PAGES

MISSING

Volume 23. Toronto. Sept. 26, 1912 Contents of this issue on page 517

The Canadian Engineer

An Engineering Weekly

REFUSE DISPOSAL PLANTS

Prior to preparing the report on the disposal of the refuse of Newark, N.J., the engineers who prepared that report—J. C. Hallock, deputy chief engineer of the Department of Public Works, and F. O. Runyon, consulting engineer—made personal inspection of ten disposal plants of various types in order to determine their merits from an economic and sanitary standpoint. The plants visited were those at Minneapolis, Minn., Milwaukee, Wis., Chicago, Ill., Columbus, O., Cleveland, O., Buffalo, N.Y., Rochester, N.Y., Westmount, Can., Richmond Borough, New York, City, and Scranton, Pa. The conditions found at these several cities were described in the report, which descriptions as abstracted by the Municipal Journal of New York are given below.

Minneapolis Incinerator.—Minneapolis has especially attracted the attention of sanitarians because of the fact that Commissioner of Health Dr. P. M. Hall has trained the householders to drain the garbage and wrap it in paper before depositing it in the can. The special virtue of this method of handling garbage by the householder lies in the reduction of the fly nuisance, a cleaner garbage can and the insurance of a good proportion of combustible matter, in the form of paper, for the incinerating plant. The latter point is a detriment rather than a benefit where the destructor type of plant is in use, as it prevents a proper mixture of rubbish and ashes with the garbage for the better distribution of moisture throughout the mass.

During the month of January, 1912, the city collection department composed of one inspector and 31 drivers gathered 841 loads of garbage and 2,298 loads of ashes. The capacity of the garbage wagons is 100 cubic feet each with a "struck" load, but in practice the wagons are heaped so that their actual capacity is at least 33 per cent. in excess of this figure, or approximately 5 cubic yards. The ash wagon is the common type of bottom dump wagon of about 3½ cubic yards capacity.

All wagons are supplied by the city and each driver is paid $100 per month for his services and that of his team. Each driver is assigned a district and held strictly accountable for the removal of ashes and garbage therein and is not required to work according to a schedule of hours per day. His duties consist in the maintaining of a clean district and not in the rendering of a given number of hours' work per day. He is, however, required to make at least one collection of mixed ashes and rubbish and one of garbage from each household in his district each week.

The garbage is collected in metal bodies mounted on wheels or runners according to the season and is delivered at a transfer station about one mile from the centre of the business district, which is also the approximate centre of population. The mixed ashes and rubbish are carted to the low lying spots of the city, whether these be streets or vacant lots. The commissioner of health believes that within a few years there will be no more available dumping grounds within the city and that when this time is reached some other method of ash and rubbish disposal must be found.

The city ordinance authorizing and directing the commissioner of health to collect and dispose of garbage throughout the city and to take charge of and operate the city's crematory says in part "that the commissioner of health, in his discretion, may require the owners and proprietors of hotels, boarding houses, restaurants, commission houses, stores and markets, at their own expense, to collect and remove their own garbage and waste material and to convey the same to said garbage crematory or dispose of the same in such manner as shall be approved by the commissioner of health."

As having a bearing upon the method of collection and disposal of garbage in Minneapolis it might be noted that even here, where the householders more generally conform to the requirements for a complete separation of garbage from ashes and under the supervision of a highly efficient commissioner of health, our inspection of their largest dump disclosed a large flock of starlings feeding on all too evident garbage, proving conclusively that a perfect separation of these two classes of refuse is still to be realized.

The transfer station is on a siding of the Sault Ste Marie Railroad, where the metal bodies of the garbage vehicles are loaded by a traveling crane onto flat cars, twelve bodies to the car, with total average weight of 36 tons per car. From the transfer station the cars are taken to the incinerating plant, which is located about four miles from the centre of the business district of the city. At the plant a traveling crane picks up one body at a time and conveys same into the building, where a special motor on a crane tilts the body, discharging the contents into a hopper opening directly over an incinerator of the Decarie type. This plant was erected by the city about twelve years ago, before the organization of the Decarie Incinerator Company, but following the original designs of the inventor with modifications developed by the present commissioner of health. This type of plant is one in which the garbage is burned on an upper grate over a grate upon which coal is used in starting and at other times as may be necessary, the garbage gradually falling upon the lower grate and being there consumed.

In this plant the gases from the furnace pass over into what is commonly termed a Dutch oven, in which coal is continually burned and the function of which is to raise the temperature of the furnace gases, destroy germ life and remove noxious vapors. From this oven the gases are made to pass through a vertical fire tube boiler and thence through an induced draft equipment to the stack. The steam generated in this boiler is used for supplying a 50 kw. direct current lighting unit and for heating a medium sized workhouse, a tuberculosis hospital and a green house.

A duplicate generating plant for 200 4-ampere magnetite street lamps is now being installed in a building adjacent to the garbage plant; also a 150 h.p. water tube boiler. Such surplus steam as the garbage plant develops over and above that required by the buildings mentioned will be used by the electric plant, but the water tube boiler will be the main source of supply for the electric plant.

The garbage plant consists of two 125-ton units, but the commissioner of health informed us that its actual capacity was 300 tons per day. At the present time they are burning about 120 tons of garbage per day of 24 hours, using between two and three tons of coal per day.

The total cost of the plant was $64,000, but allowance should be made for the fact that a large portion of the labor was supplied by inmates of the workhouse.

The cost for collection of ashes, rubbish and garbage is $1.31 per ton. The cost of disposal of garbage is $0.78 per ton, which is reduced to a net cost of $0.56 per ton by crediting plant with the heat and light furnished to the city institutions before mentioned at the rate of 6 mills per h.p. for heat and 2 cents per kw. hour for light.

Milwaukee Destructor.—The records of the cost of operation of the destructor plant are not in such condition as to warrant their use as a basis for comparison, but from the 1911 data available in the office of the director of public works we found the average cost per ton of the destruction of the garbage to be $1.44 and the cost of mixed garbage and ashes to be $0.99 per ton. This includes the cost of 400 tons of coal used during five months of the year when the percentage of green garbage was high and it was necessary to use additional fuel.

These figures should not, in justice to the plant, be accepted, for the reason that the number of employees at the present time is far in excess of the actual requirements. From our inspection we are convinced that it would be properly and sufficiently manned with two-thirds the force employed at present.

The condition of the plant is excellent, the garbage is destroyed at temperatures between 1,400 degrees and 1,800 degrees Fahr., without odor, and all of the power used about the plant is obtained from steam generated by it in boilers through which the furnace gases pass on their way to stack.

The clinkers are now being used to fill up the lake front and are very valuable for this purpose, being hard and vitreous, absolutely sanitary and superior in every way to household ash. However, on account of a demand for their use in concrete construction it is proposed to install a crusher and screen and to dispose of the ground clinker by sale to contractors at $0.75 per cubic yard. A conservative estimate of the value of the by-products of destruction at this plant is $54,000 per year—$48,000 in steam produced and $6,000 in clinker sold.

Chicago Disposal.—The city of Chicago is at present disposing of its garbage under a contract which expires in December, 1913. The ashes are being dumped along the lake front. The common council has appointed a committee to investigate the general subject of disposal plants, but the commissioner of public works recommends the continuance of the present system in order to make park land along the lake front.

For the year 1911 it cost the city of Chicago $3.80 per ton to collect and dispose of its garbage, there being included in this cost the contract price of $48,000 per year paid to a private reduction plant. It also costs them $0.50 per cubic yard to collect and dispose of their ashes and rubbish.

Cleveland and Reduction Plant.—The reduction plant at Cleveland, O., is that next described. This was purchased by the city from a private company in 1905 for $87,500, the plant having a capacity of 100 tons per day. The city has since erected additional buildings and equipment increasing the capacity to 240 tons a day.

The plant was not well designed initially and it has been impossible to improve conditions by subsequent additions, the original buildings consisting of cheap sheet iron enclosures and the arrangement of equipment not conducive to economical handling. In spite of these handicaps and except for a period during a change of political administration, the operation of the plant including the collection department has been so well organized and supervised by an official with high ideals of public service as to show in 1907 a lower cost of collection and disposal than by contract in 1905, with a considerable increase in the amount of garbage handled.

The processes of reduction are, in general, similar to those employed in the Columbus plant and the local conditions which are controlling factors in the selection of the the method of refuse disposal are also similar, natural gas being used as fuel by householders and coal costing $1.85 per ton.

One of the principal ash and rubbish dumps was found to be on fire in several places.

Buffalo Reduction and Utilization.—In Buffalo, N.Y., the refuse is collected in three separate classes—ashes, garbage and rubbish—which the householders are required to place in separate cans. Ashes are carted to the dumps, garbage to a private reduction plant and all other refuse to a refuse utilization plant owned and operated by the city. The city contracts all of the collections and the reduction of garbage.

In 1907 the city purchased the utilization plant from a private corporation for $50,000. It consists of a brick building 200 x 50 feet and contained when purchased a destructor of the Meldrum type, with boiler through which the furnace gasses were passed and which produced the power required in plant operations. Since that time two boilers have been added and a sewage pumping plant. There is now being installed a destructor of the Heenan & Froude type.

The rubbish is unloaded on a receiving floor and raked into an inclined conveying apron which conveys it to a sorting room where girl pickers remove all salable material and place it in bins, the remainder passing through to the feeding floor over the destructor furnaces. This rubbish is dry or wet according to the condition when placed in the can by the householder or to the weather conditions during transportation to plant. The salable rubbish consists of paper, charcoal sacks, bags, rags, tin cans, metal and bottles. The tin cans are loaded in cars and sold to detinning companies and machinery has been installed for converting the cans into nailing caps. Bottles are sorted and sold to breweries and blueing companies, metal to dealers and old shoes sold for burnishing and polishing castings. The plant is also credited with 70 cents per hour for steam supplied to the sewage pumping stations. The girl pickers work for $1 per day of eight hours.

The report of the Bureau of Streets for the year ending June 30, 1910, shows charges for operation of plant, including interest and repairs and also some new equipment, of $38,530.60, and receipts from the sale of rubbish of $40,653.02, or a profit for the year of $2,122.42.

Rochester Incinerator.—At Rochester, N.Y., an incinerator plant has recently been installed by the Decarie Incinerator Company for the city and was undergoing its initial test at the time of the visit of Messrs. Hallock and Runyon.

This plant is of 60 tons capacity and is representative of the largest and most improved form of incinerator designed by this company. It is intended to handle rubbish only and is equipped with inclined conveyor from receiving floor to sorting room, where the various salable rubbish is removed by pickers and deposited in bins, the remainder passing by means of the same conveyor to and over the incinerator, where it automatically dumps into a hopper and chute to the furnace.

Between the receiving floor and the incinerator room there is a baling room equipped with a motor driven baling machine in which the paper of various classes will be baled.

In connection with the incinerator there is installed a 150 h.p. water tube boiler through which the combustion gases from the furnace pass, and thence to the stack.

The power for motor driven conveyors and baling machines and for lighting the plant is purchased from a local electric lighting company at 2¼ cents per kilowatt hour, and the steam produced has been contracted for by the same company at the rate of 10 cents per 1,000 lbs. per hour.

As this is a new and as yet untried plant there are no cost statistics to be reported.

Westmount Destructor.—Westmount is a municipal corporation which serves as the residential section of Montreal and has a population of about 16,000. The rubbish of this section is destroyed in a destructor plant which is under the charge of Geo. W. Thompson, who is also general superintendent of the light and power department of the municipality.

This plant is essentially a municipal electric lighting plant designed for commercial and public lighting purposes and erected as a protest against the exorbitant rates for lighting charged to the citizens and the municipality by the local electric light and power company. The destructor plant is an auxiliary enterprise operated in the same building, the steam generated in the destruction of refuse being used in the production of electrical energy.

The complete installation includes one 50-ton Meldrum destructor, one 50-ton Heenan & Froude destructor, five water tube boilers with an aggregate capacity of 1,000 h.p., and four engine-driven electric generators with an aggregate capacity of 1,000 kw.

The destructor plant burns garbage, rubbish and screened household ash. By screening the ash a combustible much higher in heating value is obtained, but at the expense of cleanliness, power and attendance.

There is a common collection of ashes, rubbish and garbage by the city, but when no garbage or rubbish is collected by a cart the ashes are passed through a screen. Carts drive up to the receiving or upper floor and dump their contents, which is then raked into storage bins or hoppers over the destructors. The refuse is pulled down and out of these hoppers into furnaces which are of the same type as those described in the Milwaukee plant, with the exception that clinker is handled by a car which travels on an overhead rail to a clinker yard. The clinker is used by the road department in concrete and road work and any not so used is sold to contractors.

The report for twelve months ending October 31, 1910, shows a total revenue from electric lighting and destructor plants of $102,149.17 and a total cost of operation of the combined plants of $75,426.38, leaving a net profit of $26,722.79. In the operating expenses are included interest on bonds, sinking fund for retirement of bonds and a most liberal reserve for a plant depreciation. The electric plant is charged with the heat furnished from refuse consumed. The destructor plant is credited with heat sold to electric plant, clinkers sold to private contractors, and garbage destroyed, the last item charged against the Department of Health—$9,449.06 last year.

The combined plants are ably administered under the immediate direction of Superintendent Thompson and they afford a striking example of the possibilities in a municipal enterprise of this sort when conducted with the same skill and keen business acumen that characterize successful commercial undertakings of the same magnitude. The plants are entirely free from political influence and the superintendent is empowered to engage and discharge employees, and is held strictly accountable for results

The garbage plant is free from odors and there has never been a complaint made against it, although it is situated in a strictly residential community.

West New Brighton Destructor.—The plant at West New Brighton, Richmond Borough, New York City, at the present time consumes approximately 25 tons of refuse per day at a cost of $1.34 per ton, which does not include fixed charges.

All of the power used is produced from the steam generated by the destructor gases and no sale of clinker is allowed. The plant will operate with improved economy when the quantity of garbage handled reaches a point reasonably near its rated capacity. Protests were made against its erection by householders in the neighborhood, but no complaints have been received by the department since the plant was put in operation.

Another plant of the same make and capacity, but with improved devices for feeding and clinker ejection, is being installed by the same borough at Clifton.

Scranton's Crematories.—The Scranton, Pa., plant consists of four garbage crematories of the F. P. Smith design and was installed by Lewis and Kitchen. It is designed to handle garbage and light combustible matter. Its rated capacity is 50 tons, but at times it has disposed of 90 tons per day. Combustion is at comparatively low temperature and is incomplete. No records have been kept of the temperatures and from our observations and comparison with incinerating and destructor plants we believe that the temperature in the combustion chamber is commonly below 1,250 degrees Fahr., the temperature at which garbage must be burned for the complete elimination of noxious vapors.

The plant is favored by its location next to a packing plant, the odors from which are at times highly objectionable, and on account of this circumstance any odors emanating from the crematory pass unnoticed.

The plant is inherently defective and changes have been made in its construction which increased its capacity for disposing of garbage without in any way improving its destruction from a sanitary standpoint.

Comparison of Methods.—As to refuse disposal, the authors considered dumping, the reduction system, the cremation system, incineration and the destructor system. Dumping they considered out of the question for Newark, since almost the only land available was the meadows, which would involve long hauls; moreover, as they are considered to be the future site of industrial establishments any fill made there should be such as would improve the value of the property and not depreciate it from a sanitary standpoint. "Dumps include putrescible matter, which in the heat of summer produce noxious odors and seriously interfere with the rights of adjoining property holders."

The reduction system is well adapted to cities where comparatively little or no coal is used as a household fuel and consequently where the difficulties in the way of a proper separation of household refuse are the least; but under the contract system it is always necessary to provide a bonus to induce the investment of private capital in the enterprise, and if undertaken as a municipal service it involves the installation of an equipment much more costly than for incineration or destruction and of a highly complex character.

Furthermore, the successful operation of a reduction plant is dependent upon a very efficient technical administration. In such a plant it is extremely difficult if not impossible to prevent the emission of objectionable odors, and as a rule these plants are located on the extreme outskirts of a city, an admission of the nuisance liable to be created.

The most valuable product of a reduction plant is the grease extracted, and to carry the process to its greatest refinement a percolating equipment employing naphtha in large quantities is used. This constitutes a constant menace to life and property, the destruction of plants at Chicago, St. Paul and Paterson affording examples of the dangerous character of this industry.

A reduction plant can only handle organic matter, and the contents of the receptacle of the careless householder who does not make a complete separation must go to the dumps or be otherwise destroyed by other means.

The conditions described as favorable to the installation of a reduction plant do not obtain in Newark, and the only feasible location for such a plant would be one well removed from the occupied ground on the meadows, this involving a long and expensive haul.

The cremation system or burning of garbage at comparatively low temperatures does not completely consume the organic matter, gives forth objectionable stack odors, and is generally an unsatisfactory method which does not comply with sanitary requirements for installations on a larger scale. For hotel or apartment houses where the fuel used and gases given off may be used in supplying the heat for a hot water supply system, higher temperatures may be carried, but in the case of larger installations the fuel cost for high temperature combustion would make this method prohibitive.

Incineration differs principally from cremation in the temperatures obtained in combustion, and although, like cremation, it requires the use of additional fuel, it is nevertheless a satisfactory method of refuse disposal for those municipalities which are content with their partial success in the enforcement of separate collections and the more or less objectionable ash dumps containing garbage mixed with the ash. It only partially solves the sanitary phase of the problem of refuse disposal, leaving the household ash to be carted to the dumps, and it is well recognized that a perfect segregation of the garbage from the ash is impossible of attainment, as evidenced by inspection of dumps where this system is employed.

The destructor system has previously been defined in this report as the burning of ashes, rubbish and garbage at temperatures above 1.250 degrees Fahr., but this definition should be amplified to include the requirement of artificial draft as a necessary adjunct to a high rate of combustion. This system is generally favored where it is desired to utilize the power developed by the refuse consumed, but it should be kept in mind that the utilization of surplus heat is of secondary consideration, and that the primary object of mixed refuse destruction is to completely reduce the material to an innocuous clinker.

Although this utilization of heat often reduces the cost of upkeep of plant, it should nevertheless be remembered that the principal result obtained in this system is a sanitary one, affording complete destruction of germ life in all classes of refuse with entire absence of objectionable odors.

The disadvantages are few and mainly due to improper design and faulty administration. The claim is sometimes advanced by engineers that the hauling of all refuse to the plant is one of its disadvantages, but we hold that this is more than counter-balanced by the fuel value of the ash and combustible waste in the destruction of the garbage. For excessive hauls, where the expense of hauling the ash alone exceeds the cost of fuel delivered at the plant, their contention is correct; but where the haul to the plant is as costly as that to a dumping ground, or where it is practicable to maintain several plants and thereby reduce the length of haul, this argument cannot be upheld.

Another objection urged against the destructor system is the necessity for expert firemen, the stoking of refuse, which has wide variations as a fuel, requiring the exercise of greater skill and judgment than is the case in the stoking of coal of uniform heating value. In our opinion this argument is fallacious and based upon a very low conception of the grade of intelligence possessed by the competent stoker of boiler fires, who, in addition to his duties in stoking, is required to maintain a uniform pressure of steam and a stationary water line.

The advantages of this system of refuse disposal are many and have been most forcibly impressed upon us by inspection of the various types of plant. We list in the following the principal advantages:

First. The destruction of all organic matter in an absolutely sanitary manner.

Second. It permits the destruction of the ashes, rubbish, garbage and street sweepings, reducing all to an innocuous clinker.

Third. The fuel is supplied by the ashes, rubbish and street sweepings.

Fourth. The heat generated in combustion at high temperatures can be utilized in the production of power from which an income may be derived. A revenue can be obtained from the sale of clinker.

Fifth. A city can operate more than one plant with economy, which is not feasible in the reduction system. This permits of shorter hauls and reduces the risk of interference by fire or the failure of a part of the equipment.

Sixth. Separate collections are not necessary.

Seventh. The class of labor required in the operation of the plant is not as skilled as that required in the reduction system.

Eighth. The cost of renewals and repairs is considerably smaller than in other types of disposal plants.

Ninth. The plant may be located in the centre of the city without creating nuisance, experience at Westmount, Canada, and West New Brighton, N.Y., fully demonstrating this fact. This feature makes the system particularly desirable for Newark, where locations within the city limits would materially reduce the hauling cost

CONCRETE MONOLITHS.

A system for the construction of monoliths being employed in connection with harbor work at Valencia embodies the use of moulds in the form of truncated pyramids measuring 28 feet square at the bottom and 26 feet square at the top, with a height of 26 feet. The bottom of the mould is constructed of wood and the sides of iron, and the mould is built so that the sides and bottom may be detached from one another. In operation the mould is assembled and is floated into sheltered water close to the site of the construction work. It is then partly filled with concrete by means of a crane, and is towed to the position to be occupied by the monolith, where the filling is completed. After the filled mould has been left in position for ten days the fastenings are released and the sides are raised in order to be fitted to a new bottom for a repetition of the process. The advantages claimed for this system include low cost, speedy construction, adaptability to curves, and homogeneity.

AN ELECTROLYTIC STERILIZING PLANT.

A recent application of electrolysis to the industrial sterilization of water has been used in a plant in England of which the details have just come to hand. At a textile mill, which is devoted to the woolen dyeing and finishing processes, a supply of water is obtained from moorlands on which cattle are grazed, so that there is some slight contamination from this source; the result was formerly the rapid growth of algae in the storage reservoirs, which filled up the supply pipes. Grids were useless, as the fine silky threads lay across the grids in a felted mass which had to be removed with rakes every half hour, and the threads thus broken and released got into the mill and on the goods, whence they were irremovable.

Chloride of lime solution destroyed the weed but hardened the water; the result was that scale formed in the boilers and curdled the soap used in the fulling and finishing of the woolens, so the use of this chemical had to be abandoned, and the weed soon reappeared. Copper sulphate was tried, and this at once affected the dyes.

Mr. Toyne, the consulting chemist, was acquainted with Dr. Samuel Rideal's investigations into the subject of water purification, wherein the use of electrolytic sodium hypochlorite was advocated, and as a last resource he tried the electrolyzer made by Messrs. Ernest Grether & Co., of Manchester. After three days' trial this proved entirely successful; the weed was killed, and the water—which had previously been tinged slightly yellow, owing to the infiltration of peaty matter—was changed to the ordinary blue-green of pure river water. The proper strength of chlorine to effect the purpose was ascertained by experiment, and amounted to about two parts chlorine to 1,000,000 parts water. The little "Manchester" electrolyzer which was used is illustrated in diagram herewith. A couple of planks were thrown across the little stream which fed the reservoir, and the apparatus was mounted on these, so that the electrolytic sodium hypochlorite, as made, trickled into the brook, and was thus intimately mixed with all the water that entered the reservoir. An automatic feed tank was provided at a higher elevation, and a hogshead of brine, higher still, as shown, so that, after filling the hogshead once a day, the operation of the plant was entirely automatic. A little roof, not shown in the diagram, protected the apparatus from the weather. Current was provided from the mill-lighting circuit at 110 volts by means of an overhead line; the current amounted to about 8 amperes, and the overflow from the electrolyzer was at the rate of 1 litre per minute, with a strength of 3 grammes active chlorine per litre. The brine had a strength of 4 per cent.

When the amount of chlorine required had once been determined, it did its work in the reservoir, and spent itself on the organic matter therein; there was no chlorine present at the outflow. Daily chemical tests failed to show either chlorine or nitrogenous matter, and the dyes were not affected. If any free salt was present, the quantity was too small to be detected, and in any case it was harmless. The water was excellent for drinking purposes, and, in fine, the experiment was a great success from every point of view.

The subsequent development of this experiment is even more interesting: as winter set in, it was decided to stop the electrolyzer, as no growth of algae takes place in cold weather; at the end of a fortnight complaints were made of the reappearance of peculiar markings, or stains, on the material in course of treatment, which excited comment, seeing that this old trouble had been absent during an exceptionally hot summer. The bacterial action of the water was at once suspected, and the electrolyzer was restarted, when the fungoid growths at once disappeared. Needless to say, instructions were issued to run the electrolyzer henceforth summer and winter.

Further experiment has shown that in winter, when the growth of vegetation is suspended, the amount of electrolytic sodium hypochlorite may be reduced to 1 part per million, the contaminated water thus treated refusing to show any action on gelatine plates.

The importance of this later discovery calls for special emphasis, for it appears to have a much wider bearing than the original application of the system to prevent the growth of algae. The bacterial growth or mildew above-mentioned has long been a source of continual trouble in many bleach works, and has previously been ascribed to local infection, such as contact with old wood on floors or stillages infected

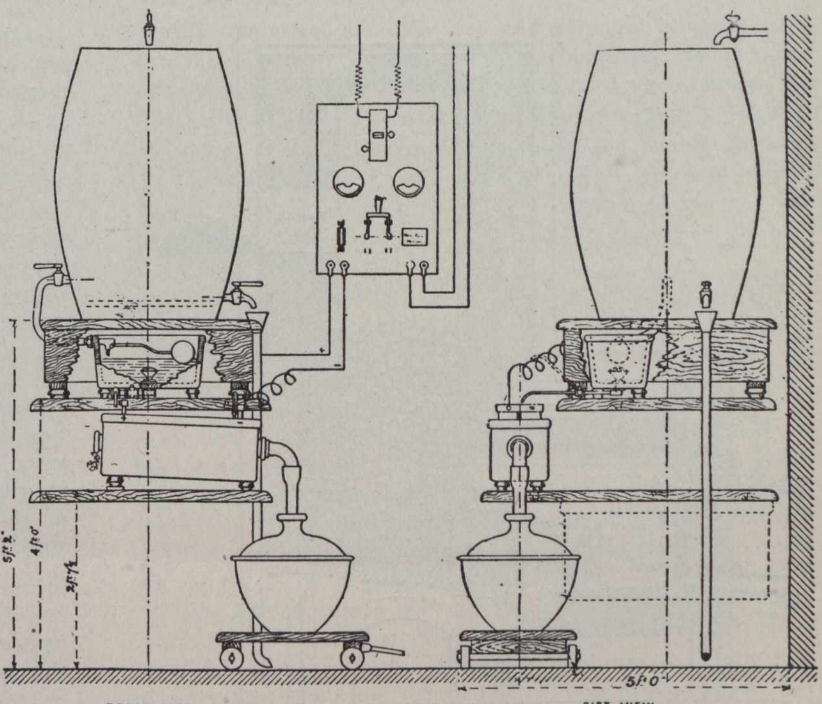


Diagram of Electrolytic Sodium Hypochlorite Sterilizing Apparatus.

with mildew, inferior sizing materials, etc., whereas it is now traced to the true cause—contaminated water supply—and simultaneously the remedy has been revealed, in the shape of the electrolytic sterilizer.

The cost of working was estimated as follows:—Taking the cost of energy as derived from the mill at about 5 cents per unit, and running the plant at 8 amperes for 10 hours a day, the consumption of energy was $110 \times 8 \times 10 = 8.8$ units, costing, say, 4 cents a day. The brine used amounted to 132 gallons of 4 per cent. density per day, requiring 52 lb. of salt, which, at the price paid by the dyehouse, cost 10 cents. The labor and attendance required was negligible, and the total cost thus came to about 14 cents a day.

The installation was at work all last summer during the exceptionally hot season, and has been in operation for nine months to the entire satisfaction of the owners of the mill. The system is, of course, applicable to a great variety of cases in which water is contaminated with organic impurities—for example, it can be used to purify the water of swimming baths, as is already done at Poplar by Dr. Alexander, with excellent results.

EXPERIMENTS IN OIL SMELTING IN BRITISH COLUMBIA.

The annual report of the Minister of Mines of British Columbia for 1911 contains some notes by Wm. Fleet Robertson, Provincial Mineralogist, on attempts to smelt with oil as fuel. For the past two years the Dominion Oil Smelting Company, Ltd., in Vancouver, has been conducting a series of experiments in the old Van Anda smelter, in an attempt to perfect or render practicable an oil-fired furnace for smelting ores, and has achieved a degree of success such as to render the process worthy of serious consideration. The particular form of furnace being experimented with is covered by Canadian patents granted to J. J. Anderson, and acquired by the company. More recently, March, 1912, Mr. Anderson has taken out United States patents for a new furnace, which is a modification of the Van Anda furnace, designed along lines suggested by Mr. Thomas Kiddie after the latter had made a test at the Van Anda plant.

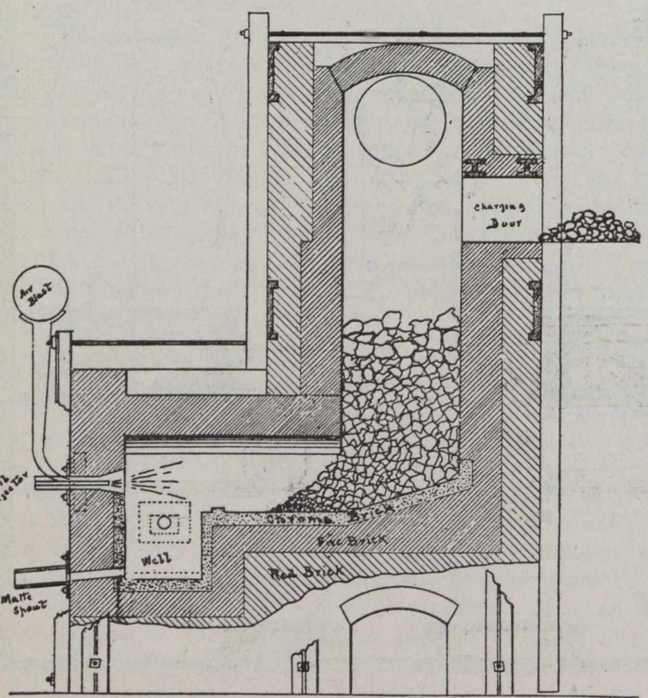


Fig. 1.—Dominion Oil Smelting Co., Oil Furnace Blast Furnace at Van Anda, B.C.

The Van Anda furnace, of which a rough sketch is given in Fig 1, is essentially a shaft furnace superimposed above one end of a reverberatory furnace or combustion chamber. In operation, the ore with suitable fluxes is fed into the shaft from the charging floor, passing down onto one end of the reverberatory hearth. The shaft thus serves as a feeding hopper for the reverberatory. The latter is fired from four injectors which squirt vaporized oil into the front of the chamber, the flame impinging on the foot of the ore column in the shaft. The products of combustion pass upward through the charge, thereby heating it to near the melting point, and escape through a suitable flue and stack. The melted ore flows down over the inclined hearth of the reverberatory into a well or sump, in which the matter and slag separate by gravity, each being tapped through holes placed at suitable levels. The injectors are operated under steam pressure, and the proper amount of air is supplied by a pressure blower.

The furnace undoubtedly requires and will receive considerable modification before it is commercially successful; but that a considerable advance has been made toward that goal is indicated by the results of a test made by Mr. Thomas Kiddie, a metallurgist of British Columbia, who has had previous experience with oil-fired furnaces at the works of the Orford Copper Company, New Jersey.

MANAGEMENT OF TRACKLAYING ON NEW RAILWAY WORK.*

In the discussion of the methods employed to obtain the best and most economical results with tracklaying on construction work, the committee has limited itself to the consideration of the following points: (1) Should the building of new yards and main lines (which are not let to contractors) be handled exclusively by the engineering departments? (2) Should such work be handled by the maintenance-of-way department? (3) Should such work be placed under the direct supervision of a practical track man?

In regard to the first point, the plans, specifications, etc., should be prepared by the chief engineer, but the actual supervision of the work should be in charge of a practical track man. There should, of course, be a resident engineer on the ground to lay out the work in accordance with the specifications.

The man in charge can best ascertain the proper kind of material to be selected and the manner in which it should be placed on the subgrade in order to eliminate the possibility of soft spots which so frequently develop in tracks under the pressure of heavy traffic and which form the most serious drawback in the maintenance of a first-class track in the future. He can also provide good drainage, sufficient ballast under the ties, and proper spacing and placing of ties in accordance with the size and condition of ties provided, all of which are essential to the construction of good, substantial tracks. The construction of all new track work or such tracks as come under the head of "construction work" should be completed in detail at the cost of construction before being turned over to the maintenance department.

As to the second point, such work should not be handled by the maintenance-of-way department, for the reason that the average roadmaster has as much maintenance supervision as can be properly looked after, particularly during the working season.

As to the third point, work of this character should be in charge of a practical track man, selected by the proper officials, together with a resident engineer.

A saving in cost and time can be obtained by the use of a tracklaying machine in laying the first track, depending largely (of course) on good organization. Second and other additional tracks can best be constructed by unloading the necessary material from the existing track; this applies also to yard tracks. All necessary grading can be done by train to very good advantage when the material is not at hand to be hauled by teams.

The advantage in making fills by train lies in the fact that better material can be obtained and used after the material is unloaded from the train with a side plow and leveled back to the full depth and width for an additional track. If gravel ballast is to be used it can also be unloaded and spread on the grade with a spreader to the width and height required before tracklaying, so that when the steel is laid there is no lifting to be done beyond surfacing or a light lift.

* Abstract of a committee report presented at the annual meeting of the Roadmasters and Maintenance-of-Way Association, Buffalo, N.Y., Sept. 10-13.

THE DESIGN OF GIRDER AND TRUSS SPANS AND TRESTLE WORK IN STRUCTURAL STEEL.

The present status of structural steel designing was discussed by F. W. Dencer, Chief Engineer for the American Bridge Company at the Gary, Indiana, Plant, before the Civil Engineering Society of Valparaiso University in a recent lecture. Many details of design were discussed for various types of structures. The paper in full is published in the Engineering Annual of the University and is here abstracted.

At the close of the last century, structural designing had reached, as it seemed to us, a very high stage of development. Yet in fifteen short years, many of the designs were relegated to the files, never to be used again. Bridge and structural designing had gone through a remarkable series of evolutions and who can say that we are nearing perfection? The chances are that in the next ten years the progress made in scientific designing will be as great, if not greater than the progress made in the last ten years.

Undoubtedly, many phases of designing will be better understood, as for instance, (a) the treatment or connections to resist secondary stresses, (b) the forces produced by impact of the drivers, (c) effect of temperature on initial stresses, (d) deformation of trusses, (e) action of columns under stress, (f) action of the top chord of through plate girder spans, (g) theory of bearing surfaces and proper materials to be used in their design, (h) use of stiffeners, etc. The speaker does not wish to convey the impression that these subjects are not understood, at the present time, but that further developments along these lines are possible and very desirable.

The tendency of the future in structural engineering, will probably be along the lines of standardization. That is, through the co-operation of various railroads, a uniform train clearance will be adopted, wheel loads for two or three different types of engines will probably be used, the steel material will be rolled to the same specifications and be of the same quality and finally engineers will agree on a uniform set of specifications for workmanship. Some attempts in this direction have already been made, as is evidenced by the work of the American Railway Engineering and Maintenance of Way Association in producing the specifications which are used by many railroads and corporations and also on the Common Standard drawings which are used by the Harriman Lines.

The engineering profession has depended on the following agencies for means for improvements in the past and developments to be made in the future: 1. Designers of railroads and bridge companies who are continually making use of new ideas based on the observation and action of existing structures. 2. Research work and investigations at testing laboratories and universities. 3. Discussions and papers of engineering societies. 4. Improvement in the quality of materials and the use of alloys.

Not many years ago, the longest angles obtained from the mills were 60 ft., to-day angles 125 ft. long may be obtained. Besides new sections have been rolled which permit of greater possibilities in designing, such as 8 x 6-in. angles, 24-in. I-beams, etc.

To show the importance of the quality of material in its relation to designing, it might be well to call attention to special materials which have recently (within the last decade) come into use and have served to revolutionize existing methods of design.

Cast steel, because of its high tensile and compressive strength and its adaptability to conform to different shapes. is used quite extensively for bearing boxes, shafts, shoes and bearing bolsters. It is used often for details where heretofore castings were prohibitive. A small quantity of aluminum is commonly added to the cast steel. It permeates through the entire mass without artificial stirring and adds to the ductility of the steel as well as preventing blow holes.

Because of the high price of cast steel, engineers were forced to design a great many details of rolled steel which from the standpoint of strength and good designing, was inferior to the cast steel designs. In recent years, the price of cast steel has dropped and engineers are using cast steel more extensively. The new Municipal Bridge of St. Louis just erected has chords of nickel steel.

Metallic nickel, nickel ore, or ferro-nickel to the extent of 3½ per cent. of nickel is added to the bath of steel made by the open hearth process. The nickel increases its density, elasticity and strength. The high elastic limit of nickel steel tends to prolong the life of the metal and because of its superior toughness, offers greater resistance to sudden strains and shocks.

Phosphor bronze, a combination of tin, copper and phosphorus, is used for bearings which are subject to high pressures and run at slow speed.

Lumen metal manufactured and patented by the Lumen Bearing Company is also used for bearings. It contains zinc, copper and aluminum. The advantages claimed for this metal are its light weight and low coefficient of friction.

Other alloys of varying proportions and metals are used for frictional surfaces, the most common of which is babbitt metal. It is composed of lead, tin, zinc and antimony. For high speed metal the base is tin, and for low speed the base is lead.

Manganese steel is used for purposes where an extremely hard metal is required, as for rail locks, frogs, or switches. The material is too hard to cut with a tool and must be ground where a finished surface is required.

Improved processes of making and rolling structural steel have enabled engineers to design structures with a higher degree of efficiency for the same weight. This statement must be taken within certain limits, due consideration must be given to the greater deformation caused on the material when the ultimate stress, and consequently the working stress, increases per square inch.

The use of alloys and special materials is mentioned briefly to show that their uses have much to do with the progress made in designing. In other words, many details that recently have come into use would be impossible were it not for the scientific progress made in steel manufacturing.

As this paper will deal principally with designs for the most practical details, we will attempt to show that many details can be simplified and made more practical without impairing their strength and often with better results.

The best design of structure is one which has the smallest number of members to resist the stresses, also each member designed with a minimum number of component parts, provided, of course, that due consideration is given to the proper distribution of the material. In other words, the simplest design is the best, other considerations being equal.

Girder Spans.—The depth of a girder is generally taken as the economic depth. This can be determined by expressing the weight of the girder in terms of the unknown depth. Frequently the depth of the girder span is determined by other considerations, such as the base of rail to masonry being fixed or to make suitable connections to adjoining spans.

An important step is to decide on the "building up" of the top flange. To avoid dapping of the ties, some railroads use four angles with side plates between. This method leaves the top flange clear on top without and projecting rivet heads or cover plates. The bottom flange is commonly made up of two angles and sufficient cover plates, the weight of the cover plates being about equal to the weight of the angles.

For the designing of the top flanges of through plate girder spans engineers differs as to what formula to use to resist the deflection sidewise. Reliable tests are lacking, which would definitely determine the resistance necessary to prevent buckling. All engineers, however, are agreed that the ratio of "l" over "r" should come within certain limits, and in addition thereto the floor beams are extended by means of brackets, within the line of train clearance, to connect to the top flange. Sometimes assumptions are made, such as treating the top flange as a column free at both ends and with an effective length equal to two-thirds of the length of the girder.

For length of girder spans up to 60 ft. the expansion ends slide on castings, the effect of the deflection not being considered except that the casting should not be too wide on top. For longer spans shoes with pins are used to permit deflection. Roller nests should be used for the expansion ends. Segmental rollers about 6 ins. in diameter are better than the circular rollers, as more rollers can be used within a given area.

Pin shoes should be designed of cast steel instead of being built up of plates and angles. The distribution of bearing necessitates the use of stiffeners which in the shop are extremely difficult to secure a perfect bearing at the bottom, certainly from a theoretical standpoint a perfect and equal bearing of all stiffeners is impossible.

When designing end posts of girders the bearing areas required should be confined to as small a space as possible to prevent unequal transmission of the shear under deflection. The centres of the end stiffeners are placed exactly over the bearing casting. It is best to lay out the bearing castings with the end of the girder to make sure that the walls of the castings are placed under the bearing surfaces of the girders.

The chamfered legs of the end post angles which fit the fillets of the flange angles should not be counted in bearing, as the shop does not get a fit perfect enough to transmit bearing. The outstanding legs are figured only for bearing. The value of the rivets through the flange angles which are above the sole plate or bearing shoe will add to the strength of the bearing, but should not be counted in the computations.

Through plate girders are frequently designed with round ends; the reason commonly given is that the round ends will deflect any material protruding from the side of the car. This method of construction is very expensive and should be discouraged, at least be restricted to the ends of the girders having considerable projection above the base of rail. The speaker does not believe that from an æsthetic point of view the round ends are better.

Where side plates are used with round ends the side plates should be cut where the bottom edge meets the curvature of the flange angles. The space under the flange angles beyond the side plates and above the end reinforcing plates should be filled with plates. This detail will simplify the shop work.

Deck girder spans, to make the most rigid structure, should have a top and bottom lateral system with cross frames at the lateral points to carry the wind stresses from the bottom to the top system. The laterals should be designed with only a few changes in section to avoid a variety of different pieces.

The cross frames should be connected directly to the top lateral plates, but for ease of erection the cross frames should be raised about 2 ins. above the bottom lateral plates. Avoid the use of lug angles for laterals where the stress or section does not require over six rivets. The small fittings add to the cost of fabrication and are not necessary for the laterals transmitting small stresses.

Engineers differ as to the use of stiffeners in stringers. Where stiffeners are not used a common specification is that the unsupported distance between the flanges should not be more than 60 times the thickness of the web. The thickening up of the web to conform to this specification and the omission of the stringers does not alter the weight materially; sometimes the weight becomes greater and sometimes smaller, and in addition has the advantage of simpler fabrication to the manufacturer and reduced cost to the buyer.

For all skew span work it is advisable for simple fabrication to study the design with the object of squaring the end frames, end stringers, etc. Frequently the skews of various spans vary by small amounts which, for practical purposes, could be modified slightly to make as many spans of one skew as possible. When designing more than one span the location of piers or bents should be studied with the idea of making as many spans of the same lengths as possible.

Truss Spans.—Inclined top chords are generally used for spans over about 200 ft. in length. For spans over about 300 ft. in length sub-verticals are used in order to give a better inclination to the diagonals. In the designs of the longer spans it is usual to connect the compression members which are built up of structural steel with riveted connections and the eye ears are connected with pin connections.

The interior columns should be designed not merely to conform to the column formula, but also to give good connections for the floor beams and bottom laterals.

Generally the flanges of the built-up members should turn out and not in, where for good packing it is necessary to turn in the flanges of the posts and diagonals; the flanges of the top chords and end post should always turn out. By turning out the flanges of built-up members the rivets in the tie plates and lacing bars can be more easily driven. To resist the thrust of the drivers as the engine comes upon the bridge the end bottom chords are generally made up of built sections for two panel lengths.

The top chords and end posts are built up of web plates, top and bottom flange angles and a cover plate. The bottom angles, which are laced, are made heavier than the top angles, so that the centre of gravity of the section may be more nearly in the centre of the member. Heavier angles give simpler shop work than the addition of bars riveted to the angles. If the desired section cannot be obtained with single webs, the webs should be doubled rather than by adding side plates between the angles. The plates between the flange angles are not connected to the angles and do not give as rigid a section as the additional webs do. Double webs may be held together in the centre by one line of rivets about 12 ins. centre to centre.

When designing sections for chords and columns of trusses the designer should draw the sections of the various members, taking into account the fitting of the posts to the top and bottom chords, so that there is clearance enough for lacing posts and bottom chords. Sometimes designs are received in which the posts are too narrow to permit a floor beam connection; again the chords are too narrow to allow the riveter to rivet the lacing bars when the angles are "turned in," and again the angles of the chords are too small to give room enough to drive the cover plate rivets where pin plates occur.

The working lines of the top chords and end posts on which the pins and intersections of posts and diagonals are located should be approximately the centre of gravity of the sections, but the fact should not be overlooked that the weight of the member itself lowers the centre of pressure. Consequently, if the eccentricity is small, the working lines may be taken on the centre lines of the chords. To reduce the eccentricity of the main truss connections to a minimum the working lines of chords, posts and diagonals should meet at a point. Also care should be taken in spacing an equal number of rivets on each side of the centre of a member for the connections. Extreme care should be taken to avoid eccentricities at connections as far as possible.

For lateral or wind bracing connections it is a common error to connect the lateral plates to resist the stresses along the line of one component only. The connections should be made to resist both components. A difficult connection to make is at the point where the bottom laterals connect at the abutment. For the best design the transverse component should be carried direct by the end floor beam and the longitudinal connection by the bottom chord. As noted before, the end bottom chord should be a stiff member.

The bottom laterals are generally connected to the bottom of the posts and to the bottom flanges of the floor beams. The longitudinal component of the wind stress must go from the bottom of the post up to the pin to be carried by the eye-bars. As this eccentricity is unavoidable in our present designs, the posts must be designed to resist this bending. This is accomplished by a plate on each side of the post running to the bottom of the post and above the pin to be utilized also as a pin plate. For the large wind stresses it is advisable to design these reinforcing plates wider than the post to add greater resistance to the bending of the posts.

As the posts cannot be laced from the floor beam to the pin, this part of the post should be amply strong, by cutting the outstanding legs of the angles as little as possible, by extending the pin plates up to reinforce the weak section and by using as few countersunk rivets as possible. Countersunk rivets are not as good as full-head rivets in bearing and, besides, remove more of the section of the plates they connect by the counterboring. The chipping of the countersunk rivet also weakens the rivets by loosening them.

Eye-bars should be designed to conform to the dies of the manufacturers. It will be found that ins. is the maximum thickness for eye-bars, for tests have demonstrated that the thicker bars are not as efficient in tension per square inch as the narrower bars. It is recommended that only two or three sizes of pins be used on a span. If the pin is too large for the bending stresses the pin plates may be correspondingly reduced. Besides, the eye-bars will be more uniform and a less number of pilot and driving nuts are used. Pinplates for transmitting bearing to the pins should be designed with the idea that the web plate is transmitting its own bearing, therefore the bearing from the chord angles to the cover plates should be transmitted through the chord angles to the pinplates direct.

As truss spans are riveted up in the field after the span is "swung" clear of the blocking, the ends of the top chords at the splices come to a bearing for dead load only, consequently the splice plates should be designed heavy enough to carry at least the live load stresses.

In good designing splices should be avoided on the principle that a splice, even if excessively strong, is never as certain of action as a full member. It is important in a splice to secure a proper distribution of material and rivets. The reinforcing material should be adjacent to the material spliced, with the correct number of rivets to each part of the splice. For instance, it would be manifestly wrong to splice a 6 x 4 in. angle by putting all of the splice material on the 6-in. leg.

On through truss spans the tendency is for the stringers to elongate as the bottom chord stretches. It is therefore advisable to design the stringer connections with a wide gauge for the rivet lines to permit the connection angles to "spring" under deflection.

On deck truss spans, having the stringers riveted between the floor beams, the top chord compresses and becomes shorter, tending to throw compression into the floor system, but in reality bowing the stringers outward. To offset this condition the stringers are built a trifle short for short spans, or one expansion pocket is provided at the centre of the span for spans over 300 ft. in length.

On deck trusses where the stringers rest on top of the floor beams the difference in movement between the top chord and the bottom flanges of the stringers is the shortening of one panel of top chord plus the elongation of the bottom flange of the stringers. This movement is taken care of by slotting the holes of one end of each stringer. In such a case the top laterals should not be rigidly connected to the stringers. The only connection necessary is such that will support the weight of the laterals to prevent sagging.

Bottom laterals should always intersect at the centre line of the truss where eye-bars occur in order to prevent the twisting of the post. This is not so essential when the bottom chord is a built member, as the stiff member carries the stress from one side to the other. The objection to having central connections where stiff members occur is that the lateral plates become very long and ungainly. However, when eccentric lateral connections are used, the two sides of the member should be rigidly connected.

Top chord sections are usually shipped in two panel lengths. The engineers should remember this and design these sections of the same material to avoid the shop splice. The weight is practically the same and the member is stiffer without the splice.

The wide lacing bar having two rivets at each end is advocated instead of the narrow bars with one rivet at each end. In addition to its greater efficiency the wider bar is more easily riveted.

For truss spans the reaction of the end floor beams should be carried on the end pin and not on the shoe. This will enable the end beam to take up deflection with the trusses and also place the loading more central on the main shoe. The pin shoes, as noted elsewhere in this paper, should be of cast steel, while the main bolsters should be of cast steel or cast iron, depending on the amount of reaction.

The tractive force of the engine exerted when the brakes are set has a tendency to bend the floor beams in the direction of the moving load. This force, which is usually taken at one-fifth of the vertical moving load, is resisted by the stiffness of the floor beams for small spans. For long spans, say over 250 ft. long, it is best to provide a truss frame to carry the tractive forces over the trusses. For a solid floor, such as a trough section floor, I-beam floor, or where four lines of stringers are used for single track, the provisions for bracing against tractive force may be neglected.

Trestle Work.—The design of the viaduct will depend upon economic conditions and on the equipment for erection—that is, the length of span is determined from the length of boom on the traveller or derrick car. We are not concerned with the erection in this paper, but this point was brought out to show that all phases of construction should be considered.

After deciding on the lengths of the main girder and tower spans, the elevation of the trestle should be determined by making the tower spans of one length, and as many as possible of the main spans of one length. The elevation at the top of the piers should be fixed with the object of making all of the tower posts alike if possible. If the contour of the ground will not permit this, the tower lights should vary only where necessary.

It is recommended that the tower spans be made of the same depth as the main girders. This has advantages, as omitting the brackets for carrying the short spans and utilizing the bottom flange of the tower span for the top strut of the longitudinal bracing.

From the point of view of the erector the erection is simplified by making the main girders and the tower spans of the same depth, for the reason that the traveller or derrick car can be run on the tower spans easily, whereas, in the case of the shallow tower spans, it is necessary to block up one end of the span and slide in the long girders afterward.

When the track is on a grade the two bents of any one tower should be made identical by adding fillers on the tops of the columns which are on the up-grade side of the tower. This provision simplifies the fabrication of the steel considerably.

The deflection of the main spans when over about 70 ft. in length throws the bearing pressure on the edge of the base plate. This unequal distribution of pressure may be overcome by the use of a short base plate or by having the girder reaction carried on a narrow strip of steel placed transversely to the length of the girder.

To secure the proper bearing of the columns on the masonry the stress must be distributed over an area considerably larger than the area of the columns. The best way to accomplish this is to provide a casting which flares out to the required area and the base of the column will be simplified without the use of elaborate wing plates, diaphragms, etc. It should be remembered in this connection that fitted stiffeners, wing plates, etc., are difficult to fabricate so as to insure bearing contact through the milled ends.

The diagonals of the longitudinal and transverse bracing are tension members. For simplified shop work it is recommended that the angles of these members be held together with tie plates and not with lacing bars. Narrow struts composed of four angles in the shape of an I-beam are perfectly riveted up with a solid web plate instead of being laced. The weight in either case is practically the same as the solid web may be utilized as part of the section of the strut.

Wide struts, of course, should be laced rather than built up with a solid web in order to save the weight.

Column sections are generally shipped in lengths not exceeding 60 ft. The engineer should design the column for the length of one shipping piece of the same cross section. The shop splices are avoided thereby, the weight is somewhat heavier, but the member is stiffer in consequence.

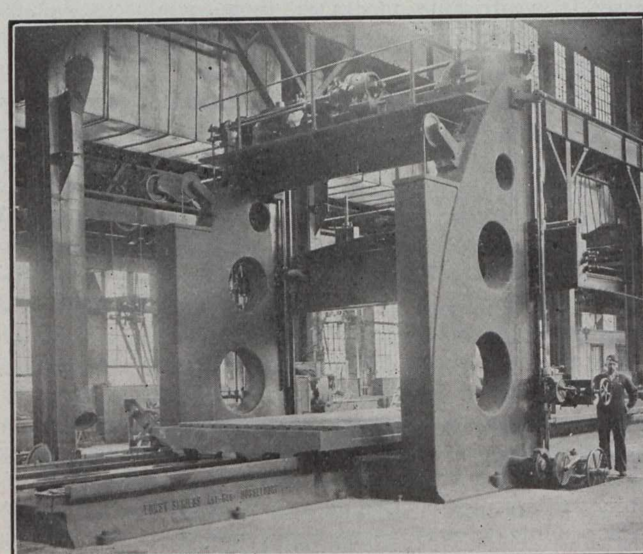
Base plates, cap plates and sole plates should be straightened in straightening rolls to secure an even surface in bearing. It is not necessary to plane the surfaces of the plates to get this result.

NEW WELLAND CANAL.

Tenders are likely to be called in a few months' time for the Welland Canal improvement. The cost will be approximately $50,000,000 and the time required for construction five years. The work is to be done at several sections at once, and seventy-five steam shovels and over a dozen dredges will work at various points along the route. The old course will be widened and deepened from Port Colborne to Thorold, but the descent from Thorold to the new harbor at McCalla's Grove, about three miles east of Port Dalhousie, will be by an entirely new channel, the outlet being at the Ten Mile Creek. Between Thorold and Lake Ontario there will be seven locks, with a depth of 25 feet. The lift system instead of the swing gate system will be in vogue. All will be operated by electricity.

A LARGE PLANER.

The planer, which is illustrated, was built by the well-known firm of Ernst Schiess, Limited, in Duesseldorf, Germany, and was furnished some time ago to the Mesta Machine Company in Pittsburg. When Mr. Mesta was in Europe some time ago he found that a great many large machine works were using Schiess planers, and was favorably impressed with the advantages of the German design. He consequently placed an order for such a Schiess planer with the agents of the German firm, the Wiener Machinery Company, 50 Church Street, New York, N.Y. The machine is now in successful operation for some time, and it may interest our readers to get acquainted with some data of this big planer. The machine has a planing length of 33 ft., a width of 13 ft. 1 in., and will accommodate pieces 11 ft. 6 in. high. There are four toolholders, two at each standard. All these holders are arranged for automatic setting in a horizontal, vertical or inclined position up to 45 degrees, and are furthermore provided with a quick-acting power arrangement, to be moved at the rate of about 2 ft. per minute, and an automatic lifting of the tools when the table is running back. The cross-rails can be lowered



View of Planer.

or raised at the rate of 10 in. per minute. All these quick changes can be made independently from the main drive of the machine, and this is accomplished by means of a 12 horse-power motor arranged on top of the machine. This motor is easily accessible from a bridge arranged for this purpose. Of course, the motor is operated in different ways very easily from a switch on the right side of the machine. The table, which is 10½ ft wide, and arranged to permit an easy removal of the shavings, runs in three wide, flat grooves, which are provided with a very good, durable and automatic oiling system. The table is driven by two broad steel racks by means of a 50 horse-power reversible motor. The motor runs with between 300 to 600 revolutions in such a way that when the table is running backward the motor is running at 900 r.p.m., which corresponds with the planing speed of 4-8 in. and backward speed of 12 in. The machine was built to accommodate pieces up to 110,000 pounds weight the normal tool pressure being about 25,000 pounds. The machine complete without the motor, which was furnished by the Westinghouse Electric and Manufacturing Company, weighs about 300,000 pounds.

A BRIEF DESCRIPTION OF A MODERN STREET RAILWAY TRACK CONSTRUCTION.*

By A. C. Polk.

With the increasing demands made on various traction companies throughout the country to provide good service, the matter of securing a permanent roadbed in the busy and paved sections of a city has become a serious problem. When the work is poorly done originally, and is not on a proper foundation, the cost of maintenance is increased, the paving along the poor roadbed becomes cracked and ruined by the movement of the track, unfavorable public comment on it arises, and the company finds itself face to face with one of two propositions, either the entire rebuilding of the roadbed or the attempt to surface and repair the old one. Either alternative is expensive, as the work will have to be done on a busy street and will interfere with car schedules, with consequent loss of revenue to the company and inconvenience to the public. Therefore, when the paving is done originally, the permanent roadbed should be substantial and effective.

In this paper the writer has attempted to give a general description of the methods and materials used at Springfield, Mo., in rebuilding the Springfield Traction Company's lines on streets which were being paved by the city during 1911.

The company's franchise stipulates that it shall pave the space between its rails and for two feet outside of the rails, when the city paves on the various streets occupied.

The work was done by the company, under the writer's supervision, and aggregated more than three miles of new tracks.

It was desired to secure as permanent a roadbed as possible, in fact, one which would outwear the rail itself and allow its replacement without disturbing the roadbed if so desired. Fig. 1 shows the general cross-section and detail of the work as put in.

General Features.—The general features of the structure were, a 7-in., 70-lb. **T**-rail section, 62 ft. long, laid on steel ties, and directly under each rail longitudinal concrete beams, each reinforced with two ½-in. twisted steel rods, and a 5-in. concrete mat over the beams and the centre of the tracks for a paving foundation.

In this case the city contractors were allowed to place the street pavement first, except where it was of asphalt. After the paving on each side of the track had been completed, the old track was moved to one side or the other on the completed pavement, and excavation between the tracks was commenced.

Excavation.—The standard depth below the finished pavement to which the general excavation was made over the whole 9-ft. space was 10 in., as shown by Fig. 1. Then two trenches were excavated to exact dimensions, a depth of 9 in. more, and running with the rail. At the joints these trenches were connected by cross trenches, 30 in. wide at an additional depth of 3 in., so that each joint tie would be thoroughly embedded and have a good thickness of concrete under it. Around each intermediate tie shallow trenches were excavated so that there would be at least 2 in. of concrete under the tie and 4 in. around its sides.

Ties.—All ties were punched at the proper gauge to take 7-in., 70-lb. or 80-lb. **T**-rails, but the 70-lb. rail was used principally. There were two types of ties, one under the joints which came opposite one another, and the other intermediate between them. The joint tie was an **I**-beam section, weighing 20 lb. per ft., 6 ft. 8 in. long, having an 8½-in. top, on which the joint rested, and a 4½-in. base. The intermediate ties were of the same length, but weighed 14.5 lb. per ft. and had a 6-in. top and a 4-in. base. All ties were spaced 5 ft. apart, or as near that as the distance between joints would permit.

Fastenings.—The rail was fastened to the tie by special lugs and **T**-headed bolts with square shoulders next to the head. These bolts could be inserted from the top, if so desired, being dropped through the rectangular hole punched in the tie, turned, and then raised until the square shoulder fitted up into the rectangular hole, which prevented it from turning while running down the nuts. The lug had a projection on its under side which also fitted into the rectangular hole, and prevented it from turning or backing off the rail. A socket wrench was used to run down these bolts rapidly. The joint ties were heavier and wider than the intermediate ones, as noted above, and were punched to allow the lug to fasten over the continuous joint which was used.

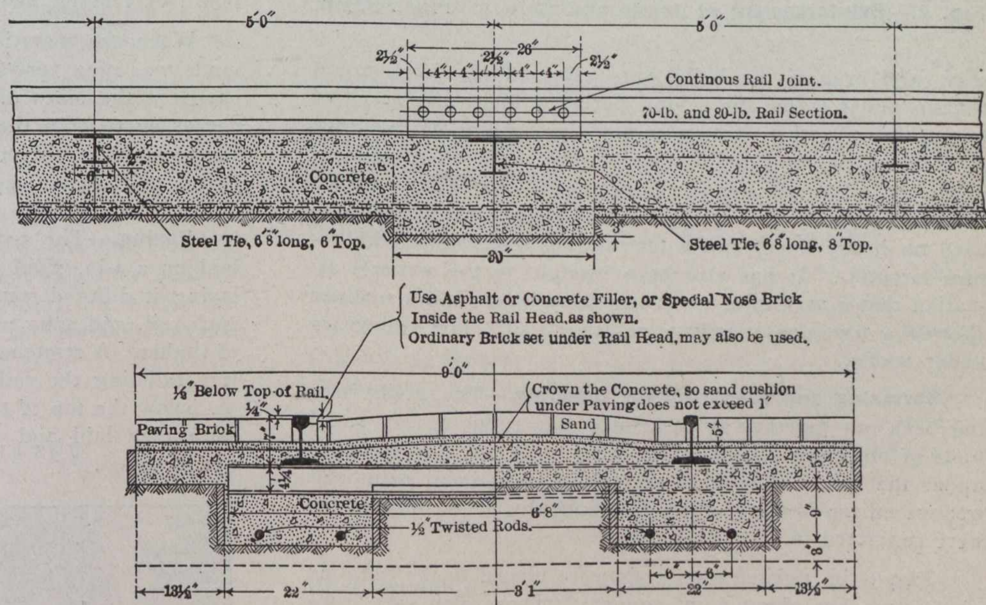


Fig. 1.—Section of Concrete Steel Tie Track Construction.

Joints.—Six-bolt continuous joints were used, and the following method of making them was adhered to with greatest care, as the joint is generally the weak part of the track work:

First, those parts of the rail with which the joint came in contact were carefully cleaned and polished with files and emery cloth until all scale, rust, and particles of dirt were removed and the surface was bright. Then those parts of the joints which came in contact with the rail received the same treatment. All contact parts were then greased and the joint put on. The tightening of the bolts was started from the centre, working out toward the ends, pulling up a bolt on one side of the centre and then the corresponding bolt on the other side, and when the bolts were

*Paper to be presented to American Society of Civil Engineers, Oct. 16th, 1912, and published in the August proceedings of the society.

all apparently tight a heavy sledge was held against the bottom of the joint on one side and the other side tapped briskly with a light sledge at the bottom only, and vice versa.

Then the tightening process was repeated until nothing more could be gotten out of the bolts by one man with a wrench having a 30-in. handle. After a continuous joint has once been carefully made in this manner it is there to

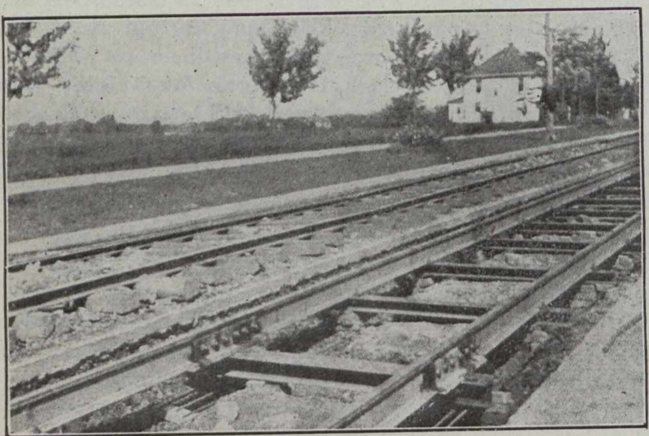


Fig. 2.—Reinforcement at Joints and General Construction.

stay, and even if the bolts were removed the joint would remain under traffic for a long period without any signs of loosening. Another feature in making a joint of this type in this manner is that no bonds were used, or considered necessary. The net area in contact has a far greater current-carrying capacity than the No. 0000 copper bond generally used on heavy lines, and a test showed no trouble with return circuits. It has also been brought to the writer's attention that a section of track put down in a similar manner showed a first-class negative return circuit after two years under traffic.

Surfacing and Preparing for Concrete.—The track, having been put together as described, was supported on small piers of old brick placed under every other tie, and centring under the rail. The final surfacing was done with oak wedges on top of these piers, and both the piers and wedges were concreted in.

Two ½-in. twisted steel rods were placed in the bottoms of the trenches about 6 in. square. These also were supported at intervals on top of a brick which held them about 2½ in. off the ground. Under each joint two extra 4-ft. lengths of these steel rods were placed, to give additional strength at this point, which is usually considered the weak spot of track construction. This is shown on Fig. 2.

The track was then given its first surfacing raise, being brought approximately to grade. Afterward, a second finishing surface and true grade was secured by driving up the oak wedges. This final surface, however, was only kept a short distance ahead of the mixer on account of the difficulty in keeping the skeleton track in correct line, variations in temperature kinking it.

Concrete.—Concreting was next started, two types of mixers being used on this particular work at different times: One was mounted on car trucks and driven with a 10 h.p. motor; it occupied the temporary old tracks which had been previously placed at one side, and was supplied by a regular work train which delivered the concrete material on flat cars. The other type was mounted on wide-tired wheels, driven with a 15 h.p., 500-volt, D. C. motor, and was equipped with a charging bucket. All materials for the latter were hauled in wagons to the streets and dumped ahead of the mixer in such manner that they were about in the right proportions. These materials were cleaned up as the mixer progressed.

Of the two methods, the latter was found to be by far the most satisfactory, as there were frequent delays in the delivery of materials to the first mixer by the work train, and the temporary track was blocked for traffic beyond the point where concreting was in progress and, on single-track work, passengers had to transfer around the obstruction.

In the second method, all material could be delivered on the street for a considerable distance ahead of the mixer, and there was no reason for the mixer to be idle at any time on this account.

The concrete was composed of 1½-in. (maximum size) crushed limestone, Kaw River sand, and chats from the Aurora Zinc Mine district, the proportions being one of cement, two of sand, two of chats, and three of crushed stone, this making a very good mixture. The concrete was mixed very wet, dumped into movable chutes from the mixer, and deposited directly by them on the track. Great care was taken at all times to keep all loose material in the excavation cleaned up ahead of the concrete and to maintain the twisted steel rods in their proper positions. The concrete was puddled carefully under and around all ties with shovels and finally crowned, when it reached grade, with a special board or templet made for the purpose.

When the material through which excavation had been made was of a very loose character, or if bad weather had caved in the sides of the trench, forms were placed where necessary to hold the concrete to the exact dimensions of the roadbed. After the concrete had set for 48 hours, and in the majority of cases longer, the brick paving was done.

Paving.—The paving was of first-class paving blocks, laid on a 1-in. sand cushion, and grouted. The method of laying it differed somewhat from the usual practice. Along each rail, and snug up against it, was laid a 2 by 4-in. piece of timber. A stretcher course of bricks was then laid against it paralleling the rail, the tops of the bricks being only ½ in. below the top of the rail. The headers across the tracks were then laid and all the bricks were thoroughly rolled and rammed.

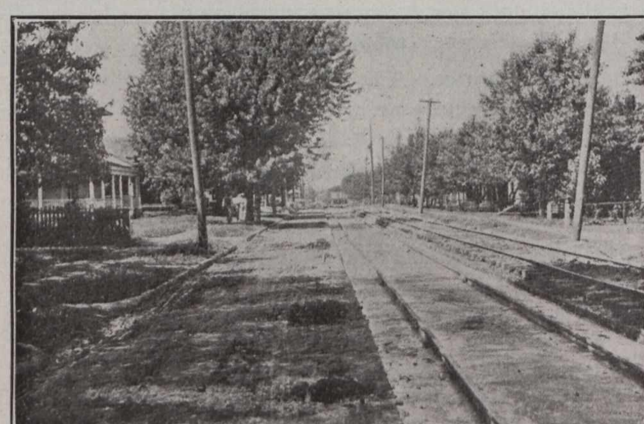


Fig. 3.—Concrete and Track Work Complete, Ready for Brick Paving.

Before grouting, the 2 by 4-in. piece was removed and the space thus left with concrete to a plane 1 in. below the top of the rail, forming the flangeway for the wheels. After this had set, the whole pavement was grouted thoroughly and carefully. When filled up, the grout remaining over the top of the pavement was allowed to stand until it had attained a set and was fairly stiff, then dry sand was sprinkled over it and the whole was swept thoroughly with wire brooms, thus removing all surplus grout sticking to the tops of the bricks and presenting a very neat, clean surface. It was noticeable, too, how very much the paving contractor improved in the character of his work, when this specification of cleaning off the top of the brickwork was strictly enforced. By this method all irregularities of laying and surfacing are strongly brought out, and easily seen and corrected.

Cost.—The cost of track construction of this type for paved streets, including the paving between and for 2 ft. outside of the rails, using the 70-lb. high **T**-rail, under the conditions at Springfield, was approximately $5 per ft. of single track. This cost may seem to be high, but, when the permanent character of the work is taken into consideration, and the cost of doing street work under other methods is analyzed and compared, it will be found to be very reasonable. It possesses several advantages over some of the methods in vogue. It takes less concrete than the old method of filling under and around wooden ties. It places the concrete and the strength where it is most needed, and, when properly put in, it is certainly permanent, and the roadbed will easily outwear two or more sets of rails under heavy traffic. The rail can be changed without disturbing the roadbed in the least, if proper provisions have been made in the steel ties originally.

On one section of similar track construction, known to the writer, not the slightest sign of any motion could be detected after 3 years' operation, and it is reported to be in as good condition as the day it was built.

The writer trusts that the foregoing brief description may prove of interest to members of this society and bring out some discussion on work of this class, concerning which very little has appeared in the technical press.

The work was done by the Springfield Traction Company, owned and operated by the Federal Light and Traction Company, of New York, and was executed under the general direction of Mr. W. A. Haller, chief engineer, the writer being in immediate and full charge of all construction matters at Springfield, Mo.

COST OF PUMPING WATER.

The following costs of pumping water by steam power and by electric power are abstracted from a letter written to Municipal Engineering by Mr. William Plattner, consulting engineer of North Attleboro, Mass.

Electricity in the waterworks has now been used for more than fifteen years, and the electrically driven pump has taken a permanent place among the steam driven machinery.

Like all other machinery in waterworks or elsewhere, the electric pump has its limitations. There are situations, however, and they are very numerous in waterworks pumping, where the electric pump is not only a great convenience but a profitable investment. In any power or pumping device, the use of electricity is a question of service, cost of power and investment charge. Conditions in different localities differ, and no two installations are likely to be the same, viz.: pressure (fire and domestic), hours of pumping (day or night), capacity of stand pipes or reservoirs, number of water consumers (flat rate or metered), total head, including suction, discharge, friction, etc.

Here are a few towns that purchased electricity for pumping water, also the price paid per kilowatt hour:

Lincoln, Ill., population 8,000, rate 5 cents to 2 cents per kw. hr.

Dover, N.H., population 13,000, rate 2 cents per kw. hr.

Norwood, Mass., population 9,000, rate 1.6 cents per kw. hr.

Cheboygan, Mich., population 6,000, rate $26.50 per h.p. per year.

Other towns pumping water with electrically driven pumps are as follows: Lima, Ohio; DeKalb, Ill.; Maywood, Ill.; Grand Haven, Mich.; Rockford, Ill.; East Douglas, Mass.; Dudley, Mass.; Harvey, Ill.; Lagrange, Ill.; Blue Island, Ill.; Holland, Mich.; North Chelmsford, Mass.; Uxbridge, Mass.; Webster, Mass.

A comparison as to cost of pumping water, electricity vs. steam, follows. This is for a town of 4,500 people in New England, 200,000 gallons of water pumped per day or 73,000,000 gallons per year. Water is pumped to reservoir from driven wells, pressure 62 pounds.

By Electric Power.

Cost of Plant.

Brick pumping station, 20 x 20 ft.	$ 800.00
Grading, road, fences, etc.	150.00
One 5½ x 8-inch double acting, triplex pump, capacity 220 gallons per minute, in place on foundations, with all measuring appurtenances, including sand and air chamber, and independent pump for renewing the latter, connected with one 20 h.p. electric motor	1,835.00
	$2,785.00

Annual Expenses.

Interest on $2,785.00 at 4 per cent.	$ 111.40
Depreciation on pumping station, $800.00, at 2½ per cent.	20.00
Depreciation on pumping plant, $1,835.00 at 5 per cent.	91.75
Electric current purchased, 60,833 kw. hrs. at 3 cents	1,824.99
Oil, waste, repairs	50.00
Attendance, one-eighth of one man's time	105.00
	$2,203.14

By Steam Power.

Cost of Plant.

Brick pumping station, chimney, coal room	$6,300.00
Grading, road, fences, etc.	250.00
One 9 x 18 x 18½ x 12 duplex compound condensing pumping engine, capacity 220 gallons per minute, set in place, with all necessary appurtenances, connected with one 90 h.p. horizontal return tubular boiler complete in brick setting	4,750.00
	$11,300.00

Annual Expenses.

Interest on $11,300.00 at 4 per cent.	$ 452.00
Depreciation on pumping station, $6,300.00, at 2½ per cent.	157.50
Depreciation on pumping plant, $4,750.00, at 3⅓ per cent.	158.33
Boiler insurance	21.00
342 tons coal at $4.75 per net ton	1,624.00
Oil, waste, repairs, etc.	75.00
Attendance, one-half of one man's time	420.00
	$2,908.33

SOUTHERN VANCOUVER ISLAND

The area described in a report to the department of mines, Ottawa, by Mr. C. H. Clapp, includes that part of Vancouver Island which is south of the Alberni-Nanaimo road, and east of the Alberni canal and Barkley Sound; and also includes Saltspring Island, and several smaller islands off the east coast of Vancouver Island, in Haro Straits. This area is approximately 4,000 square miles.

Much of the southeastern and eastern part of the region is accessible by road. In the vicinity of Victoria, on the Saanich Peninsula, and along the east coast north of Cowichan Bay, the country is well settled, and there are many good roads. Main roads extend from Victoria west to East Sooke and Jordan River, and northwest by way of Sooke and Shawinigan Lakes to Duncan. There is a stage road from Duncan to Cowichan Lake, and another from Nanaimo to Alberni. There are two railroads in the area, the Victoria and Sydney, and the Esquimalt and Nanaimo. The former is located on the Saanich Peninsula, while the latter follows the east coast as far north as Nanoose. At the present time an extension is being built across the island to Alberni. Other extensions and new railroads and tramways are projected, to open up the interior of the island.

At present the inlets and lakes, a few of the rivers, and the Cowichan Lake and Alberni roads furnish ready access to the interior of the island, and no very long packing trips need be made. Such trips at the present time must be made without the aid of pack animals, as the trails are not numerous, and with two or three exceptions are suitable only for men. Even these trails, when well located and cleared of brush, are of the greatest assistance, for on them seven or eight miles may be readily travelled in a day by one carrying a heavy pack; while without a trail three miles is often the limit which it is possible to travel in a day, with the hardest sort of muscular work. The establishment of more trails is, therefore, of the greatest importance, and would fill a most urgent need.

A large part of the shore may be safely traversed in a small boat. Coasting steamers run between Victoria and ports on both the east and west coasts.

The mineral resources of southern Vancouver Island include deposits valuable, or possibly valuable, for gold, copper iron, fuels, fluxes, lime, cement pigment, clay, sand and gravel and stone. Coal has been the chief source of mineral wealth, and copper and some gold have been commercially produced. Lime, cement, clay, sand, gravel, and crushed stone as well as coal are being produced at present.

Gold occurs in the gravels of a large number of the streams of southern Vancouver Island, but with two or three exceptions, the principal deposits all occur in the streams which drain the area underlain by the Leech River slates and have been derived from very low grade quartz veins in that formation. The gold-bearing gravels are usually of a fair grade, but are not very abundant. A large accumulation of gravel at the old mouth of Lost River and near the mouth of the present Sombrio River is being exploited at present. Mineralized shear zones occur throughout the rocks of the Vancouver group, and although they are usually more important as possible sources of copper, they also carry small amounts of gold.

The copper deposits of southern Vancouver Island are all more or less closely connected with the igneous rocks erupted during the upper Jurassic period of batholithic and dyke intrusion. They may be subdivided into three main types,—contact deposits, impregnated and replaced shear zones with accompanying quartz veins, under which is the special Sooke type, occuring in the shear zones of the Sooke gabbro, and lastly the Tyee type, a large lens of ore which was formed in a syncline in the Sicker schists of Mount Sicker. The contact deposits, which are developed chiefly in metamorphic limestones near their contacts with intrusive igneous rocks, are the more numerous. They are, as a rule, small, irregular, and of low grade, but some of them are of considerable economic interest. The deposits occurring in shear zones are of little importance, with the exception of the special Sooke type, which is of great prospective interest. The Tyee deposit, now largely worked out, is the only deposit from which there has been a commercial production.

The iron ore deposits are of four types, contact deposits, impregnated schists, replacement or segregation deposits in the Sooke gabbro, and bog ore deposits. The contact deposits are by far the most important; and consist of bodies of magnetite, which have been formed in the metamorphosed Nitinat limestones, near the intrusive Beale diorite. The bodies are large, and low in phosphorus, but high in sulphur. The chief deposits occur in the valleys of Gordan River and its tributary, Bugaboo Creek. The impregnated schists occur in the Sicker series. The mineral-bearing rocks are dark red, jaspery schists, with 10 to 15 per cent. of magnetite. Since the magnetite can be easily concentrated they are of prospective importance. The other two types are apparently of no value.

Coal is the source of a very important industry on the east coast; the coal being obtained near the base of the Nanaimo formation in the Comox basin, and in the northern part of the Nanaimo basin, from 600 to 1,500 feet above the base. These coal deposits have not been examined during the present investigation. Coal of commercial value is apparently absent from the other basins of the Cowichan group, and is almost certainly absent from the Tertiary sediments of the west coast. These sediments have also been prospected for oil, but the conditions for the accumulation of oil do not seem to be favorable.

The crystalline limestones of the Nitinat and Sutton formations furnish excellent and ample material for flux, and for the manufacture of lime and cement. Cement is manufactured in the southeastern part of the island by the Vancouver Portland Cement Company, and lime is burned by several manufacturers also in the southeastern portion of the island.

A bog deposit of yellow ochreous clay in the Sooke district is a possible source of material for a base for colored paints.

There are two types of clay deposits in southern Vancouver Island, the shales of the Nanaimo formation and the clays of the stratified superficial deposits. The greater part of the shales of the Nanaimo formation are sandy and impure, but associated with the coal in the Nanaimo and Comox basins are thin, lens-like beds of clay-shale. This shale is mined by the coal companies and used by the British Columbia Pottery Company at Victoria, where it is mixed with the clays of the superficial deposits, for the manufacturer chiefly of sewer pipe. The clays of the stratified superficial deposits are used for the manufacture of common bricks and drain tiles, at Victoria, Sidney, Sidney Island, and Somenos.

Sand and gravel are also obtained from the stratified, superficial deposits of southeastern Vancouver Island.

The fractured and sheared character of the rocks renders most of them unfit for building stones. In rare instances the marbles may be of value, and some of the dark granites (granodiorites) exposed near Alberni canal would doubtless make good building stone. The sandstones of the Cowichan group, especially of the Nanaimo and Comox basins, offer excellent material for stone of that kind.

The traps, especially those of the Metchosin volcanics, offer abundant material for an excellent quality of crushed stone. The Metchosin volcanics are quarried at Albert head, in Esquimalt district, by the British Columbia Trap Rock Company.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

JAMES J. SALMOND, MANAGING DIRECTOR
T. H. HOGG, B.A.Sc., MANAGING EDITOR
A. E. JENNINGS, ADVERTISING MANAGER
P. G. CHERRY, B.A.Sc. CIRCULATION MANAGER

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	$1.75 (7s.)	$1.00 (4s.)

Copies Antedating This Issue by More Than One Month, 25 Cents Each.
Copies Antedating This Issue by More Than Six Months, 50 Cents Each.
ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main 7404, 7405 or 7406, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square. T R. Clougher, Business and Editorial Representative. Telephone 527 Central

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS

When changing your mailing instructions be sure and give your old address in full as well as your new address.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, SEPTEMBER 26, 1912. No. 13

CONTENTS OF THIS ISSUE.

CONCRETE SIDEWALKS.

In the building of concrete sidewalks a wide diversity of opinion exists among engineers as to the foundation to be used. A few years ago it was quite customary among municipal engineers to provide in the specifications for the laying of drain tile under the centre of the walk. This drain tile was very often laid when there was no necessity and without outlet, with the consequent result, the drains filled with water and very often froze in the winter. In many of the towns and cities throughout Canada may be noted sidewalks with a longitudinal crack running along them. This in nearly all cases was the result of the water freezing in the drain tile. The drain tile is not very often used or called for in specifications at the present time, but the question of foundation is still an important one. The usual specifications call for a foundation base of several inches of cinders or gravel. The object of this base is to provide a foundation of porous material to furnish proper drainage. It stands to reason that when the sidewalk is laid upon a naturally drained soil, such as gravel or sand, this porous base is, therefore, unnecessary. If the sidewalk is built on clay, the base of cinders or gravel may have the same effect as the drain tile mentioned above, particularly if no way is provided to remove the water that will collect in the porous base. To the engineer who has had some experience in laying sidewalks, it will be appreciated how hard it is to make the contractor provide drainage for the foundation.

We believe that in most cases the best results will be secured by omitting the porous base and by placing the sidewalk on the bare earth. Information received from a number of municipal engineers recently leads us to think that this is being done in many of our towns and cities now. The results appear in all cases to be as favorable, or more favorable, than with the use of a base. The omission of the clause in the specification calling for a foundation of cinders or gravel will usually be justified, and will result in a considerable saving.

WINNIPEG WATER.

Winnipeg has reached the point where some decisive action must be taken with regard to its water supply. The chief available sources of supply, as pointed out in the recent report by Prof. Slichter, are the Winnipeg River, the Poplar Springs, the Crystal Springs, artesian wells and Shoal Lake. Shoal Lake, the source recommended in the report, is about ninety miles distant from the eastern extremity of the city, in the Lake of the Woods district. The Provincial Board of Health maintains that the water supply of the city should be of an abundant and pure character, and derived from a visible source. The Commission of 1907, who reported on the water supply for Winnipeg, recommended Winnipeg River as a source of supply, but they stated that Shoal Lake was their ideal. They thought, however, that such a project at that time was too expensive. City Engineer Ruttan, in his report on Prof. Slichter's recommendations, states that hitherto the great cost of a supply from Shoal Lake has been considered an insurmountable objection. He adds that the quality of Shoal Lake water leaves nothing to be desired, and it is to be regretted that the engineering data available is not sufficient to enable an accurate estimate of the cost of the project to be made. He suggests that steps be taken to have a thorough and accurate survey of the Shoal Lake project made, so that all the points now in doubt, including the cost, may be determined.

It is clear, therefore, that from every standpoint Shoal Lake water is the best for the city, and it comes down to a question of cost. It is to be hoped that after a thorough engineering investigation Winnipeg will be able to secure their water supply from this source.

THE POLLUTION OF WATERS.

Last week we noted in the editorial columns that the International Joint Commission has been instructed by the government of the United States and Canada to investigate the question of pollution of boundary waters. The closing session of the Canadian Public Health Association Congress, held last week in Toronto, was marked by a strong resolution adopted by the executive council, taking a firm stand on the question of the pollution of waters. The resolution states:—

"That a committee of members be nominated to draw up a memorial to be presented to the Dominion Parliament, as follows:—

"That it is against the interests of the public health that raw, untreated sewage be permitted to discharge into waters which are used as sources of water supply.

"That it is the conviction of the Canadian Public Health Association that an Act of Parliament regulating the pollution of streams and lakes is required in order to strengthen the action of provincial authorities in this matter.

"That the committee appointed be given power to draw up the said memorial and present parliament all available evidence and data bearing upon the matter of prevention of pollution of waters which may be or are used as sources of water supply."

Last year at the annual meeting of the Canadian Society of Civil Engineers a similar resolution was passed and a committee appointed to approach the Dominion government on the same question. Resolutions like the above, when backed by such powerful organizations, should be instrumental in drawing the attention of the Dominion authorities to the necessity for some immediate action towards the regulation of the pollution of streams and lakes throughout Canada.

In one of the addresses delivered before the American Public Health Association, held in Washington last week, the statement was made that so much damage does sewage do to the water in the vicinity of large cities that Lake Michigan is more or less polluted to a distance of several miles from shore, at times heavily so. The speaker added that the intake pipes supplying drinking water for the towns along the lake shore should be carried out from twelve to fifteen miles from shore, and sewage disposal plants should be provided in the cities discharging sewage into the lake or rivers emptying into it.

An Act of Parliament regulating the pollution of streams and lakes would ce ainly aid in strengthening the hands of the provincial authorities in preventing raw, untreated sewage being discharged into waters which are used as sources of water supply. The public are gradually being impressed with the dangers resulting from such a barbarous manner of disposal. Modern civilized conditions demand the abandonment of primitive modes and the utilization of scientific methods of treating sewage before it is allowed to enter the streams and sources of water supply.

ROAD IMPROVEMENTS.

The second annual report of the Road Board of Great Britain affords some interesting data concerning road improvement. The report shows that about two and a quarter million dollars has been expended upon the improvement of road crusts, and about two hundred and seventy-five thousand dollars upon road widening and improvement of curves and corners. In certain criticisms of the work of the Road Board which have been made in Great Britain, the predominating note appears to be the slowness made in the employment of tar-spreading. It is stated that there can be no two opinions that both in the case of the dusty roads of last summer and the wet roads of the present year the judicious use of tar has worked wonders. It would be difficult, even in the case of a variable and treacherous climate like that of England, to find two summers more unlike one another than those of this year and last year, but both for the crumbling roads of 1911 and for the sodden roads of 1912 the tar has been found to give excellent results. This is more especially the case with the soft roads, intended for rural traffic, made with local sandstone, as in Surrey, for instance, or with some of the more porous varieties of limestone. On certain of the Surrey roads tarred three years ago, which received a light coating of tar again this spring, there is surprisingy little wear perceptible, whereas on roads of the same character in the immediate vicinity where no tar was spread the rain is running in streamlets along the channels worn during last summer in the soft metalling, the surface having been pounded into dust and distributed over the hedges and gardens. Not only does the tarred road behave better under the elastic tire, but it certainly throws off the wet and keeps sound much longer than the untreated macadam.

Where tar or heavy oils have been used on the road surfaces in this country, it has been almost universally successful. It is surprising the improvement that will result from even one application, and it is certain that the use of such surfacings will widely increase.

AMERICAN PIG-IRON COSTS.

During a recent discussion between representatives of iron-mining companies and Ohio taxation officials of Cleveland, Messrs. Hanna and Company presented the following statement as to the cost of making a ton of pig-iron in the Valley:—

Iron ore, 2 tons	at $2.75	$5.50
Freight to Valley	" 0.56	1.12
Coke, 1.2 tons	" 2.25	2.70
Freight from Connellsville	" 1.35	1.62
Limestone, ½ ton	" 0.65	0.325
Freight on limestone	" 0.35	0.175
Cost of raw material		$11.44
Conversion cost at furnace		2.00
Cost of one ton of pig-iron		$13.44

With basic, foundry and malleable irons selling as low as $13.15, the selling price was less than the cost as given.

SPECIAL TRACKWORK FOR CITY ELECTRIC RAILWAYS.

The following is abstracted from an article by Mr. W. E. Turner, published in the August issue of Applied Science.

In the construction of electric railways in cities, and especially in paved streets, the special track layouts constitute one of the most important items to be decided on, ordered, constructed and maintained by the engineering department. The high first cost, high maintenance, and quick depreciation of even the best layouts, make them an item of great importance to the company.

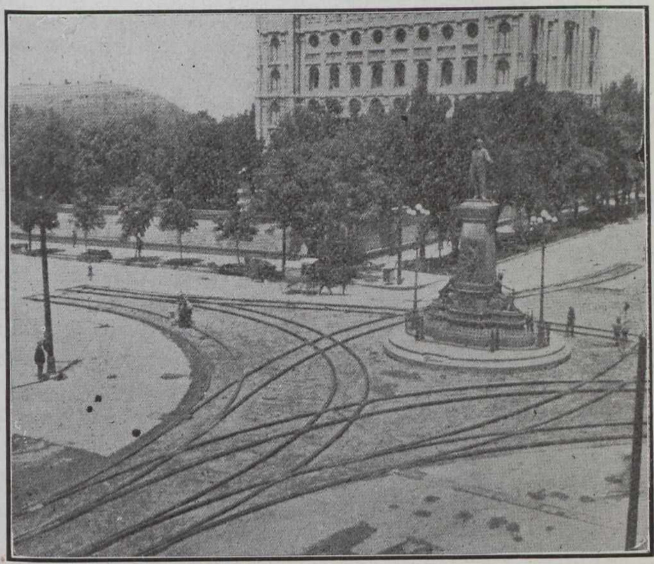


Fig. 1.

As a general rule the street railway company does not manufacture its own special work and it is not the intention of this article to deal with the manufacture of specials, but rather to present a few of the most important considerations for the engineer of the railway and at the same time to explain terms and conditions which may not be familiar to those who have not encountered much special work.

A special layout is a combination of switches, mates, frogs, crossings, and curves, arranged to make connections between different tracks. In its simplest form it is a plain ninety degree crossing of two tracks, and in its more complex phases it becomes a very intricate network of steel.

Fig. 1 shows a sample layout of average complication for a business district intersection. This particular instance is what is known as "the Brigham Young Layout," surrounding the famous statute of Brigham Young at the corner of South Temple and Main Streets in Salt Lake City. In the background may be seen the Mormon temple and tabernacle, the latter having the curved roof. This layout is on the tracks of the Utah Light and Railway Company, and the other illustrations and descriptions are drawn largely from this company's standard practice. It may be interesting to note that the Brigham Young layout cost about $13,000, complete, in place, and repaved.

In Fig. 2, showing a five-centre curve, may be found the names of the most commonly used pieces in track layouts. It will be noticed that in all cases tongue switches and mates are referred to instead of split switches, which are used entirely on steam roads, but very seldom on city electric lines. There are right and left hand switches, those shown on Fig. 2 being known as right hand because the curve turns to the right when entering it from the switch. There are also right and left hand curved frogs and crossings.

A cross-over is a connection between two parallel tracks as shown in Fig. 3. The switches and mates are the same as those shown in Fig. 2, but in this case we have straight frogs and it is not necessary to carry them in "rights" and "lefts." Right hand cross-overs are always preferable where the traffic takes the right side of the street on account of avoiding a "facing switch," that is, one in which the point of the tongue faces the approaching car. Cars must stop or run very slowly when passing a facing switch. A turnout is similar to a cross-over except that the second track ends at the turnout instead of going right through. Sometimes spring switches are convenient at turnouts. For instance, if all the traffic going south takes the turnout, and all going north takes the through track, the switch may have a spring holding the tongue in position for the turnout. It is evident that cars going north will enter the switch from the rear end and spring it out of the way as they pass.

Besides the above commonly used "specials," there is an infinite number of odd pieces, such as the frog of one curve combined with the mate of another, double frogs, etc., but such cases can only be described by individual drawings.

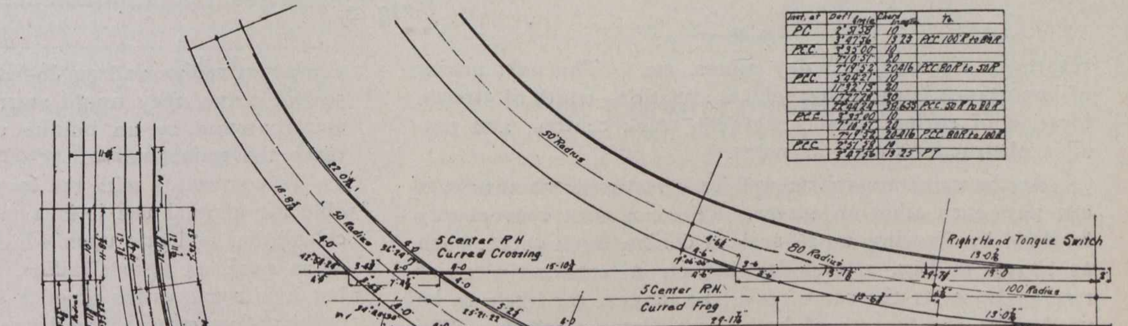


Fig. 2.

A type of special work frequently used is what is known as the bolted or built-up construction, in which the specials are built up of pieces of rail, planed off to fit together, bent for wings and curves, and bolted through steel bars and cast steel fillers. Practically all steam road specials are made in this way, and being the least expensive form of construction, the build-up specials are adaptable to electric roads in unpaved streets where traffic is light. They are used extensively for steam and electric crossings.

A more rigid form of construction is the cast iron body which, in the molten state unites so closely with the rail components as to form practically a solid mass. The cast body has usually the hardened renewable centre. The centre plate is hardend by patented and more or less secret processes, a very satisfactory combination being manganese steel, which will wear probably four times as long as ordinary rail steel.

The most substantial, and incidentally the most expensive, specials are simply solid castings with no rolled sections, but with the ends cast in the form of rolled sections to join abutting tracks. Such castings are used for very complicated pieces, and for points of heavy traffic, such as important steam road crossings in pavement, in which case the whole crossing is sometimes cast solid or hardened steel. This form is quite expensive to use.

Hardened steel rails may be obtained for use on curves where the wear is very excessive. Titanium alloy steel has been recently introduced for this purpose.

In deciding what layouts are necessary for any particular system, the first consideration is, of course, the traffic, that is, the regular car routes and special car routes for such purposes as getting in and out from barns, packing cars for

is generally better to employ compromise joints to the special work than to order specials in odd sections.

If all double tracks are maintained at a fixed distance between centres, it will be a great step towards holding to standard special work. That will at least provide that all crossovers and turnouts may be standardized and will insure the same advantage to curves to a very large extent.

In the design of curves the first consideration is to fit the ground and clear obstructions, the second to use standard pieces in every place possible, and the third to get the greatest available radius of curvature. As the most of the street intersections will probably be of similar design, a standard curve such as shown in Fig. 2 may be employed for all such places. In Salt Lake City, there are two standard curves in use, viz., the five-centre curve, which is shown in Fig. 2, for narrow streets, and a three-centre curve for the broader streets. The least radius in the three-centre curve is 66 feet 7 inches, and in the five-centre curve, 50 feet.

A compound curve, such as shown in Fig. 2, facilitates sharp curves on corners, permits the standard 100-foot switch and mate, and swings the car gradually from large to smaller radii. Its use is to be preferred to a plain curve. It is easily laid out in the field by reference to the table in the corner. Some of the large steel companies recommend spirals at the entrance to curves. Instead of running over

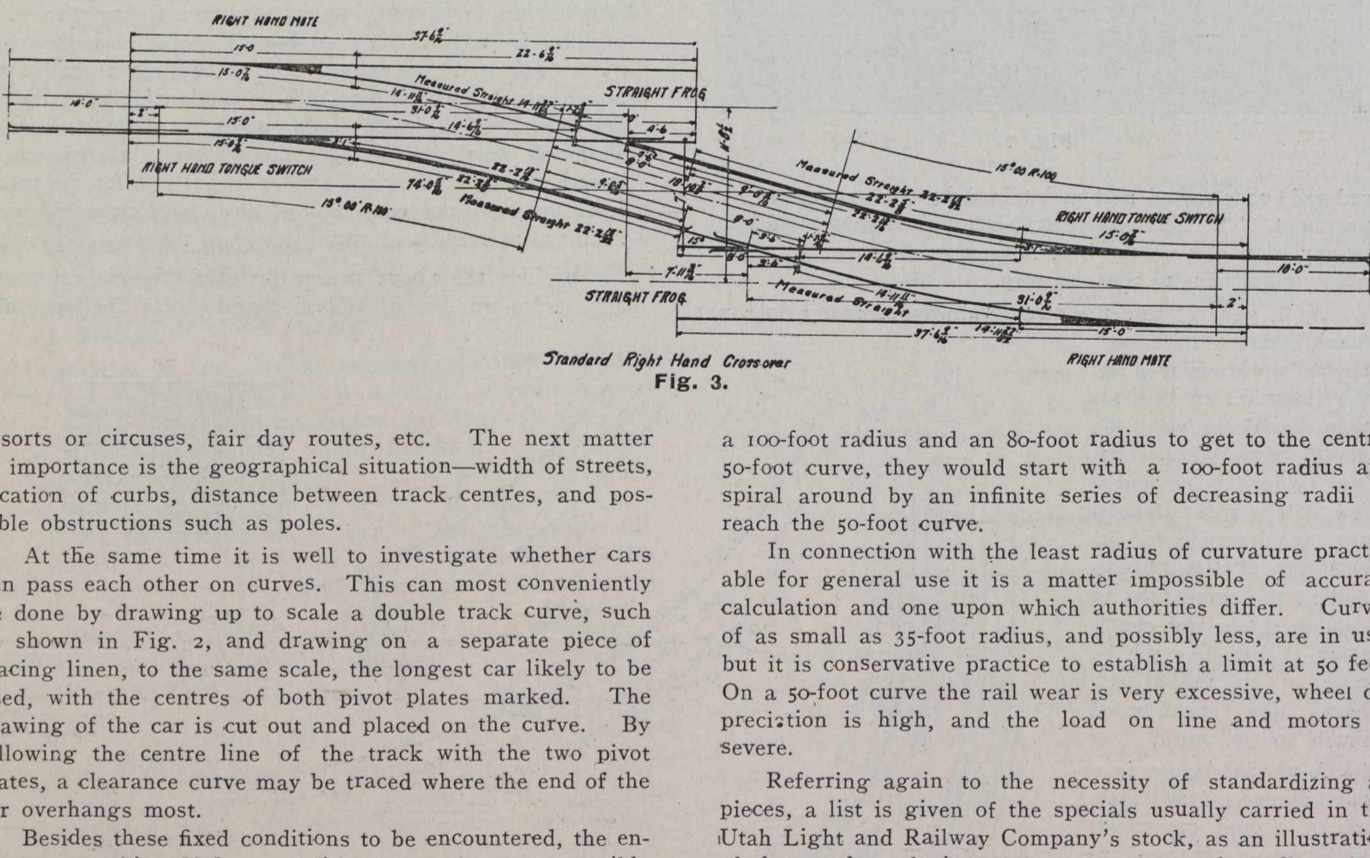


Fig. 3.

resorts or circuses, fair day routes, etc. The next matter of importance is the geographical situation—width of streets, location of curbs, distance between track centres, and possible obstructions such as poles.

At the same time it is well to investigate whether cars can pass each other on curves. This can most conveniently be done by drawing up to scale a double track curve, such as shown in Fig. 2, and drawing on a separate piece of tracing linen, to the same scale, the longest car likely to be used, with the centres of both pivot plates marked. The drawing of the car is cut out and placed on the curve. By following the centre line of the track with the two pivot plates, a clearance curve may be traced where the end of the car overhangs most.

Besides these fixed conditions to be encountered, the engineer must himself fix a condition—to make every possible piece of special work conform with certain standards. For instance, there is no reason why practically every switch and mate on the system should not be made for a 100-foot radius curve. The greatest advantage in conforming to standard pieces, is, of course, interchange ability and keeping down the stock which must be on hand for repairs, and other great advantages are the reduction in office work on ordering, keeping of records, keeping stock, in the field in laying out work, and in the shop and track departments by having pieces with which the men are familiar. Track should be standardized by using only one or two standard rail sections throughout the system, such as 65-pound A. S. C. E. rails, but where a variety of sections is used it

a 100-foot radius and an 80-foot radius to get to the central 50-foot curve, they would start with a 100-foot radius and spiral around by an infinite series of decreasing radii to reach the 50-foot curve.

In connection with the least radius of curvature practicable for general use it is a matter impossible of accurate calculation and one upon which authorities differ. Curves of as small as 35-foot radius, and possibly less, are in use, but it is conservative practice to establish a limit at 50 feet. On a 50-foot curve the rail wear is very excessive, wheel depreciation is high, and the load on line and motors is severe.

Referring again to the necessity of standardizing all pieces, a list is given of the specials usually carried in the Utah Light and Railway Company's stock, as an illustration of the number of pieces necessary even when all work is standardized. The 80-pound specials are high tee rail for use in the commercial district, and the 65-pound A. S. C. E. for use elsewhere. It will be noticed that frogs are not referred to by number according to steam road practice, as that system is not applicable to right and left hand curved frogs.

Besides this list there are some odd pieces left from previous administrations. The above are all of the manganese centre, cast body type. Steam road crossings are all special and ordered as required and are mostly of the bolted construction bought on a tonnage basis.

As the listed specials range in value from $90 to $400, they represent a considerable investment. The stock is piled in the material yard along tracks. The pieces are marked 5CL, 3CR, etc., and they are handled with a light derrick car.

List of Specials Carried in Stock—U. L. & Ry. Company.

	Frogs	Curved Crossings	
80lb R.H. switches	80lb R.H. 5C	80lb R.H. 5C	80lb straight 15° frogs
80lb L.H. switches	80lb L.H. 5C	80lb L.H. 5C	80lb square crossings
80lb R.H. mates	80lb R.H. 3C	80lb R.H. 3C	
80lb L.H. mates	80lb L.H. 3C	80lb L.H. 3C	
65lb R.H. switches	65lb R.H. 5C	65lb R.H. 5C	65lb straight frogs
65lb L.H. switches	65lb L.H. 5C	65lb L.H. 5C	65lb square crossings
65lb R.H. mates	65lb R.H. 3C	65lb R.H. 3C	
65lb L.H. mates	65lb L.H. 3C	65lb L.H. 3C	

Note.—R.H. and L.H. denote right and left hand, respectively.

Drawings should be made of all standard layouts showing distinctly the track alignment, gauges, length of wings required, and in ordering the specials the above drawings may be sent to bidders without any detailed drawings of the construction, and without any rail lengths, frog angles, or other details which may be readily worked out from the data given. The steel companies always re-calculate these items and use one of their standard forms of construction on the specials. An exception is in the bolted or built-up construction for which it is well to have a standard drawing, showing type of construction preferred, in detail but leaving

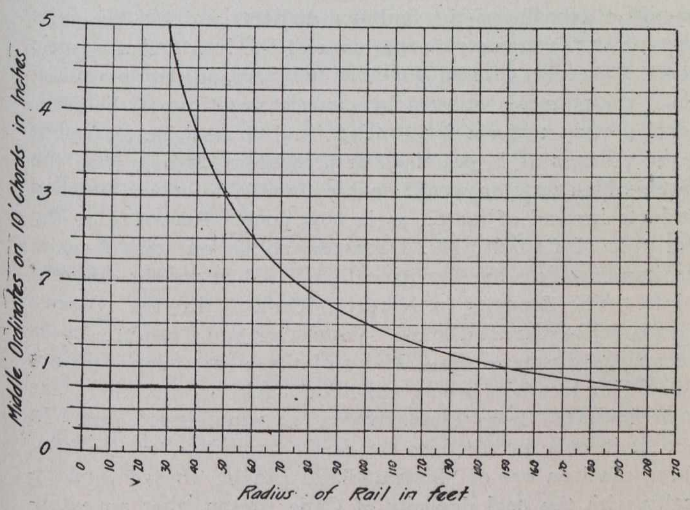


Fig. 4.—Middle Ordinate Curve for Rail Bending.

out angles, radii, wings, rail sections, etc., which must be filled in for each individual case on a separate skeleton drawing.

An order for specials should cover the points to be found in the following sample order.

Sample Order.—Three crossings, right hand, standard 5-centre curve, hardened steel renewable centre construction, C. I. body, for use with 7-in. 80-pound rail, Lorain section No. 335 with 1-in. by 5½-in. bar guard plate as shown on drawing, No. X. Drilling for track bolt, 3-in. 6-in. 1⅛-in. holes; for bonds 31-32-in. holes 6 in. from ends, all 3¼ in. above base of rail. See drawing No. Y for drilling. General layout on drawing No. Z (see Fig. 2). (It is sometimes advisable to refer to a catalogue number for type of construction.) All the drawings mentioned may be on the same or different sheets.

Whole layouts may be ordered complete from the steel companies and for complicated layouts it is a good idea to have them made up completely in the same shop, and every piece marked according to blue print. For instance, the Brigham Young layout (Fig. 1) was ordered complete and is all made of guard rail section.

It is customary to make up all simple layouts which require only the standard stock specials, in the railway company's shop. For this purpose, besides having access to a blacksmith shop, there should be a rail bender, a fairly heavy drill press, a metal saw and saw sharpener. The track shop should be convenient to a vacant space large enough to fit together one or more layouts before taking them to the work.

Layouts are staked out with a transit at the shops and in the field. (See transit notes on Fig. 2). For all curves which are not standard the following information is supplied by the engineering department for use of field and shop men; all data necessary for the exact location of track centres such as the P. C., radius and central angle of each curve, the distance between track centres and lengths of tangents. The following details more particularly for the shop men: size of rail, lengths of specials, location of switches, mates and frogs from point of curvature, lengths of each piece of rail measured straight before bending and the middle ordinate of each curved rail on, for example, a 10-foot chord.

Two points might be noted in connection with this, first, that the description of curves by degree of curvature is not convenient when the radius is small, and second, that drawings or measurements, showing the location of the points of frogs or crossings, refer to the intersection of the two gauge lines and need not necessarily coincide with any actual point.

Fig. 4 is a curve showing middle ordinates on a 10-foot chord for different radii of bent rails. For very sharp curves the middle ordinate is different for the outer and inner rail. This curve is derived from the very simple formula—

$$\text{Middle ordinate} = R - \sqrt{(R + \tfrac{1}{2} C)(R - \tfrac{1}{2} C)}$$

where R = radius in feet of the bent rail, and C = the chord length in feet.

In the case first considered, the length of chord is 10 feet.

A LARGE CONVERTER.

What is declared to be the largest converter in existence has been blown in at the Boston and Montana smelter at Great Falls, and officers of the Anaconda company are watching its operations with much interest, as the result will decide whether such a monster furnace can really effect a saving in smelting operations. President B. B. Thayer, of the Anaconda company, witnessed the start of the new converter, which will take approximately 50 tons of molten metal. It is of the upright type, to which the Anaconda company has always adhered, while others have tried the barrel-shaped converter. The bearings in the new converter weigh 13 tons each, and when it is full of metal the whole weight is approximately 300 tons. When compared with the former types in use those familiar with the smelting business will recognize the tremendous increase in size is represents. It has a diameter of 20 ft., while those in former use were 12 ft. The wind box has a height of 7 ft. The converter proper, not including the cast iron bearings and gears, weighs 65 tons, and 130 tons of brick were used in the lining. So far the converter has worked satisfactorily. Concerning the company's plans for rebuilding the Great Falls smelter, President Thayer said the contracts for the steel had been signed, and would be delivered not later than the middle of November. The work of reconstruction will then proceed as rapidly as possible.

DEODORIZING SEWER AIR AT WINNIPEG.

A sewer ventilation test, covering a period of three months, was made at Winnipeg, Canada, during 1910 to determine the efficiency of 10 Beeman sewer deodorizing machines located in manholes. Each machine consists of a reservoir containing wood alcohol, the fumes from which impinge upon a platinized porcelain disc about 1½ inches in diameter. The disc is first heated to cherry redness and remains incandescent as long as the alcohol fumes are supplied to it. The combustion of the alcohol fumes produces formalin in sufficient quantities to deodorize the sewer air when it emerges from the manhole. The cost of operation, per day, according to a report by Col. H. N. Ruttan, city engineer of Winnipeg, ranges from 9 to 18 cents for each machine, not including capital charges. Since these tests were made the large burners on some of the machines were replaced by smaller burners with a consequent reduction in the consumption of alcohol and cost.

Operation and Cost of Sewer Deodorizing Machines at Winnipeg, November 1, 1910-January 31, 1911.

Machine number	A	B	C	D	E	F	G	H	I	J
Days covered by test	92	92	92	92	92	92	92	92	92	92
Days observed	77	77	77	77	77	77	77	77	77	77
Days machine working	91	91	91	91	92	92	92	91	91	91
Days machine out of order	1	1	1	1	0	0	0	1	1	1
Days no air passing through	3	0	0	2	8	2	0	0	0	0
Days when draft was reversed	4	3	1	22	0	1	3	4	2	0
Days sewer air noticeable	0	1	0	3	0	0	0	14	1	8
Maximum cubic feet per hour:										
November	4169	3345	3428	2674	1519	1719	4525	3392	2980	3227
December	3369	3734	3898	2026	1790	2369	2886	3439	3345	3557
January	3640	3734	3628	1790	1484	2709	2992	4383	4099	3604
Minimum cubic feet per hour:										
November	400	141	70	70	58	70	35	23	212	577
December	365	376	942	58	70	82	612	318	494	435
January	424	212	47	141	70	376	494	624	247	294
Average cubic feet per hour:										
November	2251	1790	1895	622	270	648	1410	1690	1681	2046
December	1397	2641	2004	788	597	1210	1470	1933	1935	1846
January	1293	1880	1835	772	512	1195	1417	1862	1895	1870
Size of sewer, feet	5	5	2	1	4x2.8	5x3.4	6x4.8 5x3.4	7.2x9.4 6.8x8.8	6.8x8.8 6.5x8.4	6.5x8.4
Capital cost, dollars	75	75	75	75	75	75	75	75	75	75
Cost of maintenance, dollars:										
Alcohol	8.68	10.11	6.86	8.11	5.65	5.95	7.12	12.44	11.77	10.91
Repairs	.75	.75	..	.75	..	..	..	.75	..	..
Attendance	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12
Cost per day, cents	13	15	10	13	9	9	11	18	16	16

A report by Dr. J. H. Leeming, city bacteriologist, indicated that no bacteria were found in the sewer air, either before or after passing through the machine, and that the formalin is not in sufficient quantities, nor in contact with the air a sufficient length of time, to have any effect upon bacteria if they did exist in the sewer air.

From the tests at Winnipeg Colonel Ruttan draws the following conclusions: (1) The machines will deodorize sewer air; (2) they will not destroy bacteria nor will they have any effect in preventing them from emerging from the manholes, assuming that they exist in the sewer air; (3) the cost of operation may be placed at 15 cents per machine per day; (4) the number of manholes in the city sewer system is approximately 2,000 to 2,500, and the number of deodorizing machines should not be less than one in every third manhole.

During the 92-day period from November 1, 1910, to January 31, 1911, the 10 machines used alcohol, at 66½ cents per gallon, costing a total of $87.45. At the few times when sewer air was noticeable near the manholes the odor was slight and was not perceptible at a short distance from the manhole. From the results in the accompanying table it is apparent that the machines work best in very cold weather, for during January the odor of sewer air was perceptible on only two occasions, both times at machine D.

The cost of maintenance per day is based on the amount of alcohol consumed during three months, the repairs made during that time, and on the assumption that the machines will require to be examined and attended to twice a week. It will be seen that the cost of running machines H, I and J was considerably greater than the others. The explanation of this is that these machines were fitted at the beginning of the test with very large burners, consuming about 3 gal. of alcohol per week, as these machines are in the sewer coming from the abattoirs, but at the end of November these burners were removed and the ordinary burners substituted, and have been working more satisfactorily since.

The city of Winnipeg entered into a contract for 50 more of the deodorizing machines; they were supplied by the International Sanitary Company, Limited, of Winnipeg, which has submitted the following estimate of the cost of yearly operation of the Beeman deodorizers on the basis of 800 machines being operated 12 months in the year: 800 machines at $75, $60,000, or a yearly interest of $2,400; cost of alcohol, 800 machines using 1 gal. at 62½ cents every 9 days, $20,000; cost of attendance, 1 man, $900; cost of rig and driver, $1,200; cost of wicking and sundries, $100; allowance for extras, $300; total, $24,900 yearly.

To this would have to be added the cost of the machines which, estimating 12 years as the probable life, would give an annual cost of $5,000, making the estimated yearly expense a trifle under $30,000 yearly.

ELECTRO-METALLURGICAL DEVELOPMENTS IN CANADA.

In a paper on this subject read before the American Electrochemical Society, Mr. S. Dushman refers to the copper-nickel deposits in the Sudbury district, and Dr. Haanel's scheme for the magnetic separation of the iron and magnetic nickel from the copper, precious metals and non-magnetic nickel compounds, followed by electric smelting of the iron-nickel portion to form ferro-nickel, and electrolytic treatment of the tailings as is practised at present in dealing with the matte, which process would enable Canada to export finished products instead of matte, as is now done. Referring to the iron ores of Canada, Mr. Dushman points out that Canada has immense iron-ore deposits distributed at widely different points. The deposits in Northern Ontario, in the Ottawa and Gatineau districts, and in Vancouver and Texada Islands are specially noteworthy. Many of these ore deposits are situated in localities where coke for smelting operations has to be imported from Pennsylvania at prohibitive cost. In fact, it is only in the extreme eastern portion of Canada, where the iron ore of Newfoundland can be worked economically with the coal deposits of Cape Breton, that an extensive iron industry has developed. In Ontario and British Columbia coke for metallurgical purposes has to be imported. The deposits are, however, usually situated near some source of water-power that could be developed at low cost. The lack of ores suitable for treatment by the blast furnace has been one of the factors preventing the growth of an iron industry in Ontario. But by the use of electrothermic processes and some method of concentrating the ores, it is quite within the limits of possibility that a much larger iron industry could be developed in Ontario. Recent Government experiments on low-grade magnetite ores from different points in Ontario have demonstrated that first-class Bessemer concentrates (with one exception) can be produced from the crude ores submitted for testing purposes, and it has been shown that all these concentrates will form hard porous briquettes, more or less peroxidised and free from sulphur, when submitted to a process similar to the Gröndal system of briquetting. These briquettes could, of course, be treated in the electric furnace. The combination of concentration and electric furnace appears all the more advantageous when it is considered that Ontario contains numerous sources of water-power that could be developed at low cost. Considering the advantages offered by electrothermic processes and their special applicability to Canadian ores, there seems to be no doubt but that there is a promising future for the electric iron and steel industry in that country.

HOW TO OBTAIN EFFICIENCY FROM PRESSURE FILTERS.*

By H. W. Cowan, C.E.

Before discussing the efficiency of any type of filtering appliance it will be necessary to give a brief resume of what has brought about their evolution.

The first type of filter, consisting of a large prepared bed of sand, was the result of observation of the effects produced on water which had flowed through layers of sand and gravel, giving a clear and crystalline stream as the result.

On putting this into operation, good results were not obtained immediately, but after several days' run the resulting effluent was apparently satisfactory.

The reason for the change was due to the slimy deposit which had formed on the surface of the sand.

This produced a sticky coating round the particles of sand on the surface of the bed to which suspended matter adhered and was retained, in the same way as globules of mercury will run together and become incorporated.

Further experiment showed that with clear waters it took considerable time for the film to form; that only certain rates of flow were permissable, anything higher causing damage to the film, through which break the water flowed as there was little resistance to its passage through the sand at that point. The disturbance set up caused surface currents which further broke up the film, and led to still greater inefficiency.

The rate of flow being determined and maintained, a growth of algae appeared after a time which added to the closeness and strength of the film, allowing a higher rate of flow to be used.

When everything appeared to be satisfactory, after some weeks' operation the water supply showed signs that breaks in the film were present.

These proved to be due to the presence of insect larvae, blood worm tubes having formed in the sand, from which the insect Chironomous on maturity emerged in large numbers, leaving small perforations through which the water flowed at a high rate, producing vibrations which broke up the continuity of the film.

On cleaning the beds, which were an acre in extent, for a volume of two million gallons per twenty-four hours, a repetition of the first troubles in again tuning up the beds before they were effective was experienced.

Regulations being used to determine the rate of flow, and careful examination being made from day to day to show when the beds required cleaning improved the position until it was found that the algoid growth in winter was much slower than in the summer months, calling for varying adjustments to suit seasonal conditions. In short, expert attention had to be given to slow sand filters to be productive of good results.

The disadvantages of this method of filtration had to be overcome, something being required to form the filtering film quickly, positively and evenly, which would operate to the same advantage in summer and winter, the cleaning of which could be simplified so that it might be performed more frequently, before insect ova could be deposited, and allowing of a much higher rate of filtration.

The first results of these conclusions led to the construction of covered filters to prevent varying conditions in summer and in winter, and the aforementioned insect troubles, but the high cost involved, the difficulty in cleaning, the time required for filming, and the slow rate of flow were still to be surmounted.

In overcoming these difficulties America led the way by patenting the first mechanical filter, to be closely followed a few months later by British engineers with other patents of a similar nature, all claiming a rapid rate of flow, simplicity of cleaning, positiveness in filming, and the occupation of a relatively small space.

These filters were shells constructed of wood staves, steel or iron in which the sand was enclosed so that it could not come in contact with contaminating influences, crushed quartz, charcoal, polarite or oxidium, (patented substances) being also used as the media.

Ferrio Oxide was used as a means of forming the film by entangling the colloidal and suspended particles, which fell on the filter bed, forming a felt in which organic and lighter substances were arrested.

Mechanical filters passed the water at a rate of from eighty to one hundred times that of slow sand filters, and immediately came into favor on account of the clarity of their filtrate, and the large saving in space.

They were washed by passing water through from the under side of the filter bed for several minutes, and running the sediment washed out to waste.

At this time the discoveries of Pasteur, Koch, and other scientists, with regard to bacteria as the means of transmitting disease, enabled research work to be conducted with regard to the real impurities of water and not those apparent only to the eye.

The proof that water was the chief agent in carrying disease gave a stimulus to water purification, having in view the elimination of pathogenic germs.

This led to the study of the effect of using ferrio oxide on the water treated by mechanical filters, which showed that iron was left in the water after filtration.

The growth of such organisms as Crenothrix, Cladothrix, Spirophyllum was produced in the water mains, Crenothrix in particular with its sack-like bladders deriving sustenance from the iron present, and filaments discolored with ferruginous matter were produced.

These filaments attached themselves to the pipes, and diminished their carrying capacity about one per cent. yearly, while back pressure and fluctuating flow detached fragments which discolored the water and gave off an unpleasant odor.

Resulting from this alumina sulphate was put into use, and ferrio oxide practically discontinued, the disadvantages of the latter being overcome. Practically all mechanical filters use this as a film producer at the present time.

The use of alumina sulphate produces a white, sticky viscid film (alumina hydrate) which is precipitated when reacting with the lime in the water. This collects suspended matters, and deposits them on the sand bed, having at the same time the property of removing coloring matter from the water treated, by its coagulating action.

The hydrate being absolutely insoluble, no trace of it can be detected in the filter effluent by chemical reaction, even the well-known log wood test failing to show its presence.

The success obtained led to the attempt to use a coagulant in slow sand beds, by first passing water through large coagulating basins, from which it flowed to the filter beds. This has never proved satisfactory owing to the large area of the beds preventing an even deposit on their surface.

Mechanical filters were now subject to more rigorous tests for the elimination of bacteria, and were found to be unsatisfactory owing to the foulness in the filter material not being removed by washing on account of the sticky nature of the film, which a reverse flow could not remove completely.

Attempts to force air through to assist the passage of the wash water were made but while the filter was apparently

---

* Paper read before the Canadian Public Health Association Congress, Sept. 17th, 1912, Toronto.

clean it was really becoming more polluted through its whole bed.

When completely contaminated this would break through, showing a high bacteria count at varying periods, preventing continuous efficiency from being obtained and using a large amount of filtered water in the attempt to thoroughly wash the bed.

For these reasons mechanical pressure or closed filters have been looked on with disfavor for domestic supply, and American engineers have, as a body, reverted back to the open type filter, in which the sand is removed from time to time for complete cleansing, and a much lower rate of flow is used.

The excessive rating of pressure filters had much to do with causing American engineers to discontinue their improvement, but in Britain several engineers persisted in their experiments to obtain absolute cleansing, and finally succeeded in making a filter which could be cleansed mechanically.

In this filter the reverse flow was used, while the sand was violently agitated by means of agitators which released the sticky coating from the grains of sand. The power required to operate the washing mechanism, however, was so great that its use was not feasible.

A few years later the introduction of water under pressure through jets in the agitators, caused the sand to be put into such a state of suspense while they were being revolved, that a very trifling amount of power was necessary.

This allowed of continuous efficiencies of ninety-seven per cent. being obtained. A large amount of reagent was consumed which made operating costs prohibitive, and further study led to consideration of the stone germ proof filter invented by Pasteur.

It was felt that if a silica sand could be used which would compress under the water pressure into a temporary stone, allowing a high rate of flow to be obtained and the minimum of coagulant for the reduction of bacteria, that the difficulty would be solved.

Following these lines the modern filter was devised.

As it now stands the pressure filter constructed in Britain represents the highest type of commercial efficiency, more especially since the use of turbines operated by the inflow of water to pump in the coagulant have been devised

With these turbines as the rate of flow varies so does the amount of alum introduced, and the introduction of the alum before the water passes through the turbines enables these motors to thoroughly mix the coagulant so that positive hydration is obtained before the raw water reaches the filters.

Further observations have led to the discovery that the precipitation of matters in suspense and coloring matter is very much more rapid and complete when brought about under pressure than in open tanks.

For water very high in turbidity and in color large pressure settling chambers may be used to remove excess of turbidity or color before the water arrives at the filter, instead of with open settling tanks which often require double pumping operations.

The rate of precipitation or sedimentation under pressure is twelve times more rapid than in open tanks, in some cases.

Having discussed the progress of pressure filtration, it will be seen that a rounded silica sand which is not porous as such would collect impurities within the grains, where it could not be removed by washing is required. The sand should be such that impurities are retained in the coagulant between the grains, where, with efficient washing, it can be removed.

An adequate means of thoroughly agitating the sand should be employed while the washing operations are going on, and the water used should not exceed what is economical.

The best test for effective washing is to occasionally take a sample by removing the manhole and passing a tube into the sand two minutes after washing has been performed.

The sand withdrawn when placed in distilled water should show little or no turbidity, if it has been properly cleansed.

It is important that only a steady acting pump giving a steady flow free from vibrations be used, as jerks or unsteadiness in the flow might cause distortion and breakage of the film.

A means of adding the coagulant should allow of careful adjustment, varying in proportion to the water passing through the system, and such means should provide for the intimate mixing of the alum to ensure complete hydration.

In no case should pressure filters operate at a greater rate than four thousand gallons per square foot of filtration area in the twenty-four hours.

Their effluent should be free from suspended matter and color so that a platinum wire one-twentieth inch in diameter can be discerned at a depth six and one-half feet.

The bacteria count per cubic centimeter capable of growing on agar or gelatine at 18 degrees Centigrade after forty-eight hours incubation should not exceed one hundred whatever the amount present before treatment.

There should be no bacteria typical of sewage present such as bacilli coli, typhosus, enteritidis, no cholera vibrio nor dysentry bacilli in fifty cubic centimeters incubated for forty-eght hours at 20 degrees Centigrade.

No taste or odor should be distinguishable when water is heated to 37 degrees Centigrade.

Water for washing should not exceed two per cent. of the whole supply.

An effective pressure filter will satisfy these requirements besides having the following advantages:

Simplicity in operation.

Economy in operating costs.

Low initial cost.

Not more than two pounds reduction in pressure, in passing through the filters when clean.

They may be affixed direct to the main and pumped through.

They are suitable for extension by the addition of extra units.

They can be removed at little cost to another site, should circumstances require it.

They are continuous in efficiency, with proper washing mechanism.

Occupying small space they can be housed at a low cost.

Being manufactured ready for erection they can be erected rapidly, cheaply, and in any weather.

They can be used for water softening by the addition of simple appliances.

In Britain, pressure filters of high efficiency are supplying a population equivalent in this country to four hundred million gallons, large municipalities having found them highly satisfactory.

Dr. Percy Frankland, in an analysis of the supply of Banbury taken from the river Cherwell, found that the bacteria reduction was close on 99 per cent., no coli being found in 100 cubic centimeters.

The Stanley Moor reservoirs at Buxton, Derbyshire, show certified reductions of 98 to 99 per cent.

The town of Shrewsbury drawing water from the river Severn showed that coli could not be detected in less than five hundred cubic centimeters.

Many similar results, showing as high a continuous efficiency as 99.9 per cent. warrant the attention to those interested in public health work in Canada to this type of filter, which, when properly constructed, is the most suitable for the conditions ruling here.

STONE BALLAST.*

Rock ballast should be made from hard, tough, durable trap, flint, or limestone rock, or other hard stone. It should be broken to cubes, the maximum of which will pass through a 2½-in. ring and the minimum will not pass through a 1½-in. ring. The crushed stone should be free from screenings, dirt and rubbish.

Ballast can be handled in side-dump cars with flat bottoms, or in coal cars, but drop-bottom ballast cars will secure very good results. Ballast after being unloaded should be handled with a spreader. The track should be prepared by digging out the old ballast down to the bottom of the ties, and rounded up to ½ in. above the bottom of the ties in the centre. This will keep the ties from running together until the track is filled with stone. This should be leveled off at the ends of the ties.

All decayed ties should be removed and replaced with new ones. Ties should be properly spaced and track put to gauge, and all spikes driven down so that the ties will be tight up to the rail. Then crushed-stone ballast should be unloaded to fill between the ties in the centre of the track. This will help keep the track in line and prevent the ties from bunching. About 8 or 12 inches of stone ballast should be placed under the ties if possible, and a minimum depth of 4 inches should be maintained.

In raising track on a 9-in. raise, the track can be put up in one lift if a large force of men can be secured. Ordinarily the track is put up in two lifts. In raising in one lift the foreman in charge will soon learn how many rail lengths a train of 15 or 20 cars will raise to the required height. The number of rails are counted off and sufficient ballast is unloaded and plowed out. Four men are started making places for jacks. One end of the sight board is placed on the stake, and the board leveled.

Four jacks are used; two being half a rail ahead of the others. The first pair raises the track about half the required height. No tamping is required with these jacks, as the stone runs under the track by its own weight. The second pair of jacks raise the track to the full height. A force of 20 men should follow to tamp, and these should be followed by a foreman and eight men to put the track in perfect line. The first half of the day should be given to raising the track, the balance of the day being devoted to tamping and lining.

Where two lifts are made, the ties should be tamped with shovels their entire length. After the second lift, the ties should be tamped with tamping picks or bars, the tamping extending from ends of ties to 12 inches inside of rail. Particular attention should be paid to tamping under the rail, but the centre of the ties should not be tamped.

In dressing up single track with ballast, the ballast should be filled in at least within one inch of top of ties and sloped from ends of ties. The edge of ballast slope should not be less than 4 feet from gauge line of outside rail.

Double track should be dressed in the same way, the stone in the centre ditch being level with the stone in the track. When the track is bonded for electric signals, it is very desirable that the stone be kept below base of rail. The track, after being raised, should be left from four to six days before dressing.

In handling 600 to 1,000 yards of stone daily and giving track 9 to 12 inches of raise, the force employed largely depends on the amount of traffic handled, and the views of the officials. A force of 40 to 50 men should be used, and a force organized as follows will give excellent results:

1 Chief foreman.

1 Assistant foreman to raise track.

1 Assistant foreman to line track.

2 men flagging.

4 men digging out for jacks.

13 men on jacks (4 digging holes, 8 on jacks, 1 with levelboard).

20 men tamping.

8 men lining.

1 water boy (or more if necessary).

Minority Report.—The size of stone which the majority of the committee recommend is too large for the maintenance of good track. The size should run from 1¾ in. maximum to ½ or ¾ in. minimum.

*Abstract of committee report presented at the annual meeting of the Roadmasters and Maintenance-of-Way Association, Buffalo, N.Y., Sept. 10-13.

CANADIAN PACIFIC RAILWAY IN WASHINGTON.

A New York banking house is informed by its Spokane representative that, in order to obtain a water grade from Kingsgate to Grand Forks and also to avoid three mountains, Canadian Pacific will build additional mileage through the northwest part of Washington, and will utilize the lines of the Spokane International, Idaho and Washington Northern and Spokane Falls and Northern. In this way Canadian Pacific will obtain a new freight line which will occupy an important position geographically in that general section of the Northwest.

Canadian Pacific, according to the same information, has secured from the Hill interests the right to use that part of the Spokane Falls and Northern known as the Red Mountain Line, running between Northport and Rossland, and the further extension of the Hill line to Nelson known as the Nelson and Fort Shepard.

At the present time Canadian Pacific has under way the location and surveying of a new freight line from the terminus at Metaline Falls to Waneta at the junction of the Columbia and Pend d'Oreille Rivers. Canadian Pacific, according to plans recently adopted, will operate its freight to Kingsgate over its own line and over the Spokane International to Clagstone Junction, over the Idaho and Washington Northern to Metaline Falls, over the new Canadian Pacific line to Waneta, and thence by way of Spokane Falls and Northern to Marcus, Grand Forks, the Fraser River and the coast. Canadian Pacific and Great Northern recently entered into an agreement to build jointly the line over the Hope Mountains to the Fraser River.

According to Engineer Dibblee, in charge of the location work, a very easy grade between Metaline Falls and the boundary has been secured, and work will be rushed on this section as well as on the projected line from the boundary to Trail, a distance of thirty miles. Between Metaline Falls and the boundary line eleven tunnels will be built. The total length of the line from Metaline Falls to Trail will be forty miles and construction will cost approximately $3,000,000.

THE PURIFICATION OF WATER FROM STANDPOINTS OTHER THAN THE HYGIENIC ASPECT.*

By George W. Fuller.

In addition to hygienic purity, a perfectly satisfactory water supply should be of good appearance as to absence of mud, vegetable stain, grosser microscopic organisms, soluble and suspended iron; and it should also be free of offensive tastes and odors, excessive hardness and abnormal corrosive action on service pipes.

Within certain reasonable limits, depending upon local conditions, all of these characteristics are worth obtaining in a first-class modern water supply. In fact, the standards of "physical and chemical quality" as distinguished from "hygienic or bacterial quality" are steadily growing higher, due to the demands of the consumers for a supply in which there is public confidence and which does away with bottled water and household devices for treating the public supply. Indirectly, this question is related to the public health through the tendency of the public to avoid for drinking purposes a hygienically pure but otherwise unattractive public water supply, and to use well water or bottled water of doubtful bacterial content.

In this paper it is proposed to outline briefly some of the recent developments in America concerning the physical and chemical features of water purification, and to refer incidentally to the historical development of some of the more important steps.

Removal of Mud or Turbidity.

Plain Sedimentation.—Fifteen years ago, or prior to the completion of the Louisville tests in 1897, the clarification of the muddy water which is so characteristic of the majority of American rivers was accomplished but partially, if at all. Plain sedimentation when applied at its best ordinarily removed only 50 to 75 per cent. of the total suspended matter. With basins holding several days' supply, such as those at Washington, Philadelphia, Pittsburg, Louisville, St. Louis, Kansas City, Omaha, etc., the effluent as delivered to the consumers contained for weeks at a time sufficient silt and clay to make it conspicuously muddy. At times the partially settled water contained several hundred parts per million of suspended matter.

Storage Reservoirs and Avoidance of Muddy Water.—In some instances the basins were large enough to serve as storage reservoirs from which the supply from the river was shut off at periods of very muddy water in the stream. This procedure was used to advantage for some years at Washington, Baltimore, Covington, York and elsewhere. It is expensive and is seldom tried at present. When the river is muddy for a period exceeding the storage capacity of the basin the benefit of the method not only fails, but the consumers may have to use muddy water for many weeks, diluted to a varying extent with clear water.

Coagulation and Sedimentation.—Many years ago it was the custom in the Southern States to clarify the water used at some households by putting a piece of alum in a forked stick and stirring it about in a barrel of water. Sedimentation then allowed a fairly clear water to be obtaned. This practice is more or less similar to that which was followed many centuries ago in Egypt and in the Orient. Sulphate of alumina is capable of complete decomposition by the carbonates and bi-carbonates of lime and magnesium naturally present in all ordinary waters, so that there is formed a gelatinous white precipitate of aluminum hydrate. This sticky mass envelopes the tiny particles of clay and also the bacteria, and forms them into particles of a size that subside quite readily. This process, which is in effect a chemical precipitation method, is of considerable assistance in that it provides a fairly efficient means of removing those minute clay particles, perhaps one-tenth of the size of the bacteria, which will not settle by plain subsidence in an indefinite period. When coagulating chemicals, such as sulphate of alumina or sulphate of iron in connection with lime, are added to the water, it is possible to obtain a fairly clear effluent, provided a proper dose of coagulant is used with respect to quantity and quality of turbidity, and further provided that a period of one to two days or more is allowed for the particles of suspended matter to deposite upon the bottom of the basin. This method has been used at quite a number of places and is still in use at St. Louis, Kansas City, Leavenworth, Omaha, Nashville, etc. It is not wholly satisfactory as compared with the results obtained by filtration, as there is no ready way to correct the poor results obtained from an inadequate dose of coagulent and which correction is much more feasible when use is made of a filter plant. This method can scarcely be called for ordinary problems a complete and satisfactory solution of clarifying muddy water, although its favor has been enhanced somewhat recently in conjunction with sterilization processes, such as the application of hypochlorite of lime.

Plain Sand Filtration.—Forty-five years ago sand filtration was substantially an unknown art in America. There were some crude strainers of artificial construction, but they are unworthy of detailed consideration. The art of sand filtration in America dates from about 1867, when the late James P. Kirkwood, C.E., made an extensive tour of the leading European cities and prepared a report for the Water Commission of St. Louis, Mo., detailing the results of his foreign studies. That report has become a classic, not only in America, but also in Europe, as it was translated into German. It exercised much influence in standardizing the European practice of water filtration.

After Mr. Kirkwood's return to America he found by tests with small sand filters that they would not remove the enormous quantity of sand, silt and clay, such as are found in the Mississippi River at St. Louis. On a somewhat larger scale the same conclusion was demonstrated by tests conducted with the Ohio River water in 1884 by the late Charles Hermany at Louisville.

With the advent of the germ theory of disease there was found in America thirty years ago a feeling among engineers that sand filtration was impracticable through inefficiency and great cost for the ordinary American problem. Two or three small plants were built in the early seventies along the Hudson River, particularly at Poughkeepsie and Hudson, but the question of water clarification remained substantially in abeyance until it was pushed forward as an incidental feature of hygienic water purification.

It was the work of the Massachusetts State Board of Health, through its tests conducted at the Lawrence Experiment Station and its advocacy of the Lawrence city filter plant in 1892, that marked the beginning of the present period of wide-spread installation of modern filter plants in America. The Merrimac River at Lawrence contains almost no clay, and but little silt other than at rare intervals when the river is in extreme flood. The data from Lawrence, therefore, while applicable for many of the problems in New England, did not offer a solution of the typical American problem of water clarification or of water purification.

Sand filters, when operated at fairly slow rates, say from two to six million gallons per acre per day, are efficient in removing fairly coarse silt in quite large amounts. Fine

* Paper read Sept. 24, 1912, before the International Congress on Hygiene and Demography, Washington, D C.

clay particles, however, generally pass through the ordinary sand filter, even when operated at rates much lower than what is called standard European practice, namely, 100 millimeters vertical drop per hour, or 2.65 million gallons per acre per day. Experience shows that when the unfiltered water contains for several days at a time more than about 30 to 50 parts per million of fine turbidity, the effluent is liable to suffer from deterioration in quality, not only as to its appearance, but also bacterially.

There are some exceptions to the rule, but generally speaking, sand filters outside of the New England States and some points along the Atlantic seaboard have not been successful in treating American river waters, even after they are submitted to prolonged sedimentation. The only sand filter plant along the Mississippi River, for instance, at Rock Island, Ill., was abandoned some years ago, and in its place was built a mechanical filter plant.

Sand Filters Aided by Sedimentation and Coagulation.—In 1898 the writer conducted extensive experiments for the city of Cincinnati, Ohio, upon the clarification and purification of the muddy Ohio River water by sand filtration in conjunction with sedimentation and coagulation. Similar tests were made in 1901 at New Orleans. This method can be made efficient, but it is ordinarily more expensive than when mechanical filters are used in place of sand filters. Local conditions influence the solution of this problem. Successful use of sand filters with coagulation is to be found at Indianapolis, Washington, Poughkeepsie, and some other places. The feature which needs especial care is to see that the floors of coagulated masses are removed from the water with sufficient care so that the surface of the sand bed does not become clogged too quickly. Ordinarily the water should undergo sedimentation for 18 to 24 hours before it reaches the sand beds. This feature adds to the cost of the complete method and in cases where insufficient coagulant is used there is some danger from serious clogging of the sand beds.

Sand Filters and Pre-filters.—At present there are few or no instances where decided exception is taken to the use of coagulants. Experience has shown that it is safe and feasible to use them where there is intelligent management. Local custom and existing works, however, in some instances force a consideration of methods in which no use is made of these very helpful coagulants. This has led to efforts to clarify water by preliminary filters as well as by sedimentation before application to ordinary sand beds. This is the method in use at Philadelphia, Steelton, Wilmington, Albany, Montreal, and some other places. If the river water is not too muddy from fine turbidity it is of considerale aid. The method has decided limitations, however, in that at times of severe flood the percentage removal of suspended matter is least when it should be most in order to prepare the water properly for normal sand filtration.

In several instances coagulation is used in conjunction with some straining device, such as the practice at Steelton, and arrangements of this general order are now being installed at Pittsburg to aid the local sand filter.

Mechanical Filters.—Where coagulants are required, mechanical filters have rapidly come to the front during recent years. They have been installed or have been recommended for use at nearly every plant of considerable size, outside of the New England States, during the past few years. The modern mechanical filter plant is so well known from numerous published articles that no description is necessary here. It is quite different from and materially better than the earlier devices of this general type. The plant of the East Jersey Water Company at Little Falls, N.J., was placed in service in Septemer, 1902. It was the first large plant in practice to embody the technical and engineering features developed from the tests at Louisville, Cincinnati, Pittsburg, etc.

This type of plant ordinarily operates at the rate of about two gallons per square foot per minute. When the water is properly coagulated such filters may satisfactorily perform at rates from 25 to 50 per cent. in excess of this rate. Such devices deliver a water of excellent appearance and under proper supervision they are substantially as efficient as sand filters in securing bacterial removal. These plants have recently been built with concrete tanks and hydraulically operated gate valves to control the operation of the plant, as well as automatic appliances to insure a pro rata application at all times of solutions of chemicals to the varying volume of water to be filtered. Their recent history is closely identified with a succession of mechanical improvements which allow the devices to be operated reliably and economically. The cleaning of the sand layers is done once or twice a day by reversing the flow of water for periods of five minutes or so at a time. While the water is flowing upward through the sand layer the sand is also stirred by compressed air in cases where the water is not applied at sufficient velocity (2 feet vertical rise per minute) to bring about this result.

Mechanical filters have been installed at Little Falls, New Milford, Louisville, Harrisburg, Cincinnati, Columbus, Toledo, New Orleans, and at some 300 smaller plants. This type of filter constitutes the characteristic method now in vogue in America for insuring a well clarified water supply from the ordinary American rivers which are highly charged with silt and clay. Undoubtedly it is the most efficient and economical arrangement for the majority of American water purification problems outside of certain areas along the Atlantic seaboard.

Color Removal.

For many years it has been known that ordinary sand filters will remove from 25 to 35 per cent. of the color or vegetable stain from the applied water. Such results have been obtained at numerous places in New England. It has been the endeavor in solving many American problems to secure filtered water that does not contain more than about 10 parts per million of vegetable stain as measured by the platinum-cobalt standard. This is approximately the dividing line above which the color becomes readily noticeable to the consumer as seen in a glass upon the table and especially in a porcelain bath tub. Where sand filtration will not allow a result as good as or better than this to be obtained, there has been an effort in a number of places to employ coagulants and thus take advantage of the decolorizing effect of sulphate of alumina. This is an important factor which was considered in arriving at the recent determination in New York City to employ coagulation and mechanical filters for the treatment of the present water supply from the Croton watershed supplying the old city of New York. Sulphate of iron and lime do not give a satisfactory color removal, as demonstrated at Toledo and elsewhere.

In some cases intermittent filters as at Ludlow reservoir, Springfield, Mass., have aided in bringing about an unusually high removal of color. This seems to be due in part to an anacrobic decomposition having taken place in the water before its filtration. The color unites with iron in the water and is precipitated upon aeration. Another interesting feature that has been established at the new filter plant at Springfield is that when the coagulant is applied as an overdose to a part of the water to be treated, it is said that the mixture of the entire mass of treated and untreated water is decolorized to a greater extent by the sulphate of alumina than would be the case if the same quantity of coagulant were to be applied at a uniform rate of dosing to the full volume of water delivered to the purification works.

When the water to be treated contains varying high amounts of both mud and color much care is required in adjusting the required dose of coagulant to the composition of the water.

Microscopical Growths.

Some years ago an unusual effort was made to prevent the appearance in water supplies of microscopical growths of algae and other organisms larger than bacteria for the sake of minimizing their influence upon objectionable tastes and odors. In some instances, particularly in Massachusetts with unfiltered supplies, the bottom and sides of impounding reservoirs were stripped so as to obtain in the exposed surface soil only a small quantity of organic matter. This practice has not recently been followed for the large reservoirs for the new water supply of New York City, or elsewhere, particularly if the impounded water is muddy at times. It is considered better to aerate and filter the water to correct the unfavorable influence of these growths rather than to try to prevent them.

Microscopic growths have been killed in a large number of instances in America through the use of copper sulphate and to some extent by the use of hypochlorite of lime. The latter seems to have certain limitations and is not in such general use as copper sulphate.

Filters incidentally serve for the removal of microscopic growths. In some instances certain types of filamentous growths are likely to give trouble due to filter clogging. At Cincinnati experiences of this kind have been encountered and aid has been secured through the application of hypochlorite to the unfiltered water. It is a style of problem that requires special treatment in most cases.

Tastes and Odors.

Many surface waters, particularly those which are not turbid, contain at times objectionable tastes and odors. The latter are sometimes due to growths of organisms themselves. In other cases they are due to the disintegration of the organisms and to the liberation of certain oils which are very penetrating in their nature. Still other objectionable tastes and odors are found in waters that have undergone anaerobic decomposition which causes offensive gases to be liberated.

Aeration is a great help in the removal from water of these properties which produce objectionable tastes and odors. Combined with filtration, either mechanical or sand filters, there is obtained the most practicable method of securing a satisfactory water as to freedom from tastes and odors. It is one of the characteristic features of the new Catskill supply for New York City, and is being carefully considered as an aid to the filters for the Croton supply of New York.

Iron Removal Plants.

There are half a dozen plants in America, mostly of small size, where ground waters are aerated in order to precipitate the iron and then the settled water is applied to filters. Most of the earlier filters were of the sand filter type, but a few recent ones have been of the mechanical type. It is not a line of water purification upon which there is much experience in America as compared with Germany.

Water Softening.

The large water softening plant at Columbus and three or four smaller plants provide the experience up to this time in the softening of municipal water supplies in America. Many of the railroads and industrial concerns take advantage of water softening in securing satisfactory water for boiler and manufacturing purposes. Throughout the West very hard water supplies are to be found and even in the Great Lakes district the water is much harder than it is along the Atlantic seaboard. The cost of softening very hard water supplies has undoubtedly been a factor in retarding developments along this line. Experience has shown, however, that it is a perfectly feasible matter to soften the western waters if it is so desired.

At Grand Rapids, Mich., a mechanical filter plant is approaching completion that is to be used in conjunction with a softening plant. This plant will remove mud and vegetable color from the Grand River water and reduce its temporary or carbonate hardness by perhaps 50 per cent., so that it will equal what is called locally the "Lake Michigan standard." The total hardness of the softened and filtered water will be approximately 125 parts per million. The reduction in hardness will be effected by lime without soda.

Corrosion of Pipes.

Service pipes, particularly those of galvanized iron or wrought iron, are more liable to corrosion with filtered water than with unfiltered water. In part this is due to the elimination of substances, such as silt and vegetable matter which retard in a physical way the rate of corrosion, and in part it is due to an increase in carbonic acid which in the presence of oxygen is a very prominent factor in influencing the total amount of corrosion, the rate of corrosion and the amount of dissolved iron which may be present in water as drawn from the faucet and is thus the principal feature of unsuitability from the standpoint of iron stains. It is scarcely feasible to remove the oxygen present in water and, in fact, aeration tends materially to increase the oxygen up to the limits of the saturation point of this gas.

Carbonic acid seems to be the principal feature related to the speed amount of corrosion of iron by filtered water. Where coagulants are used there is a corresponding increase in amount of free carbonic acid. This has led some people to consider this feature as quite a draw-back to the use of coagulants. It has been studied recently in New York City from the chemical viewpoint with much thoroughness. The conclusion has been drawn that it is feasible to control the amount of carbonic acid through the proper addition of lime or soda. This feature will be an interesting part of the new Croton filter plant.

With hard waters in the south and west there has been comparatively little or no difficulty as regards corrosion of pipes by filtered water. The problem, therefore, is related more particularly to the soft waters along the Atlantic seaboard.

Speaking generally, water purification as relates to filtration is on a thoroughly well established basis in America. The features that differ most essentially relate to preparatory treatments rather than to material differences in designs either of sand filters or of mechanical filters. The use of chemicals for purposes of coagulation and softening has been studied in the last few years with considerable thoroughness and the problem is one that is so related to the influence of local details that each project should be carefully studied on its own merits rather than to attempt to copy blindly the style of works which may be in successful use elsewhere.

More than ever before it is now realized that the successful methods of water purification should receive intelligent management and this is particularly the case where the type of water calls for the use of coagulating chemicals.

RAILWAY RECEIPTS AND EXPENSES.

As the month of July began a new fiscal year for the railways and also from all indications a period of reviving traffic, it is probable that railway returns will be closely watched, especially during the months of the presidential campaign. But the uninitiated reader who tries from the newspaper reports of earnings and expenses to keep track of the business of the railways has a perplexing task, for in one and the same issue of a newspaper he not infrequently finds statements of earnings and expenses that may refer to different periods separated by weeks or months, or maybe a year or more.

The accounting departments of many of the principal railroad companies make up at the close of each week estimates of the receipts for that week and sometimes include estimates of the expenses. These are primarily for the information of the offiicers and directors of the companies, but are frequently sent to the newspapers. Thus appear estimates and cumulative estimates for the first, second, third and fourth weeks of each month and for the entire month. These are but estimates in gross, and as such serve as the earliest approximate indications of increase or decrease in the volume of traffic. They are widely regarded by business men as a barometer of the general business of the country. From these estimates various financial newspapers frequently compile tables showing approximately the earnings and expenses of a number of roads selected as representative.

As soon after the close of each month as practicable each railway company is obliged to send to the Interstate Commerce Commission a report of its total operating revenues during that month with separate specification of the receipts from freight, passengers, mail and express; of its total operating expenses with separate specification of those incurred for maintenance of way and structures, maintenance of track and equipment, for securing traffic, conducting transportation and in general; of the net operating revenue; of revenue from outside operations; of taxes; and of operating income which is the amount remaining as available for rentals, interest on bonds, appropriations for betterments, and dividends.

The filing of these monthly reports with the Interstate Commerce Commission is usually not completed until about six weeks after the close of the month to which they refer. From these official reports the Bureau of Railway Economics, an organization maintained in Washington by the railways, compiles a summary of revenues and expenses for the month which is usually issued within a week after all of the reports have been filed. Most of the newspaper publications of earnings and expenses give the amounts for the different railways separately, the information thus presented being of especial interest to the investor who wants to know what each road is doing. The compilations of the Bureau of Railway Economics, however, are of the collective earnings and expenses of the Eastern, Southern and Western groups of railways, thus showing the ebb and flow of traffic for the three great sections of the country, each of which has its peculiar economic characteristics. These publications also contain comparisons of the earnings and expenses per mile of line, thus showing the actual trend of railway business, the indication of which is often confused in other compilations by the use of aggregates applying to the total mileage, which is continually increasing to a greater or less extent. The earnings and expenses are thus also reduced to concrete and comprehensible units of measurement.

For example, in its summary of earnings and expenses for June, 1912, the Bureau of Railway Economics shows that the net revenue for the month increased about 48 cents for each day for each mile of line over the net revenue of June, 1911. It shows that during the fiscal year ending June 30, 1912, total operating revenues increased $23 per mile of line, operating expenses increased $83 per mile of line, leaving a decrease in net revenue of $60 per mile of line. An increase of $48 in taxes and a decrease in net revenue from outside operations resulted in a decrease in operating income of $112 per mile of line for the year. This is equivalent to a decrease in the operating income of the 215,000 miles of line to which these reports have applied on the average, of over $24,000,000.

The monthly report of the Interstate Commerce Commission issued usually about a month later than the summary of the Bureau of Railway Economics presents an abstract, company by company, of the monthly reports filed with it.

As soon after the close of the fiscal year as is practicable, and under penalty not later than September 30th, each railway company is required to make to the Interstate Commerce Commission an elaborate report of its transactions for the year. This includes a statement in great detail of receipts and expenditures, of mileage, of locomotives and cars, of the number of employees and their compensation, of the capitalization and capital issues, of statistics as to train miles, car miles, freight traffic movement, ton miles, passenger miles, taxes, and of profit and loss.

The statistics contained in these reports are of such great volume that their compilation requires several months, the annual report of statistics of the railways of the United States issued by the Interstate Commerce Commission not appearing as a rule until a year or more after the close of the year to which the statistics refer. It is a most valuable compendium placing before the student of railway transportation the most complete available information. The system of accounts prescribed for the railways by the Interstate Commerce Commission and the publicity in regard to their affairs which it has enforced have placed the railways in that position where far more is made public about their accounts and their affairs than is known in regard to any other industry of the United States, or any of the state or municipal governments.

In addition to all the reports that have been enumerated each railway company makes an annual report to its stockholders to which many newspapers give more or less extended reference, and many if not all of the State Railroad Commissions require separate reports.

MINING IN NEW BRUNSWICK

The North Shore Railway and Navigation Company, which has sixty men working a small coal mine at Beersville, in Kent County, twenty miles from Moncton, and selling the coal to the Intercolonial Railway, has also ordered machinery for the manufacture of bricks. Dr. H. J. Von Hagan, the president of the company, declares that New Brunswick has the best material for manufacturing bricks and other clay products that can be found in Canada, or in the eastern states outside of New Jersey. He is bringing several engineers from New York to inspect the company's property in Kent County.

It is announced that a large number of miners will be brought from the Old Country to work in the mines in Queen's County, where there will be great development as soon as the Gibson and Minto Railway is completed this fall. Homes are being built for miners. The Canadian Pacific Railway will take one hundred thousand tons a year out of the district, and the Intercolonial Railway has contracted for twenty thousand tons. It is estimated that there is anywhere from one hundred million to one hundred and fifty million tons of coal in this district.

SOME OBSERVATIONS ON THE DISINTEGRATION OF CINDER CONCRETE.*

By George Borrowman.

Cinders, as an aggregate in concrete, are used rather commonly where a light, cheap mixture is desirable; also in fireproof construction, and perhaps in the latter capacity this kind of concrete finds its most important application.

Its efficiency, however, has been the subject of considerable discussion. Various tests have been made, the results of which tend to show the superiority of this material over all other fire-resisting substances. There are also several patented floors involving cinder concrete which have been used successfully. Nevertheless, it has failed in some instances when employed for ordinary purposes, cracking and disintegration taking place. These discordant results are due, no doubt, as Freitag suggests in his "Fireproofing of Steel Buildings," to the use of cinders of varying quality, but to the writer's knowledge the matter has not been further investigated. A particular case of disintegration, accompanied by a powdery efflorescence on the surface of the concrete, was observed by D. S. Avery, now Chancellor, but formerly head of the department of chemistry in this University, who prompted some study of the phenomena, and also made various helpful suggestions during the experiments.

Blocks of concrete containing cement, sand and ¼-in. cinders were first prepared, the proportions by weight being 1:2:3, respectively. The cinders were from steam coal and slack, and were carefully screened. The cement and sand were of good quality, the latter being sieved through 20-mesh on to 30-mesh screens.

Another lot was made up using cinders from ½ in. to 1 in. in size, the proportions being 1:1:1. In each case just enough water was used to insure thorough incorporation without running. All the blocks were placed on a glass plate to prevent loss of moisture and covered with a damp cloth for two weeks.

At the end of this period, the specimens having the proportions 1:2:3 showed no change, but were somewhat porous and friable, owing to the realtively large bulk of cinders. A little later, however, fine cracks developed, with general disintegration. The others (1:1:1:), though compact and hard, also showed signs of cracking, and in a short time the breaks became very pronounced. In each case they radiated from certain points.

These latter specimens were broken open to facilitate examination, and in some cases the breaks originated from cinders that showed oxidation of much iron. The surfaces of the concrete bounding the cracks crumbled easily, indicating more or less general weakening.

The appearance of these oxidized cinders suggested the presence, originally, of much ferrous iron, probably as sulphide. The analysis of the cinder stock showed considerable sulphur as sulphide and sulphate; also iron, though the proportion of ferrous iron could not be determined in material of this sort with accuracy:—

Analysis of Cinders.

		Per cent.
	SiO_2	37.86
Total Fe as	Fe_2O_3	21.16
	Al_2O_3	17.40
	CaO	10.96
	MgO	0.83
	S	0.60
	SO_3	5.82
	Undetermined (C, etc.)	5.37
		100.00

It seemed probable, then, from the foregoing data, that oxidation of iron and sulphur produced internal stress and consequent cracking, aided, no doubt, by the general weakness produced by the diffusion of soluble sulphates. This theory was further strengthened by finding that the efflorescence, found on the surface of the disintegrating concrete before mentioned, was ferrous sulphate.

On this assumption attempts were made to bring about similar results by substituting for cinders artificial iron sulphide, prepared in several ways. These experiments, however, were not successful. On breaking open the blocks, the sulphide was found to be unchanged, surrounded by hard, compact cement. Soluble sulphates being absent in the mixture, the blocks had, of course, greater initial strength than those containing cinders, and would have withstood considerable stress had there been any. The lack of oxidation, though, in these tests, indicated that in the case of the cinders the necessary oxygen must have come from the cinders themselves, since they were equally well protected from the air.

This conclusion drew attention to the fact that about one-third of the cinder stock consisted of a very porous coke. As is well known, this substance will persistently occlude large amounts of oxygen. According to Starr and Lewis, air-dried coke contains absorbed gases in the proportion of about 0.7 c.c. per gram of coke, 2 to 6 per cent. of the gases being oxygen. The oxidation in the concrete was most pronounced in the coke. Moreover, some pieces of the latter were picked from the cinder stock and tested for sulphide sulphur, about 1 per cent. being found. One nodule from which cracks radiate proved to be a piece of coke so thoroughly oxidized as to look like a mass of ferric oxide. This was tested and found to contain but a trace of sulphur.

As a final experiment, some of the original stock of cinders were kept exposed to air and moisture until, on washing, they showed the presence of no soluble sulphate. They were then made into a block of concrete similar to those prepared before (1:1:1). Under parallel conditions no disturbance took place, the material retaining perfect stability.

From these tests we may conclude that cinders with much sulphide and sulphate sulphur are likely to give unsatisfactory results, especially if there is much coke or porous material present; also that such material may be improved if allowed to weather, with occasional washing, until the ferrous iron and sulphur have been oxidized and leached out.

*Abstract of paper in "The Journal of Industrial and Engineering Chemistry," June, 1912.

HARBOR IMPROVEMENTS BEING MADE.

There are now five dredges at work in St. John Harbor. None of them are doing work in connection with the big Courtenay Bay contract for which the Norton Griffiths Company will organize a subsidiary company, and for which new dredges are being constructed. It is expected that dredging in Courtenay Bay will be begun this fall. The other dredges are clearing the site for additional steamship berths at West St. John. With regard to the dry dock at Courtenay Bay, the present plans only provide for one 950 long, and an agitation is now in progress to have it made 1,150 feet, which is the length of the proposed dock at Levis.

BOOK REVIEWS.

Raising the Wreck of the U.S. Battleship, "Maine." Published by Lackawanna Steel Company, Buffalo, N.Y. Size, 8 x 10¾ inches; paper; 40 pages; price, $1.

A good deal has been written concerning the raising of the wreck of the battleship "Maine" in Havana harbor. The problem was one of the greatest engineering interest. A complete description of the entire operation has recently been issued by the Lackawanna Steel Company as Bulletin No. 102. This description is handsomely illustrated and describes in considerable detail the history of the sinking of the "Maine" and progress of the work towards its final removal. The company which publishes the book is interested because it furnished the steel piles which were used to construct the large cofferdam surrounding the wreck. This very interesting and correct description will be of considerable value in illustrating what may be done under similar circumstances.

Materials and Construction. By James A. Pratt. Published by P. Blackiston's Son & Company, 1012 Walnut Street, Philadelphia, Pa. Size, 5 x 7 inches; cloth; 187 pages; 85 illustrations; price, 90 cents.

This is a text book of elementary structural design. The author states that his purpose in compiling the text and set of problems was to present such studies in the elementary laws of construction as will give the student an understanding of the more simple formula and ability to apply such to every-day practice. The work is so arranged that it is available also as a handbook of the necessary formulae and principles of constructive details. No attempt is made to cover any advanced engineering work; only such material being included as is essential for the training of the young mechanic.

Preliminary Studies in Bridge Design. By Reginald Ryves. Published by the St. Bride's Press, Limited, London. Size, 5 x 7½ inches; cloth; with a number of illustrations; price, 60 cents.

This book is a reprint of a series of articles under the same title which appeared in "The Surveyor and Municipal and County Engineer" early in 1912, and is the first of a series of small volumes, each complete in itself, dealing with the design of ordinary highway bridges of moderate spans. The book is intended to provide the student with a foundation for the study of bridge design, and at the same time suggest to the experienced engineer that some of the facts which he takes into account in designing bridges will have more significance and greater value if he will study them in the light of the basic principles which really hold some of them together and separate these from others. This little volume will well repay reading, both to the student and the experienced engineer.

PUBLICATIONS RECEIVED.

Proceedings of the International Association for Testing Materials. Congress papers and reports delivered at the Sixth Congress of the International Association. Mr. H. F. Porter, secretary of the Sixth Congress, 1 Madison Avenue, New York.

Report on Timber Conditions Around Lesser Slave Lake. By D. Roy Cameron, B.A. Being Bulletin No. 29, Forestry Branch, Department of the Interior. R. H. Campbell, Director of Forestry, Ottawa.

Forest Products of Canada, 1910. Compiled by H. R. Macmillan and W. Guy H. Boyce. Being Bulletin No. 21, Forestry Branch, Department of the Interior. R. H. Campbell, Director of Forestry, Ottawa.

Annual Report of the Bureau of Industries, for the Province of Ontario. Being part 3, Municipal Statistics. Published by the Ontario Department of Agriculture, Toronto.

Municipal Statistics. Being Municipal Bulletin No. 6 of the Bureau of Industries of Ontario. Published by the Ontario Department of Agriculture, Toronto.

Ontario Railway and Municipal Board. The sixth annual report to December 31st, 1911. Copies may be secured from the secretary, Ontario Railway and Municipal Board, Toronto, Ontario.

Timiskaming and Northern Ontario Railway Commission. Tenth annual report for year ending October 31st, 1911. Copies may be secured through the Department of Public Works, Parliament Buildings, Toronto.

Proposed Rules and Regulations for Inside Work. Advance copies of the rules and regulations for electrical wiring compiled by the Hydro-Electric Power Commission of Ontario, to be revised and published after October 15th. Copies may be secured from the secretary, Hydro-Electric Power Commission of Ontario, Toronto.

Southern Vancouver Island. By Charles H. Clapp. Being memoir No. 13 of the Geological Survey Branch, Department of Mines, Canada. R. W. Brock, Director, Geological Survey, Department of Mines, Ottawa.

The Geology and Ore Deposits of Phœnix Boundary District, B.C. By O. E. LeRoy, being Memoir No. 21, Geological Survey Branch, Department of Mines, Canada. R. W. Brock, Director of Geological Survey, Department of Mines, Ottawa.

U.S. Department of Agriculture Publications

Bulletin No. 44, Office of Public Roads. The Physical Testing of Rocks for Road Building. By Albert T. Goldebeck and Frank H. Jackson.

Bulletin No. 46, Office of Public Roads. Oil-Mixed Portland Cement Concrete. By Logan Waller Page, Director, Office of Public Roads.

Bulletin 249, Part I., Office of Experimenting Station. Earth-Filled Dams and Hydraulic-Filled Dams. By Samuel Fortier and F. L. Bixby.

Bulletin 249, Part II., Office of Experimenting Station. Timber Dams and Rock-Filled Dams. By Samuel Fortier and F. L. Bixby. A. C. True, Director, Office of Experiment Station.

Bulletin 88, Forest Service. The Properties and Uses of Douglas Fir. By McGarvey Cline and J. B. Knapp. Henry S. Graves, Forester.

On the Measurement and Division of Water. By L. G. Carpenter. Being Bulletin 150, of the Agricultural Experiment Station, Colorado Agricultural College, Fort Collins, Colorado.

Preliminary Information Respecting Waterpowers. Being instructions relating to the gathering of certain preliminary information, prepared by Arthur V. White, M.E. Copies may be secured from the secretary of the Commission of Conservation, Ottawa, or the Department of Lands, Victoria, B.C.

Canadian Highway. Written after the planting of the first sign post of the Transcontinental Highway, by P. W. Luce, secretary, The Canadian Highway Association, Room 4, Cunningham Block, New Westminster, B.C.

Third Semi-Annual Report of the Sewage Disposal Commission. City of Fitchburg, Mass., for the six months ending March 31st, 1911.

Annual Report, Board of Water Commissioners, City of Kingston, N.Y., for the year ending February 29th, 1912, with a summary of operations for past year.

The Zinc Deposits of Northeastern Tennessee. Bulletin No. 14. By A. H. Purdue, State Geologist, State Geological Survey, State of Tennessee.

Report of the Bureau of Mines, 1912. Vol. 21, Part 2, Being reports on the District of Patricia, recently added to the Province of Ontario. Compiled and edited with an introduction by Willet G. Miller, Provincial Geologist, Bureau of Mines, Parliament Buildings, Toronto.

Calendar, The Royal Technical College, Glasgow. The Calendar of the Royal Technical College, of Glasgow, has come to hand.

CATALOGUES RECEIVED.

Pocket Magnetic Compasses. Small pamphlet forwarded by Keuffel & Esser Co., New York, illustrating different types of their pocket magnetic compasses.

Sheet Steel Piling. The Lackawanna Steel Company, Buffalo, N.Y., forward their Bulletin No. 104, entitled "Lackawanna Protected Steel Sheet Piling."

Babbitt Metals. A little booklet entitled "Shakespeare and Babbitt Metals," illustrating different babbitt metals manufactured by the Canada Metal Company, Limited, head office and factory, Fraser Avenue, Toronto.

Concrete Building. Small booklet forwarded by the Aitken Cement House Company, Peoples Gas Building, Chicago, illustrating the Aitken system of reinforced concrete building construction.

Flexible Cable. Pamphlet illustrating whipcord, braided flexible cable for use in workshops and mines, is forwarded by W. T. Glover & Company, Limited, Trafford Park, Manchester, England.

Manila Rope. Being catalogue No. 12-8, a brief treatise for engineers on rope used for the transmission of power, together with formulae, tables and data used in mill engineering. The C. W. Hunt Co., West New Brighton, N.Y.

Hoisting Engines and Derricks. The Clyde Iron Works, of Duluth, Minn., forward handsome 9-in. by 12-in., cloth bound catalogue illustrating their complete line of hoisting machinery. The catalogue conveys an excellent idea of the capabilities of this plant. Copies may be secured by addressing the company at Duluth, Minn.

Four-Wheel Drive Tractor. A little booklet describing the four-wheel drive gas tractor manufactured by the Heer Engine Company, of Portsmouth, Ohio, and represented in Canada by Mr. R. McLennan, The Canadian Heer Company, 808 McArthur Building, Winnipeg. The Heer Engine Co. also forward their catalogue of two-cylinder opposed gas, gasoline, kerosene and distillate engines.

Steam Pumps. In a 50-page catalogue just issued by the Pulsometer Steam Pump Company, of New York City, the field of operation and the different engineering features of the pulsometer are fully discussed. The catalogue gives figures and curves showing the steam consumption and the cost of operating a pulsometer under different conditions, and shows how it compares with other types of pumps. Copies of this publication may be had by addressing the Pulsometer Steam Pump Company, 17 Battery Place, New York.

FIRST GOLD FROM PORCUPINE

The returns to the Ontario Bureau of Mines show that the output of the metalliferous mines and works of that province for the six months ended June 30th, 1912, was as follows:—

Product.	Quantity.	Value, 1912.
Gold, ounces	11,854	$ 235,198
Silver, ounces	14,258,403	7,936,600
Copper, tons	5,170	736,469
Nickel, tons	10,179	2,166,895
Iron ore, tons	12,342	33,060
Pig-iron, tons	283,926	3,942,638
Lead ore, tons	17	849
Cobalt, cobalt and nickel oxides, crude cobalt material, etc., lbs.	854,324	192,073

The figures of gold production as compared with the first six months of 1911, show an increase of $192,878. This is practically the first fruits from Porcupine, chiefly from the Dome mine. Since the six months ended the Hollinger mill began turning out gold, and as there are now several smaller producers as well, the output for the full year may be expected to reach a considerable sum.

The yield of silver from the Cobalt mines, measured in quantity, shows a reduction of 973,566 ounces from that of the first six months of last year, but the money value was $292,400 greater, owing to higher prices for silver.

Nickel and copper from the Sudbury mines touched high water mark, and if the production continues at the same rate, 1912 will show a record for both metals. This is also true of pig-iron. Iron ore, however, shows a falling off as compared with a year ago.

The by-products from the refining of the silver ores, such as cobalt and nickel oxides, had a value of nearly three times that of the corresponding period in 1911.

MONTREAL TRAMWAYS COMPANY.

President Robert, of the Montreal Tramways Company, in response to a request made some time since by the city council, presented his suggestions of what was required to provide a better street railway service in the city of Montreal. He advocated that another east and west street in the down-town district—namely Vitre Street—be opened through to Windsor Street, at the Canadian Pacific Railway depot, and that the company be permitted to lay down tracks thereon. He further advocated that two additional north and south streets be given to the company for the purpose of laying car tracks, both streets being east of Bleury Street, the growth of the city in the north being rapid and the traffic being now too heavy for the existing lines. Grading and improving Guy Street, a north and south street in the west end, leading to the mountain side residential district, was also suggested and the president considered that the construction of a subway under the canal was very essential, to provide against interruptions to both the street car service and vehicular traffic. The elevation of the Grand Trunk Railway tracks was considered essential. Delays through the canal amounted to thirty-two hours in August and those due to waiting on trains to pass on the Grand Trunk Railway were sixteen hours. The Board of Control will consider the recommendations.

NEW METHOD OF TESTING WELDS.

A new method of testing welds was presented by Mr. C. Fremont, of Paris, in a paper read before the Congress of the International Association for Testing Materials. An abstract of the paper follows:

The impact test was selected to determine the strength of forged welds in order to ascertain the limits between which this strength is likely to vary. Small prismatic test pieces, measuring 8 x 10 mm. in cross-section, were employed. These pieces were left unpicked. The unit of comparison was the strength of the original metal. The welds were made in fairly large numbers in France and elsewhere by smiths, specially on account of their skill. The welds —steel on steel, iron on steel, and iron on iron—were of the scarf-jointed type, so as to obtain large contact surfaces. Each piece welded was of square section and about 35 mm. on the side. Macrographic etchings of the welds in all cases showed a line of demarcation between the two metals at the seat of the welds, the portions in contact not having interpenetrated.

The square section iron employed in these various welds had a tensile strength of from 35 to 40 kg. per square millimeter and the mild steel a tensile strength of about 40 kg. per square millimeter. The impact test on the unnicked test prisms 8 x 10 mm. in section gave about 50 kilogrameters in the case of the steels, the test pieces not exhibiting fissures in any instance, and from 26 to 32 kilogrameters for the iron, the fracture of the metal being fibrous. Prismatic test pieces similar to the foregoing were prepared from the welded pieces, but in such a way that the bending test could be applied in line with the welds to enable the strength of the latter to be determined. Under the impact test all these pieces exhibited in all cases a strength inferior to that of the natural metal. In most of the tests the test pieces fractured in consequence of the weld opening, the strength being insignificant, less than 1 kilogrameter. Among the better results the steel-steel test pieces underwent a fair amount of deformation before fracturing, the force required being from 15 to 16 kilogrameters; that is to say, only one-third of the strength of the original metal, which could be bent right over without breaking or even cracking.

The static strength obtained in the testing forged scarf jointed welds is equal to the static strength of the metal only when the welded surface is sufficiently large to compensate for the lower elementary strength per unit surface, just as in a brazed joint.

Autogenous welds are still weaker than forged welds, not only because of the smaller surfaces of adhesion they present, but also on account of the lack of continuity in the added metal and of not being hammered.

SUBSTITUTE FOR BRIDGES IN SASKATCHEWAN.

Owing to the great width of the North and South Saskatchewan Rivers, the cost of bridging them is very high, and in order to provide the settlers with access to their markets the Government maintains an ever increasing number of ferries accross these streams.

In 1905, at the inauguration of the province, there were twenty-two government ferries. There are now thirty-three, and by the end of this season there will be five more, all of them being under construction, and some of them almost finished at the present time. Three of these new ferries will be on the South Saskatchewan, namely, north of Pennant, north of Cabri, and south of Owensville postoffice in range 21, west of the third meridian. Two will be on the North Saskatchewan, one west of Hepburn, and the other south of Frenchman's Butte.

SYNTHETIC AMMONIA PROCESS.

An announcement of special interest in New York by Professor Hofrat Bernthsen, an eminent German scientist, lecturing in the Eighth International Chemical Congress. He explained that a system has been discovered in Germany for the synthetic manufacture of ammonia, by the uniting of nitrogen and hydrogen. The ammonia is prepared by passing the gases through a tube containing a substance for promoting reaction at a temperature of about 900 degrees Fahrenheit, and under a pressure.

As ammonia is extensively used in the manufacture of ice and in the preparation of fertilizers, notably ammonium sulphate, Dr. Bernthsen predicted that its synthetic preparation was an important step forward, inasmuch as its components—nitrogen and hydrogen—may be obtained from water and air respectively, at a negligible cost. The world's consumption of ammonia for 1911 was estimated in value at $80,000,000.

MINERAL PRODUCTION IN BRITISH COLUMBIA

Copper is the only mineral showing an increased production in British Columbia. Lead and zinc show decreases, while iron is a negative quantity in the preliminary review for 1911, compiled by the provincial mineralogist, Mr. W. Flett Robertson.

A considerable falling off in the production of lead is shown, the average price of which for 1911 was practically the same as for 1910. The most serious decrease was in the output of the St. Eugene mine; this amounted to more than 8,000,000 pounds. The Sullivan increased its output between 2,000,000 and 3,000,000 pounds, and to that extent reduced the decrease in quantity from East Kootenay mines as compared with 1910. Approximate figures of production for 1911 are: St. Eugene, 6,000,000 pounds; Sullivan, 11,000,000 pounds. Ainsworth Division mines produced but little lead in 1911, whereas in 1910 they contributed about 2,500,000 pounds to the total for that year, the three shippers having then been the Bluebell, Highland, and Whitewater group. The 1911 total from all properties in Ainsworth Division is estimated at less than 300,000 pounds. Slocan maintained its output, the total from the Richmond-Eureka, Ruth-Hope, and Rambler-Cariboo, and that from the Slocan Lake section—Van Roi, Standard, and Hewitt-Lorna Doone—having together been somewhat higher than the corresponding figures for 1910. Nelson Division had the Emerald and Molly Gibson mines as its chief producers of lead. There was a relatively small production from the Lardeau District, and still smaller from Portland Canal.

A statement published last autumn showed the total expenditure by the Dominion of bounty on lead to July 1st, 1911—that is, for eight years—to have been $1,617,020. Of this sum, $249,370 was paid in the fiscal year ended March 31st, 1911, and $49,714 for three months to July 1st, 1911. After deduction of $50,000 appropriated for zinc-ore reduction experiments, there remained, as at July 1st, 1911, of the $2,500,000 originally voted an unexpended balance of $832,980.

The estimated increase in the copper production of the Province, as compared with 1910, is about 1,200,000 pounds.

The Boundary District made a decreased production in 1911 by about 6,500,000 pounds (the reason for which has been already explained), and West Kootenay (chiefly Nelson Division) also shows a decrease of about 300,000 pounds; but against these decreases is to be placed an increase of about 8,000,000 pounds in the Coast District. The more important copper-producing districts of the Province are the Boundary, Coast, and Rossland; of these, the Coast bids fair to in future make a much larger output of this metal than it has done in recent years, for in both the Britannia mine, in New Westminster Division, and the Hidden Creek mine, near Goose Bay, Observatory Inlet, very large bodies of copper ore of commercial grade have been opened. No production of copper has yet been made at the latter mine, which was not extensively developed until the year just past, but it is planned to put in reduction works as soon as all arrangements necessary for smelting ore on a large scale are made. The increase in output of copper at the Britannia mine in 1911 as compared with 1910 is believed to have been between 6,000,000 and 7,000,000 pounds, but the actual output is not yet available. The Marble Bay mine, Texada Island, also made a substantial increase, but this was in part offset by a decrease at the neighboring Cornell mine. There is little comment to be made relative to either Boundary or Rossland mines in regard to their copper production, which is being generally well maintained, except when the supply of coke for the blast furnaces of the copper smelteries is interrupted.

The New York average price of electrolytic copper for 1911 was a trifle lower than that for 191—12.376 cents as compared with 12.738 cents—but the former year closed with an average for the month of December of 13.552 cents per pound, which was the highest monthly average since January, 1910. The expectation is that a higher price will rule in 1912, so the outlook for this year is considerably brighter. If this increase of one cent a pound occurred in the beginning of the year and had been maintained throughout, it would have meant an increase in the total value of this year's copper production of about $400,000, and the copper mining companies would have benefited to this increased extent.

The smaller output of zinc in 1911 than in 1910 is accounted for by the fact that it was not practicable for either the Whitewater group of mines or the Lucky Jim, in the Slocan, to ship ore, owing to the absence of transportation facilities, for the Kaslo and Slocan Railway line, six miles of which was destroyed by fire in the summer of 1910, has not yet been reconstructed. Further, the Whitewater mill, also burned, has not been replaced, though in both mines much development work has been done, and shipment of ore will take place whenever it is possible to send it out.

No zinc concentrate was produced by the Slocan Star mill, though production may be resumed in 1912. There are now three mills in Four-Mile camp, Slocan Lake, equipped for producing a zinc as well as a lead concentrate, namely, those of the Van Roi, Silverton Mines, Limited (Hewitt-Lorna Doone), and Standard. Of these, the Van Roi produced in 1911 concentrate containing more than 2,000,000 pounds of zinc, and the Silverton Mines, Limited, a much smaller quantity. The Standard mill is a new one, the operation of which was only commenced late in the year.

No commercial results appear to have yet have been obtained from experiments in reduction of the zinc-lead ores of the Kootenay, neither by the Dominion department of mines, experimenting in the East, nor by any process tried in the province.

Some prospecting for iron ore has been going on in the vicinity of Quinsam and Battle Lake, on Vancouver Island, and it is stated that a large body of magnetite has been developed there, eighteen men being employed during the year. Statements were made as to the large quantity of ore; also that the ore contained as much as 68 per cent. iron, and was more than ordinarily free from impurities. No iron ore was mined in 1911, and the mines remain just as in 1910.

CORROSION OF IRON AND STEEL PIPE.

The resistance to corrosion of iron and steel pipe has been the subject of controversy for a long time, both steel and iron having adherents who believe the one would corrode less than the other under the same conditions. A recent series of experiments undertaken by William H. Walker, of the Massachusetts Institute of Technology, results of which were published in July, 1912, by the National Tube Co., indicates that there is no difference in the corrosion of iron and steel pipe taken on the average.

Naturally a poor steel will show less resistance to corrosion than a good iron, but the converse is also true. Comparisons should be made on practically equal grades of product.

Water which contains oxygen induces a rapid corrosion of pipe of either kind, while water without oxygen, other conditions being equal, will show much less corrosion, or none at all if no other corrosive elements are present.

Doctor Walker made 64 comparisons of steel and iron pipe where the history of the installation was known. The cases where iron was found more corroded than steel amounted to 20, and where steel was more corroded than iron to 18. There were 9 cases where there was no difference between the two.

In order to determine the relation between the so-called acid-corrosion test and actual corrosion in service an experiment was made in which pipes were subjected to 20 per cent. sulphuric acid for four hours at room temperature. Although every care was taken to have identical conditions with all samples subjected to the test, it was found that no reliance could be placed in it. It was shown to be erroneous and misleading. The acid test not only did not agree with the service test, but the steel and iron showed no agreement when considered by themselves.

ENGINEERING WORK IN QUEBEC.

Some important engineering work is in progress and projected at Quebec owing to the prospective entry of the Transcontinental Railway, which will have its eastern terminus in that city. This work includes a new bascule bridge to provide railway connections with the Louise Embankment, a pontoon to provide a berth for coasting vessels, several landing sheds, new piers to form part of other harbor work which will cost $2,000,000, and two grain elevators. Plans have been prepared, and the work is to be undertaken as soon as financial conditions permit. It is anticipated that when these proposals have been put into execution Quebec will be able to obtain a larger share of the St. Lawrence grain traffic.

The Canadian Mining Institute held their annual session in Victoria, B.C., during the week of September 15th. Some of the speakers and entertainers illustrated their topics with lantern slides, among these were, Mr. E. Jacobs, secretary of the western branch of this institute, who spoke on the Copper Mining and Smelting Industries of British Columbia.

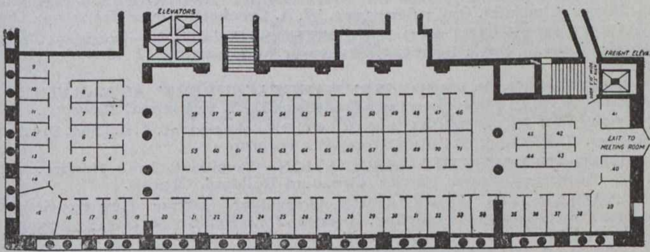
OBITUARY.

Mr. William R. Rombough, Toronto, the oldest Dominion Land Surveyor is dead. He came to Toronto about twelve years ago from Durham, Ont., where he had lived for a great many years. In early life he was probably the best-known surveyor in the employ of the government. Two of his greatest tasks were the surveying of the Counties of Grey and Bruce about half a century ago. He retired from active work 20 years ago. He was 90 years of age.

CONVENTION OF ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.

The fifth annual convention of the Association of Railway Electrical Engineers will be held in the Auditorium Hotel, Chicago, October 21-25.

The electrical men of all the big railroads of United States and Canada will here be gathered together for a conference



on standardization of electrical practice on steam railroads, and many valuable papers and committee reports are planned.

The great hall occupying the 9th floor of the Auditorium Hotel has been reserved for convention exhibits, and judging from previous years, this space will all be taken by prominent manufacturers of electrical equipment.

Size of Booth and Cost.

Booths Nos.	Area.	Price.
1–8	42 sq. ft.	$18.90
9–14	48 " "	21.60
15	126 " "	56.70
16–18	60 " "	27.00
19	56 " "	25.20
20	90 " "	40.50
21–38	60 " "	27.00
39	142 " "	63.90
40	56 " "	25.20
41	64 " "	28.80
42–45	48 " "	21.60
46–71	60 " "	27.00

As in previous years, an excellent entertainment programme will be provided which will include an informal dance, automobile tour of Chicago's parks, theatre party, closing with the annual banquet.

THE MEMPHIS UNION STOCK YARDS.

The Memphis Union Stock Yards, recently completed at Memphis, Tenn., are generally considered to be the most modern and up-to-date stock yards in the world.

About 20,000 horses and mules were sold annually in the city of Memphis before the erection of these stock yards, nearly all of them at retail. With the completion of the new structure and the wholesale trade which it is estimated that this will bring, the annual sales will undoubtedly run 60,000 to 80,000 head.

The stock yards comprise the auction and commission stables, which have a capacity of 2,000 horses and mules, a private mule barn with a capacity of over 8,000 head, and an auction pavilion arranged for the selling of from 500 to 1,000 horses and mares throughout the week.

One of the important features which had to be arranged for in the construction of these stock yards was the covering of some 400,000 square feet of the buildings with a durable fireproof roofing.

As the buildings were situated alongside a railroad, the fire risk was believed to be too great for shingles or any other inflammable roofing, and, on account of the space to be covered, a roofing unduly high in cost or that necessitated painting or gravelling, or any considerable amount of repairs or renewals, was considered impracticable. After investigation of roofings that were claimed to meet these requirements, the J-M Asbestos Roofing, made by the H. W. Johns-Manville Company, New York, was selected; in consequence, all the buildings were covered with this roofing.

This fabric is made of pure, long-fibred asbestos (stone) felt, securely cemented together with a combination of Trinidad Lake and other natural asphalts. Approximately 400,000 square feet were necessary, or about ten acres.

It is estimated that these new stock yards will effect an enormous saving between buyers and jobbers in the horse and mule business. The stock will be shipped direct to the yard by the raisers, instead of being sent to some other wholesale market and re-sold to come to Memphis. This will cut out an average additional expense of about $200 per car load by approximately $10 per head, and, with the sixty to eighty thousand head it is expected will be handled in a year, the saving approximates three-quarters of a million dollars annually.

A NEW ENGINEERING FIRM.

A new office has been started by four Montreal men, a mechanical, an electrical, and two civil engineers, each with a number of years' practical experience in their several particular lines. The scope of the work to be taken up embraces all kinds of estimating for contractors and their engineers, such as taking out quantities on building work to assist the contractor in tendering on contracts, estimating on heating, plumbing, ventilating and electric lighting, making up valuations for insurance purposes, drawing up detail plans for every description of engineering work. There should certainly be a field for such an engineering firm in this country. The address and offices of the company are: Estimators and Quantity Experts, 210 Board of Trade Building, Phone Main 786, Montreal.

PERSONAL.

MR. JAMES T. CHILD, city engineer of Calgary, Alta., has tendered his resignation to the city commissioners.

MR. FRED L. OLMSTEAD, of Boston, Mass., has been engaged by the Toronto Harbor Commission in connection with the preparation of plans for the water front of this city. Mr. Olmstead is well known amongst municipal officials both in Europe and North America.

MR. FRANK L. CODY has resigned as assistant manager for the Northern Ontario Light & Power Company, at Cobalt, Ont., because of ill health. Mr. Cody has been in Cobalt district for the last six years, and was formerly general manager of the Great Northern Silver Mines and the Cobalt Light, Power and Water Company.

DR. A. E. BARLOW, president of the Canadian Mining Institute, left Montreal for British Columbia, August 18th. His intention is to visit a number of the mining centres in West Kootenay and elsewhere before proceeding to the Coast. He presided at the western meeting of the institute in Victoria on September 18th and 19th, and will preside also at a meeting to be held September 30th, at Frank, Alberta.

MR. A. D. WOODMAN, of the Canadian Domestic Engineering Company, Limited, Toronto and Montreal, has been elected to membership in the Engineers' Club, of Toronto. Mr. Woodman's firm has obtained a large number of Toronto contracts within the past couple of years, including the new Technical School, on which the engineering work will probably amount to $350,000. At the present time the Canadian Domestic Engineering Company, Limited, has approximately ninety contracts on hand for engineering work in connection with heating, ventilating and power houses.

COMING MEETINGS.

AMERICAN ROAD CONGRESS.—First Annual Session to be held in Atlantic City, N.J., at the Million Dollar Pier, September 30th to October 5th, 1912. Secretary, J. E Pennybocker, Colorado Bldg., Washington, D.C.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE CANADIAN HIGHWAY ASSOCIATION.—Meeting will be held in Winnipeg, Man., October 9th to 12th. Secretary, P. W. Luce, Room 4, Cunningham Block, New Westminster, B.C.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary. Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson. Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell. Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary.; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALTIES.—President, Reeve Forke Pipestone, Man.: Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy: Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5. Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except une, uly and August at Winnipeg.