cuba Street, 64, Havana.
Eppinger, Alberto, Havana.
Heilbut & Company, Havana.
Michaelsen & Prasse, Obrapia, 18, Havana.
Paetzold, M., & Company, Havana.
Seeler, Pi, & Company, Obrapio, 16, Havana.
Tillman, M., & Company, Havana.
Toennies, H., Havana.
Upmann, H., & Company, Amargura, 1, and Mercaderes, 34, Havana.

ECUADOR.

Bartels, Carlos, & Company, Bahia de Caraquez.
Bartels, Carlos, (partner of Carlos Bartels & Company), Bahia de Caraquez.
Bartels, Guillermo, (partner of Carlos Bartels & Company), Bahia de Caraquez.
Becdach, Hermanos, Quito and Guayaquil.
Becdach, Kamal, (partner of Becdach, Hermanos), Quito and Guayaquil.
Becdach, Rene, (partner of Becdach, Hermanos), Quito and Guayaquil.
Behreint, Frederick, Manta and Bahia de Caraquez.
Borchert, W., (partner of Jeremias & Borchert), Guayaquil.
Bunge, Julio, (partner of Guillermo Kaiser), Guayaquil.

Burau, Juan, Manta.
Cassinelli & Company, Guayaquil.
Castro, Allen, Guayaquil.
Dassum, Mustafa, Guayaquil.
Dehmlow, Alfred, (partner of Kruger & Company), Guayaquil.
Dierks, Hugo, (partner of Otte & Company), Bahia and Caraquez.
Donner & Blackett, Manta and Porto Viejo.
Donner, Roberto, (partner of Donner & Blackett), Manta and Porto Viejo.
Duve, Federico, (partner of Kruger & Company), Guayaquil.
Flemming & Schnabel, Bahia de Caraquez.
Flemming, George, Bahia de Caraquez.
Gleschen, Carlos, (of Tagua Handels Gesellschaft, Manta Branch).
Grim, Juan, (partner of Adolfo Poppe), Guayaquil.
Grimmer, Karl, (partner of Kruger & Company), Guayaquil.
Guzman, L. e Hijos, Guayaquil.
Haas, Max, (of Tagua Handels Gesellschaft, Esmeraldas Branch).
Harnack, H., (of Tagua Handels Gesellschaft, Bahia de Caraquez Branch).
Heinert, Leonard, Guayaquil.
Hinnaoui, Arif (or Aref), (partner of Hinnaoui Hermanos), Guayaquil.
Hinnaoui, Azat (or Azzet), (partner of Hinnaoui Hermanos), Guayaquil.
Hinnaoui, Faud, (partner of Hinnaoui Hermanos), Guayaquil.
Hinnaoui, Hermanos, Guayaquil.
Kugelman, Ferd., Bahia de Caraquez.
Jeremias & Borchert, Guayaquil.
Jeremias L., (partner of Jeremias & Borchert), Guayaquil.
Jungnickel & Loose, Guayaquil.
Jungnickel, W., (partner of Jungnickel & Loose), Guayaquil.
Kaiser, Guillermo, Guayaquil.
Koppel, Samuel, Guayaquil.
Kruger & Company, Guayaquil.
Kruger, Juan H., (partner of Kruger & Company), Guayaquil.
Loose, (partner of Jungnickel & Loose), Guayaquil.
Lopez, Romulo G., Guayaquil.
Luders, Carlos, Guayaquil.
Malheur & Company, Manta.
Maydoub & Ramadan, Ambato.
Maydoub, Amin, (partner of Maydoub & Ramadan), Ambato.
Miketa, Rodolfo, (partner of Otte & Company), Bahia de Caraquez.
Moller, Herman, (partner of Rickert & Company), Guayaquil.
Moreira, Nicanor, Manta.
Otte & Company, Bahia de Caraquez.
Otte, Carlos, & Company, Manta.
Patrel, J., & Hermanos, Bahia de Caraquez.
Patrel, Juan, (partner of J. Patrel & Hermanos), Bahia de Caraquez.
Patrel, Luis, (partner of J. Patrel & Hermanos), Bahia de Caraquez.
Poppe, Adolfo, Guayaquil.
Ramadan, (partner of Maydoub & Ramadan), Quito and Guayaquil.
Rickert & Company, Guayaquil.
Rickert, Carlos, (partner of Rickert & Company), Guayaquil.
Rickert, Edward, (partner of Rickert & Company), Guayaquil.
Rickert, Enrique, (partner of Rickert & Company), Guayaquil.
Rischanek, Max, (partner of Kruger & Company), Guayaquil.
Ruperti, Emilio, Jipijapa.
Schnabel, A., (partner of Flemming & Schnabel), Bahia de Caraquez.
Tagua Handels Gesellschaft, M.B.H., All Branches.
Tresselt, W., (of Tague Handels Gesellschaft, Bahia de Caraquez Branch).
Urban, Gustavo, (partner of Carlos Luders), Guayaquil.
Voelcker, Carlos, Manta and Bahia de Caraquez.
Yauch, Theodore, (of Tague Handels Gesellschaft, Esmeraldas Branch).
Zohrer, Adolfo, Guayaquil.

PARAGUAY.

Costaguta, David, Asuncion.
Staudt & Company.
Stofen, Schnack, Muller & Company, Asuncion.

PERU.

Banco Aleman Transatlantico (Deutsche Ueberseeische Bank).
Brahm & Company, Lima.
Casa Grande Zuckerplantagen Actien Gesellschaft, Trujillo.
Dauelsberg & Company, Mollendo.
Dolmann & Einfeldt, Lima.
Dunkelberg, F., Lima.
Emmel, Fernando, Arequipa.
Emmel Hermanos, Arequipa, Cuzco.
Freundt & Company, Espaderos, 586 and 594, Lima.
Freundt & Quistorf, Lima.
Garcia, Antenor & Company, Paita.
Gildemeister & Company, Trujillo and Lima.
Gildemeister, Siegfried (of Gildemeister & Company), Trujillo and Lima.
Gulda, F., and Company, Lima.
Hardt, E. and W., & Company.
Hardt, Engelbert, & Company.
Hassler & Michaelson, Trujillo.
Herklotz, A., Lima.
Hilbck, F., & Company, Piura.
Hilbck, Kuntze & Company, Cajamarca, Chiclayo and Pacasmayo.
Hilman, (partner of Gulda & Company), Lima.
Justus, W., (partner of Brahm & Company), Casilla 89, Lima.
Klinge, F., & Company, Lima.
Knell, H., Callao.
Leon, Felix, Pacasmayo.
Ludowieg & Company, Lima.
Muelle & Dammert, Callao.
Oeschsle, A. F., Lima.
Ott, Ph., & Company, Lima.
Pallete, A. A., Pacasmayo.
Raygada, R. Y., Paita.
Schaefer, Carlos, Piura.
Schroeder, C. M., & Company, Lima.
Sociedad Industrial Infantas, Limited, Lima.
Sociedad Tubos Mannesmann Limitada, Lima.
Soto, Bernardi, Iquitos.
Strassberger, F., & Company, Iquitos.
Trittan, Geo., Lima.
Umlauff, B., Lima.
[illegible] de Mercaderes, 493, Lima.
Wiebe, F., & Company, Salaverry & Trujillo.
Wiebe, S., (partner of E. Wiebe & Company), Salaverry and Trujillo.

ALL COUNTRIES IN CENTRAL AND SOUTH AMERICA.

German Coal Depot Company, (Deutsches Kohlen Depot).
Hardt, E. and W., & Company.
Hardt, Engelbert, & Company.
Sociedad Tubos Mannesmann Limitada.
Staudt & Company.

SUBSTITUTES FOR FERRO-MANGANESE.

In a letter to "The Iron Age," Mr. W. A. Janssen, of the Bettendorf Company, Iowa (U.S.A.), observes that with the shortage of supply of the 80 per cent. ferro-manganese and its excessive cost, due to the cessation of exports from Europe, the American steel-makers naturally became somewhat pessimistic and fearful for his source of supply of this all-important constituent. Naturally, many of them resorted to the use of spiegeleisen. Because of the low manganese content and the proportionately larger amounts necessary to be used, they were forced to the additional cost and inconvenience of preheating this material. Some others reduced the percentage of 80 per cent. ferro-manganese and in addition used an equivalent amount of specular irons of lower percentages in order to offset the initial preheating. "With the embargo which has been placed on Caucasus ores by the Allies," proceeds the writer, "Germany has been able to meet the shortage of ferro-manganese by the use of calcium-silicide. American steel manufacturers have tried as a substitute a by-product of the abrasive industries, known as silicon-aluminium-titanium, with indifferent and variable success. Realizing that the function of manganese in the final product contributes to the ultimate strength of steel only indirectly, in that the usual percentage of approximately 75 points of manganese assures complete de-oxidation and a resulting homogeneity, some tests were instituted wherein the final manganese content was reduced about 35 per cent. further. In the preliminary experiments the original ferro-manganese addition was reduced about 35 per cent. and the de-oxidation was further augmented by the use of ferro-carbon-titanium. Although ferro-carbon-titanium normally sells at a considerably higher price than ferro-manganese, its substitution was economically possible at the current price of 80 per cent. ferro-manganese, permitting the conservation of the present supply of the latter. Physical tests indicated that the elastic limit, ultimate strength, elongation and contraction were the same as in previous practice when 80 per cent. ferro-manganese was in abundance. Further economies were found from experiments which led to the use of 30 per cent. of the original 80 per cent. ferro-manganese addition, augmented by twice the amount of 40 per cent. spiegel and the addition of 3 lbs. of ferro-carbon-titanium alloy per net ton of metal charged."

Great Britain has contracted to take from Australia 100,000 tons of zinc concentrates and 45,000 tons of spelter annually during the period of the war and for ten years after.

British Columbia is this year producing copper at the rate of $20,000,000 per annum. The total copper production of the province is now at the rate of 90,000,000 pounds a year, and when the new mines now being developed are in a producing condition, as they will be in from six months to a year, the annual output will reach 110,000,000 pounds. This great total will be further increased by close to 20,000,000 pounds when the new mill at Britannia is completed. At average copper prices, the yield of 130,000,000 pounds will therefore be about $30,000,000, nearly double the production of 1915.

TOPICAL DISCUSSION ON THE RELATION BETWEEN YIELD POINT AND PROPORTIONAL LIMIT IN VARIOUS GRADES OF STEEL.*

By J. E. Howard.

IN the testing of steel the property first to be observed is its elasticity. It is extensible and compressible, having the ability to recover its shape provided the strains are small. Its rate of extension or compression, that is, its modulus of elasticity, is the first factor to be measured, and this constitutes the fundamental feature on which it is convenient to judge of the elastic limit of the metal.

Provided the modulus of elasticity has a constant value under different loads, which appears to be true in the case of steel that has not been overstrained, it follows that the stress-strain curve will be represented by a straight line, and any departure therefrom will signalize the introduction of a permanent set. The point of departure of the curve from a straight line will be its proportional limit, or preferably it may be designated as its elastic limit, the term under which it has so long been known.

This brief introductory statement of the case virtually comprises all that appears necessary to say on the subject, and the paper might be summarily brought to a close so far as it relates to the definition of or what constitutes the elastic limit of steel.

If the composition of steel were to be extended over so wide a range that different values in the modulus of elasticity prevailed, such a circumstance would not affect the case in judging of the limit at which a permanent set was first developed in any given grade. Engineering practice, it is known, does not recognize different values in the modulus of elasticity covering the usual range in composition of structural steels, nor does it assume that the modulus possesses a variable value, depending upon the intensity of loading. Unless a constant value prevailed, structural engineering would be in a state of utter confusion.

The term elastic limit inherently carries with it a definite meaning. It conveys the idea of a limit beyond which the resilience of the metal is incomplete; that permanent sets are introduced when the steel is strained beyond this limit. The expression needs no qualifying adjective to explain or restrict its meaning. The term "limit of perfect elasticity" can only be synonymous with the expression elastic limit.

Elastic Limit and Proportional Limit the Same.—The behavior of steel is generally such that the elastic limits and proportional limits coincide; nevertheless, it would not be inconsistent with the meaning which might attach to the latter expression were the extensions or compressions of the metal to include both elastic strains and progressive permanent sets. A restricted meaning should properly be placed on the term proportional limit to exclude permanent sets, without which it presents no barrier against the presence of permanent sets of any magnitude.

Preference may very properly be given a term, the use of which in itself conveys the meaning for which it is employed, and for this reason the term elastic limit commends itself.

With a known value of the modulus of elasticity the strain under any given load may be anticipated and followed during the test of the steel, and without release of load or interruption to the progress of the test, the elastic limit may be recognized and the amount of permanent set determined when the stresses shall have exceeded the elastic limit. A change occurs in the value of the modulus of elasticity in overstrained steel, noticeable after the development of decided permanent sets. The value is then variable, having a diminished value as loads are advanced.

Elastic Limit Sharply Defined in Mild Steels.—For loads below the elastic limit there is an immediate response upon application of the straining forces, the strains promptly developing in full degree. For stresses above the elastic limit, particularly in mild steels, the full development of sets takes place more or less sluggishly. In mild steels, jogs not infrequently appear just after the elastic limit has been reached during which period strain proceeds under diminished stresses. This is suggestive of a zone of structural instability in the vicinity of the elastic limit. At certain temperatures, above atmospheric, several jogs make their appearance in the same test specimen.

In steels of such grades there can be very little difficulty in acquiring a close approximate knowledge of the elastic limit under ordinary conditions of testing. If the test specimen has the mill scale upon it, the brittle character of the scale may serve as an index of the elastic limit having been exceeded, when it flakes off.

In the harder steels the introduction of permanent sets takes place gradually, without abrupt change in the direction of the stress-strain curve. Jogs are absent, that is, there is no extension of the metal under loads lower than it had previously sustained. With increase in hardness, by composition or by heating and quenching, the steel tends toward maintaining a straight line in the stress-strain curve until there is a close approach to its ultimate strength.

Working the steel at temperatures below the usual rolling or forging heats modifies the shape of the stress-strain curve. If the metal is extended by tensile stresses while at a blue heat, in the zone of 400 to 600° F., a decided increase in both elastic limit and tensile strength may result. If the straining is done when the steel is cold, quite naturally the elastic limit is raised, in the direction of the overstraining force. Permanent extension which is exhausted under a given load is not renewed until a higher stress is reached.

Overstraining Test Specimen Before Determining Elastic Limit Undesirable.—Recommendations are occasionally made to initially overstrain the steel and then re-test for its elastic limit. Such pre-treatment might be carried to any extent, with corresponding effect upon the elastic limit in the direction pre-strained. Obviously, such treatment does not commend itself. Straining cold, however efficacious it may be in raising the elastic limit to any desired value (in the case of music wire the cold drawing results in phenomenal elastic limit and tensile strength), nevertheless has a detrimental effect on the value of the opposite elastic limit. Earlier tests have shown that the total range in elastic movement is greater in the primitive state of the hot-worked steel before either elastic limit of tension or compression has been exceeded, than in its subsequent state after an overload has been applied in either direction. That is, the loss in the reverse direction is greater than the gain in the elastic limit in the direction of the overstraining load. A proposed method of testing which involves such results, or has such tendencies, does not appear to be a desirable one.

It must be assumed that the object of testing is to determine the pre-existing physical properties, and not

*The above observations are taken from a discussion which took place before the last annual meeting of American Society for Testing Materials.

to introduce new combinations by the process or method of testing. Of course, tests may be conducted for the purpose of ascertaining the effects of different kinds of treatment of the steel, but not to accredit values to the steel which are due to the manner of making the tests.

It is a matter of ordinary occurrence to find, in the testing of steels, that permanent sets of small magnitude make their appearance at an early stage, and before there is reason for believing that the metal as a whole is overstrained; that in some part of its volume sets are developed which have a local character, while the elastic limit of the greater part of the material has not at the time been reached.

Initial Strains in Steel Obscure Elastic Limit.—One of the common causes which leads to the development of local sets is the presence of initial or internal strains in the steel. Internal strains not infrequently exist in steel which is not under the influence of external loads. The metal is in a state of equilibrium, therefore the initial strains must be of two kinds, namely, those of tension and those of compression.

The relative intensities of these opposing strains may vary in different cases, and it follows that the volumes of metal in tension and in compression will be unequal. Under these conditions permanent sets will be developed locally, earlier or later, according to whether the steel is loaded by tensile or by compressive stresses. The initial strains may have values practically coinciding with the elastic limit of the metal, and would then be expected to display sets under the earliest applied loads, increasing with each increment.

Initial strains are readily introduced by differences in the normal rate of cooling of one part over another, whether in the ingot or in rolled or forged shapes; also by accelerated cooling in air or other quenching media. Initial strains may be introduced by mechanical means. It is difficult to work steel without introducing initial strains of greater or less magnitude. The operations of shearing and punching introduce initial strains, and the machining of finished shapes must be carefully done to avoid causing such strains. Bending stresses, with the metal either hot or cold, are prolific causes in the introduction of initial strains.

The influence of initial strains in modifying the shape of the stress-strain curve is easily recognized. They cause the gradual and progressive development of local permanent sets and tend to obscure the elastic limit of the metal or detract from its sharp definition. Certain high physical properties are attained only in association with some of these causes.

The partial or complete elimination of initial strains may be accomplished by annealing the metal, and apparently by annealing only. By mechanical means internal strains may be modified, and differently disposed in the cross-section of the member, and some portions brought to a neutral state, but the entire mass does not admit of being relieved in this manner. It is improbable that the entire effacement of initial strains is accomplished in ordinary annealing operations.

So far as may be judged, initial strains, the primitive values of which coincide with the elastic limit of the cold steel, are progressively dislodged as the temperature of the metal is raised. The lowering of the elastic limit as higher temperatures are reached appears to be the explanation of this. Initial strains can hardly exist having higher values than the strains corresponding to the elastic limit of the steel at any given temperature, hence residual strains may be taken as an index of the elastic limit of the steel at the annealing heats, the time element being a factor.

When cold, the initial strains should not affect the shape of the stress-strain curve below that extension of the metal at which the combined internal strains and the strains due to the external force attain a maximum, equal to the elastic limit of the steel in its cold state. This statement of the case explains why permanent sets may progressively appear in greater degree as the normal stress representing the elastic limit is approached.

Unsatisfactory Manipulation of Test a Source of Danger.—Another cause for the introduction of permanent sets, of a premature character, attaches to the manipulation of the test, a source of error more common than should exist. Test specimens which are not axially pulled, progressively acquire sets along the overstrained elements. Results are currently reported which show great variations in the extensions on different sides of the test specimen, even negative extensions appearing in the records.

Some Testing Apparatus Not Adapted for Determination of Elastic Limit.—Some testing machines are not provided with suitable holders for axially straining the test specimens. Indifferent manipulation accounts for eccentric pulling in other cases. Erratic behavior does not characterize steel when its modulus of elasticity is the only factor which is called into play. Extensometer readings, under early increments of loads, serve to show the satisfactory progress of the test or otherwise as the case may be. Readings on different sides of the test specimen, while they promptly show whether the pull is an axial one, or eccentric, are hardly necessary for the purpose. The modulus of elasticity in steel has so nearly a constant value that the appropriate extensions for given loads may be taken as indexical that the test is being properly conducted. The adaptation of extensometer devices for the purpose of indicating the mean strains for test specimens under eccentric pulling loads, do not commend themselves as substitutes for the proper treatment of the metal.

Speed of Testing Not Objectionable with Suitable Testing Equipment.—Concerning the rate of speed of testing, with suitable apparatus, rapid work is of some advantage in the determination of the elastic limit in continuous testing. The influence of time, in respect to rapidity of loading, has no practical effect on the display of elastic extensions. The strains which are displayed by the steel correspond to the stresses, however rapid the application or alternation of loads may be. This has been shown in the case of repeated alternate stresses, and there is no reason for doubting the same to be true for direct loads of tension or compression. The conditions attending ordinary testing, however, are such that very rapid extensions are difficult to follow. This limitation pertains to the testing apparatus rather than to the behavior of the metal.

The rate of testing is quite a different matter when the stresses exceed the elastic limit and the resistance of the steel against viscous flow is encountered. When the elastic limit, particularly in ductile metal, has been passed, the full display of permanent extension is sluggishly developed. The full development of permanent sets under each successive increment of load necessarily affects the shape of the stress-strain curve; a matter not directly under consideration at this time.

Observations to be Made on Test Specimen, Not on Testing Machine.—If observations are directed to the behavior of the testing machine itself, and not made on the test specimen, then rapid testing may readily be found undesirable. The results on testing machines of the ordinary commercial type do not always admit of being referred to in a critical discussion of the elastic limit. The means employed in testing must be adequate for the determination of the property under consideration, and the behavior of the steel is in some cases more sensitive than the apparatus used in its examination. If adequate apparatus is employed to judge of the introduction of permanent sets, it is not felt that the rate of loading will materially modify the recognition and definition of the elastic limit.

Vagueness of So-called Yield Point.—It has not been undertaken in the present remarks to point out a relation between the elastic limit and any so-called yield point. The term "yield point" does not appear to have any fixed meaning, and unless it is made to apply to some definite feature it would be held impractical to establish a relation between a definite and an indefinite object.

There seems to be no feature in the behavior of steel which calls for the use of this term, or to which it could properly apply. The term is essentially vague and uncertain, and well calculated to create confusion. Steel, as in the case of all substances, yields with the first increment of load, after which it becomes a matter of degree, changing its rate, when permanent extensions are ushered in. It is tacitly accepted that the term yield point, when used, will mean a value above the elastic limit. It is an approximation to the elastic limit, but having been given a name it purports to have a definite meaning, and should define some useful feature or limit in the use of steel. The most that can be said about it is that a structural member loaded up to its yield point will suffer a certain amount of permanent strain.

If circumstances do not admit of the careful determination of the elastic limit, it would convey all the useful information justifiable to report to designate the value given as the approximate elastic limit. It is, of course, possible to pre-establish a certain limit in the amount of permanent set to be developed and to give that limit a name, but it is not clear that any further advantage would result over its use than would attend calling it the approximate elastic limit. Experience has shown that a very critical determination of the elastic limit is essential in order to judge of the durability of steel which is exposed to repeated alternate stresses, that possibly such critical determinations even may not go far enough to meet the requirements of the case, and that the treatment of the steel should be considered in conjunction with its elastic limit. Service requirements which demand the careful determination of the elastic limit are frequently of such a nature that approximate determinations may have no value or may be misleading and harmful. Such a factor as the elastic limit purports to be should possess as great reliability as possible, and when satisfactory determination is not feasible it is believed that the report of the test should indicate its approximate character.

In closing this paper, introductory to a topical discussion on the subject matter assigned, and set forth by its title, it is hardly necessary to add that a relation has not been mentioned between yield point and proportional limit, since, according to the views of the writer, one of these terms is vague and without definite meaning while the other is held to be synonymous with the expression elastic limit, the expression which is regarded as preferable to use.

In indicating the enormous increase in the production of asphalt during the past few years it is interesting to note from Bulletin 11: 13 of the United States Geological Survey, that whereas the total production in 1882 was 3,000 tons valued at $10,500 or $3.50 a ton, in 1915 the amount was 266,824 tons valued at $9,652,866.

PENETRATION METHODS WITH REFINED TARS.*

By A. W. Dean, M.A., S.C.E.,
Chief Engineer, Massachusetts Highway Commission.

THE inventive minds of many men have for several years been engaged in conceiving practical low-cost road surfaces that will withstand, without prohibitive maintenance expenditures, the modern mixed vehicular traffic.

Stone block, brick and other durable pavements are economical under very heavy traffic, but their first cost makes them prohibitive on streets and roadways where the traffic consists largely of comparatively light motor or horse-drawn vehicles.

The sudden or gradual wearing away of water-bound macadam surfaces which, previous to the advent of the motor vehicle, were considered the best surfaces for suburban roadways, called for immediate action by maintenance engineers. Innumerable experimental methods have been tried during the last decade, but the most extensively used in many localities, of any semi-permanent surface, has been and is the bituminous bound surface, applying the bitumen by the so-called penetration method. In such a surface, properly constructed, there is combined low cost of construction and maintenance, good tractive qualities and cleanliness.

Broken stone roadway surfaces built by the penetration method, using refined tar or asphalt as a binder, are quite generally, and for the sake of brevity will be herein, termed "bituminous macadam." Theoretically, as usually built, they are faulty, but practically they have been sufficiently economical in construction and maintenance to warrant continued use of such construction in localities where the materials can be conveniently obtained.

While comparatively easy to construct, care in both the selection and application of material is absolutely essential for proper results. First, as in all pavements, there must be a good foundation, properly drained, that will be firm under all climatic conditions. In some localities the natural sub-grade furnishes such a foundation, while in others the soil must be excavated and a foundation of stone, gravel, slag, or other proper material or combination of materials substituted and thoroughly compacted.

On this foundation, broken stone is spread and compacted and the voids thoroughly filled with stone dust or sand. This course should be brought to a true surface and any surplus stone dust or sand above the amount necessary to fill the voids should be removed, leaving the upper surface of the stone fragments bare. The depth of this course may be varied according to local conditions. If a heavy stone foundation has been constructed, this course need not be more than two inches in depth. If, however, it is laid on a natural foundation, the thickness should be greater, the customary depth varying from three to six inches, depending upon the exact nature of the subsoil and weight of traffic to be supported.

The determination of sizes of stone used in this course is not particularly important so long as there is no segregation.

Upon this surface a second layer of broken stone is spread and rolled. The customary thickness for this

*Read before the Third Canadian and International Good Roads Congress.

course is two inches after rolling, although frequently it is built two and one-half, or even three inches in depth. It is in the construction of this upper course that great attention to details is necessary. If the stone is soft the large size output of the crusher should be used, as the roller will crush the stone sufficiently to furnish the necessary small particles. If the stone is very hard, small stone may be used, depending somewhat upon whether it is desired that the finished travelled way shall be absolutely smooth or somewhat rough. The use of stone in this course varying in diameter from one and one-half to two and three-quarters inches permits or produces under proper treatment a somewhat rough surface, thus providing some foothold for horses. If stone one-half inch to one and one-half inches is diameter is used, the finished surface will tend to be very smooth and slippery. Whatever size of stone is used, it must be entirely free from dust or dirt; it must be spread evenly, with the different component sizes distributed and not segregated; it must be properly rolled to reduce the voids and make the surface as stable as possible without the aid of a binder, yet not sufficiently to unduly crush the stone if soft; and it must be brought to a true and even surface before any binder is applied.

Upon this surface refined tar or asphalt is spread uniformly in sufficient quantity to fill the voids without leaving a surplus on the surface. The voids in the lower course having been filled, all of the bitumen remains in the upper course, practically filling every void in this course so that when cooled it constitutes a stable surface of stone and bitumen.

Great care needs to be exercised in spreading the bitumen to insure an even distribution. If the crude method of hand-pouring is used, only skill in pouring will prevent undesirable results. If single pressure nozzles are used, skill and intelligence sufficient to secure uniform distribution is of essential importance. By far the best method for spreading the bitumen is by means of a pressure machine, forcing the bitumen on to and into the surface through a series of nozzles that insure a uniform amount on each square yard of surface.

The exact amount of bitumen to be used depends upon the size of stone and the thickness of the course. Too much bitumen needs frequent subsequent covering and tends to cause bunches, and too little permits water to penetrate the surface and is otherwise detrimental. While three-quarters of a gallon per square yard per inch thickness of stone is frequently very close to the amount used, it cannot in any way be used as a rule. Skill and experience (or the lack thereof) will here show results.

After applying the bitumen there should be spread immediately a sufficient amount of pea stone (one-half inch stone) to cover the exposed bitumen, followed by thorough rolling. A second application (or seal coat) of bitumen is then spread, using about one-half gallon to the square yard, which should be covered immediately with pea stone and rolled.

Every application of any material in the upper course must be uniform, otherwise good results are not obtained.

The bitumen used, if refined tar, should have a specific gravity at 60° F. between 1.22 and 1.28, and should have a viscosity of 125 to 200 at 212° F., using 100 c.c. with the Engler viscosimeter. If of asphalt, it should preferably have a penetration between 100 and 130, using the Dow penetrometer.

The maintenance of a properly constructed bituminous macadam roadway is very simple. If slight depressions or small holes occur, they are usually due to imperfections in construction and may be repaired by painting with bitumen and filling with chips or pea stone, or they may be filled with coated stone, and tamped or rolled.

Traffic and climate govern the demands for more extensive maintenance. With moderate traffic, perfection of surface is maintained by spraying the surface about once in two years with a lighter grade of tar or asphalt. The process consists in sweeping thoroughly the surface, spraying at the rate of about one-fourth to three-eighths gallons per square yard, and covering with pea stone. If the surface becomes worn too much for such treatment, it may be restored by lightly scarifying, smoothing by rakes or harrow, adding more stone and rolling it into place, and then treating the same as previously outlined for new construction.

This last method of resurfacing, provided the road foundation was originally properly constructed, may be subsequently repeated as often as necessary, thereby utilizing the permanent base and first course and maintaining a semi-permanent surface good for any except extremely heavy vehicles.

The cost of grading, drainage and foundation will, of course, vary greatly, being governed entirely by local conditions and necessities. With local stone conveniently available the cost of the first course, three inches in thickness, should not exceed forty cents per square yard and might not exceed thirty cents per square yard. Under the same conditions the first cost of the wearing course, if made two inches in thickness, should not exceed fifty cents per square yard. This is based upon the assumption that the cost of the bitumen, including heating and applying, does not exceed twelve cents per gallon.

The cost of patching holes and depressions will, of course, depend upon the perfection of material and workmanship in the original construction. The cost of placing one seal coat is from eight to ten cents per square yard, consequently, if required only once in two years, this would call for an average annual expenditure of four to five cents per square yard. If such a seal coat were only needed once in three years, the average annual expense would be reduced proportionately.

The cost of renewing the surface by scarifying and adding new stone and bitumen would not be far different from the cost of the original construction of a two-inch surface. Such surfaces have not been in use under varying traffic for a period sufficiently long at the present time to permit even an estimate of the frequency at which such renewal would be required, consequently, an estimate of the average annual expense of renewal might be misleading.

MINERAL RESEARCH FIRST.

The Research Bureau to be established by the Government in connection with Toronto University will be under Hon. G. H. Ferguson's Department of Lands, Forests and Mines. It will be on a small scale at first but will be developed to meet the needs of the Province and render the best possible assistance. For the time being it will be chiefly research along mineral lines, but it is proposed to develop it further. A small plant has already been put in to handle certain ores and a metallurgical chemist is being engaged for the work.

AUTOMATIC COAGULANT FEEDING DEVICE FOR MECHANICAL FILTERS.*

By M. F. Newman.

The apparatus as illustrated in Fig. 1 shows an automatic coagulant feeding device which is based upon using a saturated solution of coagulant made from aluminum sulphate or ferrous sulphate, depending upon the water supply. Briefly, this apparatus consists of a weir tank containing a fixed and an adjustable weir, a coagulant dissolving and saturating tank, the necessary pipe connections to introduce the coagulant solution, and means to keep the stream of coagulant solution from crystallizing.

In operation the water enters the weir tank, in which it is divided into two streams, the main flow of water, passing out through the fixed weir and a small stream of water being passed through the circular adjustable weir. These weirs are of the same shape and are set on the same elevation, so that the depth of water flowing through them is the same; therefore, they are exactly in proportion. The water from the adjustable weir flows to the coagulant saturating tank. This tank is so constructed that the coagulant is partly submerged and the water coming from the adjustable weir flows over the submerged coagulant, then down through the submerged coagulant, through the wood fibre filter into the storage chamber in the bottom of the tank.

The discharge pipe from the storage chamber is carried up to the height required for keeping a portion of the coagulant in submergence. The height of the discharge pipe fixes the level of the solution in the tank and the inflowing water from the adjustable weir displaces an equal volume of solution. The coagulant solution is delivered into the main stream of water flowing from the fixed weir. To prevent the strong solution from crystallizing and depositing in piping when exposed to the air, a small stream of water from the weir tank is constantly flowing into the discharge from the coagulant saturator.

It will be noted that there is an exact proportion between the water flowing from the weir tank into the sedimentation tank and that flowing into the coagulant saturator, varying with the height of water in the weir tank; also that when no water is supplied to the weir tank the flow of coagulant stops, and when the flow of water over the weirs again starts the proper proportion of coagulant is introduced.

The dry coagulant is introduced in lump form, and in order to charge the apparatus it is only necessary to introduce dry coagulant to maintain the proper level above the submerged coagulant in the saturator. The starting and stopping of the flow of coagulant is directly dependent upon the flow of water to the weir tank, and it does not require any opening or closing of valves to start or stop the flow of coagulant solution. To vary the quantity of coagulant solution, the adjustable weir is opened or closed. This weir consists of two slotted brass tubes, fitted one within the other, the inner tube stationary, while the outer one operates to increase or diminish the number of the slot openings. On top of the stationary tube is mounted a pointer which indicates on a dial on the outer tube the extent of the slot opening, which can be adjusted from a mere drip to a stream of any size required.

This apparatus has been in successful operation for several years, and in practice has successfully met all of the conditions for accurate and automatic introduction of coagulant, requiring but a minimum of attention.

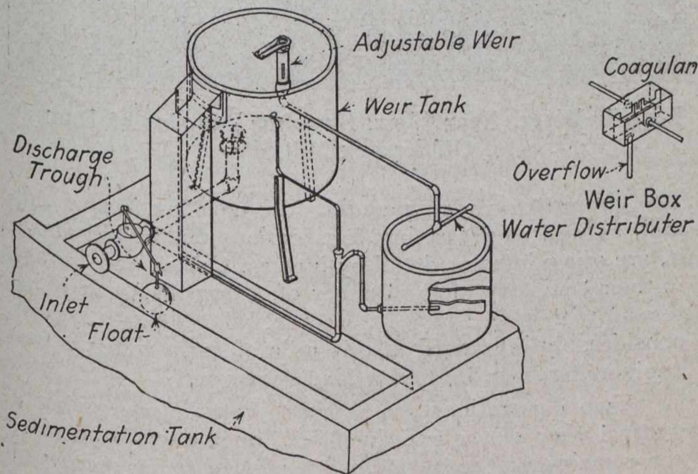


Fig. 1.—Coagulant Feeding Tank.

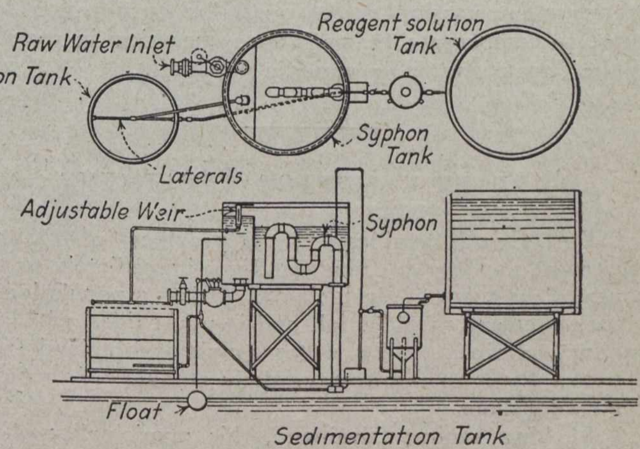


Fig. 2.—Device for Introducing Reagent.

In connection with the automatic coagulant feeding device there has been developed an automatic device for the introduction of a reagent (Fig. 2), to meet the conditions where the alkalinity of the water to be filtered is too low, or too variable within low limits to insure the proper decomposition of the coagulant. The apparatus, as illustrated, provides for the introduction of a reagent in exact proportion to the flow of water. This is accomplished by placing a partition in the weir tank before described and having the discharge of the fixed weir occur within the tank to fill the compartment in which the siphon is placed. When this compartment fills to the height which starts the flow through the siphon it continues until the compartment is empty. When this siphon begins to flow it starts an auxiliary siphon, which introduces the reagent solution during the period of its flow.

As soon as the compartment from which the main siphon operates is emptied, both siphons stop flowing until the siphon compartment again refills to the point where it starts the siphon to flow. The harmonious action of these siphons depends only upon the periodic rise of the water to the same height in the siphon compartment of the weir tank and a direct proportion is established

*Proceedings, Engineers' Society of Western Pennsylvania, January, 1916.

between the flow of reagent solution and the flow of water to the sedimentation tank through the siphon. The reagent introducing siphon is connected to a constant level tank supplied from the reagent solution storage tank. The siphon draws from the constant head tank under a uniform condition, so that the volume of solution for any given period of siphon discharge is constant.

This siphon reagent feeding device is adaptable for one or more solutions, and with it a solution of hypochlorite of lime can be introduced into the effluent from the filter, and the flow automatically controlled by means of the flow of water into the filter system, so that when no water is flowing to the filter system no solution is introduced, and when the flow starts the introduction of solution starts without the necessity of opening or closing valves.

The primary principle underlying these two devices, that is, the control of the feed as a function of the water flowing to the system without depending upon the human element for starting or stopping, is, in the writer's opinion, a decided advantage, and one that is extremely desirable, in view of the variations that occur in the flow of water to a filter system, and the difficulty in securing first-class supervision of the operation of filtration systems, to compensate for variations occurring in practice in the flow of water or periodic pumping.

FORT ERIE SEWAGE TREATMENT.

Fort Erie is a village of the province of Ontario located at the head of Niagara River immediately to the south of the town of Bridgeburg. It has a population of 1,500, is entirely residential, and is unprovided with any sanitary drainage. Its water supply is obtained from Niagara River to the average daily amount of 300,000 Imperial gallons.

Lacking sanitary drainage, this municipality offers no problem in a study of pollution remedies, and its only interest lies in the effect of the application of any adopted standard to sewerage of future date.

Bordering the river as it does, sewerage in Fort Erie would undoubtedly assume the form of several small parallel outlet lines with laterals in the River Road. For collection it would be necessary to enlarge these laterals to interceptor size and to extend them to a site at either end of the corporation limits. Owing to the lack of slope this would probably entail the use of automatic pumps. The following represents a very rough estimate of what would be needed additional to the normal street system as established by the conditions described:

Sewer.	
800 lineal feet interceptor, at $2.50	$ 2,000
2 automatic pumps, at $800	1,600
Treatment.	
Imhoff tanks & disinfection, 2,000 persons, at $5..	$10,000
Total	$13,600

Annual operating charges may be estimated at about $1,500, with fixed charges at 6 per cent. of the construction cost, or $816.

*From a report to the International Joint Commission made by Prof. Phelps, consulting sanitary engineer to the Commission.

THE OLDEST WATER MILL.

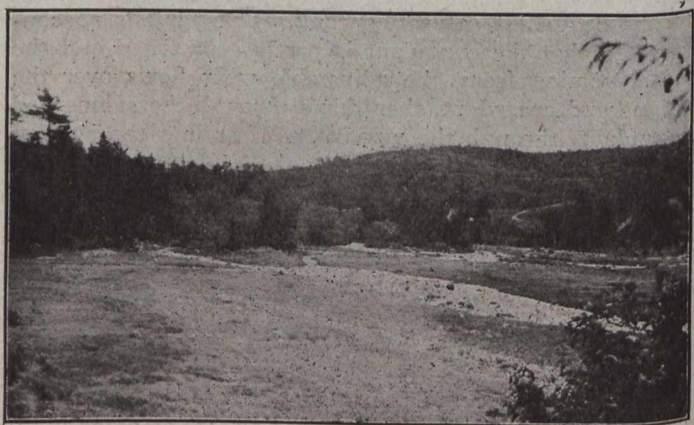
By K. H. Smith, A.M.Can.Soc.C.E.

IN the introductory chapter of Mead's "Water Power Engineering," it is stated that one of the first applications of water power in the United States was an old tidal mill near Boston, constructed in 1631. The writer recently had an opportunity of looking over the site of a water mill, built as early as 1607. This mill, according to well authenticated records, was built by the early French settlers near the head of tide on what is now known as the Lequille River at Annapolis Royal, N.S.

Lequille River, Near View, Showing Remains of Dam at Old French Mill Site.

The circumstances surrounding the construction of this mill, as well as protecting fortifications on the hill above it, are given in some detail by Messrs. Calnek and Savary in their "History of the County of Annapolis." It is interesting to note that Mr. Calnek, who apparently was considerably interested in this relic of early water power engineering, was himself a land surveyor.

Two illustrations are shown herewith, one giving a general view of the site, in which, on the left-hand side, the remains of the old dam are plainly to be seen, and one giving a much nearer view of a part of the old dam



Lequille River at Head of Tide, Showing Site of Old French Mill.

which was built mainly of earth and stones. Within recent times oak timbers, apparently parts of the original mill, have been taken from the stream bed and cut up into various articles for souvenirs.

There seems to be little doubt but that this is the earliest example of "Water Power Engineering" by Europeans in North America.

The Engineer's Library

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer, 62 Church Street, Toronto.

CONTENTS.

Book Reviews:

BOOK REVIEWS.

The Theory and Practice of Modern Framed Structures, Part 3—Design. By the late J. B. Johnson, C.E., C. W. Bryan, C.E., Chief Engineer of the American Bridge Co., and F. E. Turneaure, C.E., Dean of the College of Mechanics and Engineering, University of Wisconsin. Rewritten by F. E. Turneaure and W. S. Kinne, Associate Professor of Structural Engineering, University of Wisconsin. Published by John Wiley & Sons, Inc., New York. Ninth edition, 1916. 486 pages, illustrated, 6x9¼ inches, cloth. Price, $4.00 net. (Reviewed by W. W. Pearse, City Architect, Toronto.)

An examination of this third volume of this well-known work shows that it will be a very serviceable text book, not only for advanced students but also for practising engineers, especially as the arrangement and indexing are adapted for ready reference. The volume completes the series begun in Volumes I. and II. previously published, and deals more particularly with the application of the theory developed in the two earlier volumes to practical designing.

Chapter 1 is a good and very complete discussion of such general topics as location, selection of type of structure, cost of maintenance, artistic appearance and economical lengths with reference to bridges.

Chapter 2 is a discussion of working stresses in tension members. One feature of this discussion worth noticing is the decided stand taken for the use of working stresses materially below the elastic limit in order to take care of such unknown quantities as poor workmanship, corrosion, etc.

Chapter 3 continues the discussion of working stresses with particular reference to compression members, and recommends strongly that the safety factor should be based on the elastic limit instead of the ultimate load. Columns loaded concentrically and eccentrically are discussed in a very interesting manner. The Rankin-Gordon and Straight-Line column formulae are compared with each other and also with the parabolic formula derived by the late J. B. Johnson. Tests are cited with which the latter formula seems to agree very closely, and the authors recommend its use. For students, this chapter would be more valuable if more problems were worked out as examples of the algebraic discussions.

With respect to shear in lattice columns a formula is derived on the assumption that the axis of the column under load will tend to take the form of the sine curve, the equation to which is $y=(\Delta+e)\sin. qx$ —where e is the eccentricity of loading and $q=\frac{\pi}{l}=\sqrt{\frac{P}{EI}}$; if e is zero and $q=\frac{\pi}{l}$, then $y=\Delta\sin\frac{\pi}{l}x$; which is the familiar equation for the sine curve as used in the discussion of column formulae.

Chapter 4 is a general treatment of riveted joints, combined direct and bending stresses and secondary stresses. Mathematical formulae are developed for the determination of these secondary stresses under different conditions and special emphasis is given to the necessity for investigating pin-connected trusses for secondary bending.

Chapter 5 gives a more detailed and very complete description of riveted joints, including eccentric connections for which a general formula is derived. This chapter could have been improved by a more thorough discussion of top and bottom chord splices in large trusses, of approximately 200 feet span, where it is frequently very difficult to get sufficient rivets to transmit the chord stresses properly and fully. The advantage to students and engineers of a text book fully covering this matter is obvious. The statement in the last paragraph that bolts are ordinarily use for temporary work only, as in fitting up during erection, is hardly applicable to building work under 12 stories in height where it is customary in many cases to rivet only the connections framing into the columns. In this connection the specifications of the Metropolitan Life Insurance Company may be quoted as requiring only column splices and all connections within 3 feet of the columns to be riveted, permitting bolts for all other connections.

Chapter 6, on plate girders, gives a careful explanation of bending moments, shears and the internal stresses in the girder with numerous diagrams for explaining the derivation of them. Diagrams and discussions in the text are also given for the spacing of stiffeners and the lengths of flange plates.

Chapters 7, 8 and 9 cover very completely the design of bridges with both riveted and pin-connected trusses, and makes special reference to impact and the use of shear and moment diagrams for moving loads. There are interesting formulae presented for roughly estimating dead weights, approximate costs and the best types of structure for use under varying conditions.

Chapter 10 gives quite completely the design of a riveted highway bridge.

Chapter 11 covers the design of steel roof trusses, giving a formula for determining safely the wind load to be used, and stress diagrams for combined dead and wind loads.

In conclusion, it should be added, this volume has brought up to date a text book which has long been considered a standard on structural engineering and it will doubtless prove a valuable and interesting addition to the engineer's library.

Waterworks Handbook. By Messrs. Flinn, Weston and Bogert. Published by McGraw-Hill Book Co., New York. First edition, 1916. 800 pages, illustrated, 6 x 9 inches, cloth. Price, $6.00 net. (Reviewed by R. O. Wynne-Roberts, Mem.Can.Soc. C.E.)

The compilers of this book are well-known engineers. Mr. Alfred Douglas Flinn is deputy chief engineer and Mr. Clinton Lathrop Bogert is assistant engineer, Board of Water Supply, New York, and Mr. Robert Spurr Weston is consulting sanitary engineer, Boston, Mass. As they state in the preface, "this book gives a usable compilation of information, old and new, for the waterworks engineer and superintendent, the designer, constructor, operator and inspector. The materials have been accumulated by the compilers in the course of their practice in various branches of waterworks engineering.

This volume is an excellent compilation of information extracted largely from the transactions of the American Society of Civil Engineers and the leading American engineering papers with frequent paragraphs taken from European sources. It contains a large number of illustrations, diagrams and tables, a good index and references to the sources of information. The compilers have arranged the material in natural sequence and have pieced together the data by personal observations so that the volume contains concentrated opinions and practice of many engineers, chemists, etc.

The paragraph dealing with "Volumes of Prismoidal tanks" on page 114 would be more appropriately placed, say, on page 103. It has no particular connection with the subject of forestry and grassing.

The economic development of a water shed is discussed on Pages 93, etc. Reference might have been made to Binnie and Lapworth's contribution on "Reservoir storage in relation to stream flow," and to Mr. W. Watt's paper on reservoir storage.

Examples of pipe scraping are given on page 411, but the results of scraping could with advantage have been more extensive.

Aqueducts, steel and wooden pipes, cast iron pipes and distribution systems occupy about 150 pages. Diagrams are given showing the quantities of earthwork—excavation and filling—for different sized aqueducts and screens and gauging chambers are illustrated. The construction of steel mains is fully dealt with and particulars of different coating methods are presented.

The monograph on page 390, showing the cost of cast iron pipes of any standard weight per foot run, can be easily extended to suit West Canadian prices.

The universal metering of a city does not eliminate the waste in street mains, for on page 414 several cases are given where 13 to 52 per cent. of the water delivered is not accounted for. The "slip" of pumps will doubtless in many places be greater than is estimated and the actual quantity unaccounted for will be reduced. Bulk meters would eliminate questions of this kind, and they should be installed in every well-regulated waterworks system. Service reservoirs are dealt with in five pages, whilst standpipes and tanks are discussed in 22 pages.

In connection with hydraulic computations the compilers state that "the use of many significant figures is a time-wasting absurdity, *e.g.*, giving total consumption of water, capacity of a reservoir, total pumpage, flow of a stream and similar quantities to the gallon, when millions of gallons or tens of thousands would be appropriate, since inherent uncertainties commonly range from 5 to 25 per cent. Likewise most estimates of total cost should end with two to four ciphers before the decimal point." This observation is to be commended, but human nature is a queer attribute. Some men are impressed by the minuteness of expressions of computations as indicative of carefulness, whilst others immediately heavily discount the same. Some of the diagrams might have been more fully explained or examples given of their use and thereby enhance their value.

An interesting experiment to ascertain the rate at which air would separate from water is described on page 590. The average time for the bubbles to rise 10 feet were: 1/64 inch bubble, 0.47 minute; 1/32 inch bubble, 0.30 minute; 1/16 inch bubble, 0.31 minute; ⅛ inch bubble, 0.24 minute. The data given in the book on this point may be useful to those who are interested in the activation of sewage by aeration.

When dealing with the character of water reference is made to Lake Ontario, near Toronto, as an example of polluted lake water. The examination of this water was made in 1912 and table 237, page 664, by Longley, is quoted to confirm the statement. The character of water and the inspection of the sources of supply are dealt with in 33 pages, whilst storage, sedimentation, aeration and chemical treatment are given 40 pages. Water softening, 13 pages; filtration, 56 pages, and examination of water, 16 pages.

The book will be valuable to those engaged on waterworks and especially those of large cities. Although the data pertaining to large works can, more or less, be applied to smaller systems, there are difficulties and problems in the latter which have not to be faced in the former. The illustrations of works and descriptions in this book are those of larger installations.

The volume can be recommended to all water engineers as valuable for reference on almost all subjects connected with water supply.

Hydraulic Tables. By Joseph H. Harper. Published by D. Van Nostrand Co., New York. First edition, 1916. 192 pages, 17 illustrations, 4 x 6½, flexible leather. Price, $2.00 net. (Reviewed by R. L. Hearn, B.A.Sc., Hydraulic Dept., Hydro-Electric Power Commission of Ontario, Toronto.)

This book of hydraulic tables will be welcomed by the office and field engineer alike for its completeness, both as regards hydraulic flow and the wide range of values covered by the tables.

The book is divided into seven parts and an appendix. Part I. is introductory and discusses the various formulae upon which the tables are based, interpolations and coefficients of roughness. The use of the tables is outlined and explained by the solution of typical problems.

Part II. to Part V. contains tables for the flow of water in the following conduits: (a) Circular pipes running full, computed by D'Arcy's and Kutter's formulae; (b) open rectangular channels, computed by Kutter's formula; (c) open trapezoidal channels, computed by Bazin's and Kutter's formulae, (side slopes of 1:1 and 1½:1 are covered by the tables); (d) egg-shaped conduits running ⅓ full, ⅔ full and full, computed by Kutter's formulae.

Part VI. contains miscellaneous information and reference tables. The miner's inch, hydraulic units, conversion factors, fluid pressure, buoyancy, discharge through various types of orifices, measurement of water, flow over various types of weirs, limiting velocities in the different types of conduits, are subjects that are clearly presented and fully covered by numerous tables.

Part VII. gives a very concise and yet explicit discussion of the old and modern hydraulic formulae, showing their application and also their limitations.

The appendix contains several charts plotted solely for the purpose of giving a comparison of the formulae used in computing the hydraulic tables.

The author of this little book is to be commended for the way in which he has presented these tables, as they are most complete and conveniently arranged for quick computations. The binding and typography are both excellent.

The Engineer in War. By Major P. S. Bond, M.Am.Soc. C.E. Published by the McGraw-Hill Book Co., Inc., New York. First edition, 1916. 187 pages, illustrated, 5 x 7½ ins., flexible leather. Price, $1.50. (Reviewed by F. A. Snyder, M.Can.Soc. C.E., M.Am.Soc.C.E., Lieut.-Col. National Guard of Pennsylvania—retired.)

The Engineering Record, in 1915-1916, originally published a series of articles, by Major Bond, on Military Engineering. These articles have been rewritten and greatly added to, and are now put before the public in a small, readable book that should be in the hands of all engineers, contractors and military men, whether they are in training for war or merely use this book to add to their general knowledge. This book should especially appeal to men who are constructing works of any description, where improvised methods have to be used, as most of the methods used by military engineers are of the makeshift variety.

The book describes the military policy of the United States and other countries, and the training necessary to supply engineer troops for service in war; the general duties of the military engineers and all engineer troops, both at the front, on the line of communication, and elsewhere. The tools and equipment employed in military engineering are fully described. In detail, the manner in which streams are crossed by the different bridging expedients, carried by an army in the field or improvised in the vicinity of the crossing, are shown. The different types of military roads are fully described.

There is a chapter on field fortifications, siege operations and military mining. The different methods of making demolitions are shown. The chapter on military reconnaissance, sketching and surveying, describes the methods and equipment by which it is possible to train men in a remarkable short time, so that they are able to make excellent military sketches. This chapter should appeal to engineers who are required to make a rough reconnaissance survey. Military sanitation is covered in a short chapter.

The methods urged for a country to mobilize its national resources should be read by all men who have the success of their country at heart.

The last chapter shows how engineers and contractors can prepare themselves to meet the military obligations of citizenship.

In an appendix is shown a list of books on military topics for civilian engineers and others. A glossary gives the military terms shown in the text.

The book is well illustrated, has good, clear type and an excellent index.

The Planning of the Modern City. By Nelson P. Lewis, M.Am.Soc.C.E., Chief Engineer of the Board of Estimate and Apportionment of New York City. Published by John Wiley & Sons, Inc., New York. First edition, 1916. 423 pages, 62 illustrations, 6 x 9 ins., cloth. Price, $3.50 net. (Reviewed by Douglas H. Nelles, D.L.S., Geodetic Survey of Canada.)

This book supplies one of the needs in the literature on this subject. It explains itself in the opening paragraph as follows: "Most of the literature of this subject has been contributed either by architects, who emphasize its architectural or artistic side and appear to consider it an architectural problem, or by students of city government, who regard it as an administrative problem. This volume is just as frankly written with the idea that the fundamental problems of city planning are, and from their very nature must be, engineering problems."

If architects, following out the wishes of business men, design and build large numbers of modern skyscrapers in a city whose public utility services were designed by engineers to serve a population housed in buildings of from three to five stories, these services, including water supply, sewerage and transportation, both passenger and freight, become overcrowded and are unable to supply the demand. When this occurs they either have to be supplemented or entirely renewed, involving many difficult and costly engineering problems. When these problems have been dealt with, there comes another limit to this class of building and that is a financial one. The office occupants find that they can make more money by renting an office in a smaller and less expensive building and in a less crowded business centre.

Then there are the questions of health, education, amusement and happiness of the wage-earner, and we are all wage-earners to a greater or less extent, and many other problems which enter into the lives of the people of this day and age living in the cities, towns and the villages of our great but comparatively young country and now is the time to tackle them in scientific and systematic way, and the engineer is the main factor in them all. This volume, in its 423 pages, deals with these various problems in an orderly, concise and readable manner from an engineering standpoint.

While the subjects are treated, as they must be in a work of this nature, from a general viewpoint, there has been collected and tabulated a tremendous amount of detail in regard to the facts, figures, and costs of various special problems concerning harbors, railroad terminals, street openings, etc., situated all over the world.

The following headings of the 21 chapters of this book will give the reader a good idea of its contents:—

1, Introductory; 2, The City Planning Movement; 3, The Correction of Mistakes; 4, Elements of a City Plan; 5, The Transportation System; 6, The Street System; 7, Parks and Recreation Facilities; 8, Public Buildings and Civic Centres; 9, The Economic Value of a City Plan; 10, The Industrial Town or District; 11, Street Traffic; 12, Street Details—Utility and Adornment; 13, The Railroad and Its Relation to the Street System; 14 Restrictions; 15, The Environs of the City; 16, Garden Cities; 17, City Planning Legislation; 18, Progress and Methods; 19, Financing a City Plan; 20, Municipal Land Policies; 21, The Opportunities and Responsibilities of the Municipal Engineer.

This book is splendidly illustrated, containing as it does 62 figures and diagrams, 87 subjects illustrated by plates and 12 tables, listed under their separate headings. There is also a complete alphabetical index of the subject matter.

In Chapter 6 are the following statements: "An accurate topographic survey of the entire territory will be of great value. . . . Many street plans have been made which are very attractive on paper but which are found to be entirely impractical when transferred to the ground. Had a sufficient topographic survey first been made, such impossible plans would not have been proposed." The subject of thorough topographical city maps is one of great importance to all Canadian cities and to most of the cities of the United States. In Europe, one of the first things they did was to make accurate maps of their cities and on these all city planning is based and all engineering problems planned. If this book can be criticized it is because the author did not devote a chapter to this important subject. The book is, however, one that should be in the library of every municipal engineer, city surveyor and all other engineers whose work lies in dealing with city problems.

PUBLICATIONS RECEIVED.

Department of Labor, Ottawa.—Fifth Annual Report (1915) on labor organizations in Canada.

Mines Branch.—Annual report of the minister of mines, Victoria, B.C., for the year 1915, being an account of mining operations for gold, coal, etc., in the province of British Columbia.

Results of Physical Tests of Road-Building Rock.—Bulletin No. 370 of the United States Department of Agriculture. By Prevost Hubbard, chemical engineer, and Frank H. Jackson, Jr., assistant testing engineer.

Saskatchewan.—Map showing the disposition of lands of this province corrected to January, 1916. Prepared in the Railway Lands Branch, Department of the Interior, Ottawa, under the direction of Mr. F. C. C. Lynch, superintendent.

American Society of Municipal Improvements. Proceedings of the 1915 convention.—This volume just to hand contains the papers and discussions read before the convention last year, among which are a number of addresses that will be found of considerable interest to all municipal engineers. It contains 618 pages, bound in cloth, and forms a very welcome addition to municipal engineering literature.

Annual Report of the Association of Ontario Land Surveyors.—This publication contains the report of the proceedings of the twenty-fourth annual meeting held in Toronto in February, 1916. It contains the report of the meeting, the president's address, reports of the various committees, together with papers presented before the meeting and the discussions which grew out of them. It contains 388 pages, 6 x 9 inches.

Concrete Sewers.—This is a 44-page pamphlet issued by the Portland Cement Association, 111 West Washington Street, Chicago, giving information as to the merits of concrete in sewer construction, as found in different parts of the United States and Canada. The pamphlet is very fully illustrated, showing concrete sewer pipe in its various stages of construction and also deals with the laying of concrete sewer pipe. It contains a list of the cities using concrete sewers in the United States and Canada, of which there are about 200. The pamphlet will be found of great interest to all those who have to do with the construction, design and maintenance of sewer work.

Range Finder and Slope Card.—This is a little instrument designed by Capt. C. R. Young, Assistant Professor, Structural Engineering, University of Toronto, Adjutant, School of Infantry, Camp Borden. By means of this instrument one is able to find distances and slopes by a very simple and rapid method. It may also be used for approximate topographical surveys with advantage. It can be used for any units—the yard, metre, foot, inch, etc. It consists of a 3-in. x 6-in. card of opaque celluloid with a string attached measuring 25 inches exactly. This string enables the user to hold the card exactly 25 inches from the eye when using the range finder. The reverse side of the card contains instructions for its use and a table of approximate dimensions of familiar objects on the landscape. A protractor on the reverse side makes the instrument useful for determining the slope of ground and also for finding the height of any point above the ground upon which the observer stands. The instrument is to be had at bookstores or The Canadian Engineer Book Department at 85 cents each. Instructions for using the instrument accompany each one.

CATALOGUES RECEIVED.

Pelton-Doble Centrifugal Pumps.—Bulletin No. 9, issued by the Pelton Water Wheel Co., San Francisco, Cal., describing with illustrations their different types of centrifugal pumps.

Belts.—An interesting little twelve-page magazine which is issued monthly by the Federal Engineering Co., Limited, Toronto, discussing the economics of belting and allied subjects.

Schoop Metal Spraying Process.—A sixteen page illustrated booklet issued by the Metals Coating Company of Canada, Limited, Montreal, describing their process of metal spraying.

Cooling Water for Ice Plants.—Small folder issued by the Spray Engineering Co., Boston, Mass., describing their method of cooling circulating water for ammonia or steam condensers by spraying.

Portable Conveyers.—Bulletin No. 184 of The Jeffrey Manufacturing Co., Columbus, Ohio, describing their portable conveyers for handling barrels, boxes, sacks, packages, bags, etc. Contains 11 illustrated pages.

Spraco System for Cooling Condensing Water.—Bulletin No. 201, issued by the Spray Engineering Co., 93 Federal Street, Boston, Mass. Contains 16 illustrated pages describing the "Spraco" system in use by different firms.

Concrete Reinforcement Bars.—The Burlington Steel Company, of Hamilton, Ont., have recently issued a catalogue dealing with concrete reinforcement bars. It contains a great deal of useful information for all those who have to do with the design and construction of reinforced concrete work. The catalogue is excellently printed and illustrated, and contains thirty-four 9 x 12-inch pages.

Domestic Gas-Engine-Driven Contractors' Machinery.—A new 28-page, 6x9 bulletin issued by The Domestic Engine & Pump Co., Shippensburg, Pa., describing their line of gas-engine-driven contractors' machinery, which includes diaphragm, centrifugal, combination and force pumps, geared and chain-driven hoists and special hoisting outfits for applying power to hand derricks. A number of new electric-motor-driven pumping outfits are also shown. A copy of this bulletin may be obtained by application to Domestic Engine & Pump Co.

Editorial

ENGINEERING SOCIETIES AND INDUSTRY.

Periodically the question is raised either among the membership of the technical societies themselves or through the medium of the technical press as to what relationship such societies should bear to industry and to the public.

Since the outbreak of war this question has been brought before a number of important engineering societies in all parts of the world and seems to be more insistent than ever. This has been accentuated by the war, in Great Britain, the United States and in many other countries, the feeling being that technical societies should relate themselves more closely to the problems, both economic and industrial, which it is expected will arise after the war is over.

There appears to be two distinct camps on the subject —first, there are those who believe that as technical bodies, engineering societies should, for the present at least, relate themselves in a more practical way to industrial problems. Then there are those who maintain, and maintain strongly, that such societies should stick to the line of work for which they were founded, *viz.*, scientific and educational, leaving the trade and industrial problems to boards of trade, employment federations, and similar bodies in which province it is claimed they rightly belong.

While there is much to be said in favor of having the technical societies more closely identified with the industries that support them, along practical lines, there is, on the other hand, the danger that this tendency will go too far and tend to make the lecture rooms of our societies the centres around which unscrupulous manufacturers will radiate for their own selfish purposes.

If, as so many of our leaders profess, the struggle between the nations after the war is one where science is going to be the leading factor, the claim is made by many, and it would appear to be a reasonable one, that the technical societies should stick to their line and not allow their interest in things scientific to be interfered with by the consideration of purely trade problems.

CONSISTENCY OF CONCRETE.

To indicate the consistency of Concrete, most writers employ terms such as "dry," "moist," "medium," "wet," "sloppy," and the like. These terms are without definite significance, and only remain in use because there is no authoritative standard of consistency.

One of the committees of the American Society for Testing Materials recommends the following method of determining the proper consistency of concrete for use in laboratory tests:—

Mix a batch of concrete sufficient to make a 6-in. by 12-in. cylinder, and place it in a smooth metal mould in layers of 3 in. to 4 in. thick, puddling with a steel rod of ½ in. diameter. After removal of the mould from the finished specimens, the cylinder will be found to have shortened by about ¼ in. if the correct amount of water has been used.

The consistency so determined is termed "standard consistency," and it will be found that for a 1:2:4 mixture from 7 to 10 per cent. of water will be required, according to the nature and proportioning of the aggregate.

It would not be difficult to establish standards of consistency for mixtures in general use, and given such standards, other consistencies could be conveniently expressed in percentages of standard consistency, a procedure much preferred to the use of vague and meaningless adjectives.

IMPORTANT MEETING OF AMERICAN CHEMICAL SOCIETY.

The forthcoming gatherings of chemists and technical men in connection with the annual meetings of the American Chemical Society, the American Electrochemical Society, the Society of Chemical Industry, and the Technical Association of the Pulp and Paper Industry will reveal to the American public the pre-eminence of chemistry as a factor in the great national industries. The great scarcity of potash has almost crippled many of our industries, notably our fertilizer industry and some of our glass industries.

The glass used in making electric light bulbs is a very special kind of glass that must withstand sudden changes in temperature and also great pressure. Heretofore it has been thought that only glass made with a certain amount of potash was suitable.

The outbreak of the war two years ago cut off all supply of potash from Germany and threatened to make us go back to gas lighting and the kerosene lamp. However, American ingenuity and enterprise was equal to the occasion and the wizards of the wonderful research laboratories of the General Electric Company set to work to find a substitute. At the second National Exposition of Chemical Industries, which opens concurrently with the meetings of the chemical and technical societies, the accomplishments of American glass chemists will be shown.

There are a great many chemical operations in which soda and potash might be regarded as chemical cousins. Recently the research chemists of the General Electric Company have succeeded in producing a glass for making electric light bulbs by replacing potash with soda in the glass mixture. This glass has proved greatly superior to the old potash glass; so much so, indeed, that from now on potash glass will no longer be used.

The world supply of potash comes almost entirely from Stassfurt, in Germany, because the natural deposits there have been cheaper to work than any other known source.

There was a time when the American supply of potash was produced by the leaching of wood ashes. This process was expensive and cumbersome. To-day a number of large firms, among others the Armours and Swifts, of Chicago, are getting their potash from the gigantic seaweeds and kelp of the Pacific Coast. Potash is also obtained from the brines of Great Salt Lake, the deposits of alunite in Utah, and by special recovery systems from certain granitic rocks; it is also secured when the ingredients that go to form Portland cement are subjected to the intense heat of the process and the resulting fumes precipitated by electric discharges. All these sources of supply have, however, proved utterly inadequate to meet the great demand of the industries.

Soda, on the other hand, is produced from salt, the ordinary table salt, great natural deposits of which are to be found in different parts of the country. There is one immense bed 30 feet to 100 feet thick underlying Michigan, Ohio and Western New York at depths ranging from 1,000 to 3,000 feet, which give an inexhaustible supply for the production of soda. Salt refining and salt products will be on exhibition at the chemical meetings in the Grand Central Palace from September 25 to 30.

Germany has built up a great glass industry just as she has built up a great dyestuffs industry, producing certain qualities of glass that were formerly the despair of chemists to imitate. Nearly all the lenses for microscopes, telescopes, field glasses, cameras, etc., and almost all the glassware suitable to special chemical purposes have been produced in Germany. The Jena glassware is famous throughout the world as the acme of perfection, and it is only within the last two years that certain American glass chemists have succeeded in producing its equal. Glass for chemical use the equal of that produced in Jena is now made in the United States, thus putting America in a position of economic independence in another great field of industry.

Our readers are respectfully referred this week to the department in *The Canadian Engineer* known as "The Engineer's Library." This is the season of the year when many engineers give some consideration to the matter of their fall and winter reading, and in this connection we would suggest to them to read The Engineer's Library this week with some care, because it contains reviews of many of the very latest engineering titles, these reviews having been written by men who by reason of their observation and experience are well qualified to do so.

This department also contains the reviews of trade literature, reports of public bodies, etc., and many good suggestions are often to be found in engineering trade literature publications.

PERSONAL.

A. E. HALL has been appointed superintendent of the mines and mill of the Sable River Copper Company, Massey, Ont.

C. J. YORATH, city commissioner, of Saskatoon, Sask., is reported to have been offered, and it is believed he will accept, a captaincy in the Canadian Engineers.

DUNCAN CAMPBELL, general manager in British Columbia for the Canadian Northern Railway Co., is reported ill in the hospital at Kamloops, B.C. He is now believed to be out of danger.

F. W. W. DOANE, city engineer of Halifax, N.S., was elected first vice-president for Nova Scotia of the Union of Canadian Municipalities at the recent annual convention held in Montreal.

E. W. PATTERSON, of the engineering staff, Point Grey, B.C., has enlisted for overseas service with the Foresters' Battalion. He has been in the municipal employment for the past five years.

E. P. COLEMAN, general manager of the Dominion Power and Transmission Company, Limited, of Hamilton, Ont., was elected president of the Canadian Electric Railway Association at its meeting July 26 and 27 at the Royal Canadian Yacht Club, at Toronto.

Lieut. R. FRASER ARMSTRONG, engineer of waterworks and sewers of St. John, N.B., has left for Petawawa to join the 58th artillery, which is expected to sail soon for overseas service. He will be temporarily succeeded by FRANK McINNIS, who for the past thirty years has been chief engineer of the waterworks department of Boston, Mass. Mr. McInnis is a native of Fredericton and a graduate of the University of New Brunswick.

Capt. A. R. KETTERSON, who recruited half of the No. 1 Construction Battalion in Montreal district in six weeks, has now been appointed adjutant of the battalion, which is at Valcartier. Capt. Ketterson is a graduate civil engineer of Glasgow, Scotland, and before coming to Canada was connected with the firm of A. Findlay & Co., bridge builders, Motherwell, Scotland, first as draughtsman and then designer of steel structures. He was also for three years assistant to the late C. R. Bonn, of Babtie & Bonn, civil and consulting engineers, Glasgow, Scotland—engaged in the design of structures and foundations and in personal charge of the work in the field. Since coming to Canada he has been for nine years with the Canadian Pacific Railway, the first two years as bridge inspector, then draughtsman, then assistant engineer, bridge department, Montreal, and for the last three years assistant engineer at Winnipeg, representing the bridge department, Montreal, on western lines. He is an associate member of the Canadian Society of Civil Engineers, and an associate of the Royal Technical College, Glasgow, Scotland. Prior to joining the No. 1 Construction Battalion he had military experience, having been for four years in the Argyle and Sutherland Highlanders (Territorial Forces) in Scotland.

OBITUARY.

J. A. DAVIS, a former Winnipeg contractor, died recently at the age of 83.

R. M. W. McLAREN, secretary and managing director of the D. K. McLaren Company, of Montreal, and with offices in Toronto, passed away on August 20 in Montreal in his 40th year.

Hon. EDGAR DEWDNEY, former lieutenant-governor of British Columbia, died recently at his home in Victoria, B.C. He was born and educated in Devonshire, England, and immigrated to British Columbia in 1859, being employed by Sir James Douglas and Colonel Moody in the laying out of New Westminster. He spent many years practising his profession of civil engineer in building roads through the country, and was responsible for the completion of the Dewdney Trail from New Westminster to the eastern boundary of the province, in 1865.

An important Russian-American enterprise, organized with the principal object of the construction of railways and the exploitation of motive and water-power in Russia, has been put on foot, according to the semi-official Russian News Agency. In line with this undertaking, the Russian-American Chamber of Commerce is planning an exposition of American manufactures which will be held in Moscow.

The increase of railway mileage in Canada for the year ending June 30, 1915, was 4,787 miles, bringing the total railway mileage of the Dominion up to 35,582 miles. The increase during the last 12 years has been 87 per cent. In addition to the lines completed there were, on June 30, 1915, 1,161 miles of railway contracted for and 432 miles completed, but not yet classified as under operation.