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The Canadian Engineer

*A weekly paper for engineers and engineering-contractors*

# PUNTLEDGE RIVER POWER DEVELOPMENT

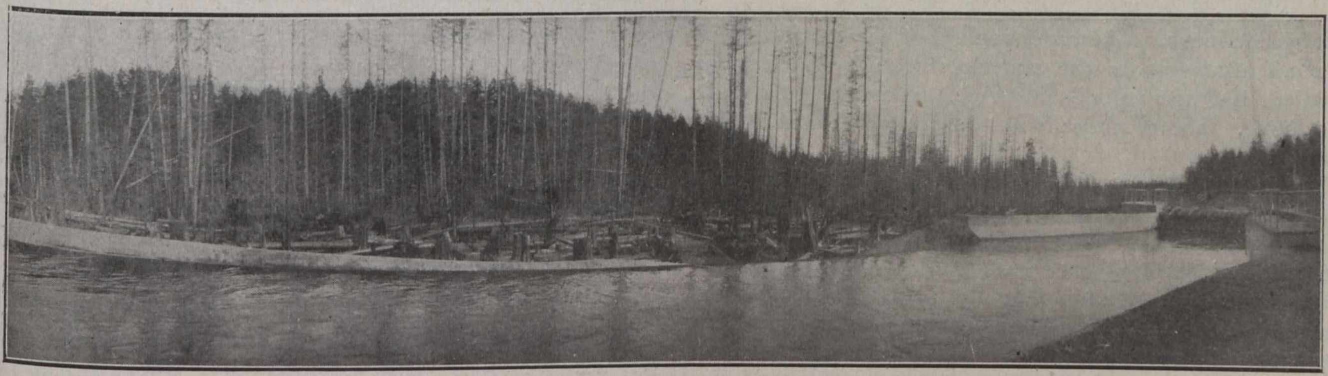
ONE OF THE MOST UNIQUE CANADIAN INSTALLATIONS—NOTES ON THE DESIGN OF IMPOUNDING AND DIVERSION DAMS, CANAL, FLUME AND POWER HOUSE—METHOD OF POWER REGULATION ADOPTED.

ONE of the most interesting hydro-electric power developments of Western Canada is that recently put into commission on the Puntledge River, British Columbia, by the Canadian Collieries (Dunsmuir), Limited. This firm operates a group of coal mines in the vicinity of Union Bay, Vancouver Island, and the output of the new installation is being used for lighting and hoisting purposes around the mines and docks, and also for lighting the town of Cumberland. Heretofore, power for the coal mines was generated by separate steam plants at the various mines, but the problem of power extension presented itself a few years ago and estimates secured for a central steam-electric power station with distribution system and also for a hydro-electric power installation. With coal for the former at $2.50 per ton delivered, the cost of installation and operation was greatly in favor of the latter, and plans were accordingly prepared and adopted.

Puntledge River has a flow which varies from 330 to 3,500 second-feet. It is the outlet of Puntledge Lake, situated about 8 miles from Comox Harbor. The lake has an area of about 9 square miles and a level at low water 420 ft. above tide water. As shown in the general plan, the scheme included the construction of an impounding dam at the outlet of the lake. This dam is of the Buttress type with 9 spillway openings closed by needles. It is approximately 300 ft. in length with a crest elevation of 445 ft. and a gate spill elevation of 416 ft. The gateways, together with the spillways, aggregate 100 ft. in length and give a flood discharge capacity of 10,000 second-feet, which exceeds the highest recorded outflow from the watershed.

The dam is built on solid rock, and is of concrete, partly reinforced. The mix used was F. : 1 : 2½ : 5, with about 10% of hydrated lime added as a neutral filler to obtain watertightness. To insure against uplift of the structure from pressure in horizontal seams which might exist in the underlying rock, a number of weep-holes were drilled in the rock and fitted with open pipes leading out to the down-stream face of the dam. A special feature of the impounding dam is a log-sluice 10 ft. x 26 ft.

There are 6 steel butterfly valves each 5 x 6 ft. and stepped in bearings set in the sill. The valves fit loosely into the gateway, it being not intended to obtain watertightness. Spindles extend to the gallery at the top of the dam, and through a cast iron pedestal frame which carries the weight of the valve and spindle and holds a worm-operating gear fitted with double hand cranks. The dam has a maximum height of 30 ft.

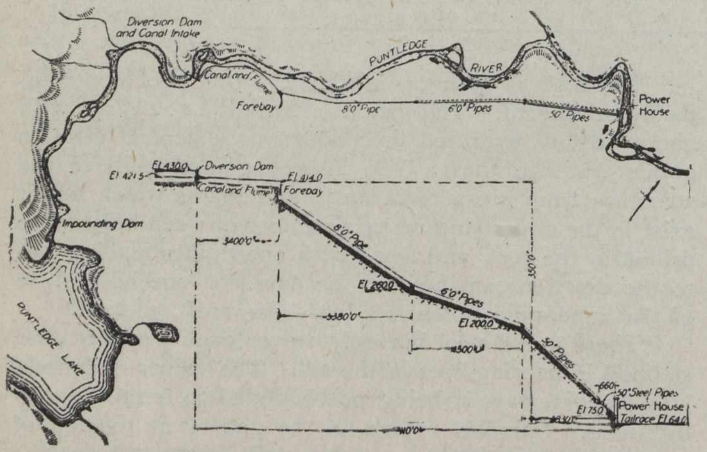


**Concrete-lined Canal and Circular Forebay, Showing Spillway and Tainter Gate.**

**Diversion Dam.**—The course which the water takes from the impounding dam is the natural bed of the river to an intake reservoir formed by a diversion dam about 2½ miles below the lake. This is a gravity type structure with a spillway 100 ft. in length, having a maximum height of 7 ft. with a possible 11½-ft. flow over the spillway. This dam is also built of concrete and is partly reinforced at the intake end. The government regulations required a fish ladder which is built in one of the concrete abutments so as to be protected from damage in time of flood. There are two gateways in this dam, each 7 x 6 ft. The gates are constructed of steel plates riveted to frames of steel channels and fitted with rollers to reduce friction during operation. The gates are operated vertically by screw gears, the stems being 2½ inches in diameter with bevel-geared operating stands and hand cranks located on an overhead working platform.

**Canal and Flume.**—From the diversion dam to a point as near the power house site as the topography will allow, but distant therefrom approximately 3 miles, the water is led in an open canal and flume aggregating 3,400 ft. in length to a forebay. The first section consists of rock masonry-lined canal 14 ft. x 7 ft. deep, for a distance of 330 ft. This leads to an open semi-circular wood-stave flume 2,200 ft. in length and 12 ft. in diameter. The flume rests in round iron supports suspended from stringers. Water enters it from the canal through a small spillway.

The flume leads to 900 ft. of open canal, the first part of which runs through unlined clay, and the remainder of which is concrete lined by concrete plaster on two layers




**Puntledge River Development in Plan and Profile.**

of triangular mesh. The cross-section of the canal varies somewhat according to the material through which it is excavated, but corresponds in area and capacity to that of the flume. The gradient from the diversion dam to the forebay is 0.002.

The latter section of the canal leads to a circular reinforced concrete flow tank, and has about 100 ft. of spillway just at the intake to the forebay. The latter is about 25 ft. in diameter and 25 ft. in depth. It is reinforced concrete structure, cylindrical in form with vertical axis, the canal entering on one side and a pipe 8 ft. in diameter connecting on the opposite side. The intake to the forebay closes by a counterbalanced tainter gate about 12 ft. wide and 9 ft. deep. The tank is divided by a wall and screen to separate the entry from the delivery sides, forming a sedimentation basin at the entry side at the bottom of which a blowoff is provided. Just above the forebay the canal is provided with a spillway with drainage to the river, to carry away any surplus water at this point.

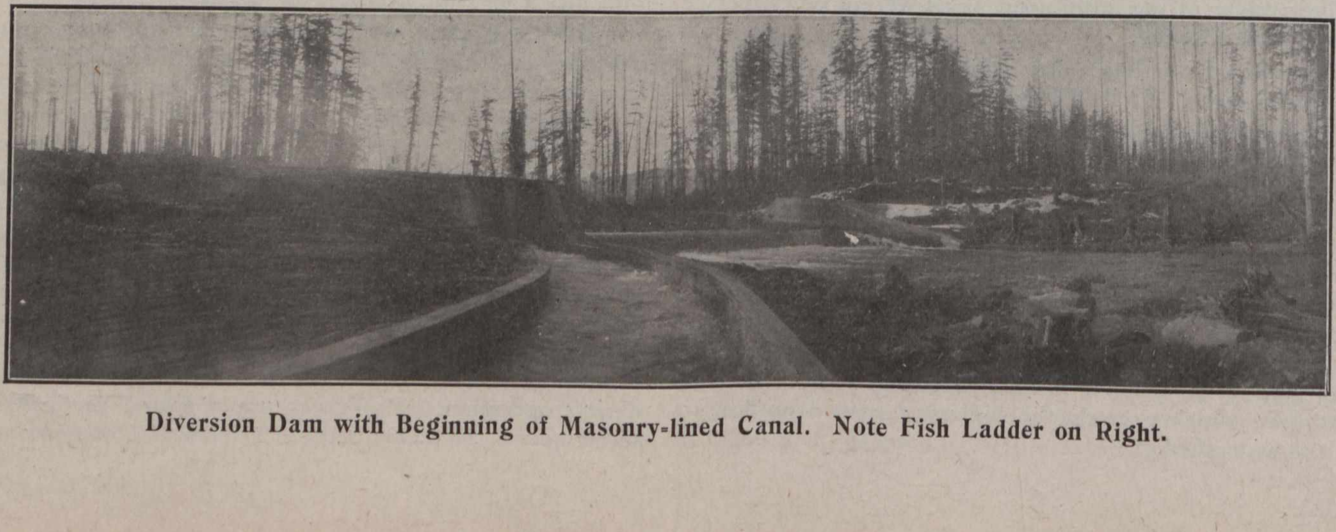
From the forebay the penstock line consists of a single 8-ft. wood stave pipe leading for a distance of 2,380 ft. to a reinforced concrete Y with gates. From this Y one 6-ft. wood stave pipe leads for 4,477 ft. to a second Y, which has two inlets, being provision for a second 6-ft. pipe and four outlets. This second Y is also of reinforced concrete and has a 72-inch crane gate valve on the inlet pipe, tested to 240 pounds, and two 50-inch valves on the outlet pipes installed at present. The present installation from this on consists of two 50-inch wood stave pipes for 3,056 ft. It will be noted from the above that there is provision for four of these 50-inch pipes. Below the 50-inch wood pipe there is 660 ft. block beam steel pipe 3/8 inch thick at the upper end and 7/16 inch thick at the lower end, leading directly into the power house. They are laid in trenches, much of which is in solid rock.

By means of gate valves placed in the 72-inch and in the 50-inch penstock lines either of the lower or 50-inch penstocks may be fed from either or both of the 6-foot pipes above described, each 72-inch pipe line having a valve at each end and each of the 50-inch pipes having a valve at the structure to which they connect.

Expansion joints are fitted about midway in each steel pipe. These are steel castings with packed slip-joints. Each joint is in a concrete chamber and the steel pipe is laid in tarred felt through the walls of this chamber so that it is free to slip. The lower ends of the steel penstocks are anchored near and at the power house foundation and terminate within the building with a cast iron closing piece connecting them to hydraulic shut-off valves installed at the respective turbines.

**Power House.**—The power house is built of reinforced concrete on a rocky site at the river's edge; only approximately one-half of the principal building contemplated has been erected for the annex section of the building which contains the switching and other electrical apparatus and the wire outlets has been built complete. Provision has been made in the design for extension of the main body of the building to house the remaining units without disturbance to the operation of the present plant.

The annex section, which is three stories high and 18½ x 65½ ft. in floor dimensions, has the upper floors of concrete supported by I-beams. The roof of the entire building is built of concrete laid on ribbed-steel mesh plastered underneath. The roof framing of the annex section consists of 9-in. 12-lb. I-beam rafters and that of the main section of steel trusses placed 20 ft. centre to centre, supporting 9-in. 21-lb. I-beam purlins. The sides

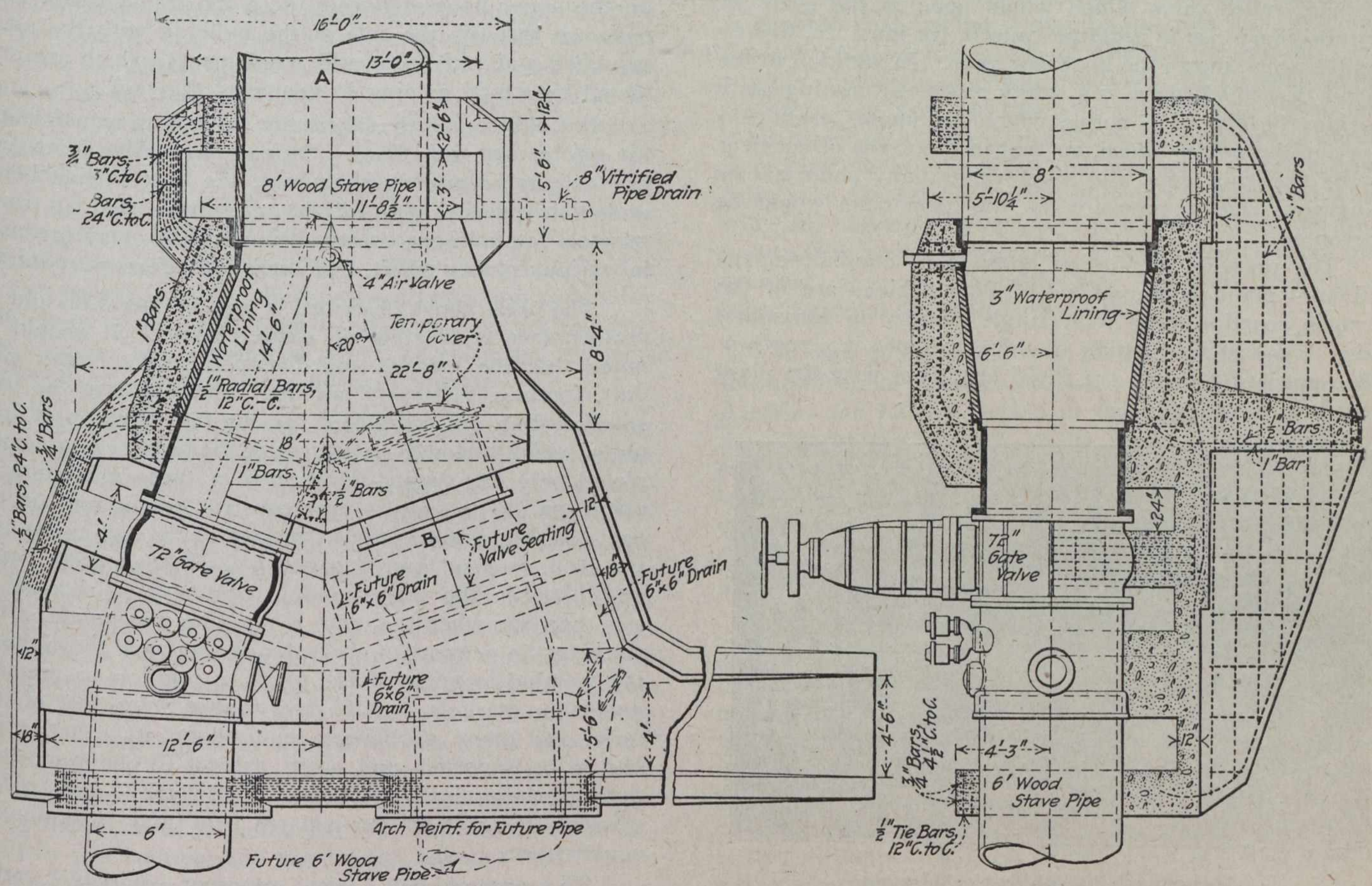


**Diversion Dam with Beginning of Masonry-lined Canal. Note Fish Ladder on Right.**

of the building are of glass in large proportion. The main building is designed with crane girders on which a 40-ton traveling crane has been installed. These girders are of reinforced concrete with embedded runway rails. All of the concrete in the exterior of the building was made with 10% hydrated lime. The roofs are covered with felt; the roof drainage is run through the interior of the building to a central drain to guard against frost in the leaders.

ratio obtained was the best possible owing to naturally unfavorable topographical conditions. The forebay is located at the nearest suitable point gradually to the station site.

In a penstock system of such a high head-length ratio, it is difficult to obtain power regulation by means designed to conserve the water supply, but inasmuch as there was no scantiness of supply and economy of water

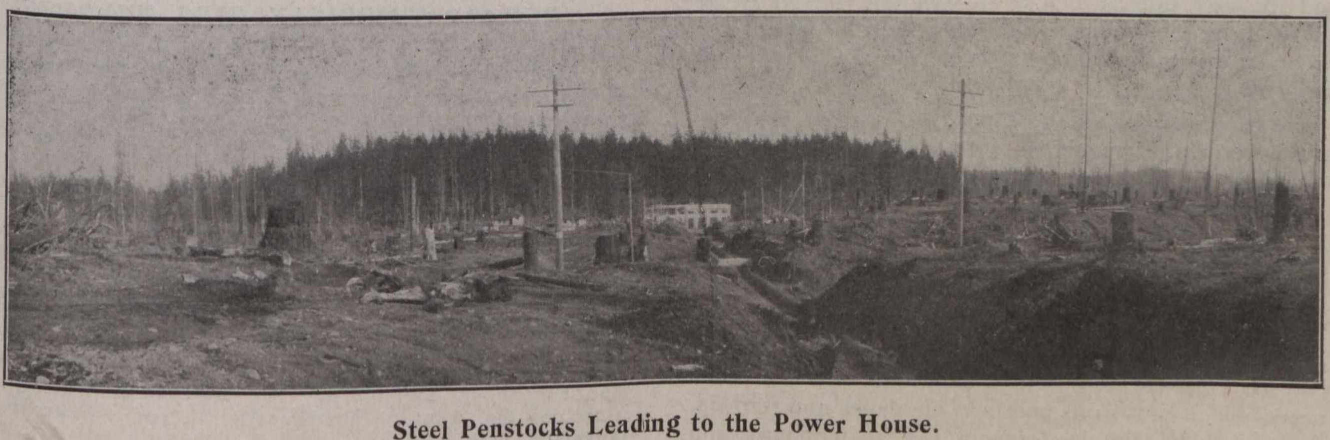



**Sectional Plan and Vertical Section of a 96 x 72 x 72-inch Reinforced Concrete Y-pipe Connection.**

**Regulation.**—The elevation of the intake is 414 ft., the elevation of water in the tail race is 64 ft., giving a static head of 350 ft. The length of penstock system being 13,700 ft., the head-length ratio of the pipe is about 1 : 40. The part played by such a high ratio, as an unfavorable element in the problem of regulation under varying power-load conditions, was fully realized; much study was given to the general development to obtain the arrangement most favorable to good regulation, but the

did not enter, the problem of regulation as presented was comparatively simple. The arrangement adopted, however, insures against sudden or high rises in pressure in the penstock system.

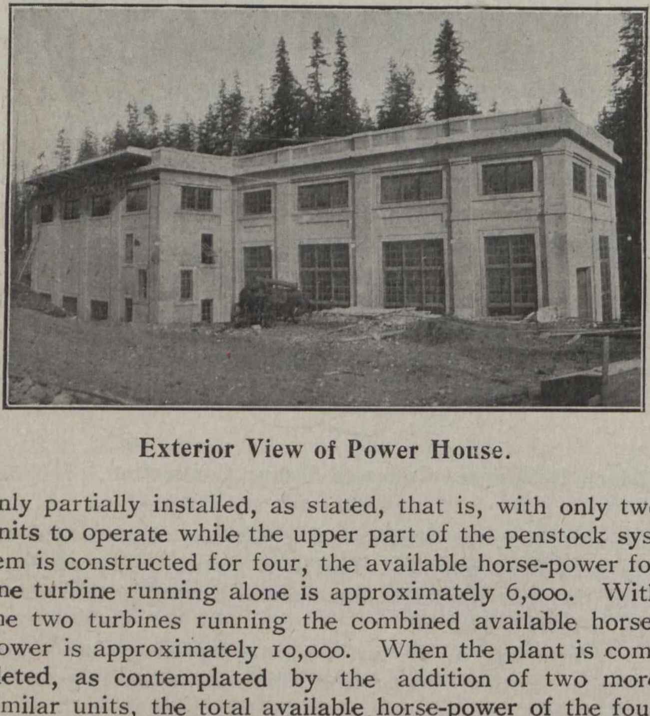
Throttling of the turbine gates by the governor gear of each turbine operates a relief valve on its penstock which opens and closes with the turbine gates, thus permitting water to waste in approximate proportion to the load taken off and maintaining so nearly a uniform rate



**Steel Penstocks Leading to the Power House.**

of flow in the penstock as to prevent the pressure rises due to governor throttling to exceed a nominal percentage of the pressure due to the active head. This relief-valve gear is adjustable to close in any desired length of time so that the water waste need be no more than sufficient to diminish the penstock flow at a proper safe rate. The general arrangement as designed includes, in addition to the governor-actuated relief valve, an independent direct-pressure relief valve which would open in the event of extraordinary rise in pressure caused, for instance, by any trouble occurring to the governor gear. In addition to the valves described, there is a safety relief—a bursting plate closing the end of a nozzle which terminates each penstock in the power house, so that in the event of accident to the governor gear and relief valves, any abnormal or dangerous rise in pressure in the penstocks would be prevented.

The present installation consists of one-half of the ultimate plant contemplated. The turbines are of the Francis reaction type with single runner on horizontal axis. The specified rating of these turbines is 4,700 h.p. when operating under 272 ft. of head, but with the plant



**Exterior View of Power House.**

only partially installed, as stated, that is, with only two units to operate while the upper part of the penstock system is constructed for four, the available horse-power for one turbine running alone is approximately 6,000. With the two turbines running the combined available horse-power is approximately 10,000. When the plant is completed, as contemplated by the addition of two more similar units, the total available horse-power of the four turbines operated at one time will be approximately 19,000.

The machines are placed with the shaft parallel with the longitudinal axis of the building. The floor space required for each unit is 32 x 50 ft. and the floor space of the ultimate power house as designed is 34 x 214 ft. The main building, as far as constructed for the present, is 34 x 117 ft.

The generators are 4,400-k.v.a., 13,200-volt, 3-phase, 25-cycle, 500-r.p.m. machines supplied by the Canadian General Electric Company. They have the lower portion suspended from the foundation piers within the foundation pit. These machines are designed for a 25% continuous overload. Each machine has its exciter direct connected but the capacity of one exciter is sufficient for two machines when operating at 80% power factor.

The electrical conductors from the generator pits are laid in the concrete floor and foundations and the leads are accessible at numerous points in manholes and tunnels. The grouping of the leads from the switchboard and switching apparatus is effected in a central tunnel. The switchboard and control station are placed on an extension of the second floor of the annex, projecting as a gallery within the main portion of the building, from which the full interior of the power house proper is visible to the operator. The switching apparatus is located on the annex second floor and is contained in a series of reinforced concrete cells. Six lightning arresters are located on the upper floor and from these the transmission lines pass out through the side of the building with the usual insulated wall entrances and attachments, which are protected by a 6-ft. awning extension of the roof.

It will be noted that there are no step-up transformers for the transmission lines. On account of the short runs no such apparatus was required, the longest line being under six miles. Most of the current is used at transmission line voltage but step-down transformers are used in various places where the lower voltages are required.

The plant above described is now in operation and its performance is meeting all expectations. It should be noted that the storage and diversion works, water conduit, forebay, waterway and the upper third of the penstock system are completed for the full capacity of four units, while the lower two-thirds of the penstocks are completed only for supply to the two of these units now in operation. The cost as now constructed, figured on the basis of the normal output capacity of the two units now installed, is less than $70 per h.p. at the power house switchboard; the corresponding cost will be reduced to less than $60 when the plant is ultimately complete. Considering the permanent character of the work throughout, the isolated location of the plant in relation to material and labor markets and the fact that a great deal of material and many appliances required for its construction had to be imported and were subject to heavy customs duties, these low costs are noteworthy and reflect efficient design and particularly neat and workmanlike construction.

The water-wheels, with governor equipment, relief valves, etc., were supplied by Escher Wyss & Co. Generators and all electrical apparatus were installed by the Canadian General Electric Co. The gate valves, air valves, etc., were installed by the Crane Company of Chicago. Messrs. Grant, Smith & Co., Seattle, were the general contractors. Messrs. H. K. Owens and A. V. Bouillon, Seattle, were the consulting engineers for the work. Mr. L. Netland was resident engineer for the Canadian Collieries (Dunsmuir), Limited, during the construction. Mr. Joseph Hunter is the company's chief engineer.

## RECORD AMERICAN ZINC EXPORTS.

All previous records in exports of zinc from the United States were surpassed by those of the three months ended with November, which rose to the unprecedented total of 65,504,574 lbs., as compared with 1,346,877 lbs., in the corresponding period a year ago. During the last four fiscal years, zinc exports have averaged 12,800,000 lbs. per annum. In 1897, the former high record year in exports of zinc, the total was 35,869,987 lbs. That figure, however, was surpassed by the single month of September last with an export total of 38,090,144 lbs. of zinc pigs, ingots, etc. The unusually large exports of zinc in recent months were sent chiefly to Europe. In September, when the exports of zinc pigs, etc., rose to the highest point ever known, 28,000,000 lbs. were sent to England, 3,000,000 lbs. each to Scotland and France 333,300 lbs. each to Denmark and Italy, while 1,250,000 lbs. went to British Africa, and 250,000 lbs. to Australia.

## ENGINEERING IN ENGLAND DURING 1914, AND OUTLOOK FOR 1915.

**By Thomas W. How, M.I.Mech.E., Consulting Engineer.**

From The Chamber of Commerce Journal.

In the early part of the year 1914 there were indications in England of reaction from the prosperous years which preceded it, and although as time progressed the effect upon industrial operations was not so marked, or the diminution in trade so rapid, as was anticipated, the decline was nevertheless appreciable and this was reflected in the increasing percentage of unemployment during the first six months of the year, the percentage rising rapidly from 3.6 per cent. at the end of July to 6.3 per cent. at the beginning of September, which percentage, however, steadily declined after that date. This was primarily due to two causes, namely, the large and important orders for war material and the large number of men drafted into the Regular and Territorial Army, necessitating the employment of other hands to fill their places.

The advent of the war, whilst having a stimulating effect upon certain engineering branches of industry, more especially those capable of undertaking War Office materials and supplies for the Navy, undoubtedly had a depressing effect both upon the trade of the country in general and upon engineering enterprises in particular. As a general rule it may be said that only such undertakings as were actually in progress and under contract for completion were proceeded with, and many of these could not be actively continued on account of the uncertainty of the money market, and partly in consequence of the moratorium, which acted as a deterrent to rapid procedure with work in progress. This not only applied to constructional works by private enterprise, but to a very large extent also to public works. Railway companies, both in this country and the British colonies and dependencies, and even in India, limited their contracts for supplies, renewals and extensions to such works as were of primary importance or urgent necessity, whilst public bodies and municipalities restricted their expenditure in the main to relief works and to such improvements as would provide employment, rather than to the improvement or enlargement of the areas under their control.

As regards private enterprise, the many schemes in contemplation both in this country and abroad with respect to new railways or feeder lines, water supply, sanitation, the improvement of electrical supply, and even tramway and motor traction, were perforce for the time being either held in suspense or abandoned until after the war, with the inevitable result of greatly minimizing if not altogether stultifying the labors of the professional men engaged in the promotion of such enterprises. In normal times this state of uncertainty could not fail to have a most depressing effect both upon professional and commercial branches of industry, as well as upon trade generally, but, in the exceptional circumstances which have now to be faced, there is generally a spirit of submission to the inevitable, combined with a strong patriotism, which has engendered a universal desire to share in the present sacrifices of the common lot, and at the same time to take an optimistic view as to the revival of prosperity after the advent of peace.

Much has been said and written upon the question of capturing the engineering export trade from Germany, but little if any tangible result has so far been achieved. It is perfectly obvious that if anything is to be done at all it must not only be done soon, but effectively, and should be undertaken collectively and in combination rather than individually, and as the result of careful deliberation and research. The British manufacturer must not only be prepared to produce in larger quantities, but even to establish new industries. The principal difficulty appears to be chiefly one of manufacturing cost, and the feeling is general that, whilst it may be possible to supply the present demand for goods of German design at prices slightly above those charged hitherto by German manufacturers, the flow of orders is not likely to be so constant after the war as to justify the expenditure of capital in putting down new plant and producing in large quantities with the attendant risk of fiercer competition which will then undoubtedly ensue in order to recover the trade lost to Germany, an operation in which the German government may, and probably will, assist by bounties or other financial aid on a large scale.

In view of the necessity at the end of the war to revise the commercial treaties between Russia, Germany and Austria, and having regard to the importance of Russia as a market for British goods, there is an obvious increased opening for British enterprise in Russia, and this would no doubt receive preferential welcome in that country, and thus ensure stability and expansion for a great variety of trades which up to now have been more or less fluctuating.

The opportunities for the professional or consultant in engineering business have been very limited since the outbreak of the war, and whilst undoubtedly there must necessarily be a great deal of reconstruction work undertaken after the war, chiefly abroad, it is probable that the bulk of this work will be undertaken locally and by the professional and skilled staffs of, or belonging to, each particular country concerned, and the material will also be largely supplied locally, though some of it may possibly have to be furnished by other friendly nations.

The practical immunity of England from damage will remove any necessity for reconstruction works here, and so far as can be seen at present no large new undertakings are likely to be taken in hand in the immediate future. Such works are generally forecasted by the applications to Parliament for the necessary powers, and if the list of plans deposited for the ensuing session of 1915 is any indication of the works contemplated, very little will be undertaken. Only four railway bills, as against twenty-three of last year, have been deposited, and these are for comparatively small powers, and out of the six tramway bills (as compared with four last year) that of the London County Council for improvements appears to be the most important. Instead of fifty miscellaneous bills deposited last year there are only thirty-four for the session of 1915, and these chiefly by municipal authorities for additional powers. With regard to electric lighting powers and schemes, there are seventy-three applications for provisional orders, as against fifty last year, but none of them appear to be of any great consequence.

Thus it is apparent that municipal and other public bodies, as well as the railway companies, are limiting their new undertakings to such works of necessity as cannot conveniently be postponed, and are leaving to more propitious times other works of magnitude, which, though desirable, may involve large capital outlay both in their design and practical development.

## THE ENGINEER'S FUNCTION IN MUNICIPAL DEVELOPMENT.*

By Morris Llewellyn Cooke
Director, Department of Public Works, Philadelphia, Pa.

THE rôle which the engineer is to play in the development of our municipalities will depend primarily upon the attitude taken by the profession as a whole toward what appears to be a wonderful present opportunity, and also upon the ability with which the work of the engineer is brought to the attention of the public. There is no real reason why municipal engineering should not be made to comprise most municipal undertakings.

The test by which the rôle of the engineer is to be determined will be the development in our profession of a genuine spirit of public service. The community is apparently ready to accord the engineer a leading, perhaps a controlling, part, if the engineer will consider that in every decision and act there shall be the clearest possible recognition of the public interest.

Engineering has now reached the stage of development where it has become a profession in the highest sense of the word. The engineer being a scientist, his responsibility should be for the development of facts, regardless of whose advantage they may serve. I have in mind that the service of an engineer should be as the service of a judge and as opposed to the service of a lawyer who confessedly seeks out and represents the interests of his client, and often "makes the worse appear the better cause." This is justified by the fact that lawyers are not scientists, and by the assumption that there shall always be opposing counsel.

In the medical profession during the last generation, largely owing to the enlightened leadership of the American Medical Association, there has been inaugurated a great forward movement with the slogan of "preventive medicine." The medical profession in a way seemed to launch a campaign to wipe out its opportunity for a livelihood. There were, and I suppose still are, doctors who held that in advocating "preventive medicine" the profession was standing in its own light. The profession, however, is held in higher esteem than ever before. Under the new conditions there is a broader field for the activity of practitioners, both medical and surgical, than had ever before been available.

On the contrary, in inviting the attention of our profession to the municipal field, we are apparently opening the door of opportunity to tens of millions of dollars' worth of work which is not now either considered engineering nor carried on by engineers. The municipal field is almost virgin soil so far as engineering is concerned. As recently as ten years ago the problem of snow removal, for example, was so absolutely in the hands of thumb rule, and in many instances even of inexperienced men, that it is probably true that in no city in this country was it being attacked either by engineering methods or by engineers. Yet it will not be denied that on work of this kind, in which one city spent nearly $3,000,000 in six weeks last year, there is in reality an engineering problem of considerable magnitude.

Many municipal engineers in this country are beginning to adopt the European system of employing non-residents for certain highly specialized positions. Whenever this is practised it excites criticism and abuse. As yet no technical organization, so far as I know, has recognized the opening thus made for technical merit and given moral support to the movement.

Especially in engineering work, almost the entire absence of what may be called a financial programme is the great handicap. Private institutions can go along for years on a straight operating basis and without the necessity for undertaking any extensive construction work. But a growing city—and all our cities are growing cities—must necessarily have to spend a considerable part of its income on construction. This can be done with intelligence only by taking a long look ahead. For instance, at the present time in Philadelphia we are facing expenditures of from $20,000,000 to $25,000,000 on a sewage disposal installation; perhaps $40,000,000 for rapid transit; with extensive additions to our water supply system, not to mention other millions which could profitably be spent on sewers, bridges, grade crossing removals and a much needed programme of modern highway construction. There is probably no city in the country that is even attacking this obvious business problem in an intelligent or energetic way. Reform will not be brought about until the community, and especially the business part of the community, is educated as to its necessity.

I am not one of those who feel that all our shortcomings are "the fault of the people." I would rather assume my share of the responsibility for conditions as they are and then join with my professional associates and the community at large in bettering them. If we engineers are to have any prominent part in this, there are fundamental changes which we shall have to make in our own equipment for the work. In the first place, we have to get rid of the now old-fashioned idea that advertising is a crime. I admit that as a part of my work as a public official I put in a great deal of thought on what may be quite properly called advertising. By that I mean that I pay less attention in my reports to dignity of form and diction than to making them sufficiently interesting to be read. It is only as we engineers who are public officials learn to make the public, sometimes against its will, understand our work, that we are to get that degree of popular support for it which will make it possible for it to be done in an efficient manner.

In my opinion it is going to become more and more a necessity, not only in public, but in private work, for engineers to be able to popularize what they are doing. It is true to-day that a man who wants to do really good and efficient work can do so only after an aroused public opinion. You cannot drive people in a democracy. So I admit that in offering employment to an engineer, other things being equal, I want what might be called a good advertiser. You can secure appropriations for work more easily when it is well advertised. The Panama Canal is a good example of this principle. Again, advertising is the best possible check against ill-advised expenditures. If the public knows how a street is supposed to be constructed or cleaned, you do not require as many paid inspectors on the job.

The development of some varieties of municipal engineering is absolutely dependent upon the development of public opinion and must proceed with it. The matter of street cleaning is largely a question of an improved public taste in the matter of street paving. Unless streets are well paved they cannot be well cleaned, except at a prohibitive cost. To jump from one degree of cleanliness

*From a paper presented at the annual meeting of the American Society of Mechanical Engineers, New York, December, 1914.

in this respect to another, without a supporting public opinion, may be enough to wreck an administration and to set the tide of civic improvement running in the opposite direction.

The newspaper is the great educator in these matters to-day. But we are already using in Philadelphia moving pictures, parades and exhibitions. The possibilities of these and other means of publicity are not yet fully understood.

Again, more effort must be put into humanizing public administration. The engineer shares with those who have had the opportunity for education the mistaken idea that the man at the top is in a position to tell the man at the bottom what is good for him. The fact that our country was founded and has been perpetuated on the contrary idea has not seemed to affect the situation very much.

Take, for instance, the movement which has led to the formation of large numbers of business men's associations. This affords one of the very best examples of the present vitality of American public life. Our leading men should accept them as something that has come to stay and co-operate with them in such a way as to direct their activities into profitable channels. It seems to me they afford the most promising agency through which in the first place the thought of the public on civic questions can be crystallized, and, secondly, through which that thought can be given expression in definite public procedure. I have found these associations ready and anxious to hear from men who had definite knowledge on matters of public interest. It should be the attitude of any engineer who wants to play his part in the community to affiliate with one of these organizations and to help to make it an influence. You can rest assured that the man who is in public life for his own personal advancement is bending every energy to defile and degrade these institutions and to divert them from the high mission which they have it in their power to carry out, so they need our help.

## GYROSTATIC CONTROL DEVICES.

In a paper read before the Institution of Engineers and Shipbuilders in Scotland, Dr. J. G. Gray described a number of new gyrostatic devices for controlling moving bodies, such as torpedoes, and showed that they possessed marked advantages over those at present in use. The latter were effective only for short distances, but the new devices could ensure the maintenance of motion in a straight line for very long distances. Torpedoes thus controlled could also be steered by wires, but the author considered that the direction of torpedoes by wireless transmission was not practical at present, as the sending apparatus would have to be tuned to the receiving apparatus on the torpedo beyond the possibility of interference from without. Aeroplanes and airships capable of being steered and elevated or depressed, under the control of electrical action, could be devised. Dr. Gray held that motor gyrostats would in the future play a great part in warfare, and urged that this country should take the lead in the scientific advancement of the subject.

A French firm is producing cement from the scum formed by boiling beet for sugar manufacture. The scum consists chiefly of carbonate of lime and water. Out of 70,000 tons of beet 4,000 tons of carbonate of lime is obtained; to this 1,100 tons of clay is added, the resulting product being 3,162 tons of excellent cement. The scum is pumped into large tanks, where it is allowed to dry partially; finely divided clay is then mixed with it; the mixture is thoroughly amalgamated with beaters for an hour and burned in a rotary kiln, much in the same way as Portland cement. The clinker is then removed and pulverized into cement.

## SHRAPNEL SHELL MANUFACTURE.

A NEW industry for Canada has arisen as out of the night. Orders for shrapnel shells have already amounted to millions of dollars and have solved the employment problem for thousands of men. Up to the present these orders have been for shells for the British alone, but it is understood that orders are also being placed in Canada by the French and Russian Governments. At any rate, the manufacture of parts for shrapnel shells is proving a boon to the metal and machinery industries throughout the country, many of them otherwise sorely pressed for something to do.

These orders are not in any known instance for the complete and finished shell, but are, as stated, for shell parts, as will be outlined later.

The shrapnel shell differs in design in different countries. It consists essentially of a case, forged by hydraulic pressure from a solid billet of alloy steel of high tensile strength. This case has a space at the closed end for the bursting charge, this charge, in the British type, being enclosed in a snugly fitting tin cup. A steel diaphragm, shaped to give a conical spreading effect to the bullets in front of it, separates the charge chamber from the long middle section of the case, which contains the lead balls. The British specification calls for 364 of these per shell, each ½ inch in diameter, composed of an alloy of antimony and lead, and pressed into shape cold. When the required number is in place a matrix of pitch, resin, and other inflammable material, designed to protect the bullets from deformation during the discharge of the shell from the firing gun, is poured in. This matrix varies in composition. Sometimes a special smoke-producing mixture is used to facilitate range finding.

Down through the centre of this chamber of bullets runs a tube of drawn brass. It contains quick-burning material and extends from the nose of the shell to the lyddite, or other bursting charge, in the tin cup at the base, threading into the steel diaphragm mentioned above. This central pipe, at its upper end, is threaded or soldered to another diaphragm which is the other retainer of the bullets. In some shells this is also of steel, but in those being manufactured in Canada at present this second diaphragm is a brass cap.

The mechanism of the fuse plug or nose is an interesting and vitally important piece of construction. The plug contains the timing device and a percussion cap. The former is accurately set by vernier, to set off the bursting charge, according to mathematical calculation, after range has been obtained. When the shell is discharged from the gun the shock causes the percussion cap to ignite the primer charge, which starts the fuse burning at a certain point, designated by the vernier. The fuse is thus timed to reach the brass tube and thereby the bursting charge, at the proper time, as found by range; the time allowed depending, of course, upon the distance the shell is to travel, its course being of a parabolic nature.

Besides this time-fuse, the nose of the shell is equipped with a percussion cap which will cause the shell to burst immediately upon impact, should the actual range be shorter than that calculated.

The shrapnel case, owing to the great accuracy required in its manufacture and also to the composition of steel used, requires relative slow cutting speeds in the machining of it. This is accomplished by two series of operations on turret and automatic lathes. Great care in this machining is necessary as the case is to act solely as an aerial gun, projecting a cone of bullets when the bursting charge is fired. The British shell is designed to blow out at a point just outside the threaded opening, at the nose cap. Other designs force the threads.

While a finished surface is not required on the inside of the case, the inner and outer diameters must be accurately concentric to ensure true projection through the air. The outer surface is carefully machined and finished. An annular ring is tooled and knurled to take a copper band, near the base of the shell. This band is fitted to rotate easily, and is indispensable in the firing of the shell.

There is also a protecting cap, which screws into the end of the shell, safeguarding the interior parts from injury while in transit to the arsenal to be loaded.

Thus there are a number of parts, all requiring a fine degree of accuracy in making. The Dominion Shell Committee, which places the contracts in Canada, has distributed the contracts to many firms. The forgings are made by the Nova Scotia Steel and Coal Co., the Canada Forge Co., and others; the brass tubes by the Northern Electric Co., the Canadian Seamless Wire Co., and the John Morrow Screw and Machine Co., and others; the bullets by the Canada Metal Co., the Thos Davidson Co., and others; the tin cups by the Sheet Metal Products Co.; the copper bands by the Canadian Westinghouse Co., the Hamilton Steel Co., and others; the sockets and plugs by the Canada Foundry Co., the Empire Manufacturing Co., the Chadwick Brass Co., and others.

The parts are assembled, sent to the arsenal, where the bursting charge and fuses are added, and packed in wooden crates, six to the crate, for shipment.

## CANADA'S STEEL INDUSTRY.

The steel industry in Canada has suffered in recent years from many adverse factors. These include the tariff question, the dumping of United States products here when prices are low in the republic, and trade depression. However, the production of steel here in 1913, the latest year for which official statistics are available, amounted to 1,042,503 gross tons, an increase of 189,472 tons over 1912. Of the 1913 production, 1,006,149 tons were ingots and 36,354 tons were direct steel castings, being respective increases above 1912 of 185,357 and 4,115 tons.

The total productions of steel ingots and castings has increased rapidly in recent years, and the 1913 output was by far the largest in the history of Canada. A table covering the production by both classes, in gross tons, during the last ten years, follows:—

| Years. | Ingots. | Castings. | Years. | Ingots. | Castings. |
|---|---|---|---|---|---|
| 1913 | 1,006,149 | 36,354 | 1908 | 500,300 | 9,657 |
| 1912 | 820,792 | 32,239 | 1907 | 629,026 | 17,728 |
| 1911 | 768,559 | 22,312 | 1906 | 555,913 | 14,976 |
| 1910 | 723,002 | 18,922 | 1905 | 394,055 | 9,394 |
| 1909 | 664,789 | 13,962 | 1904 | 142,279 | 6,505 |

The production of all kinds of finished rolled iron and steel, in gross tons, by provinces, during the last four years, follows:—

| Provinces. | 1913. | 1912. | 1911. | 1910. |
|---|---|---|---|---|
| Nova Scotia | 380,488 | 337,466 | 336,520 | 310,460 |
| Quebec | 72,439 | 88,172 | 65,378 | 62,605 |
| Ontario | 504,900 | 418,346 | 367,768 | 356,645 |
| New Brunswick, Alberta, Manitoba | 9,270 | 17,240 | 12,358 | 10,101 |
| Total | 967,097 | 861,224 | 781,914 | 739,811 |

In 1913 there were twenty-one works engaged in rolling finished forms of iron and steel, and also the same number in the previous year. There were five idle rolling mills and steel works in 1913, compared with four in 1912. Three new steel plants were built in 1913, all equipped to make steel castings but not rolled iron or steel products. At the close of 1913 three additional similar plants were in course of being constructed.

## SEWAGE DISPOSAL WORKS AT LETHBRIDGE, ALBERTA.

An instructive paper will be presented on March 4th, 1915, to the Canadian Society of Civil Engineers, by A. C. D. Blanchard, Mem.Can.Soc.C.E., dealing with the design, construction, operation and maintenance of the recently completed sewage disposal works for the city of Lethbridge. The novel features which it possesses have been already presented to our readers in an article in which the design was described in detail in our issue of February 4th, 1912. Editorial reference was also made in this issue to the sedimentation tank, which, by virtue of this, the first installation of its kind in Canada, was called the Lethbridge tank.

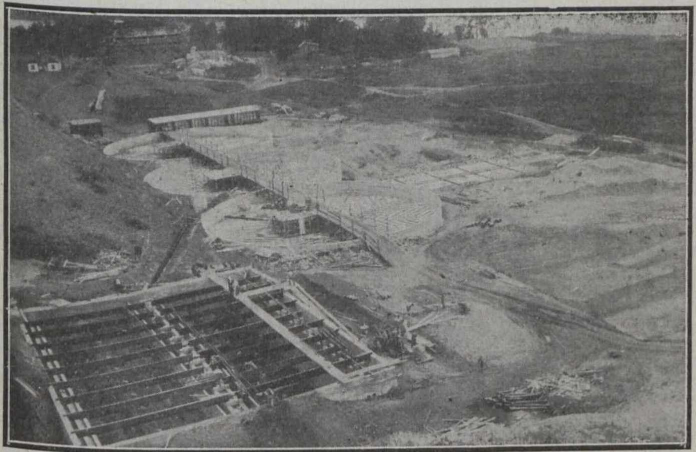
With the exception of the sedimentation tank, there is nothing unusual about the other parts of the plant. The sewage of the city is being treated by preliminary screening, sedimentation, sprinkling filters and further sedimentation, after which it is subjected to chlorination. The detritus tanks have each a volume of 675 cu. ft., a liquid surface of 120 sq. ft., and a screen area of 52 sq. ft., the screens being of ½-inch wrought iron with ½-inch openings. From a collecting channel the sewage passes through two 18-inch pipes controlled by penstocks into the distributing channels of the duplicate sedimentation tanks. Each tank is 100 ft. long and 32 ft. wide. Twenty-four-inch I-beams support a 6-inch concrete roof, except above the channels, which are roofed by removable creosoted wood plank. Two distributing weirs extend the entire length of each tank, the first with a slope of 2 inches in its 100-ft. length, and the second being level, the intention in the latter instance being to equalize the flow so that the velocity of the liquid across any portion of the tank will be uniform. The sewage is required to pass through 4-inch apertures at intervals of 3 feet in a 6-inch concrete baffling wall, before reaching the collecting weir. The collecting channel averages 15 inches in depth and has a slope from end to end of 6 inches.

The distinctive feature of the Lethbridge tank is an apron of ¼-inch wire glass laid on 4-inch I-beams spaced 5 ft. on centres, upon which apron accumulate the particles capable of settling during the period of flow in the tank. When they have gathered in sufficient mass the solids slide down the slopes and under the glass apron into the sludge compartment. The slope of this apron is 1:3.3. It covers the sludge chamber completely.

For maximum capacity, the period of flow through the tank is practically 2½ hours, and the maximum average velocity of flow is .037 ft. per second. The following are given as the total contents and measurements of the various compartments: Total capacity, 34,000 cu. ft.; sludge capacity, 10,133 cu. ft.; capacity above apron, 16,475 cu. ft.; capacity between sludge line and apron, 8,000 cu. ft.; liquid surface area, 3,200 cu. ft. There is a storage provision for a period of 3½ months, based on the separation of 3½ cu. yds. of liquid sludge to each million gallons of sewage.

Each compartment has 4 hopper-shaped bottoms, a separate sludge valve being provided at the junction of the four slopes in each bottom. Two slopes of each hopper have a pitch of 1:2 and the other two slopes have a pitch of 1:3. The sludge valves open on a 6-inch cast iron pipe line running lengthwise with each tank, and meeting beyond the wall of the tanks, a 9-inch pipe line leading from the detritus tank sludge chamber directly to the sludge beds. The stems operating the sludge valve extend through the glass apron to the roof and are exposed for use by removing small cast iron covers sét in the concrete roof. One-inch water services direct from the city force main are connected to the end of each line of sludge pipes for the purpose of flushing, if desired.

The collecting channel between the sedimentation tanks discharges into a cast iron pipe with a bellmouth on a level with the bottom of the channel. The sewage in entering this bellmouth is subjected to a natural vortex motion for the purpose of giving the liquid a chance to draw down and absorb all the oxygen possible. This pipe,



**General View, While Under Construction.**

which is 21 inches in diameter, discharges into a distributing chamber in which are located the three controlling valves for each of the three filter units. The liquid passes through to either of the filters by means of 12-inch cast iron pipes laid along the bottom of the filter floors to the riser pipes at the centres of the filters. The sprinkling arms cover a circle, having a diameter of 108 feet, and are probably the largest yet installed in this country.

There are three filters, with concrete floors and walls and with open tops. They have a total area of .62 acres, and an average depth of 7 ft. of medium, the minimum capacity of the sprinklers being 133,300 gallons to each distributer, the maximum capacity being five times the amount. The medium consists of a mixture of broken brick, hard furnace slag and gravel, sizing from 2½ to 3 inches on the average. The slope of the floor is 6 inches in 54 feet of radius.

The humus tanks, into which the sewage flows after filtration, are also constructed in duplicate and adjacent to the filters. Their purpose is to collect further settling of the partially purified liquid. The tanks have a capacity of 4,120 ft. Each is drained through one central sludge valve. Floor, walls and roof are of concrete. The liquid is drawn off over weirs 12 inches wide into a bafflerace leading to the float chamber and the chlorinating house. Measurements of each humus tank are as follows:—Capacity, 4,120 cu. ft.; liquid surface area, 1,200 sq. ft.; length of influent and effluent weirs, 80 ft.; distance apart of influent and effluent weirs, 15 ft.; difference in elevation of influent and effluent weirs, .1 ft.

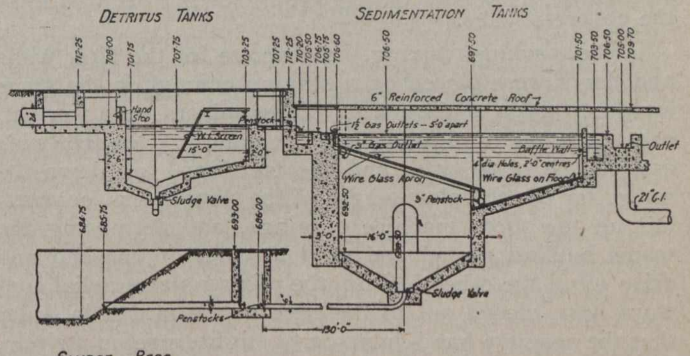
In the chlorinating house there is an automatic regulation of the chlorine solution, effected by a lever regulating the supply and operated by the float in the float chamber.

The sludge beds, each with an area of 480 sq. ft., are simply rectangular excavations in the soil.

For further details respecting the design of the entire plant the reader is referred to the article mentioned above.

**Construction.**—According to Mr. Blanchard's paper, construction work began with the excavation for the sedimentation tank, about 6,000 cu. yds. being removed. This excavation, with the exception of two or three feet of surface soil, was hard clay, requiring no shoring or timbering.

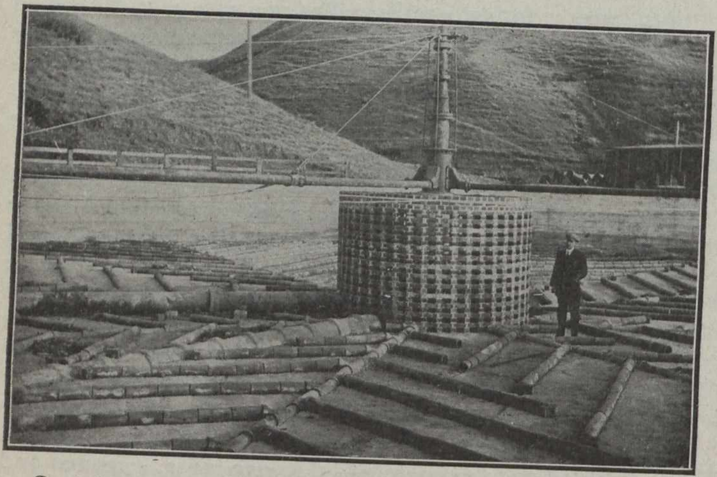
The concrete was first started by running the footing for the walls and erecting on them sectional forms of dressed boarding. The forms were placed the required distance away from the face of the shale wall and braced from the parallel wall 16 ft. distant, the same bracing thus serving for two walls. The concrete was poured in layers of from two to three feet, a complete circuit being made each day. No reinforcement or joints of any description were introduced, the 18-ft. walls being 3 ft. and 4 ft. thick at the bottom and tapering to 18 in. at the top. The 5-ft. walls were a uniform thickness of 18 in. For a small portion of some of the walls near the top 2-ft. square metal forms were used. These were found easily and quickly handled, left a good face, but were awkward when the length of the wall was not a multiple of the size of the form, or when the intersecting floors were not square with the surface. In laying the hopper floors a runner was laid down each angle, and after laying the concrete side, these were extracted and the spaces were filled in a week or so later. This was found satisfactory where the foundation was hard shale. The floors were 12 in. thick of 1 : 2 : 4 concrete laid in one layer, screeded and finished with a steel float. The aggregate used for all concrete was river gravel obtained close to the site; occasionally sand was screened out, but usually the natural gradings with slight adjustment were found to be sufficiently accurate. The 6-inch concrete roof was reinforced with No. 3 mesh 10-gauge expanded metal. The concrete was 1 : 2 : 4 laid in one layer, and finished with light tamper and wooden float, the cribbing being partly sup-




**Sections of Detritus and Sedimentation Tanks and Sludge Beds.**

ported from underneath and partly hung from the 24-inch beams carrying the roof. The foreslope was composed of a 9-inch concrete base with ¼-inch wire rolled glass 2 feet square laid on the surface, and embedded in a rich mortar of cement; no clips were found necessary. The glass apron was carried on 4-inch I-beams at 8.5 lbs., with 5-ft. centres let into the wall at the upper end and supported on concrete piers 18 inches high at the lower. On the top flange of the beam creosoted wood strips were fixed with small iron cleats sunk flush with the wood. The ¼-inch wired glass in sheets 5 ft. x 3 ft. were laid on these strips, embedded with a mixture of litharge and white lead. Each sheet was secured along the lower edge with two copper clips 3 inches wide secured to the wood. Thus, each sheet was supported entirely independent of the other.

In building the circular walls of the filters, templates, convex and concave, cut to the proper circle, were placed on top of the foundation, which had been run in trenches. The boxing of placed boards bent horizontally and attached to upright studs was kept in position by the templates at the bottom, and at the top by distance pieces, and securely wired through the thickness of the wall. The boxing was braced from the inside only by means of



**Sprinkling Filter Drain System and Central Post of Distributing Mechanism.**

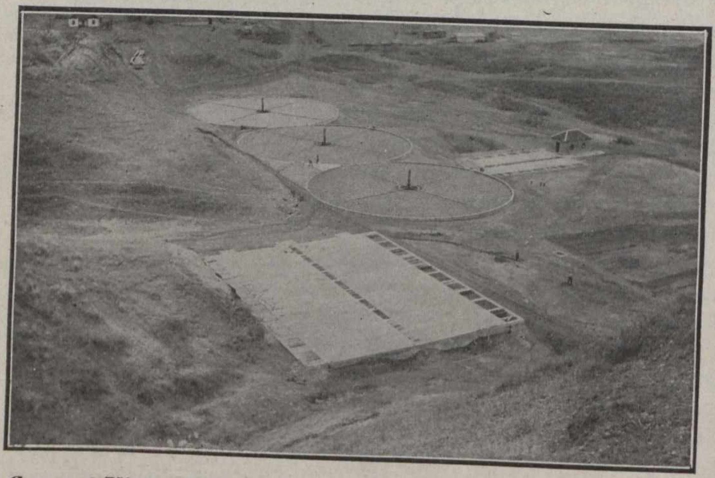
perpendicular pieces of 2 in. x 6 in. placed at a distance of about 7 ft. from the cribbing opposite every second stud and tied into the studding at the top and bottom, and one diagonal brace to each. This method of construction fulfilled the double duty of efficient bracing and also of providing bents for the gangways from which to pour the concrete walls.

The machines mixing the concrete for the filter walls and floors were placed on a staging erected on the same level as the top of the walls. Three mixers were worked, one at the centre of each filter. A gangway ten feet wide and on the same level, and 330 feet long, ran down the centre for the complete length of the three filters, connecting up the three machine stagings, and permitting the teams hauling gravel and sand to enter at one end and drive off at the other. From the mixing stage radial runways were placed out to the edge of the filters, in order that the concrete hand-dump-carts might travel in a circle. The proportions of materials composing the concrete for the floors and walls were the same as for the tanks, the floor being lightly tamped and screeded off. In each filter eight lines of 4-inch vitrified open jointed branch pipes were embedded half their depth in the concrete. These lines ran from the circumference to the centre, and had a fall of 6 inches. The portion of the floor lying between the lines of branches was built with a slight cross fall and drained with 4-inch butt-jointed field pipes.

In placing the medium, the overhead gangway, and especially constructed wagons were used. The medium for filters No. 1 and No. 2 was first broken to the required sizes, selected and shaken free from dust and small particles by means of coke forks, and carefully placed in the wagons. The bottoms of the wagons were of an inverted "V" shape, and projected beyond the sides and over the wheels. The sides were hinged at the top to the two ends, allowing the cart to be dumped on to chutes at each side of the gangway. Each chute terminated on a portable platform from which the medium was taken and spread by means of wheelbarrows. Any medium smashed in dumping was shovelled off the platform back to the gangway. The medium for filter No. 3 consisted entirely of screened gravel, and was carted from the borrow pit directly into the filter.

**Operation and Maintenance.**—Operation of the plant was commenced in the month of October, 1912, and the apparatus was given a fair trial before heavy frosts set in. Some difficulty was encountered in obtaining a proper seal in the drums of the rotating filters, and it required a considerable length of time to find out the exact cause of the defect. After careful examination it was found that the upper portion of the drum had developed a very small leak which allowed the air gradually to escape, with an ultimate loss of the seal. This was easily repaired and continuous running of the filter units was then possible.

After a month or two, however, it was noticed that a very considerable amount of colloidal matter was accumulating in the revolving arms of the filters, and it was found necessary to employ a man for a large portion of the day to keep the small holes in the filter arms from choking. After several endeavors to find the cause of this trouble, it was observed that when the accumulation in the detritus tank increased the accumulation in the filter arms became more objectionable. Since no adequate means were provided for removing the detritus from the bottom of the tanks, it was decided to flush the accumulating sludge out into one of the sludge beds. This process was then adopted at regular intervals. It appeared, however, that if the detritus tanks were sufficiently shallow to cause practically all the matter which would not pass through the screens to go over into the sedimentation tanks and there be deposited as sludge, the liquid reaching the tanks would be more uniform in consistency, and



**General View of Plant Completed and in Operation, Showing Sedimentation Tanks in Foreground, Sprinkling Filters in Centre, Humus Tanks and Chlorine House to Right of Filters, Sludge Beds at Extreme Right.**

the process of treatment improved. An alteration of the shape of the chambers was then considered, providing for the filling up of the lower portion of the detritus tanks with stone or gravel, and the building in of a concrete floor, the screens being sloped sufficiently to give the proper area for the capacity of the plant. By doing this it was hoped that the difficulty in connection with the clogging of the filter arms would be obviated, and the nuisance caused by the flushing of the fresh sludge into the sludge beds eliminated. The particular design adopted for the detritus chamber was felt to be the most troublesome feature of the plant.

After the plant had been operating for a month or two, severe frosts were experienced, which caused considerable ice to form on the top of the exposed filter beds, and on one occasion, after a snow fall of some six or eight inches, one of the filters was started up with the expectation that the warm sewage would melt the snow. Unfortunately, however, the weather suddenly became colder, and instead of the snow disappearing, it was changed into ice, and it was found impossible to get rid of this accumulation until it was removed entirely from the filters. This was the only time that there was any trouble with the revolving arms on account of the accumulations, and it should never recur, as the operator has had the benefit of past experience. Throughout the winter months ice appeared on the surface of the filter beds during cold weather, and gradually built up into circular ridges between which were narrow openings, these openings, of course, appearing directly in the line of spray from the filter arms. No attempt was made to measure the efficiency of the beds under such conditions, but it is hoped that a proper laboratory will soon be installed with a chemist in charge, and analyses made of the effluent not only from the filters, but also after passing through all stages of purification. After running the plant throughout the winter months, it was found possible to obtain continuous operation of the filters with their machinery and surfaces exposed to the weather. In the following summer it was established that the fly nuisance was not a serious factor in so isolated a position. The construction of costly roofs over the filter units was therefore abandoned, although provision had been made in the design of the filter machinery for the support of roof trusses from the central posts.

The filters are all thrown into use by the opening of penstocks by hand, which would appear to be a better arrangement than automatic control, for the reason that the winter conditions are sufficiently severe to cause freezing in the drums of filters which might be thrown out of commission for any length of time unless these were drained. Every time a filter is shut down, therefore, the operator proceeds to drain out the drum forming the air seal.

The difference in level between the surface of the liquid in the sedimentation tanks and the top of the riser at the centre of each filter gave considerable trouble when a large volume of sewage was delivered to the plant. There was a noticeable surge in the distributing chamber at the entrance to the filters, and frequently the top of the riser would overflow, thus discharging unfiltered sewage into the humus tanks. It was deemed advisable to make an overflow from the distributing chamber, and this was accomplished by cutting through one of the walls of the chamber and inserting a 12-inch pipe delivering into a trough laid on the top of the filter medium between filters Nos. 1 and 2 at a place not reached by the distributing arms. This arrangement seems to give satisfaction, and once or twice each day there is a surge which is efficiently taken care of in this way.

The design provides for a capacity of two million Imperial gallons daily for a population of 20,000 inhabitants using a maximum of 100 gallons per head per day. The total cost of engineering and construction amounted to $84,000, or $4.20 for each unit of population with the plant operating to capacity.

The general design of the plant was prepared by Mr. T. Aird Murray, consulting engineer, and carried out by Mr. A. C. D. Blanchard, then city engineer of Lethbridge. Construction work was supervised by Mr. W. A. Adam, assistant engineer. Messrs. Hotsen, Leader and Good were the general contractors. The filter machinery was furnished by Adams Hydraulics, Limited, York, England.

## THE ENGINEER'S INTEREST IN DEEP WATERWAYS, WITH SPECIAL REFERENCE TO THE MISSISSIPPI RIVER AND ITS TRIBUTARIES.*

**By Harry N. Wagner, Reading, Pa.**

We cannot speak of flood protection or river control without due consideration of the conservation of other resources. Streams form a large part of our vast store of resources, and as they vary widely in beauty and magnitude so they may also vary in their constructive and destructive characteristics. What can be more beautiful than a peaceful blue river noiselessly wending its way to the ocean, furnishing means of transportation, power and what not at every turn? and, on the other hand, what can be more unsightly and destructive than the same stream at flood stage spreading havoc, ruin and death in its wake? Like all other possessions which we enjoy, our streams, large and small, need care, protection and control.

One of the greatest problems before the American people to-day is the conservation of natural resources. These resources have been given us for our enjoyment and comfort and to a large extent are considered necessary for our very existence. Our forefathers may have been negligent in that they did not conserve these great gifts for their posterity, but only a few decades have passed since great quantities of the products of our forests and mines were prepared for the markets by utilizing the "lion's share" and leaving the remainder to be wasted. These rejected portions are now being recovered in many ways, such as the working of abandoned mines and waste piles therefrom. The major portions, however, are beyond redemption and it behooves the thinking people of the present generation to recover the remnants and preserve them, together with those which are yet in their virgin state, for the comfort and enjoyment of ourselves and our posterity. This stupendous task requires the co-operation and energy of the foremost thinkers in all walks of life. Legislation without the co-operation of engineering skill will accomplish little, neither will a combination of these be sufficient without the support of business interests and of those upon whom falls the burden of bearing the expense. Unwise legislation which catered to private interests, in the past, is in a great measure responsible for the skepticism of the public in supporting any works for national or state improvements. Because costly river improvements have been made out of public money for the benefit of a few mine operators in certain

*Presented before Section D of the American Association for the Advancement of Science at the Philadelphia meeting, December 30-31, 1914.

localities, is no no reason which justifies the condemnation of all public improvements which make for the conservation of our vast resources, any more than the "high financiering" of a few American railroads should be a just cause for setting up a bitter feeling of the public against all common carriers. We seem to have reached a climax in unjust legislation which caters to private interests, boodling, high financing, fraudulent mining schemes, etc., which has produced a state of unrest and skepticism among the honest and fair-minded people of our country. But we are now entering upon a new area, and while we may not be the last of the generations to be visited by the sins of our fathers, yet let us hope that these experiences, however costly they have been or will be, will guide us in choosing the servants of the people in future legislation. There never was a time in the history of this great country when the responsibility for the proper use of our resources rested more heavily upon its people than the present. There should be concerted action on the part of all who are interested in our future welfare. Great undertakings cannot be successfully and economically carried to completion without thorough preliminary studies and adequate provision for financing.

The conservation of our natural resources covers such a large field that an attempt will be made here to touch upon a few points only which bear directly upon inland waterways. There has been a great amount of publicity given to this subject during the past decade by the associated press as well as through our engineering journals and engineering society proceedings. The question now arises upon whom rests the responsibility of the proper guidance of the servants of the people in appropriating vast sums of money to be judiciously expended in carrying these extensive projects to completion. The engineering profession has contributed practically all of the data which we now possess relative to this all-important subject, and it would seem that upon the engineers of our country rests the responsibility. In all of our great developments such as our transcontinental railroads, canals, etc., the engineers were the pioneers and upon their judgment and counsel rested the future of the project.

Someone has said, "An engineer's reward lies in his promotion." Many engineers would prefer to change this phrase to "An engineer's reward lies in the satisfaction of doing great things." The engineers to whom will be entrusted the task and honor of the proper guidance in the expenditure of the vast sums of money necessary for this work will find great reward in having served their fellow men in the saving of life and property from the destructive agencies of floods as well as in providing a means of cheap transportation by water and utilizing the energy of streams for manufacturing and other purposes.

Certain sections of our country have been calling for federal and state protection against floods, others for increased transportation facilities in the way of deep waterways, and practically the whole population have awakened to the necessity for immediate action in the matter of conserving our resources. If this problem is to be solved from the standpoint of economy, and if the greatest "income" is to be derived from the investment, broad and well-developed plans must be made for carrying out all of these projects at the same time. Flood protection work cannot be economically and permanently completed without any consideration of the others, neither can canalization be economically done while flood protection is being postponed for the future. The matter of inland waterways to be used as a protection during times of warfare has received a great deal of consideration during the past few months, which has been largely due to our experience gained at the expense of those who are at present engaged in the great European conflict. It is a difficult matter to even estimate what the value of such inland waterways, which would provide passage for our largest war vessels, would be to the country in times of war. There can be no disputing the fact that these would be of inestimable value. It is not the intention, however, in this short paper to give a complete discussion of inland waterways, neither is it intended to give a general discussion on inland waterways as applied to protection of property from floods and the canalization of inland streams. The object of this paper is to cover a few points which bear directly upon the Mississippi River and its tributaries, namely, protection work which will reduce damage by floods and canalization of the main stream and the larger tributaries.

**Engineer's Interests Two-fold.**—The engineering profession will be interested in this great problem from the standpoint of citizenship as well as that of engineering. The layman can ordinarily judge a project of this kind only from the results which it produces, while an engineer is capable of judging it from its inception to its completion. When we consider that about forty per cent. of the entire area of the United States is drained into the Mississippi River and that probably more than one-half of the cultivated land of the country is contained within this drainage area we can form some idea of the magnitude of the feat to be accomplished. There is but one way possible for such a project to be financed. The United States government must appropriate large sums annually for years to come. This is a project which will outrival the Panama Canal in extent of cost and benefit to our entire population. In view of the great cost (and there will be a demand for like improvements throughout the other drainage areas) and diversity of opinion in regard to methods to be pursued, it would be unwise to delegate this work to a few engineers whose powers are limited and whose decisions might be influenced by political means. We need only to view a few projects of this kind which have been completed recently to justify our claim for more care in expending public money. The New York barge canal, now nearing completion, is an example of mismanagement due largely to selfish interests centered in Buffalo. The national engineering societies would gladly co-operate with the government in deciding questions of vital interest as they might arise from time to time. These societies are representative of the best engineering talent available and committees delegated by them would render strictly conservative and unbiased reports whenever called into consultation. The feasibility of canalizing a stream in connection with flood protection, power development or municipal water supply should be studied from every angle and should include a study of traffic statistics and conditions by experts in that branch of engineering. Power development and municipal water supply should receive like consideration. Such a body of engineers would safeguard the interests of the public and should not be actuated by personal motives, neither could they be dominated by politicians. It behooves the national engineering societies to enter this field with a solid front and to protest against extravagant legislation or methods of construction which are not in keeping with good practice.

**Relation of Floods to Storage Reservoirs and Forests.**—The commonly accepted theory regarding the influence of forests upon stream flow is that deforestation at the headwaters has greatly increased the damage due to floods. That the influence of forests upon floods has been overestimated by the public is plainly emphasized by Mr. H. M. Chittenden, M.Am.Soc.C.E., in an excellent and timely paper presented before that society, November, 1908. It is reasonable to assume, however, that floods are reduced in magnitude and that stream flow is more constant where the same are influenced by the presence of forests at the headwaters. In view of the fact that our timber supply is rapidly being exhausted it would seem to be a wise plan to re-forest the land as much as possible at the sources of streams and rely upon storage reservoirs, wherever necessary, to prevent disastrous floods.

The topography of the drainage areas is not all such as will afford large possibilities for storage reservoirs, and even where conditions are otherwise favorable for storage such is rendered prohibitable by property values. Much consideration has already been given to the storage possibilities of the headwaters of the Mississippi, and the Missouri has also great possibilities for storage. So far as the writer has been able to learn, the function of storage reservoirs in the minds of those who have been discussing this matter is to provide storage room at or near the source of the streams and thus prevent a combination of conditions which usually result in disasters. The combination of several conditions producing disastrous floods frequently occur over limited drainage areas and we have comparatively heavy loss of life and property such as has been experienced at Johnstown and Pittsburg, Pa., and to a much greater degree over the whole of Ohio, Western Pennsylvania and New York in March, 1913. If such a flood as that of 1913 should occur over the Ohio River basin in conjunction with a repetition of that of 1903 over the upper Mississippi and Missouri, the disastrous result over the Mississippi Valley at and below Cairo would be unprecedented in the history of the country, and if it were possible to have the above-named combination together with the condition which existed on the lower tributaries of the Mississippi in June, 1904, there would be a disaster such as has never yet been recorded in the lower Mississippi Valley. The objections which are usually raised in considering a combination of this kind are that we never have a combination of all the conditions on so many of the tributaries at the same time. However, in providing a system of protection it is wise to provide for the worst possible conditions if the finances will permit. The increased cost in construction and maintenance necessary to provide for extreme conditions would in some cases be justified, but while this phase of the subject may be clear in the mind of the designer, it does not always appeal to those who control the finances.

The feasible locations for storage reservoirs would be governed to some extent by local conditions resulting from the probable sale of power, water for municipalities, etc. The reservoirs on the tributaries should, in almost all instances, serve for purposes of flood control and power development, while many of them would, in addition to this two-fold service, assist navigation and supply water for municipal use. Another class of reservoirs (locks and dams) will be necessary for navigation, but these have little or no influence upon flood control.

A third class of reservoirs which has received entirely too little consideration is that of storage reservoirs adjacent to the lower Mississippi and especially at the junction of the tributaries with the main stream. A great many people are not aware of the fact that the Mississippi Valley from Cairo to the Gulf has the appearance at times of a great lake. Were it not for the levees this lake would cover many thousands of square miles. The grade of the Mississippi Valley from Cairo to New Orleans ranges from about 3 to 6 inches per mile. It is evident that with large volumes of water being poured forth by all of the tributaries at the same time, and with the main stream already at flood stage, this volume of water must be forced onward in its course into some storage reservoir or it will be forced higher and higher until the levees in certain places are over-topped and destroyed. To one unfamiliar with the destruction caused by a break in a Mississippi levee it is almost impossible to form any idea as to the extent of the damage. What may be a prosperous plantation to-day may be the scene of disaster and ruin to-morrow. During extremely high water on the Mississippi River it is the rule rather than the exception to patrol the levee system in order to protect the levees from being cut by selfish property owners on the opposite side of the river in order to reduce the stage of the water and thus protect their own property against possible destruction. Natural storage reservoirs exist at the present time at the entrance of the tributaries to the main stream. At low-water stage the Arkansas and the White Rivers empty into the Mississippi through the former mouth of the White. During flood stage on the Mississippi, and with a comparatively low stage on both the Arkansas and White, it would be impossible to locate either of the tributaries within twenty miles of the Mississippi were it not for the timber which defines the banks. This storage basin covers an area some twenty miles square bounded by the levee south of the Arkansas, the levee north of the White, the levee on the east bank of the Mississippi and the prairie to the west, situated between the Arkansas and White. At high stage the depth of water over this area ranges from 10 to 25 feet over the entire area. There is probably again as much water stored in this basin on the lowlands bordering the two tributaries farther up stream.

The tendency among property owners adjacent to the Mississippi River is to oppose the location of new levees constructed under the supervision of the Government which would throw their lands outside of the levees and expose them to overflow. A levee constructed so as to protect a plantation from overflow would, of course, be a matter of much private gain to the planter, while if constructed so as to expose his plantation to overflow there would result an equal financial loss. So far as the writer has been able to learn, it is not customary for planters to receive any remuneration for their land which is exposed to overflow by reason of the construction of a new levee, and it is therefore evident that many new levees have been wrongly located on account of objections which have been raised by those financially interested. It is true that some of the most valuable and productive land in the United States is protected from overflow by the Mississippi River levee system, but it is also true that there are thousands of acres of timber land which could be utilized to good advantage in providing storage room to lower the crest of Mississippi River floods. In some cases valuable cultivated plantations would necessarily be exposed to overflow but owners of these could be well remunerated for their property and the country in general would greatly benefit by the transaction. Thousands of acres of low lands are covered with timber which would not be materially damaged by being thrown outside rather than being protected by the levee. In the writer's opinion the problem of protection of the Mississippi Valley from occasional destructive floods will never be solved until additional storage room is provided to lower the crest of these extremely high waters.

**The Levee System.**—A history covering the development of the levee system of the Mississippi Valley would be interesting reading. On the banks of many rivers and bayous, large and small, are found evidence of this development. Small levees constructed by planters for their private protection have long since become obsolete. It was found to be necessary to construct one large levee to protect the entire area beyond either bank of the river. Not a few planters of mature age and judgment in different parts of the Mississippi Valley informed the writer that in their opinion the people would be better off if there never had been a levee constructed. Without the levee system the soil was formerly enriched by the sediment deposited by the annual overflow. They also stated that the flood water was distributed over such large areas that the damage to crops was but slight. Very good crops are being raised outside of the levees in spite of the fact that there is always danger of the crops being entirely ruined by the traditional "June rise."

Whatever the arguments may be for or against the levee system, the levees are here to stay and the question of vital interest to the present generation is, how shall they be constructed and maintained so as to protect this large fertile valley from periodical overflow. Disastrous results do not frequently occur from a break in the levee system, but when they do occur they usually reach such proportions that steps should be taken to reduce the number of floods to a minimum, and this result will be obtained by creating additional storage capacity through the use of a part of the comparatively worthless low lands. Those of us who are unfamiliar with the Mississippi levee system would probably expect to see a levee on each bank of the river plainly visible from a steamboat in the main channel, while as a matter of fact, the levees are seldom visible except where the river has shifted its bed so near to the levee as to place it in danger of being destroyed by the caving bank. New levees, when properly located, are seldom placed within a mile of the river bank, except where property is extremely valuable or for the protection of a town or city, in which case the river bank must be protected from the action of the current.

**Bank Protection.**—Caving banks on the Mississippi River and some of its tributaries, particularly the Arkansas and the Missouri, have been the source of great expense in connection with the levee system. If the levees could be built and completed for all time, with the exception of additional raising and reinforcing at times, they would not be a matter of such great concern as they otherwise are. The lakes throughout the lower Mississippi are positive evidence of the shifting of the bed of the river. Planters who were at one time wealthy have been reduced to poverty because of the changing condition of the streams due to caving banks. A trip on a Mississippi River steamboat will convince one of the facts in this case. Remnants of the old levees may be seen and the progress of the development of the levee system may be studied step by step by the observer as he notices these remnants on the caving banks. Many methods have been employed in attempting to control this changing of position of the rivers. As yet little bank protection work has been done on the Mississippi, except at excessive cost, which can be considered permanent work, and so long as bank protection work does not reach a higher stage of development it is essential that the expensive new levees should be located a sufficient distance back from the river bank to insure their protection from the encroachment of the river for many years to come. The control of the Mississippi River is a problem of such magnitude that bank protection work has been done at only a few places where cities were threatened with being cut off from water transportation and where the damage due to the changed location of the channel would have been greatest.

**Canalization.**—It is rather doubtful if the great task of maintaining the Mississippi River navigable to a depth of, say, 9 feet, as proposed, would justify the necessary expenditure if canalization alone were to be considered, and a general scheme of bank protection on account of its great cost would be justified only in connection with canalization. Canalization would assist in reducing flood damage by carrying off the flood waters more rapidly. Bank protection which would be necessary as a part of the general scheme of canalization would also serve as a protection for the levee system. If the Mississippi River can be kept in approximately a fixed location even at great first cost and a reasonable cost of maintenance the expense will be justified. With an approximately stable location of the river assured, the cost of maintaining a levee system would be greatly reduced since the levees would no longer be exposed to caving banks. The Arkansas River some ten years ago had but one line of boats operating on it, and during the greater part of the year (except during high stages of the river) specially constructed boats were used which could navigate on a minimum depth of three feet of water. Navigation on most of the tributaries (except possibly the Ohio) is probably about on a par with that on the Arkansas. Canalization should not be undertaken until after systematic and thorough studies have been made and until it can be shown that it is a paying proposition to the country in general.

Many people are now advocating the control of flood waters by reservoirs, proper forestation, levees, channel improvements and other works, all of which are recognized aids in flood protection, but their effectiveness can be determined only by careful study of all conditions. Many serious floods are now being caused by encroachments upon river banks, drainage ditches, etc. In different parts of the drainage area in question vast areas have been covered with drainage ditches. Where formerly the precipitation from these areas reached the streams very gradually it is now delivered in large volumes and is one of the direct causes of the disastrous floods. In view of these floods which have occurred recently throughout different parts of this drainage area, there should be no further delay in establishing a complete system of river control in which there should be systematic co-operation between the National Government, the states, the municipalities and local interests.

## HIGHWAY ENGINEERING INSTRUCTION AT CORNELL UNIVERSITY.

In view of the growing demand for instruction in highway engineering, a short course will be given from February 15 to 20 inclusive, at Ithaca, N.Y., by the college of Civil Engineering of Cornell University, with the co-operation of the New York State Highway Department, the Federal Office of Public Roads, and a number of expert highway engineers from other organizations. A series of practical, instructive lectures will be given covering the fundamental principles of highway engineering. Practical highway engineering experts will discuss the most recent practice and developments of each type of road construction and maintenance and the erection and care of highway structures.

## BUSINESS ETHICS OF THE MINING ENGINEER.

Students and graduates of Queen's University School of Mining were favored on December 15th with a most interesting address upon the occasion of their annual dinner. The speaker was G. G. S. Lindsey, K.C., president of the Canadian Mining Institute, and his address was given in response to the toast "The Engineering Profession." We extract from it as follows:—

Professional ethics differ in no respect from some of those promulgated on Mount Sinai. No human rules have as yet been laid down which are binding, and which have been accepted as the test to which all mining engineers must subscribe as the standards of their profession. And because there is no law, the greater is the moral obligation on the engineer to fix high standards and voluntarily to live up to them on all occasions. Legal sanctions will come, perhaps soon, prescribing what is right in some matters now left to conscience. Among the first of them will be those which provide that whenever the public is asked to subscribe for mining stock it must bear the hall-mark of a qualified engineer.

The constituency of the mining engineer is the mining community, and while his endeavor is always in the direction of elevating the industry he serves to as high a commercial plane as is possible, yet it is true that the constituency to which he devotes his life's work is one in which the speculator largely predominates, and necessarily so. That the public will speculate is no fault of his. The community should welcome the man, who on chance, puts his money into what becomes a fruitful mine. It has been said that "Mining is, was, and will be to the end of time a sane speculation or a silly gamble, but never an investment; the element of risk is never eliminated and any statement to that effect, as regards a particular mine, is made by a charlatan or a fool. To part of this statement not everyone will subscribe. The most serious objection made to it was that it was too frank an admission of the truth. But as successful mining is based on the application of science to that industry the nearer we get to the truth, the less danger we run, and the closer we come to solution of the mining problem, how to dig ore and make it pay.

Of the two capacities in which the mining engineer may be engaged whether as mine valuator, or to advise on development, equipment and operation of mines and metallurgical works, the former alone calls for attention; because in connection with the other what were formerly matters of conscience such as taking what was called the "customary commissions," a percentage paid on the price of machinery and supplies recommended by him, is now penalized by statute. As a mine valuator, the engineer will find his duties are divisible into two sets; those business methods concerning which a bargain can be reached satisfactory to all concerned, consistent with thorough and honest work; and those business ethics in which the exercise of his moral faculties is called into play. To the latter only I intend to direct your attention.

When a client selects an engineer, such reputation as the engineer has gained is assumed to have a market value and the price is offered him on that basis. Once engaged, the engineer's fiduciary relation, outside of his duty to himself, is two fold, he is trustee for his employer as well as such of the investing public as may be asked on the strength of his report to invest in the shares of the company for whom it is made. The engineer should therefore never make a report for a contingent fee, a fee in stock, which depends for its value upon his report in creating confidence in the public mind. Such conditions cannot but influence the judgment of the maker of the report.

When outfitting, the question comes up, what part of the engineer's equipment can be charged to the client? The engineer is assumed to be equipped and outfitted for the work pertaining to mine examination. A charge should only be made for such equipment as is either consumed in the work or returned to the employer. If special equipment is needed for the particular task, the client must provide it.

On the journey the engineer is entitled to first-class passages on trains and boats and to the best accommodation at hotels. But the expense account is not one which admits of personal gain. It is always desirable for him to travel as a gentleman and not appear cheap in any way. But to travel by one class and charge for a higher is petty larceny. Opinions differ as to the spending of money on entertainment for the purpose of obtaining pertinent information, and although the engineer is sent to secure information and trusted to use his discretion, it is better not to do this at the expense of the client unless it is so agreed.

The engineer's examination may indicate that the shares should be worth more than they are selling for on the market and he asks himself: Is it fair to buy the company's shares before my report is turned in, or, if not, is it right to do so afterwards? This means buying shares on information gained at the client's expense. To use his broker before advising his client of his conclusions would be unpardonable. The man of capital does not employ the engineer with the idea that a business trust is to be turned into a personal coup. As was said of the contingent fee, personal interest constitutes a bias in the engineer's opinion. An engineer cannot mix up in a stock deal at the time of reporting without directly laying himself open to the imputation of dishonesty. It is better, too, for the engineer not to buy shares after his report is in. It may be that his buying or selling of shares would work a distinct injury to his clients as he may not be informed as to the object of his employment. It is better on the whole to leave the stock market entirely alone when engaged in confidential work of this nature. But it may be asked: should an engineer be precluded from buying a good stock because his examination and personal knowledge shows it to be good? must he always buy stock in something he knows nothing about personally? Is it not an excellent way of showing his confidence in his own judgment, to buy the shares? The confidential relation of engineer and client does not end with turning in the report; and a conscientious man will therefore neither buy nor sell shares. If it be done with the knowledge and consent of the employer, there is less objection. But the unwisdom of taking shares even under these conditions is well illustrated by what has actually happened. The shares go up, can the engineer sell when he thinks they have gone high enough without affecting his employer's position? In the case of Yukon Gold, while the owner was making a market price for the shares, the engineer who had made the report was selling. The engineer's inbeing a seller must affect the market. Whatever the propriety of the owner's course, the engineer was using information he had been paid to give his client to the client's disadvantage. In any case such shares are dangerous to the young engineer who has not learned that stock manipulation is one thing and the value of stock based on the merits of the mine is another thing and not necessarily in accord. The stimulus of a share gamble is the most insidious lure he faces in the early stages of his career. A good authority has said, "it has spoilt many fine fellows, it has ruined twenty times as many good engineers as it has enriched."

Being in a district, it is not legitimate for the engineer to take advantage of his presence there to examine and perhaps option mining properties for himself, or to examine and report on properties for others, even though no time is lost that properly belongs to his employer. It certainly is not legitimate to take advantage of his presence in a district to report on properties for other parties in the absence of specific agreement to that effect. Apart from such questions as possible competition, he is there on his client's money. It is proper and advisable to see as much of a district as possible, but not to use the information for personal gain; if the engineer's examination shows that the properties in the district are of value the information belongs first to his client. The acquisition of property or options over property on his own behalf would be liable to severe criticism, and place the engineer in a very false position, even if acting in perfect good faith. An engineer returning from the Portland Canal where he has made an examination finds himself at Prince Rupert and no boat due for a week. He takes a trip to a nearby district, examines and options a prospect paying all expenses himself and returns in time for the boat. His clients have lost nothing, but as they have paid the expense of his trip to Prince Rupert they should have the opportunity to take the prospect. If after full disclosure and report the client consents to his keeping any part of what he has got then it is quite proper to do so.

When the engineer has returned home he is concerned to know, if he may properly publish in technical periodicals a description of the district visited, giving general information of the conditions obtaining there, the topographical and geological features and conclusions concerning the possibilities of successful mining. This is a question for his client, not for himself. It is in all cases proper to ask permission to publish articles the material for which is gathered at the expense of another. All general information on any district has an important bearing on any investment in that district. This information is the exclusive property of the client until such time as it no longer concerns his interests. When he permits it, is soon enough to give it to the public.

The answer the engineer is to make to the questions submitted to him necessarily depends on the form of the questions. The man who desires a report wants to know whether the information obtainable justifies his putting up the money that is asked. The demand is for something more than a judgment which hedges. The responsibility should be faced if a judgment is required on the commercial question involved. If an opinion can be expressed in one word, he should use it, but if he can't he should say so. He is entitled to say he does "not know," when the conditions are such as to leave the matter in doubt. He may condemn a substantially good mine being unable to get sufficient information to warrant a favorable report, and will be right in doing so. The positive answer should be given only when all the conditions justify it. If there are any reasonable doubts, they should be expressed, leaving the client to take the risk.

Every form of disguised advertising is to be avoided. This is an age of commentary, but many of the reviews of professional work to be found in our literature to-day on the subject of mining engineering have for their purpose only the aggrandizement of the reviewer. This serves no good purpose and stamps the man. It fails in its object —not a very noble one—to bring the writer into prominence at the expense of the more proficient. An engineer is entitled to just such standing as his merits justify, and he is unworthy who seeks notoriety through the medium of criticism of honest and creditable work.

Adherence to such a code of honor as I have endeavored to outline should bring success to the young engineer. A fine sensitiveness is rarely appreciated at its value by those who employ professional services, and confident assurance often commands respect where modest merit is sometimes distrusted.

## CANADIAN EXPORT OF ELECTRICITY.

Mr. W. Himsworth, Deputy Minister of the Department of Inland Revenue, Ottawa, gives the following statement of the amounts of electrical energy produced for export and for consumption, under the authority of the Electricity and Fluid Exportation Act, for the year ending March 31st, 1914:

At the end of the fiscal year which the report covers (March 31, 1914) the International Railway Co., Electric Distributing Co., Cedars Rapids Power and Manufacturing Co., or the Sherbrooke Railway and Power Co. had not yet commenced to export.

| | Units produced for export. | | Units produced for use in Canada. | | Total output of generating station or other source. | |
|---|---|---|---|---|---|---|
| | K.W. hours. | H.P. years. | K.W. hours. | H.P. years. | K.W. hours. | H.P. years. |
| Ontario Power Co. | 282,123,004 | 43,168.36 | 412,597,896 | 63,137.10 | 694,720,900 | 106,305.46 |
| Canadian Niagara Power Co. | 400,214,980 | 61,241.15 | 11,420,020 | 1,747.53 | 411,635,000 | 62,988.68 |
| Electrical Development Co. | 42,154,000 | 6,443.53 | 191,885,670 | 29,356.78 | 234,039,670 | 35,800.31 |
| Ontario and Minnesota Power Company | 21,649,327 | 3,306.60 | 868,856 | 132.95 | 22,518,183 | 3,439.55 |
| Maine & New Brunswick Electric Power Co. | 2,846,016 | 435.49 | 57,967 | 7.87 | 2,903,983 | 444.36 |
| British Columbia Electric Railway Co. | 395,831 | 60.58 | 114,697,400 | 17,511.56 | 115,093,231 | 17,612.14 |
| Western Canada Power Co. | 23,213,891 | 552.28 | 39,339,239 | 6,019.83 | 62,553,130 | 9,572.11 |
| Totals | 772,597,049 | 118,207.99 | 770,867,048 | 117,955.62 | 1,543,464,097 | 236,162.61 |

# Editorial

## RAILWAY ELECTRIFICATION IN 1914.

Considerable progress was made during the past year in the electrification of steam railways and in the establishment of new electric lines. While the year did not witness the completion and actual operation of many such developments in Canada, substantial developments were manifested during the year both in electrification projects themselves and in the systems in vogue.

Relating to the former, the year has much to its credit in the progress of the great undertaking of the Mount Royal Tunnel and Terminal Company, for the Canadian Northern Railway. When the section of line between the cities of Mount Royal and Montreal is placed under service it will be entirely under electrical operation. The power used will be 2,400 volts, d.c.; 1,200-volt motors will be operated two in permanent series; the contact circuit will be of the overhead catenary type, and 60-ton multiple unit cars will be used, drawn by 80-ton electric locomotives.

Much attention has been diverted to the west since the spring of 1914. The Canadian Pacific Railway is putting a 5-mile double-track tunnel through the Selkirk mountains, traffic through it to be moved by electricity. The details of the electrification system have not as yet been completely decided upon.

The electrification of the London and Port Stanley Railway in Ontario; the extensive radial projects of the Hydro-Electric Power Commission of Ontario, and other projects and extensions of a similar nature in Quebec, Manitoba and British Columbia, all go to show that the year's progress in Canada was encouraging and of far-reaching importance.

Direct current electrification has been adopted in the United States in several notable instances during the year. One of these, the Butte, Anaconda and Pacific, a 2,400-volt, d.c. electrification, has recently been referred to in these columns. The Chicago, Milwaukee and St. Paul is equipping a subdivision of its line with 3,000 volts d.c. Besides these actual installations, some very important experimental work has been done with higher voltages. A great drawback to the use of high voltage direct current has been the difficulty of building high voltage motors for car equipments. This difficulty seems to have been largely overcome since an equipment consisting of two 100-h.p. motors has been operated successfully from an overhead trolley with voltages from 5,000 to 7,000 d.c. The tests were quite successful, both as regards motors and control, and the further development of this apparatus will be watched with interest. The apparatus has thus far been tested only in an experimental way; it is, however, shortly to be placed in actual service on a branch line of a large system where it can be given a thorough test. If it is found that direct current at a voltage of 5,000 can be utilized commercially for railway purposes without increasing the cost of equipment or of maintenance to an undue amount, there is no question but that such an equipment, together with the mercury arc rectifier for substation use, will have a large field.

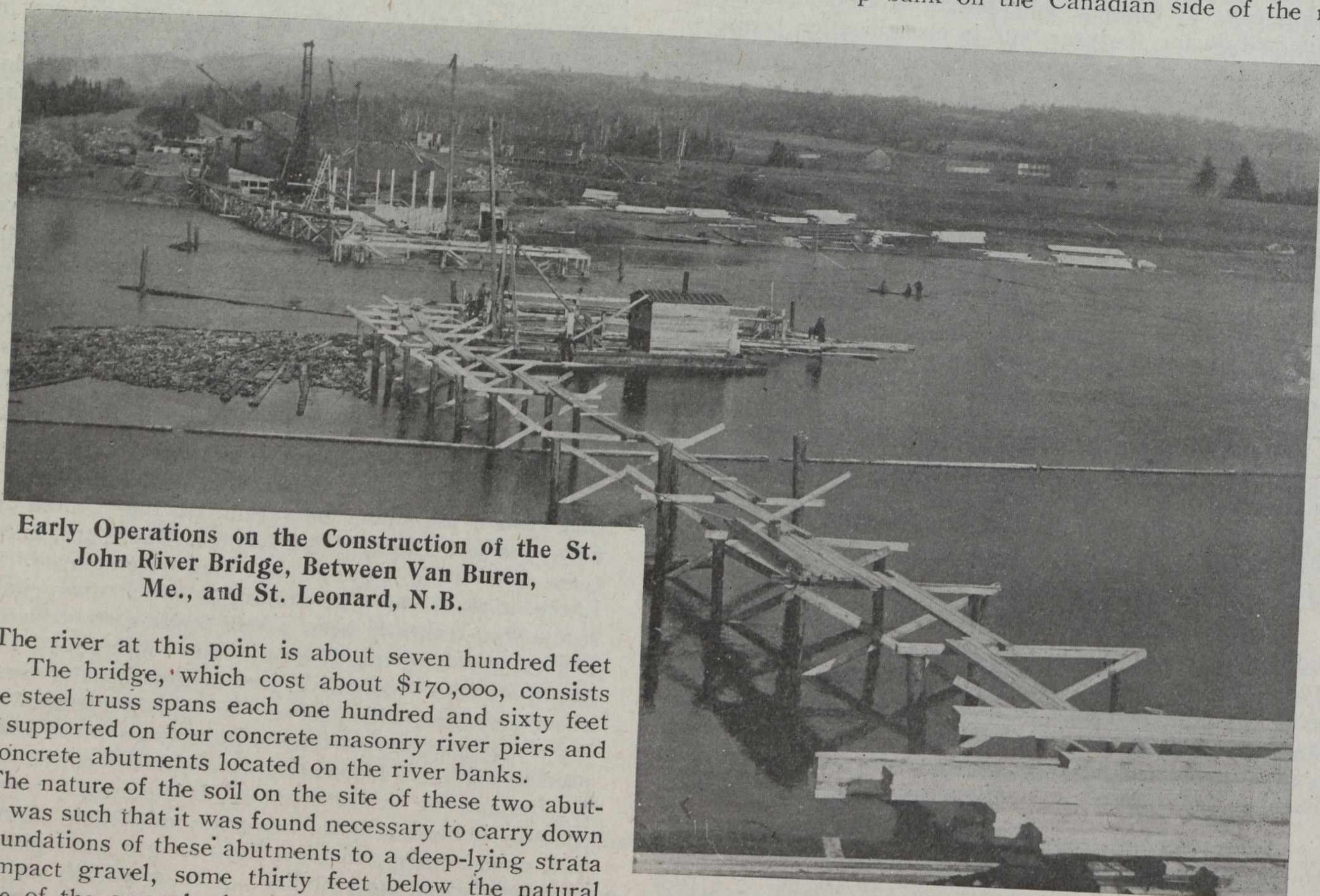
The mercury arc rectifier itself has been an object of considerable advancement during the past year, particularly in its adaptation to heavy railway service. This to such a degree that electric railway men are elated over the results achieved, and look forward with interest to its successful commercial application. It is applicable either to d.c. or single-phase a.c. systems. In the former its place will be in the substation in place of the synchronous converters and motor generator sets which are now used to transform from alternating to direct current. Here its high efficiency under all conditions of load and its adaptation to any commercial frequency make it certain that if it proves to be a satisfactory piece of apparatus, it will be used very largely for substation work where direct current is applied to the trolley. By means of the rectifier any direct current locomotive can be adapted for operation from a single phase trolley by the addition of a transformer, rectifier, and a few additional pieces of control; thus, all of the advantages of transmission at high voltage alternating current will be enjoyed and all of the advantages of the direct current motor will be secured, together with the flexibility in speed control which results from changing the voltage applied to the motor.

Then, the single-phase system also claims material progress during 1914. Several extensive applications of this system are under operation in the United States, using the series compensated motor. There are, in reality, three alternative methods that may be employed. There is the commutator type motor, to which many improvements have recently been added tending to reduce maintenance cost and increase reliability of service. There is the splitphase locomotive, employing in the system a phase converter which serves the triple purpose of supplying polyphase current for the induction motors which are used to drive the locomotive, and also drives the ventilating fan and the air compressor. It is generally recognized that the induction motor has many admirable characteristics, chief among which are light weight and rigid design, high efficiency, and ability to automatically regenerate power on descending grades. This type of motor makes it possible to secure an output from a locomotive with a given number of drive wheels, which would be practically out of the question with the commutator type of single-phase motor on account of its larger dimensions. The use of this type of motor in heavy freight service on mountain grades is especially desirable on account of the automatic regenerative characteristics which enable a train to be operated down grade at a constant speed without the use of brakes. There is also the rectifier locomotive, using d.c. motors with rectifiers and single-phase transformers.

These three types of single-phase electrification enhance its value for heavy electrification for long lines where high voltage is essential. Thus both the d.c. and the a.c. single-phase systems have practically reached stages in their development that ensure for the future the successful application of each to the various kinds of traffic which it may be called upon to move. This is important in our Canadian electric railway development as the selection will then depend upon the conditions surrounding each individual project, rather than upon the established reliability of the service selected.

## FOUNDATIONS FOR RAILWAY BRIDGE OVER THE ST. JOHN RIVER, N.B.

THE Van Buren Bridge now being constructed over the St. John River between Van Buren, Maine, and St. Leonard, New Brunswick, is of international interest since it is designed to link up the Bangor and Aroostook Railroad of Maine with two Canadian roads, the Canadian Pacific and the National Transcontinental, and thus provide an outlet to United States markets for lumber from the rich Canadian timber lands of New Brunswick, and permit the clearing and improvement of large areas of good land.



**Early Operations on the Construction of the St. John River Bridge, Between Van Buren, Me., and St. Leonard, N.B.**

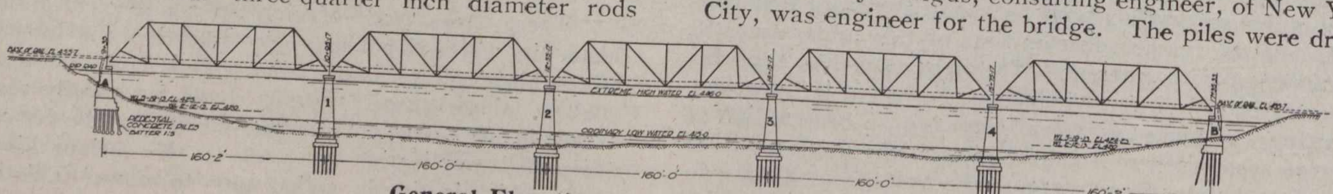
The river at this point is about seven hundred feet wide. The bridge, which cost about $170,000, consists of five steel truss spans each one hundred and sixty feet long, supported on four concrete masonry river piers and two concrete abutments located on the river banks.

The nature of the soil on the site of these two abutments was such that it was found necessary to carry down the foundations of these abutments to a deep-lying strata of compact gravel, some thirty feet below the natural surface of the ground, through water-bearing sand and quicksand. To carry down these foundations to such a level by the use of piers would have proved a slow undertaking, and the engineer of this structure therefore decided to use Pedestal concrete piles for these foundations.

Pedestal concrete piles about twenty feet long, spaced on three-foot centres, were driven over the entire area of the base of each abutment. Piles were of the molded-in-place type with a sixteen-inch diameter shaft and an enlarged foot, or base, about three feet in diameter, which rested on the compact gravel. The stem of each pile was reinforced with four three-quarter inch diameter rods wired together every twelve inches. These rods strengthen the shaft of the pile as a column and also took care of possible eccentric thrusts that might come on the piles resulting from the horizontal component of the earth pressure back of the abutment. To provide further resistance to these earth pressures the piles in the outer line under the toe of the abutment were driven on a batter of one to five. All in all, this foundation construction has proved to be exceedingly satisfactory and economical. Fig. 1 shows the elevation of one of the abutments and the concrete piles, together with the nature of the soil.

The execution of this pile work presented more than usual difficulties. The site was a remote one; pile driving equipment had to be hauled on wagons over dirt roads and country bridges for some three miles and lowered down a steep bank on the Canadian side of the river. After the piles were driven for this abutment the driver had to be lowered and the outfit loaded on scows and transported to the United States side. On this side the abutment was located so near the edge of the river that a timber pile trestle had to be constructed to partially support the driver in installing the piles. To remove the plant, all the equipment had to be hauled up a very high and very steep bank and hauled another three miles to the nearest railroad siding. The work, however, was rapidly and efficiently executed.

Mr. W. J. Wilgus, consulting engineer, of New York City, was engineer for the bridge. The piles were driven by the MacArthur Concrete Pile and Foundation Company of New York, and their eastern Canadian representatives, the Douglas-Milligan Company, Montreal and Toronto.




**General Elevation of St. John River Bridge.**

## THE INSPECTION DEPARTMENT IN ITS RELATION TO THE MANAGEMENT OF MANUFACTURING ORGANIZATIONS.*

By Fred. B. Corey, Consulting Engineer, Pittsburgh, Pa.

FACTORY organization and management is a science that is steadily increasing in complexity and importance, on account of the increasing magnitude of our modern industrial establishments. Its practical application demands a thorough knowledge of men and of methods by which men can be organized into a great machine to operate with minimum friction and at maximum efficiency. In the consideration of academic theories and sociological ideals, we must not lose sight of the fact that the main reason for the existence of most manufacturing corporations is the payment of dividends on their capital stock. Whatever other advantages may accrue to the employees, or to the community, are merely incidental. The value of any scheme of organization or method of procedure must, in general, be gauged by its effect on the net earnings, either for the immediate present or the distant future.

In any manufacturing company, consideration of the inspection department should begin with a study of the relation of that department to the management of the company and to the various departments of the organization. These relations must be positively fixed and thoroughly understood. In many cases, the inspection department is not rendering the service of which it is capable or operating at maximum efficiency, on account of lack of co-operation between it and the departments effected thereby.

It is, of course, the primary function of the inspection department to inspect and pass upon the material submitted for its action, approving that which meets the requirements laid down and rejecting that which fails to come up to the adopted standard of excellence. At the same time, this department is in a position to render valuable assistance to the sales department and the purchasing department as well as to the engineering and production departments, if the proper spirit of co-operation exists throughout the whole organization. I wish to call attention to methods that tend to promote such departmental co-operation.

In the majority of manufacturing corporations, the inspection department is under the authority of the factory manager or superintendent. In other words, that branch of the organization which builds the apparatus decides whether that apparatus is properly built. It is unnecessary to point out the inherent weakness of this arrangement. The judgment of the inspector may continually be biased by the fact that he is a part of the factory organization and is responsible to the factory management. It is, therefore, evident that the highest standards of quality and workmanship hardly can be maintained continuously if the members of the inspection department are in any degree subject to the control of a factory superintendent or any other executive who is directly responsible for the factory production and has no connection with the engineering or sales organizations. This statement should not be understood as expressing a doubt in regard to the loyalty or honesty of purpose of any factory official. We must recognize the fact, however, that defects, due to drawings or specifications, are often disregarded by inspectors if they know that no criticism can attach to their superiors on account of their approval of the apparatus, especially when a rejection would prevent meeting a promised date of delivery.

In a smaller number of manufactories, the inspection department is under control of the chief engineer. With this arrangement, the judgment of the inspector is liable to be biased by the fact that any defects in the finished product, due to improper specification of materials or any failure of the apparatus to function properly, might be considered as reflecting on the abilities of the engineering department. The inspector will often hesitate to reject a devise if he thinks that the objectionable feature may be attributable to his superior officer, as it would imply a difference of opinion that might reflect discredit on the inspector's judgment. Moreover, there is often a tendency among young and subordinate engineers to refuse to recognize slight defects in a design for which they are personally responsible, and to severely criticize an inspector who points out what he considers may be a defect in such apparatus or holds material on account of insufficient engineering data for its proper inspection. Therefore, it will be seen that in most cases the executive head of the inspection department should be as free from control of the engineering department as from the manufacturing department.

The only logical plan of organization is that in which the head of the inspection department, whatever may be his title, is responsible directly to the general manager of the company or the chief executive in control of the factory output. He should report to the same officer as does the works manager or the chief engineer. At the same time, he must be in full sympathy with all other departments. He must command the respect of the other department heads and be ready always to co-operate with them to further the interests of his company.

The executive head should exercise a most thorough control over all the activities of the department. To that end, there should be no recognized paths of communication between this department and the heads of the other departments, except through his office. The strict enforcement of this rule is essential to the efficient working of the department and to the avoidance of misunderstandings and duplication of effort. This requirement, if rightly understood, will not be interpreted as limiting the useful activity of any member of the department, but will be recognized as a necessary feature in the conduct of inter-department business.

The executive head of the inspection department should be thoroughly familiar with general engineering practice and standards. He should be well informed in all shop methods, including foundry and machine shop practice, and be thoroughly versed in the use of testing machines and gauges. He should, if possible, be conversant with chemical laboratory methods and apparatus, so as to be able intelligently to direct that part of his organization. Moreover, he should be familiar with the uses of the factory product and the conditions under which it is to operate after it has passed beyond control of the factory. He must have absolute control of every inspector in the plant and be held responsible for the quality of material and workmanship of all that the plant produces.

In the majority of manufacturing corporations, all dealings with the customers are conducted by the sales department exclusively, which is the logical arrangement. For this reason, complaints, on the part of the customer, are made directly to the sales department and usually

* Presented before Section D of the American Association for the Advancement of Science at the Philadelphia meeting, December 30-31, 1914.

reach the shop through a more or less tortuous channel. There is sometimes a tendency on the part of the sales department to assume that all of these complaints are justified, to criticize the shop for turning out on unsatisfactory product and especially to blame the inspection department for failure to prevent the issuance of the material to which the complaints refer. In justice to all concerned, including the sales department, all such complaints should be referred to the executive head of the inspection department for a personal investigation and report, and action on the part of the sales department, except so far as it relates to the replacement of material urgently needed, should be deferred until the report is in hand. This report may entirely change the attitude of the customer with relation to the alleged defective material, as it may clearly show that its failure to meet his expectations was due to no fault of the manufacturer or of the apparatus involved. The trouble may have been due to injury in shipment, rough handling after receipt, failure to install or to apply it properly, lack of proper maintenance on the part of the customer or his employees or to a misconception of the capacity or function of the apparatus itself. Any errors on the part of the factory or inspection department must be freely acknowledged and any steps to prevent their recurrence should be fully explained. An unbiased report, based on all available facts, rendered by the head of the inspection department to the head of the sales department, may be invaluable to the salesman in his negotiations with the customer.

The inspection department is for the mutual protection of the manufacturer and the customer. The salesmen should be informed in regard to the methods and practice of the inspection department, as this knowledge may be of great service in promoting friendly relations with a prospective or actual customer. The customer is often much interested in the means employed to insure accuracy in the manufacture of the apparatus he proposes to use. The head of the inspection department should therefore make it his duty to advise the sales department of any change in procedure or equipment that might be of interest to that department in their dealings.

The relations of the inspection department to the engineering department are most important, especially in the influence that may be exerted on the designs for new apparatus and the improvement of the old. In many places, new drawings, when completed and before their final approval, are submitted to a committee (variously known as "mechanical design committee," "limit committee," "standard committee," etc.) to determine if the limits set by the designers are such as can be met commercially in the factory, and to decide if any changes are desirable on account of methods to be used in the foundry, machine shop or elsewhere. The head of the inspection department should be one of the most important members of this committee; in some instances he is ex-officio chairman. His principal duty in connection with this committee is to advise if the dimensions, tolerances and limits, called for on the drawings, are satisfactory for the various fits and if the quality of finish called for will be satisfactory to the inspection department. Thus, the work of the inspection department should begin even before the designs are approved for manufacture.

It is not within the scope of this paper to consider the internal organization of the inspection department or the means and methods best adapted to carry out the details of its work. These are matters that will depend to a great extent on the management and operation of the larger manufacturing organization of which it forms a part. A plan of organization that may be highly efficient in one factory may be woefully deficient in meeting the needs of another shop producing a different product or producing a similar product by widely different methods. The organization of inspectors that is perfectly suited to a factory having a large output of a few well standardized articles would be wholly unable to cope with the situations arising in a smaller factory producing a great variety of articles, but making each in comparatively small numbers. It is obviously absurd to try to apply big-shop methods to a small shop and the converse application, while far more usual, is no more logical.

Such matters must, therefore, be subjects of careful investigation and study in each individual plant. In presenting this paper to the Association, the writer has thought best only to call attention to some of the more important matters in connection with the inspection department, and especially in its relation to the management and main sub-divisions of the organization. If it serves to indicate the important place that inspection should occupy in a manufacturing corporation, its purpose will have been accomplished.

## ARGENTINE TRADE IN CEMENT.

Argentina is a large purchaser of cement. Up to the outbreak of the present war, Belgium was the largest exporter to that country, according to a recent trade report. This is presumably because the product of that country is cheaper than that of the others, although the English and the French article is said to have the best name. Germany has had a small share of the trade, but the 1912 figures evince a considerable falling-off as compared with the previous year.

It can be expected, owing to the disturbed financial conditions which have been reigning, that some little time will elapse before the trade in cement reaches the figures of 1913. Nevertheless, as this article of construction is so largely used in the Republic, it may be taken for granted that any improvement in commercial conditions will react very quickly on this commodity.

That country's consumption of cement, according to import statistics is denoted by the following:—

| | 1907-1911. | 1911. | 1912. | 1913 | Jan.-June, 1914. |
|---|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. | Tons. |
| Belgium ........ | 538,343 | 156,458 | 168,558 | ....... | ....... |
| United Kingdom. | 347,587 | 74,843 | 60,341 | ....... | ....... |
| France ........ | 309,277 | 79,617 | 70,926 | ....... | ....... |
| Germany ...... | 135,352 | 41,904 | 24,318 | ....... | ....... |
| Sweden ........ | 42,798 | 23,858 | 30,925 | ....... | ....... |
| All Countries . | 1,400,965 | 389,291 | 375,821 | 721,461 | 255,143 |

The report emphasizes the present time as being a very favorable opportunity for Canadian producers to enter this field.

The Creosoted Block Paving Company, Limited, sales agents for The Canada Creosoting Company, Limited, have moved from the Bell Telephone Building to 408 Royal Bank Building, Toronto.

The use of cement as an anti-sand blast is possibly one that is little known. The sand blast in question, however, is not that which is so familiar to all of us, but is quite of another type. When locomotives stand under steel or iron bridges or viaducts, the blast from the stacks throw out gases and numerous small particles of ashes and coal. This when continuously projected against the overhead iron or steel gradually causes its disintegration. In such cases cement has been successfully used, and now it is common practice for railroads to cover the bottoms of their bridges with wire netting or metal lath covered with a coating of sand and cement which it has been found resists the attack of gases and also the sand blast coming from the locomotives.

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**Book Reviews:**



## BOOK REVIEWS.

**American Sewerage Practice.** By Leonard Metcalf and Harrison Eddy. Vol. 1, Design of Sewers. Published by McGraw-Hill Book Co., New York, 1914. 747 pages, size 6x9 ins., 328 illustrations, 172 tables. Price, $5.00.

It is with the first volume that we are here dealing. In the past the literature dealing with sewers has been compiled from the experience gained in European cities. In this volume Messrs. Metcalf and Eddy, consulting engineers of broad experience in this special class of work, have brought together the results of good practice on the American continent and have presented in a most thorough manner a vast amount of data from their own experience and from that which has been placed at their disposal by other engineers.

From the character of the volume it is quite evident that the authors have produced a book which will be a valuable aid to the engineer engaged in a sewerage practice. It presents the various steps taken in designing a sewerage system and the reasons for each step. In addition to dealing with the general features connected with such design, special structures necessary for various local conditions are dealt with.

The list of chapters indicate clearly the breadth of scope of the volume:—Introduction: The lessons taught by early sewerage works; the general arrangement of sewerage systems; flow of water in pipes and channels; velocities and grades; measurement of flowing water; quantity of sewage; precipitation; formulas for estimating storm-water flow; the rational method of estimating storm-water run-off in sewer design; gauging storm-water flow in sewers; sewer pipe; the design of masonry sewers; examples of sewer sections and the loads on sewers; the analysis of masonry arches; street inlets, catch-basins and manholes; junctions, siphons, bridges and flushing devices; regulators, overflows, outlets, tide gates and ventilation; sewage pumping stations.

A most practical test such a volume can be put to would be to make use of it in the solving of problems that arise in the practical designs and construction of work. When put to this practical test and allowance made for the slight variation of practice in different offices it will not be found wanting.

This volume tabulates results which are rather the result of experience than experiment and as such will be more readily accepted.

Those who have read or studied this volume will await with much interest the publication of the second volume entitled "The Construction of a Sewerage System" and the third volume which will deal with the "Design of Works for the Treatment and Disposal of Sewerage."

**Gasoline Engines, How to Run and Install.** By C. Von Culin. Published by Norman W. Henley Publishing Co., New York City. 1915 edition. 98 pages, plus advertising; illustrated, 3½x6 ins. Paper cover. Price 25c.

This is a pocket instructor for those who use marine engines of the two and four-cycle types. The instructions given will enable anyone to properly install, care for and operate his own engine. The book contains a complete index by which each trouble, remedy, etc., can be readily referred to. The 1915 edition is a considerable enlargement on those of previous years.

**Engineering Workshop Drawing.** By Henry J. Spooner, C.E. Published by Longmans, Green & Co., London and New York. First edition, 1914. 128 pages, 618 illustrations, 9½x7 ins. Board cover. Price 50c. net.

The author has written a number of books on geometrical drawing and machine design, several of them being to-day in prominent use. This new work relates to the first steps to be taken in engineering drawing. It deals with the drawing instruments and their proper use; with the proper presentation of conic sections and such simple problems relating to them as occasionally occur in engineering drawing; with scales, their construction and use, and with spirals and miscellaneous curves such as are used in machine drawing. Then there is taken up the subject of detail in working drawing, such as keys, bolts, nuts, pipes, and pipe joints, etc. A chapter is devoted to lettering, dimensioning and tracing. An interesting section of the work is a chapter on the principal metals used in the construction of machines.

While a work of this kind necessarily entails an abundance of illustrations, some of them not susceptible to reproduction on a scale which a page of ordinary size will permit, one regrets the use, however, of an 8-inch reading line such as is used in the compilation of this work. There is no small difference of opinion respecting the most suitable length of lines, but, fortunately, one is rarely called upon to use a line much longer than five inches. In the opinion of the reviewer, the work would have been presented to better advantage had this unusual length of line been avoided by the use of two columns. This is, however, a mechanical detail, and does not detract from the instruction value of the publication.

**Motion of Liquids.** By Lieut.-Col. R. de Villamil. Published by E. and F. N. Spon, London and New York. First edition, 1914. 205 pages, 86 illustrations and 30 tables, size 6 x 9 ins. Cloth. Price $2.

The author of this work, an ardent and enthusiastic student of Col. Dubuat and Col. Duchemin, whose respective works "Principles d'Hydraulique" and "Les Lois de la Resistance des Fluides" are not so well known in England or America as in continental Europe, starts from the assumption that when a body moves in a liquid the latter moves by some means or other from the front to the rear of the body—a very common observation. By reference to suitable experiments, he goes on to show, step by step, how the liquid moves. Then, by confining his attention to flat plates, he has been able to neglect the resistance due to viscosity and to treat the fluid as if it were inviscid. The questions of static and non-static liquids, relative motion, co-efficient of contraction, negative resistance, etc., are severely taken up. A very interesting chapter is devoted to rivers and canals, in which many curious points are brought up; amongst others, the frequently disputed point of a body floating in a stream moving faster than the stream.

Each chapter closes with a summary and list of references that will be found valuable by the reader. The index is comprehensive, the illustrations are clear, the half-tones being particularly attractive. Taken altogether, the book contains much of interest.

**Use of Water in Irrigation.** By Samuel Fortier, D.Sc., chief of irrigation investigation, U.S. Department of Agriculture. Published by McGraw-Hill Book Co., New York City. First edition, 1915. One of the Agricultural Engineering Series of which Mr. E. B. McCormick, U.S. Department of Agriculture, is consulting editor. 264 pages, 71 illustrations, 5½ x 8 ins. Cloth. Price $2.00 net.

The importance of the scientific use of water in certain sections of America, and the legal and administrative features which irrigation presents, has called for literature on the subject that may be depended upon as being authentic, easily read, understood and thoroughly practical. This book deals with the agricultural side of engineering. It aims to benefit three classes of readers: the new settlers, irrigation farmers and those interested in irrigated agriculture, and students in agricultural and engineering classes of colleges and universities. It describes the manner in which water is used in irrigation throughout the United States, including that of cotton and sugar cane in the southwest, rice in the extreme south, truck and fruit along the Atlantic seaboard, vineyards and orchards along the Pacific, and of forage and cereal crops in the mountain states. It records the experiences gained in the field and laboratory rather than that which may be compiled in a library.

Following the introduction are chapters on The Irrigated Farm; The Necessary Equipment and Structures; Methods of Preparing Land and Applying Water; Waste, Measurement, Delivery and Duty of Water; Irrigation of Staple Crops. Besides the illustrations, there are a number of plates and tables.

**Construction of Masonry Dams.** By Chester W. Smith, consulting engineer. Published by McGraw-Hill Book Co., New York City. First edition, 1915. 280 pages, 68 illustrations, including numerous folding plates; 6 x 9 ins. Cloth. Price, $3.00 net.

While there is an abundance of useful literature on the design of masonry dams, to such a degree perhaps as to establish certain standards, in features and practice, there is a decided scarcity of corresponding literature devoted to the details of construction and supervision. The present book is written primarily for the construction engineer, and relates only to those features of design which have to do with the particular case or cases under consideration. Earthwork, rock excavation, cement, pumping and many similar subjects have been excluded from the book, either because they have been fully treated in other works, or because adequate treatment was impossible in the present volume. The following review of chapter headings will be of interest: Exploring the Site; Temporary Works for Stream Diversion; Preparing the Foundation; Masonry Construction; Quarrying; Miscellaneous Features; Plant and Power; Installation Required and Power Consumption; Assembling Materials, Crushing and Mixing; Transportation of Materials; Probable Future Methods; Estimates and Costs; Partial List of Existing Dams with Descriptions and Costs. The book is replete with construction views in half-tone, and with drawings of many of the less usual types of construction.

A very important chapter of the book is that devoted to estimates. The inception and promotion of masonry dam projects and their examination by financiers result in a number of engineers being called upon for estimates of cost. Such estimates must often be prepared within a limited time, and for a limited expenditure. In facilitating the rapid and reasonably accurate treatment of such estimates, the chapter included in this book will be found of great value.

**Canadian Almanac, 1915.** Edited by Arnold W. Thomas. Published by the Copp, Clark Co., Limited, Toronto. 528 pages, 6 x 9 ins. Price, $1.00.

This publication has attained its 68th year, and its usefulness has annually increased. The result is that a great deal of authentic information of a commercial, financial, educational, statistical and departmental nature may be found therein. The work is carefully indexed; a number of additions appear that had not been included in previous editions, and there is little doubt that in its new form the inclusion therein of this new matter will make the work of considerably greater value.

**Concrete Specifications.** By Jerome Cochran, C.E., M.C.E. Published by D. Van Nostrand Co., New York City. First edition, 1913. 274 pages, illustrated, 6 x 9 ins. Cloth. Price, $2.50 net.

This book contains a set of general specifications for concrete and reinforced concrete, including finishing and waterproofing. While during the past decade committees of various associations and engineering societies have published specifications of this nature, this work is of value in that it makes a vigorous attempt to clear up a number of divergent views upon the substance, form, scope, and phraseology of specifications, and in that it endeavors to present all with due observation for logical order and proper proportioning of different parts.

By chapters the scope of the work is as follows: Concrete Materials; Proportioning and Mixing Concrete; Forms and Centering; Steel Reinforcement; Transporting and Placing of Concrete; Finishing Concrete Surfaces; Waterproofing Concrete Work; Design of Reinforced Concrete; Reinforced Concrete Building Construction. An appendix suggests formulas for reinforced concrete construction. A carefully compiled and extensive index closes the work. A pleasing feature of the book is the well selected bibliography which concludes the more important chapters of the work.

**The Enemy's Trade and British Patents.** By Sir G. Croydon Marks, M.P. Published by the Technical Publishing Co., Limited, London, W.C. First edition, 1914. 54 pages, 5 x 7 ins. Paper binding. Price, 25c. net.

In his preface the author states that England grants about 47 per cent. of the entire patents that are issued annually, to persons resident outside the country. Austria grants 71 per cent., and Germany 33 per cent. to foreigners. The work goes on to show that England is merely suspending, and not in the slightest degree confiscating or destroying foreigners' patents, but instead making a home market for such that would possibly never have been otherwise created, and incidentally safeguarding and protecting British inventors owning patents in the enemy countries.

The work will be found of extreme interest by those interested in trade marks, patents, designs and inventions.

**New Time Savers in Hydraulics and Earthwork.** By C. E. Housden. Published by Longmans, Green & Co., London and New York. First edition, 1914. 31 pages, illustrated, 5 x 7 ins. Cloth. Price, 75c. net.

This book is virtually in two parts, the first of which presents hydraulic scales for ascertaining the dimensions of pipes, drains and sewers, taken from the author's work entitled "Water Supply and Drainage Systematized and Simplified." The dimensions to the nearest inch of pipes, of half pipes and of any design of drain or sewer in which a semi-circle or circle may be inscribed, can be ascertained from them, adopting at will any desired co-efficient.

The second part of the book is devoted to, and called, rapid earthwork calculation, and contains a number of improvements suggested to the author after the publication of his work "Practical Earthwork Tables." The author claims for these new tables that earthwork quantities can be from them ascertained more quickly and with less labor than in any other way. This part of the book, to which 24 pages are devoted, gives the tables, explains them, how they are framed and their application.

**Railway Engineers' Field Book.** By Major G. R. Hearn, R. E., and A. G. Watson, C.E. Published by E. and F. N. Spon, London and New York. First edition, 1913. 230 pages, 33 illustrations, 4 x 6½ ins. Leather binding. Price, $5.25 net.

This is a practical manual, and, according to the authors, is written especially for railway engineers in India and the East. It has to do with directions for the conduct of a railway survey, instruction on the tacheometer with new reduction tables, tables of latitude and departure, full curve tables for every minute of arc for all angles from no degrees to 120 degrees. It also contains details for transmission curves.

The instruments used on a railway survey are all described, some of the descriptions being illustrated. Conditions entering into reconnaissance work such as traffic considerations, flow of water, roads, hill sections, rough estimates of cost, etc., are carefully considered in Chapter III. The next chapter is devoted to exploratory and preliminary survey work. A special chapter described the tacheometer and its use. Following this are chapters on Preliminary Survey of Hill Railways; Considerations on Location; Location; Curves; Transition Curves; The Taking of a Solar Observation for Time and Azimuth.

Transition curves are dealt with at considerable length and a special feature is the demonstration of the method of laying them down on existing railways where they have not been allowed for.

Although specially prepared for the followers of railway construction in India, the book will be found useful by every railway engineer.

## PUBLICATIONS RECEIVED.

**Ontario Agricultural and Experimental Union, 1913.**—Thirty-fifth annual report; 104 pp.; 6 x 9 ins.

**Metal-Mine Accidents in the United States, 1913.**—Technical paper 94, by A. H. Fay, United States Bureau of Mines. A 72-page booklet covering metal-mine accidents in the United States during 1913.

**Mineral Resources, Lardeau and Trout Lake Mining Divisions, British Columbia.**—Bulletin No. 2, British Columbia Bureau of Mines. Prepared by N. W. Emmens. 66 pp.; illustrated with maps, half-tones, and drawings.

**Permeability Tests on Gravel Concrete.**—By M. O. Withey. An illustrated reprint from the journal of the Western Society of Engineers relating to tests made at the Materials Testing Laboratory of the University of Wisconsin.

**Manitoba Water Powers.**—By D. L. McLean, S. S. Scovil and J. T. Johnston, engineers of the Water Power Branch, Department of the Interior. Published by that Department as Water Resources Paper No. 7. 214 pp.; illustrated by maps and diagrams; 6½ x 6 ins.

This report was prepared under the direction of Mr. J. B. Challies, superintendent of Dominion Water Powers, for the Manitoba Public Utilities Commission. Several articles relating to the investigated work which it covers appeared about a year ago in the reading columns of The Canadian Engineer. The report covers a general summary of the power situation in that province; hydrology; Winnipeg river powers, and rivers in the south-west, east and northern portions of the province, respectively.

**The Electric Furnace in Metallurgical Work.**—Bulletin No. 77, United States Bureau of Mines. Part 1 devoted to design, construction and operation. Part 2, the smelting of metals, and Part 3, the manufacture of Ferro-Alloys in the electric furnace. 216 pp.; well illustrated and indexed.

**Report, Minister of Public Works, Ontario, 1913.**—148 pp.; 6 x 9 ins., including reports of Minister, Deputy-Minister, Architect, Engineer, Superintendent of Colonization Roads and Accountant, for the year ending October 31st, 1913, Department of Public Works, Province of Ontario.

**The Observer's Hand Book for 1915.**—Edited by Prof. C. A. Chant, University of Toronto. Published by the Royal Astronomical Society, Canada. 76 pp.; 5½ x 8 ins.; bound in paper. The hand book has several important additions over previous publications, together with minor alterations and corrections.

**Concrete Pile Standards.**—By Hunley Abbott. Published by the author, 1915. 59 pp.; illustrated; 9 x 12 ins. Price, 50 cents. This is a book of drawings, specifications and other data prepared for engineers, architects and designers having to do with concrete pile foundations. It is comprehensive in its scope, and no important feature of design has been overlooked. It contains standard details of reinforced concrete pile caps; specifications for all types of concrete piles; a comparison of costs of concrete vs. wood pile under various soil conditions; theory of pile support, and description of method of testing a concrete pile.

**Bow River Power and Storage Investigations.**—By M. C. Hendry, B.A.Sc., chief engineer, water power branch, Department of the Interior, Ottawa. Published by the Department as water resources paper No. 2. 345 pp.; numerous illustrations, maps and diagrams; 6½ x 10 ins.

This report covers investigation carried out during 1911, 1912 and 1913. The importance of the conservation of the Bow River flow has been well recognized in that section of Canada, both from a power-producing and an irrigation point of view. The Water Power Branch has made its investigation a most thorough one, and the report states that it is economically feasible to regulate the flow of the river by means of storage works in its upper waters, to warrant the development at six power sites of over 45,000 h.p., continuously for 24 hours, all within a 50-mile radius of Calgary. The report shows also that the use of such waters for power purposes does not conflict with its use for irrigation purposes, and that the regulation necessitated by the former would be a distinct advantage to the latter.

The report reviews studies of rainfall, precipitation, run-off and other phenomena, observations of which have been taken for a period of years. The existing developments on the river are described, and the possible developments outlined with estimates of cost, etc. The question of storage is very fully considered.

The report will be found of great value to hydraulic and hydro-electric engineers. It is accompanied by a full set of maps and plans.

## CATALOGUES RECEIVED.

**Small Motors.**—Leaflet in two colors descriptive of the advantages of Westinghouse electric small motors for alternating and direct current.

**Storage Batteries.**—Eighteen-page leaflet descriptive of the "ironglad-exide" battery for storage battery locomotives. Issued by the Electric Storage Battery Co., Canadian agents, Canadian General Electric Co., Toronto.

**Belt-driven Friction Hoist.**—A 4-page illustrated leaflet, issued by the Herbert Morris Crane and Hoist Co., Toronto, describing this hoist for small loads. The leaflet quotes dimensions, prices and general particulars.

**Air-Compressors.**—Twenty-four-page illustrated catalogue issued by the Chicago Pneumatic Tool Co. describing several classes of fuel-oil and gas-driven compressors and their application to the unit system of air-power plants.

**Stock List.**—The 144-page monthly catalogue list of Joseph T. Ryerson & Son, Chicago, in which is announced an offer of a $100 prize for the best trade name to cover their product. They manufacture a complete line of tool steel.

**Cranes and Hoists.**—A handsomely illustrated little 32-page booklet issued by the Northern Crane Works, Limited, Walkerville, Ont., illustrating many notable installations in Canada, and showing the widely varying uses to which they are put.

**Concrete Machinery.**—A 48-page miniature illustrated catalogue of the London Concrete Machinery Co., describing their types of mixers, barrows, scrapers, tampers, block and brick machines, hoists and engines, tile and pipe machines, moulds, pumps, etc.

**De Laval Centrifugal Pumps.**—A very complete commercial publication devoted entirely to centrifugal pumps. It contains about 300 pages and over 300 illustrations of pumps of all capacities and heads for various drives and uses. The text matter is divided by suitable chapter headings. The catalogue is well supplied with tables and charts required in the determination of pipe resistance, and relation between heads and spouting velocities, etc. The catalogue will be found of considerable value, as some of the chapters, particularly that entitled "Pump Characteristics," contain some very valuable information. The catalogue is issued as catalogue B, De Laval Steam Turbine Co., Trenton, N.J.

## PERSONAL.

WESTRUPP ARMSTRONG has recently been appointed engineer of bridges to the Toronto-Hamilton Road Commission.

ARCH. STURROCK, formerly district master mechanic at Cranbrook, B.C., has been appointed master mechanic of the Alberta division of the C.P.R.

M. B. R. GORDON, who has been manager of the Cobalt Lake Mine for the past four years, has retired, and is being succeeded by Mr. Chas. E. Watson.

H. D. LANGILLE, of Portland, Oregon, is the author of an article on Canadian competition in the lumber industry which appears in the American Forestry Magazine for February.

H. C. BARBER, B.A.Sc., previously with the Toronto and Hamilton Hydro-Electric Systems, has accepted a position with the Standard Underground Cable Co. of Canada, Limited, Hamilton, Ont.

G. A. IRWIN has been appointed sales manager of the Algoma Steel Corporation, Limited, with headquarters in the McGill Building, Montreal, the corporation having decided to reopen its Montreal office.

## OBITUARY.

The death occurred in Winnipeg last week of Horatio F. Forrest in his 76th year. Mr. Forrest was born in Montreal. He took a course in the military college at Quebec, and engaged in civil engineering on the Intercolonial Railway. Later he identified himself with the Canadian Pacific Railway, and in 1873 he assisted in the location of the line from Kenora to Winnipeg. Later he was appointed government inspector of railways, which position he held for a number of years. He then entered the employ of the Canadian Northern Railway as district engineer. He resigned two years ago because of ill-health.

The University of Michigan has established a short course in highway engineering under the direction of its department of engineering in co-operation with the Michigan State Highway Department. Lectures are to be given on February 15th to 20th, inclusive.

The American Wood Preservers' Association held its 11th annual convention in Chicago on January 19th, 20th and 21st. A number of very instructive papers were read and discussed under the following sessional headings: Plant Operation and Miscellaneous; Preservatives and Specifications; Ties, Timbers, Piling and Cross-Arms; Wood-Block Paving.