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PARTRIDGE ISLAND WATER SUPPLY, ST. JOHN, N. B.

FLEXIBLE BRONZE TUBING USED FOR CARRYING FRESH WATER SUPPLY FROM THE CITY MAINS TO PARTRIDGE ISLAND, ST. JOHN HARBOR—NOTES ON OLD AND NEW PIPE LINES.

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PARTRIDGE ISLAND, situated at the entrance of the harbor of St. John, N.B., has an area of about thirty acres, and is used for quarantine purposes in connection with immigration, and also for a training depot. The island is 3,500 feet from the nearest point of the mainland at high tide, and 1,490 feet from the end of Negropoint Breakwater, which partly closes the west channel. This channel has a depth of 15 feet of water at low tide, but a maximum tidal range of 28 feet, giving a depth of 43 feet at high tide on spring tides. Owing to this great tidal range, a flow of from 2 to 3 knots per hour is sometimes encountered in this channel. Moreover, the tide here sets outward strongly until nearly half flood, owing to the reversing falls at the outlet of the St. John River into St. John Harbor.

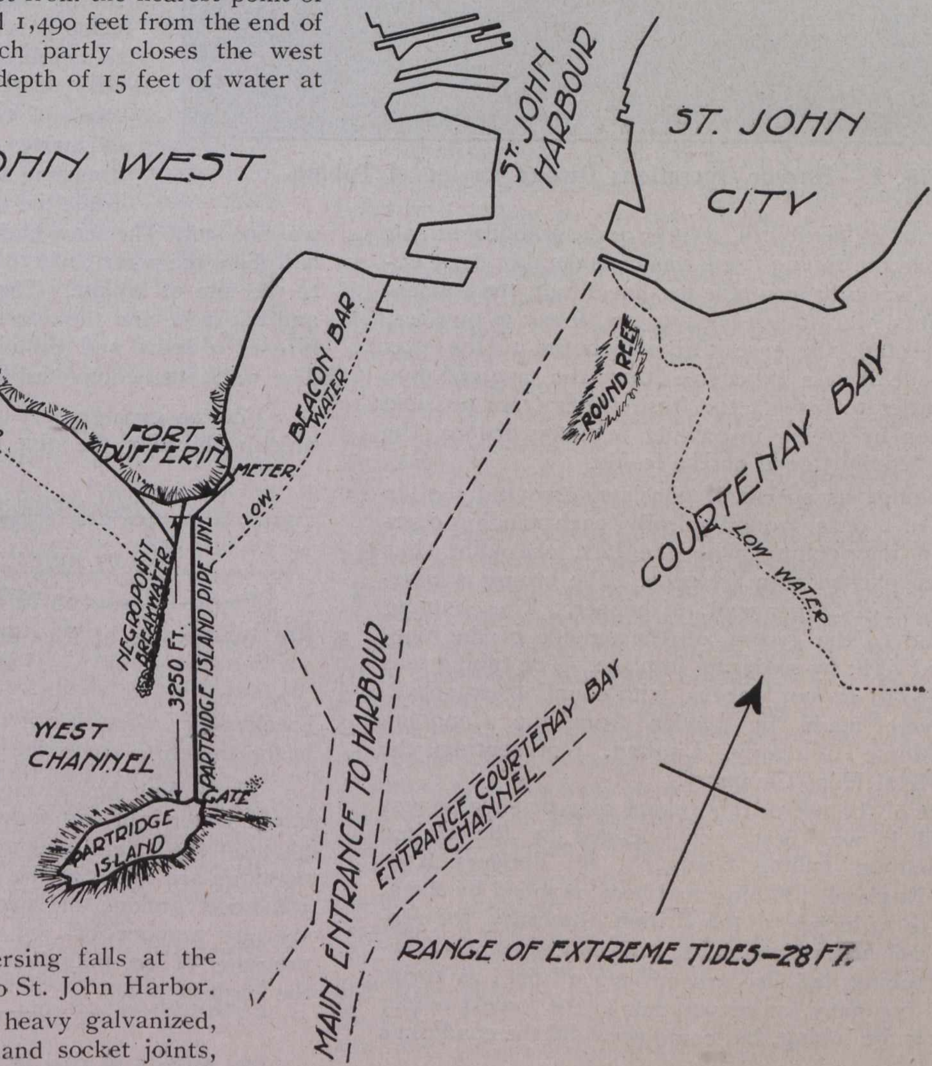

Fig. 1. Location of Partridge Island Pipe-line, St. John, N.B.

In 1906, a six-inch, extra heavy galvanized, wrought iron pipe, with ball and socket joints, was laid across the west channel from the mainland, connecting with the city mains, to provide Partridge Island with a fresh water supply. This pipe, in 18-foot lengths, connected up on a scow, was lowered into a dredged trench for a distance of 2,000 feet, where protected by the breakwater, but was placed on the surface of the bottom across the channel, where the bottom is very level. The joints allowed the pipe to bend twenty degrees at each connection, in the laying. While this pipe is claimed to have been found tight when completed, it was damaged almost immediately by the anchor of a vessel, and was probably strained in several joints. On one occasion also, in especially cold weather, within a year of its completion, the fresh water froze in the pipe submerged in the salt water, which was found to have a temperature of 31 degrees, Fahrenheit. Hence, the pipe did not give satisfaction, and in five years, more money had been expended on searching for and repairing leaks under the water than the original cost of the pipe; while only an intermittent supply had been provided and an immense amount of fresh water wasted. In 1912 the pipe was finally condemned.

To replace it, a four-inch, flexible, bronze tubing was chosen, being considered especially adaptable for this work owing to its flexibility, weight and durability in salt water. While the tubing itself was considerably more expensive than wrought iron pipe per lineal foot, the connections, or joints, were much cheaper and fewer in number, and, as expected, the ease with which the tubing was handled, made it less expensive than the original pipe used. In order to protect the fresh water from possible contamination by laying in contact with the bronze, the tubing was heavily tinned on the inside.

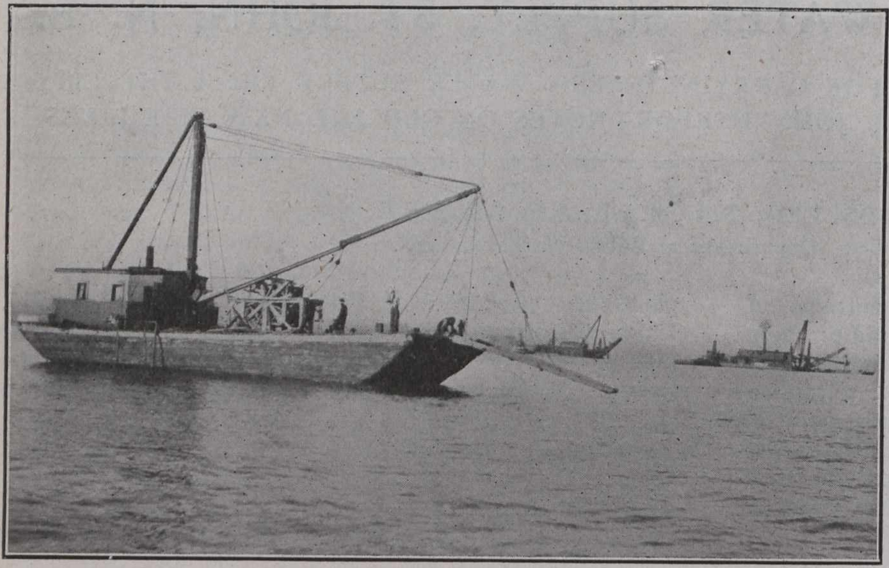

Fig. 2.—Harbor Operations During Laying of Tubing.

The tubing, as specified, consists essentially of a single strip of bronze, wound spirally, each winding overlapping and interlocking with the last, the joint thus formed being packed with asbestos. The bronze was required to contain 98 per cent. of copper. The coupling was threaded to the groove on the outside of the pipe, and rendered tight by soldering in place. The tubing was supplied in 30 to 40-foot lengths, with couplings attached. Purchase was made by tender from the Canadian Fairbanks-Morse Company, Limited, representing the American Metal Hose Company.

No case of the use of this tubing as a water pipe was known, and it was first recommended by the United Flexible Metallic Tubing Company, of Ponders End, Middlesex, England. Tubing had been supplied by them, in sizes up to 12 inches, to the British Admiralty, for conveying oil fuel aboard warships, and had given satisfaction. This tubing had also proved very efficient as steam hose. This company, moreover, put in the lowest tender for supplying the tubing, but could not fulfil the conditions of delivery.

Instead of allowing the new pipe to lie on the surface of the bottom, it was buried in a dredged trench, 6 feet deep, the whole way across the channel. Owing to the fact that the material in the channel was generally sand and gravel, the pipe had to be laid immediately behind the dredge, as the trench would fill. On one occasion the end of the pipe was buried in the trench by a storm, and a hole, 12 feet deep, had to be dredged beside the end of the pipe, until the material fell away, uncovering the end.

The tubing was placed from a steam scow on which a wooden reel, 9 inches in diameter, had been erected. Some 200 feet of the tubing were connected up at a time, wound on this reel, and subjected to a pressure of 200 pounds per square inch, supplied from a pump connected with the engine, one end of the tubing being capped. It was then connected up with the section already laid, and this connection tested. The scow was then pulled ahead, along the dredged trench, which was marked by ranges on shore; and the pipe, unwinding from the reel, was allowed to slide down an inclined and partly submerged platform. Detachable, tagged lines, with buoys, were attached to the tubing every 50 feet, and by the aid of these lines and sounding along the pipe it was possible to see that the tubing was placed satisfactorily in the trench.

The work was much delayed by bad weather; and the actual placing of the tubing was delayed by the dredging, since part of the time it was necessary to employ a large dredge, which could only work during high tide. The actual work of testing and laying the tubing, exclusive of delays from weather and dredging difficulties, only took 25 days; while the maximum length laid in one day was 600 feet. The scow had to be towed about a mile and a half from the wharf, where the pipe was loaded and tested, to the site of laying. The party consisted of a foreman and ten men, and the average cost per day, including the hire of a scow and gasoline tow boat, was about $70. The work was completed last September.

For the greater part of the distance the trench filled quickly, burying the pipe, but near the inner end of the

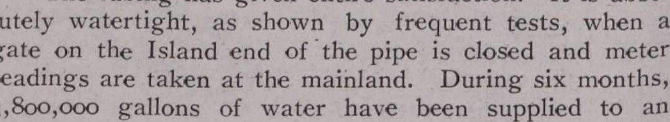

Fig. 3.—Profile of Pipe-line from Mainland to Partridge Island.

breakwater, a few scow loads of soft mud were dumped in the trench to cover the pipe.

The tubing has given entire satisfaction. It is absolutely watertight, as shown by frequent tests, when a gate on the Island end of the pipe is closed and meter readings are taken at the mainland. During six months, 3,800,000 gallons of water have been supplied to an average number of 325 people on the island; and a pressure of 40 pounds per square inch maintained at the highest point.

The exports of coal in 1914 were 1,423,126 tons, valued at $3,880,175, as compared with exports of 1,562,020 tons, valued at $3,961,351 in 1913, a falling off of 138,894 tons or 8.89 per cent.

The value of the production by provinces is as follows:—Nova Scotia, $16,381,228; British Columbia, $6,994,810; Alberta, $9,367,602; Saskatchewan, $375,438; New Brunswick, $260,270; Yukon, $53,760.

OILING OF CITY STREETS.

In our issue of May 20th an article appeared which dealt with the prevention of dust on road surfaces by the application of oil. The article described the ways of shipping and applying the oil, made some cautionary observations against misuse and careless application, and pointed out its value, when correctly applied, as a dust layer. The following information is of a similar nature, but dealing more with city streets than roads. It is abstracted from a bulletin of instructions issued by Prof. T. R. Agg, University of Iowa, in connection with the technical service bureau of that State, the object of the instructions being to correct some misconceptions of the proper method of applying the oil.

The oils commonly offered for street work are obtained from petroleum, but oils from some other sources are available at somewhat higher prices than is paid for petroleum products. The petroleum oils are supposed to contain asphalt, but whether any particular sample does or does not depends upon the source of the oil and what is meant by the term asphalt. As a matter of fact, few of the road oils do contain asphalt if we use the term in the strict sense, but it is not important what we call the black sticky portion of a road oil. If the oil contains good "body" and possesses some stickiness, while being fluid enough to penetrate the road slightly it will serve to lay the dust. For ordinary conditions the oils containing from 40 per cent. to 50 per cent. of so-called asphalt are best. In general, the oils are fluid and greasy and have little binding value so that they cannot be expected to give a dense, closely knit surface. Some of the oils, however, do contain a sticky constituent which has some binding value and probably adds to the stability of the roads.

If the street be very sandy or is of gravel or crushed stone macadam, there can be no question as to the advisability of using an oil that is sticky and free from the greasy characteristics of the ordinary petroleum oil; nevertheless, fair results can be obtained with many of the petroleum oils if they are handled properly.

Preparation of the Street.—If a street is to be oiled for the first time, preparations should be started some weeks before the oil is actually applied. The effect of the oiling is to render the earth partially impervious to moisture and if the surface of the road be uneven when treated or becomes uneven afterward, the depressions will become basins for holding water. Traffic will gradually work the soil and the water thus retained into mud, to the serious detriment of the street. If the street be smooth and well crowned, the water will run to the gutters so quickly that only in long continued wet weather will the street be softened to any great extent and therefore traffic will not make any considerable amount of mud on the surface.

The principal object in oiling a street is to prevent dust; therefore there should be no dust on the street when the oil is applied. If dust has formed, it must be removed, which costs something. It would be better to treat the surface before the dust has formed, if possible.

For the best results the street oiling should be planned ahead and the preparation of the street be carried out in the early summer so that the oiling can be done before a layer of dust forms on the street.

Grading.—Good results with oil cannot be expected on a flat and poorly drained street. Early in the summer the street should be carefully rounded up with even slope from the middle to the gutter. The gutter or ditch should be deep enough to readily carry the water and to permit a slope of about an inch to the foot from the middle of the street to the gutter. Generally, the bottom of the gutter should be about 18 inches below the middle of the street where the width of the street is not over 35 feet between gutters. This is about right on a residence street. On a business street having a width of 50 feet, the bottom of the gutter should be at least two feet below the middle of the street.

After the street has been shaped with a grader, it will undergo a period of settling, during which some depressions and uneven places will appear. These should be filled with earth and the entire roadway be kept dragged until it finally becomes hard and smooth and free from depressions.

It is very important to secure a firm, smooth surface for the oil and the small expense incurred will be more than made up by the increased effectiveness of the oil treatment.

When the street has been brought to this stage it is ready for oiling and usually the best time is during the latter part of May and during June. If the oiling is delayed until a layer of dust has formed on the street, it is best to scrape off most of it before oiling.

The decision to oil a street may sometimes be reached after the summer is well along and the streets have become hard and dry. In that event, it is not advisable to do any extensive earth work because at this time of year newly placed earth will not compact readily and if oiled before well packed, the results are unsatisfactory. Such a condition is not ideal and only poor results can be expected.

Applying Oil.—After the street has been prepared as described, the oil should be applied, the quantity being one-third gallon to one-half gallon per square yard of surface. If the street has never been oiled before or if more than a season has elapsed since a previous oiling, the quantity used should be about one-half gallon per square yard, but if the street is being oiled regularly each season, about one-third gallon per square yard is sufficient after the first year. If the oil is being applied on a busy street in the business district, then it is necessary to oil every year, using about one-half gallon per square yard of surface for each oiling. In many towns the business streets are oiled twice a year.

An ordinary street sprinkler may be used for distributing the oil and after a few trials the operator can get his spray adjusted so as to deliver about the proper amount of oil and spread it evenly. Care must be taken to secure a nice even distribution of the oil and to avoid forming pools or covering sidewalks and crossings. Many of the disagreeable features of street oiling can be avoided if care be taken to keep sidewalks and crossings clean. The crossings may be covered with dust or sand before the oil is spread so as to keep them clean. After the street has been under traffic the crossings may be cleaned and from that time no trouble will be experienced.

If a street sprinkler be not available for delivering the oil, a thresher or any similar tank can be used by attaching a pipe at the back for distributing the oil. The best pipe distributor consists of an 8-foot length of two-inch pipe made up with a tee at the middle and caps at the end. Along this pipe, tee included, should be drilled two rows of one-eighth inch holes one inch centre to centre in the rows. This pipe is connected at the rear of the tank so that it will hang about one foot from the ground, and parallel to it, the connection to the tank being made with two-inch pipe in which there is an ordinary blow-off cock or gate valve. A little better distribution will be secured if a "spatter" board is suspended just under the spray pipe so that the oil will strike the board and will break up into spray before striking the ground. This will make it possible to cover the surface fairly uniformly instead of in streaks, as will be the case if no board is used.

After the oil has been spread it should stand without being covered for about a day. Then it should be covered with just enough sand to keep the oil from picking up. Emphasis is placed on the importance of using sand for this purpose rather than dust from the old road surface. The amount of sand needed is only two or three loads per block and at any reasonable price the benefits derived from the use of sand justify its use, wherever it can be secured.

After the road has been put in service, it may be apparent that more sand is needed in spots, and such places should be covered lightly; the covering being repeated two or three times if necessary. Use just enough sand to keep traffic from picking up patches of the surface.

When a residence street is oiled the second time, the method to be followed is exactly the same as is followed the first time, except that the quantity of oil used may be reduced to about one-third gallon per square yard of surface. It is advisable to repeat the oiling the second year in any case and then it may be omitted the third year and resumed the fourth year. Better results would be obtained if the work were done every year, however.

Results to be Expected.—Surface oiling finally results in a street covered with a layer of granular soil which is oil saturated, and consequently does not blow about readily. The suppression of dust is the principal benefit to be expected. Beneath the thin layer of loose oil-soaked soil the firmer portion of the street is saturated with oil for a depth that varies from one inch to perhaps six inches.

Water penetrates this layer rather slowly. If the street has plenty of cross slope so that water does not stand on the surface, only a small amount of mud will form under light or moderate traffic. A street that is oiled systematically for a series of years gradually acquires an oil-soaked crust which becomes more and more impervious as the oiling is repeated. An oiled street never gets to the place where it will not be muddy in seasons of heavy rainfall, nor will the surface be stable in ordinary wet weather if the road carries heavy traffic.

Unloading from Tank Cars.—The oils used for dust suppression can be purchased so much more cheaply in tank car lots than in barrels that it is always advisable to purchase in such lots. If the town be so fortunate as to have a siding or embankment 8 or 10 feet high, the car can be placed thereon and the oil allowed to run into the sprinkler wagon from the tap in the bottom of the tank car.

Usually such a siding is not available, and in that case the oil must be pumped from car to wagon. For this purpose the ordinary tank pulp used with traction engine tanks is as good as anything. It should be placed on top of the tank car with all connections made of pipe, as hose does not last long in oil. If a small steam or gas engine driven pump be available it will, of course, be faster than a hand-pump, but it is not worth while to purchase one for a small amount of work.

Cost of Surface Oiling.—The cost of preparing a street for the oil treatment may vary from 25 cents to $1 per lot 60 feet wide, but it is hardly proper to charge extensive earth work against the oiling. The street ought to be kept well shaped up regardless of whether it be oiled or not.

Some cleaning is almost always necessary prior to the oiling, which costs from 30 cents to 50 cents for each 60-foot lot where the street is oiled about 25 feet wide. The oil can be unloaded, hauled and distributed for about $2 per lot, including the cost of covering the oil with sand. The cost of the oil will be about $1 per lot and the cost of sand about 25 cents per lot. The total cost for each 60-foot lot on each side of the street is as follows:—

Cleaning the street	$ .40
Applying oil and covering with sand	2.00
Cost of oil	1.00
Cost of sand	.25
Total	$3.65

These prices are about an average and will serve as a guide in estimating the cost of work of this class. Oiling is often done considerably cheaper and in other instances has cost more. It is assumed that the application will consist of about one-half gallon per square yard of surface and that the oil cost 4 cents per gallon.

Oiling Macadam Roads.—When oil is used to prevent dust on a new broken stone or gravel macadam it should be applied after the road has been well seasoned, but before traffic has brushed off the fine material from the surface. Usually a road will reach the proper condition within a year after it is built, but the time varies greatly. If allowed to go too long, the surface will be a little rough after oiling. If oiled too soon, a putty-like mat will form which will scab off the surface under traffic.

If an old macadam road is to be oiled it should be repaired and thus brought to a smooth, even surface. It should then be placed under traffic just long enough to get a good texture to the surface before the oil is applied.

A macadam road is in the proper condition to oil when it has a true cross section and a uniform surface whose texture is close and compact, but upon which there is very little loose binder, be it either sandy loam or stone screenings. If the surface be porous, the oil will penetrate too deeply and will interfere with the bond of the surface. If the surface be covered with fine material, the oil will mix with it and form a mat covering which is not durable.

It should be noted that the general statements made above apply only in those cases where a light petroleum oil is used for dust-laying and not to the construction of macadam by the penetration method.

GRANBY CONSOLIDATED CO. (B.C.) SMELTER EXTENSIONS.

The Granby Company has announced its intention to enlarge the smelter at Anyox, operating on ores of the Hidden Creek mine, to a capacity of 4,000 tons a day. This is the same capacity as the company's large smelter at Grand Forks, hitherto the largest copper smelter in the British Empire. Work has been started on the new additions to the plant at Observatory Inlet and the fourth furnace is under construction, to be followed by the addition of two more furnaces, each having a capacity of between 600 and 700 tons a day.

The new plant should be in operation by fall, and as soon as it is completed the Granby Company will be in a position to produce at both plants a total of 50,000,000 to 55,000,000 lbs. of copper per annum.

SLOW SAND FILTRATION OF WATER.

By Joseph Race, F.I.C.,
City Bacteriologist and Chemist, Ottawa.

FILTRATION through sand as a means of purifying water has been used for a large number of years, but it is only comparatively recently that the principles which are the foundation of this method, have been investigated in a scientific manner and thoroughly recognized. It cannot be claimed that perfection has been arrived at in this respect, but it is undeniable that great advances have been made and that water filtration is now a specialized science. Sand filtration was primarily introduced for the purpose of removal of suspended organic and mineral matter and it was not until many years had passed that it was found that bacteria, pathogenic and otherwise, were also removed in this process. It is now generally accepted that the action of filters is a combination of mechanical, physical, and biochemical functions and although these functions are interdependent and proceed simultaneously it is convenient to discuss them separately.

Mechanical.—When turbid water, *i.e.*, water containing matter in suspension, is passed slowly through a bed of fine sand the coarser suspended particles are intercepted by the sand grains on the surface and gradually a coating is built up in which the interstices become smaller and smaller. This coating is composed of finely divided mineral matter together with any micro-organisms (algae, etc.) that were present in the unfiltered water and is generally known as the blanket layer or "schmutzdecke." This layer performs the sole mechanical function of the sand filter and becomes denser as the period of service increases, until finally the resistance produced by it interferes with the operation of the filter. The resistance, measured as loss of head of water, is nil for properly designed filters when new and it is generally found convenient to operate a filter until the loss of head becomes so great that the full capacity of the bed cannot be obtained. The loss of head, under normal conditions, usually increases slowly for some time but finally a point is reached when the loss of head increases rapidly with a constantly decreasing capacity. It is not advisable to allow such conditions to continue as they prolong unduly the time required for draining a bed preparatory to scraping and washing.

The flora of the raw water lying comparatively stagnant on the filter tends to multiply, and by increasing the schmutzdecke reduces the filter-run. Covering the filters has been found beneficial in this respect, especially in tropical regions. In Canada, the covers are necessary as a protection against frost, but in summer they are also an advantage.

It was formerly believed that the "schmutzdecke" was the only purifying agent in a sand filter, but now it is regarded as merely incidental and as a disadvantage rather than otherwise. Schmutzdecke formation governs the length of the run and modern improvements in filtration are in the direction of processes tending to reduce its formation. Sedimentation reservoirs, coagulation basins, and roughing filters are being employed for this purpose. When the raw water is run directly onto the sand filters the suspended matter is almost entirely arrested in the top layer, such turbidity as escapes from a matured bed being often ultra microscopical in size and of a colloidal nature.

Hazen (Trans. Am. Soc. C.E., Vol. LIII., p. 59) has suggested that for very small particles of suspended matter the time of subsidence is controlled by the viscosity which will vary as $\frac{T+10}{60}$, in which T, the temperature, is expressed in degrees Fahrenheit. Longely (Trans. Am. Soc. C.E., Vol. LXXII., p. 398) found that the results obtained during the operation of the Washington filters supported this theory, the turbidity of the effluent being approximately twice as great at temperatures less than 40° than at 70° when the initial turbidity was the same.

The tendency in modern practice is to reduce to a minimum the turbidity of the water supplied to the filter. In the Puesch-Chabal process the degrossiseurs also remove about 60% of the bacteria in addition to reducing the turbidity and a similar action is found in Washington where sedimentation has been supplemented by coagulation. In the latter case an endeavor is made to keep the turbidity of the water supplied to the filters under 20 parts per million.

Physical and Biochemical Action.—When a bed of clean sand is used for water filtration, the purification effected is at first small and it has been found that increased efficiency is coincident with the formation of a slimy, gelatinous covering over the surfaces of the sand particles. These masses or zooglea contain large numbers of bacteria and algae and are responsible for the bacteriological and chemical purification of the water. The bacteria of the water whilst passing over these gelatinous coatings adhere and unless the momentum of the particle is greater than the adhesive power of the sand envelope it remains and is digested. Dunbar, in his "Principles of Sewage Treatment," points out that this film is the active principle in the changes taking place in sewage filters and that, when freshly removed from a submerged bed, has the property of absorbing large quantities of oxygen. When sewage is poured onto a mature bed purification is effected much too quickly to be accounted for by bacterial action, and Dunbar therefore assumed that the action was a physical one, *viz.*, that of absorption of the organic impurities in the water with a simultaneous loss of the oxidized nitrogenous products produced during the previous period of aeration and rest. The Massachusetts Board of Health experiments at Lawrence have shown, that with sewage filters constructed of fine sand, a given volume of material is capable of oxidizing a constant weight of carbon and nitrogen in a given unit of time. This purification is much larger than sand filters are usually required to perform for water purification purposes and, as in the latter case, the operation is continuous and the sand submerged, the oxygen required for the aerobic processes must be obtained from the dissolved oxygen of the water. Non-submerged filters have been employed for water purification purposes, but as the capacity is strictly limited to very low rates this type is not likely to become at all general. In the process of purification the albuminous substances dissolved in the water are absorbed by the film and afterwards decomposed and oxidized; dialysis and osmotic pressure being, according to Dunbar, of minor effect.

The reduction of organic matter by a filter is generally of secondary importance, as organic matter, per se, is not objectionable from a sanitary standpoint. When this organic matter is of such a nature as to produce discoloration its removal is of some importance but in this respect the sand filter is comparatively inert. The usual removal is about 20% to 25% but the amount, as might be anticipated, varies with the nature of the discoloring material.

Chemical Changes Effected.—The free ammonia is usually reduced 75% to 90% and in many cases this ammonia is found as nitrates in the effluent. The nitrates do not invariably increase as it has been found that when the free ammonia content of the raw water is very low an actual reduction in the nitrate content has taken place. The albuminoid ammonia and the organic matter generally as estimated by the oxygen absorbed method are also materially reduced, but not so effectively as the free ammonia. The soluble mineral constituents remain unchanged except in cases where waters containing noticeable amounts of free carbonic acid gas are filtered through sand containing limestone or dolomite; then the water is hardened a little by the bicarbonates of lime or magnesium taken into solution, but as this is accompanied by a reduction in the corrosive properties, due to removal of free carbonic acid, the sum total of the qualities of the water is unchanged.

The chemical changes are not themselves important, as there is no evidence that they affect the hygienic properties of the water in the slightest degree, but inasmuch as they are coincident with certain bacteriological conditions it is important that they should remain normal.

Bacterial Purification.—It is now generally acknowledged that the zooglea or gelatinous films covering the sand particles are responsible for the reduction in bacterial content of the water supplied to a filter. The microscopic particles present are carried down by the velocity of the water and if the momentum of the particle (MV) is greater than the adhesive forces of the film upon which it impinges, the particle is carried forward. Dr. Kemna (Trans. Assoc. Water Eng., 1907, p. 330) considers that the reduction of bacterial content in gravel strainers is independent of the speed of percolation and concludes that the product MV is infinitesimally small compared to the adhesive forces prevailing. However true this may be for the coarse gravel strainers of the Puesch-Chabal process the experience with fine sand filters is that the diminution of bacteria decreases with an increase in the rate of filtration.

Some of the earliest experiments dealing with this phase of filtration are recorded by Fraenkl and Piefke (Zeit. für. Hyg., Vol. VIII., 1890) and these show that the number of bacteria in the effluent was approximately proportional to the square root of the rate of filtration. The examinations were only made for a very short period, however, so that these experiments are only worthy of record as the first attempt to put filtration on a scientific basis. Hazen, as a result of his experiments at Lawrence (Mass. Board of Health, 1892-1893), considered that the number of bacteria passing increases rapidly with increasing rate and slowly with decreasing sand thickness and increased size of sand grain. As a tentative hypothesis he suggested the following formula:

Per cent. of bacteria passing

$$= \frac{1}{2}\,\frac{(\text{rate})^2 \times \text{effective size of grain}}{\text{thickness of sand in inches}},$$

the rate being expressed in U.S. gallons per acre per day. This formula gave fairly good approximation with the actual results obtained at Lawrence and also for general European practice after allowance had been made for germs passing from the underdrains. Clark (New Eng. Water Assoc., Vol. 24, page 589) experimented with filters using Merrimac River water at rates ranging from 3,000,000 to 16,000,000 U.S. gallons per day. His results are shown in the following table:—

TABLE I.

Merrimac Water—Lawrence Results.

Effective size of sand.	Filter No.	Rate in imperial gallons per acre daily.	Bacteria per cubic centimeter in effluent.	Bacterial efficiency.	B. Coli in 1 c.c. (percentage of positive tests).
0.28	A	2,500,000	48	99.1	5.0
0.25	B	4,200,000	85	98.4	24.0
0.22	C	6,300,000	105	98.1	25.0
0.22	D	8,400,000	110	98.0	25.0
0.22	E	13,400,000	280	95.0	38.0

Between 2.5 and 4.2 million gallons per acre per day and 8.4 and 13.4 million gallons per acre per day the number of bacteria passing is directly proportional to the rate, but for the intermediate period the percentage of bacteria passing increases more slowly than the rate.

A series of exhaustive experiments carried out by Hardy at Washington, D.C., (Trans. Am. Soc. C.E., Vol. LXXII., page 301) seem to show that up to 10 million gallons per acre per day the bacteria passing did not increase directly as the rate but somewhat slower and that further increases in the rate had little effect on the bacteria passing.

TABLE II.

Filter No.	Rate. Million imperial gallons per acre per day.	Percentage of bacteria in effluent.	Percentage of original turbidity in effluent.	Millions of gallons filtered per acre per run.
1	0.88	3.3	5.0	177.15
2	2.72	1.7	5.0	252.35
3	5.58	2.4	9.5	272.30
4	8.47	2.7	9.1	347.69
5	21.80	2.7	22.2	311.79
6	32.12	3.0	15.7	301.60

It is possible that in these, and in other experiments on this subject, the methods of calculating averages have had an appreciable effect on the results recorded. It should always be borne in mind that the average should represent the condition of the total volume of water filtered, and to obtain this, samples should be taken after the filtration of a unit volume of water and not, as is invariably the case, after the lapse of a unit of time. With the unit of time method, the greatest error would be produced when the maximum and minimum rates differ appreciably from the average.

In the Washington experiments the variations are given in the following table:

TABLE III.

Filter No.

Rate. Millions of U.S. gallons per acre per day.	1	2	3	4	5	6
Maximum	1.35	3.95	7.96	12.60	37.50	118.90
Minimum	0.62	2.30	3.73	5.77	6.68	7.10
Average	1.06	3.26	6.69	10.17	26.10	38.54
Ratio of average to						
Maximum	1.27	1.21	1.21	1.23	1.44	3.09
Minimum	0.58	0.71	0.56	0.57	0.26	0.18
Average = Unity.						

The variations in the two highest rates are very high and detract considerably from the value of the results if the samples were taken in the usual way.

Much work has been done on this subject by the Provincial Board of Health of Ontario and the results as reported by Dallyn in the annual report for 1912 are worthy of careful study. The experiments cover a considerable period but only during the earlier months was a natural water used. Later, the chlorinated city water was used and finally a mixture of chlorinated water and sewage.

The latter are artificial conditions and as they are not in any way comparable with the experiments previously mentioned they will not be considered. The results are given in the following table and have been calculated in several different ways. It should also be mentioned that several samples were taken daily so that the criticism offered with regard to the Washington experiments does not apply in this case.

TABLE IV.

September to December of the year 1909.

	Rate. Millions of gallons per acre per day.			
	5.	10.	15.	20.
Bacterial efficiency as recorded in report	95.3	91.2	89.9	96.2
Calculated from recorded average bacterial content of raw and filtered waters...	94.9	95.4	98.4	95.1
Calculated from average of all individual bacterial counts of raw and filtered waters.	93.9	95.5	96.7	97.0

These results appear to show that the purification is practically independent of the rate of filtration. This table also shows the serious errors that can be made by the use of different methods of calculating results. The first line is presumably obtained by taking the average of the average efficiency of each run, the second by calculation from the recorded average bacterial counts which are again presumably the averages of averages and the third by calculation from the averages of all the individual counts. The author believes the third method to be the only accurate one.

The average length of run and volume of discharge, as recorded, are as follows:

Rate. Millions of imperial gallons per day.	Average length of run in hours.	Average volume of discharge in million gallons per acre.
5	167.0	34.7
10	101.9	42.4
15	72.2	45.8
20	49.3	38.0

These figures appear small compared with those obtained at the filtration plant on Toronto Island in 1912 with water from the same source.

Considerable attention is devoted in this report to abnormal and irregular bacterial counts in the filtered water, but a study of the detailed results shows that these were all obtained during the period when chlorinated tap water was being used as the influent and that the abnormalities were pronounced when the rates of filtration were reduced. The author has previously pointed out (Jour. Soc. Chem. Ind., July 15th, 1912) that the effect of chlorine upon filter sand is to disturb the organic equilibrium and to produce a pabulum which is available as food supply for water bacteria. This may account for the abnormalities reported.

The author's experience at the Toronto filtration plant and elsewhere has been that, after sand filters have matured and consolidated, the variations in the filtered water count are small and follow the variations in the raw water after an interval dependent upon the volume of water in the filter. The Albany results given in the report are in accordance with this experience. Several hours' reservoir capacity are essential to a filtration plant for various excellent reasons, such as maintaining a constant rate of filtration, and for fire purposes, but it is not necessary on account of irregularities as they do not exist in well-managed plants. In the gravel layer at the bottom of a bed where there is a region of very small velocities, it is possible that some bacterial development takes place and that this may be disturbed by variations in the rate of filtration. This is minimized or entirely eliminated by avoiding sudden changes in the rate. Pennick, by means of self-registering filter gauges, showed that at the Leiduin waterworks (Amsterdam) the velocity of flow alternately increased and decreased. With a low filtration rate the intensity of the oscillation is low with as many as eight maxima per minute, but as the rate increases the iintensity also increases, the difference between maximum and minimum reaching as high as 10% at 20 million gallons per acre per day.

Whilst the author was in charge of the laboratory of the Toronto filtration plant a series of experiments was made on the effect of rate of filtration on purification. These differ from most of those previously referred to inasmuch as they were carried out with filter units such as are used for purification purposes. The 12 beds of 4/5 acre each were divided into three groups, these three being operated at nominal rates of 2.5, 4.5 and 6.0 million gallons per day. By this method of working, the author considered that if the results on a large scale were in accordance with the Washington experiments the plant as a whole would benefit as regards purity of output, whilst no harm would be done if the bacteria passing were directly proportional to the rate. In other words, there was everything to gain and nothing to lose by making this experiment. It was commenced in March, 1912, and continued until the end of May. The only objection that may be taken to these experiments is that the filters had not matured, only having previously been in operation for about two months, but the results show that during the period of operation the maturing did not affect the relative results.

These are shown diagrammatically in Fig. 1, and Fig. 2 shows the average results compared with the Lawrence and Washington figures.

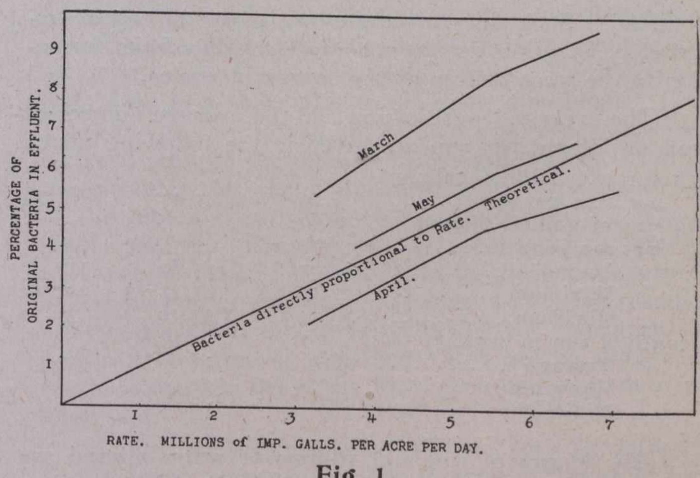

Fig. 1.

These experiments show that the number of bacteria in the effluent of a filter, other things being equal, is directly proportional to the rate of filtration. The sand in all the filters used in these experiments was identical and the depth of sand, although varying a little in each bed, averaged the same for each group.

In the following table the results of the turbidity determinations are given for each group of filters. As it is impossible to determine turbidities of less than one part per million, those effluents showing less than that quantity were assumed to have an average value of 0.5. This method of calculation is not accurate and detracts from the value of the quantitative expression of the results but it suffices in order to show that the general order of the turbidities is similar to that of the rate of filtration.

TABLE V.

Lake Ontario Water—Toronto Island Plant.

Turbidities in Parts per Million.

	March, 1912			April, 1912			May, 1912		
	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.	Min.
Turbidity of Raw Water	9	73	1	44	163	2	68	44	2
Filter Rates in Million Gallons per Acre per Day	5.44	6.79	3.09	5.41	7.05	3.10	6.45	5.52	3.67
Turbidities of Effluents	0 63	0.59	0.54	2.35	2.63	1.29	0 60	0.63	0.53

The degree of fineness of the particles causing the turbidity was determined on many occasions. At the commencement of a storm the coefficient of fineness ($\frac{\text{suspended solids}}{\text{turbidity}}$ both expressed in parts per million) was often approximately 2, but this usually decreased as the total turbidity diminished until values of 0.4 were

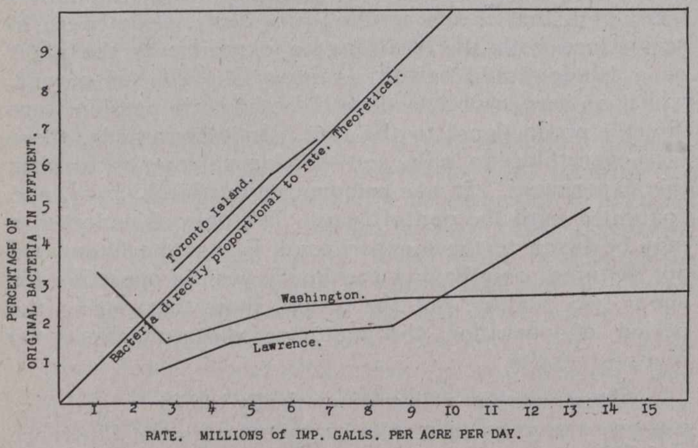

Fig. 2.

obtained. Such fine turbidities are more difficult to remove by filtration but do not affect schmutzdecke formation to the same degree as the coarser particles.

The average length of run and the average number of gallons filtered per run are given in the following table:

Filter rate. Million gallons per acre per day	3.29	5.46	6.76
Millions of gallons filtered per run per acre.			
Average	121.72	111.89	130.91
Maximum	177.92	165.35	222.40
Minimum	76.94	55.40	39.39
Length of run in days.			
Average	38	20	19
Maximum	59	32	32
Minimum	25	10	7

The length of run and volume of water filtered are both about three times the values obtained by the Provincial Board of Health with the experimental filters.

These results show that although slower rates of filtration tend to prolonged runs, the quantity of water filtered per run is approximately the same for the three rates used.

Taking bacterial purification, turbidity removal, and volume of water filtered per run into consideration, the highest rate, about 605 million gallons per acre per day, would seem to be the most economical, and where bacterial purification can be supplemented by chlorination, there seems to be no reason why such rates should not be advantageously used.

Removal of Odors.—The objectionable fishy and grassy odors of many waters are due to the decomposed or disrupted particles of algae and, being in solution in the water, cannot be removed by filtration. The organisms usually found to be the cause of such odors are Asterionella, Volvox, Uroglena, Eudorina, and Pandorina. The green color and fishy odor of the St. Lawrence River water in October is probably due to Uroglena Americana, an organism which contains many surficial oil sacs whose contents are discharged on the disintegration of the cell. An abnormal development of Asterionella at one of the filter works of the London Metropolitan Water Board during the summer of 1913 was the origin of many complaints of this character.

Filter Manipulation.—In order to obtain efficient working combined with a minimum expenditure, a thorough appreciation of the general principles of sand filtration is essential. New beds should be worked below their nominal rate until bacteriological examinations indicate the desired quality of filtrate or the effluents sterilized by chlorine before being sent into the supply. As chlorination as an adjunct to filtration is becoming more and more general, it will generally be found advisable to put the beds into operation at once at approximately their nominal capacity with the exception of the reserve ones which are matured as slowly as possible. If all the working beds are run at exactly their nominal capacity they would all require scraping at the same time and it is therefore preferable to vary the rates slightly until a rotation is secured in the runs. Once this has been established the rates should be kept as constant as possible and radical changes only made in cases of emergency.

As the rate of filtration varies with the head of water in a filter, this must be kept constant also. When a filter is taken out of service for scraping or raking, the water above the sand should be allowed to filter through into the reservoir if time will permit, and the level reduced to about six inches below the surface of the sand. This, of course, does not apply where the Brooklyn or similar methods of washing are in operation. After scraping, the filter should be slowly back-filled with the effluent from another filter until the water level is several inches above the sand before running raw water on the bed. This prevents the formation of ripples on the sand surface. When a filter is put out of operation owing to loss of capacity due to excessive friction in the schmutzdecke, the rate can be restored and the loss of head reduced by scratching the surface thoroughly with rakes. This is not so effective as scraping and cannot be repeated successfully twice in succession, but as the time and labor required are less it is probable that it is economical to alternate such treatment with scraping. The sand section removed after raking followed by scraping is, of course, thicker than when scraping alone is used, and this complicates the difficulty of arriving at the comparative cost of the two methods.

When the dirty sand is removed from the filter for washing it is desirable that either special provision be made for storage of this sand in the winter or else the sand-washing plant and storage bins covered and heated so as to permit of operation all the year round. In the former case the sand-washing plant generally must be of very generous dimensions and sand bins in proportion, but in this climate the latter is probably the better method.

Filter operators agree that the sand should not be washed thoroughly clean, as slightly dirty sand gives better results in the filter and does not require as much time to mature as clean sand. Some are of the opinion that sand should be allowed to mature for some time in the storage bins before being returned to the filter, but the advantage of this is not very clear in plants where the sand is replaced by hydraulic methods. Any film that may develop during storage is surely lost during the violent treatment it receives during replacement.

The depth to which the sand layer can be reduced by scraping before re-sanding is often determined by the capacity of the sand storage bins, but when this does not apply a minimum of 16 to 18 inches is usually regarded as safe.

Sphere of Utility.—As the color of the water is but slightly reduced by slow sand filtration, this method of purification should not be used when the color exceeds 10 to 15 parts per million. It is also unsuitable for waters which constantly contain excessive turbidities, but where the turbidity is generally low and only occasionally excessive, successful results can be obtained by the use of pre-filters as at Albany, by coagulation as at Washington, or by alterations in the design of the plant in the direction of more filter reserve and generous allowances for sand-washing appliances. Whichever alternative should be employed depends upon local conditions, and is almost entirely an economical problem.

Slow sand filtration still has its spheres of utility, and although these are much more limited than sanitarians considered them to be several years ago, it is, in these spheres, the most suitable and economical form of filtration. The prestige it lost was entirely due to the imperfections in our knowledge of its limitations, and once these are universally recognized it will probably regain at least a semblance of its former position in the science of water purification.

Unprecedented demand for high-speed steel is reported at Sheffield, England. Nothing approaching the present demand has heretofore been experienced; orders are not only numerous but they are of tremendous size and value. In addition to British sources, orders come from Russia, France, Italy and the United States. The price at present varies from 4 to 97 cents per pound. An immense quantity of tool steel is being used in the production of armaments, and every engineering shop in England is busy on this work.

According to a description in The Engineer (London) of a recent patent of Dr. F. M. Perkin and H. E. Fenchelle, hydrocarbon oil or liquefied solid hydrocarbon, such as kerosene, naphthaline, or paraffin wax is forced under high pressure through one or more long, narrow conduits heated to such a degree that the combined temperature and pressure produce a cracking of the hydrocarbon while still in its liquid condition. Thereupon this liquid, still under pressure, is cooled and then passes a check valve, and escapes at atmospheric or other relatively low pressure into a chamber surmounted by a dephlegmator or rectifying column, the previous cooling under pressure being such that the subsequent reduction of pressure on the liquid entering the chamber causes a separation of the lighter hydrocarbons from the unconverted portion of the liquid by spontaneous vaporization of the lighter portion. The ascending vapors undergo dephlegmation or rectification, and the residual liquid collects in the chamber. The rectified vapors are conveyed to condensers, and the residual liquid is heated by steam generated in a boiler adapted to serve as a heat interchanger between the water to be vaporized and the highly heated oil that has undergone cracking. In this way the heat abstracted from the cracked oil during the cooling of the latter is usefully employed.

THE CITY MANAGER versus COMMISSION GOVERNMENT.

MUNICIPAL journals in the United States have devoted much space during the past year or more to the city manager plan of government. It is claimed to be a decided step in advance of previously heralded and successively tried systems. Its supporters claim as many or more advantages for it over the commission form as the advocates of that now better established form had over the old mayor and council system. That either of the newer forms are slow to receive adoption in Canadian cities is largely owing to deeply rooted and tenacious ideas that the mayor and council method is the only way to govern a city. In fact the commission government has received but scant consideration in Canada while regarding its more recent rival, the city manager, the Canadian citizen has done nothing more than assume the role of dubious spectator, with a careless eye cast occasionally at the way things are turning out in the cities in the States where city managers are shouldering the responsibility of forging out a success.

A casual glance is not enough. The results are worthy of careful consideration. As for the commission form of government, the advantages claimed by its supporters over the old mayor and council system may be briefly summarized in the words simplicity and centralization of authority and responsibility. The enormous interest manifested in it and the rapidity with which it has spread over various States to the south furnish conclusive evidence that commission government met a real need in the improvement of municipal affairs. The testimony from practically all commission-governed cities, however brief their period of experiment may have been, is that city government has been improved in many respects, as compared with its former condition.

The rapidity with which the city-manager plan is supplanting the old-established system of mayor and council is certainly sufficient to warrant in its turn the attention of all students of municipal problems. There is really little new in it over the commission government form. The latter, as we know, substituted one responsible body for two, reduced the number of elective officers, fixed the responsibility for the administration of various services of the city and provided certain checks in the way of public control. The city manager attempts to interfere with or alter none of these legal or political characteristics of commission government. That is to say, the responsibility of the elective body remains and the instruments of public control are not abolished. It is on the administrative side that the departure from commission government takes place.

The principle of the new form was aptly explained by H. G. James, secretary of the League of Texas Municipalities, in a recent address on the rapid adoption in that State of the important innovation. He states that one of the chief arguments made by the advocates of commission government was that the business of a municipal corporation is much like the business of a private corporation, and that the form of organization which has proved successful in the latter might naturally be expected to prove successful in the former. The conclusion drawn was that the board of directors of a private corporation would correspond to the commission or board of directors of the city. But commission government is unlike the government of a private corporation in one very essential particular. No officer is provided to correspond with the general manager of the corporation. In other words, the city commission is like a board of directors in a private corporation, each one of whom attends to the supervision of some particular branch of the activities of the corporation but no one of whom is particularly responsible for the efficient and practical management of the concern as a whole. It is well known that that is not the way in which corporate affairs are run.

If we would be guided, then, by the analogy of private corporations we should not stop at the most important point by failing to provide an office corresponding to the general manager but we should adopt that feature of business corporation management which is perhaps more largely than any other responsible for the efficiency with which private business is conducted.

In order to show that, in the operation of the commission form as originally adopted, the lack of a city manager must result in friction, duplication, or lack of responsibility in some of the affairs of the city government. Mr. James divides the general affairs of the city into five or six groups and charges a man with the responsibility of the administration of each one of these groups. He states that that man should, in the first place, be an expert in his line and all these men should in the next place be responsible to some common superior. For, without the expert professional administrator the affairs of each department will suffer, and without the central authority the affairs of all the departments will suffer.

The division of the work of a city into five or six branches can in its very nature not be an absolutely inclusive and exclusive division. The nature of these affairs is such that many of the most important branches of municipal service will cut into the sphere of two or three departments. Simple co-operation cannot be relied upon to secure the harmony necessary for efficient working together, because many times the general public welfare may demand the subordination of what might seem to be the interests of one department to those of another.

It might be said, then, that commission government fails in two respects. In the first place it puts into the hands of elective officers the management of affairs which are extremely technical in their nature and demand professional experts, and in the second place it fails to coordinate the work of administration by subordinating it to one central responsible authority. Both of these defects the city-manager plan will remedy. The city manager is chosen because of expert qualifications, not because of friends and relatives who may like to see him in a public office. He in turn chooses his subordinate officers on the basis of the same qualifications. The heads of departments, being appointed and removed by him, under proper limitations, are responsible to him in every particular, and he is able to use that compulsion which is frequently necessary to secure successful co-operation.

Such, in brief, is the theory of the city-manager plan and it would seem to be too clear for argument that these changes must materialize if the plan is worked out on the foregoing principles. There are, however, some objections which have been urged against this plan and which it may be well to dwell on very briefly here.

Perhaps the commonest objection is that this plan is undemocratic; that it is bureaucratic because the central authority is in the hands of a single individual and he not even elected by the people. The answer to that, of course, is apparent. The control of the electorate is continuous over the members of the commission. The members of the commission appoint and remove the city manager and consequently have the absolute power of direction. If the elected representative body of the people is dissatisfied or if their constituents are dissatisfied with the city manager he can be removed more easily than if he were an elective officer who might have succeeded in building up a strong machine.

There is, however, a real danger in this centralization of responsibility in those communities, and in those only, in which the electorate is unable to exercise its control over the members of the elected representative body. If a community is hopelessly boss-ridden the city manager would doubtless be the tool of the boss, but in any community in which that primative stage of political development has been passed and the citizens can elect and keep elected a responsible and responsive commission, there need be no fear of an autocracy.

Another argument advanced against the city-manager plan, for larger cities at any rate, is that the entrusting of all administrative authority to one individual confers more than one individual can be expected to administer effectively. To this it may be answered that private corporations could easily be instanced whose capital and expenditure exceeded that of many large cities and yet which have found the general manager an indispensable officer. There is no distinction, as far as the question of administrative efficiency is involved, between the smaller city and the larger city. Every city, whatever its size, will gain by increased efficiency in its administration; and concentration of power and responsibility in the hands of a single individual chosen on the basis of professional qualifications cannot help but result in increased efficiency.

FIVE MILLION SHELLS FOR RUSSIA.

The $83,000,000 contract now being handled by the Canadian Car and Foundry Company for the Russian government calls for 5,000,000 shrapnel and howitzer shells at an average cost price of $17.85. According to the New York Journal of Commerce, the Canadian Car and Foundry Company's profit will be, it is said, 25 per cent. The following are the principal sub-contracts sublet by the Canadian company, and their value:—

Hydraulic Pressed Steel Company, $475,000; American Rolling Mill Company, $930,000; Barney and Smith Car Company, $1,122,000; Dayton Manufacturing Company, $463,000; Federal Pressed Steel Company, $1,850,000; Northern Electric Company, Montreal, $275,000; United Lead Company, New York, $280,000; Recording and Computing Machine Company, Dayton, Ohio, $6,000,000; Michigan Brass and Copper Company, $2,400,000; American Brass Company, $375,000; Auto Parts Manufacturing Company, $650,000; Vermont Farm Machine Company, $650,000; Consolidated Manufacturing Company, $550,000; United States Steel Products Company, $840,000; Mead Morrison Company, $900,000; Crocker, Wheeler Company, $450,000; Platt Iron Works, $630,000; Lauzon Engineering Company, Levis, $180,000; Dayton Manufacturing Company, $320,000; Worcester Manufacturing Company, $480,500; Bridgeport White Metals Company, $360,000.

The total of these and other contracts awarded is $21,724,000. Contracts still being negotiated include American Locomotive Company, $10,000,000; Pressed Steel Car Company, $10,000,000; United States Cartridge Company, $10,000,000; Dayton Manufacturing Company, $104,330; total, $30,104,330.

The remainder of the $83,000,000 contract, not shown above, is to be filled directly in Canada by the Canadian Car and Foundry Company, with the assistance of other Canadian firms.

SINGLE TRACK AUTOMATIC SIGNALS, T. H. & B. RAILWAY.

During the summer of 1911 the Toronto, Hamilton and Buffalo Railway, which forms a connection between the New York Central Lines and the Canadian Pacific Railway, began its first automatic block signal installation on a short stretch of track, nine miles in length, from Kinnear to Vinemount. In 1913 the automatic signaling was extended from Vinemount eastward to Welland, a distance of 26 miles, and in 1914 signals were installed on the west end from Hamilton to Brantford, a distance of 25 miles. There remains approximately 16 miles of single track between Hamilton and Brantford which is not equipped with automatic block signals.

Traffic is heavy, the average being 32 trains per day, and the maximum 52 trains per day, as follows:

Freight, westward	average 6	maximum 10
Passenger, westward	" 10	" 16
Freight, eastward	" 6	" 10
Passenger, eastward	" 10	" 16

Formerly, trains were operated by the telegraph block or time interval system in connection with train-order boards, and in some cases by standard semaphore train-order signals. Trains following a passenger train were held at train-order stations until passenger train was clear of the block, and a time interval of five minutes was maintained at train-order stations between following freight trains.

Train orders and instructions regarding train movements are transmitted by telephone, and there is a telephone at each passing siding so that trainmen can communicate direct with the dispatcher when occasion requires.

The system of signaling is the General Railway Signal Company's absolute permissive block system, in which the block for opposing trains is from siding to siding, and for following trains the block is from signal to signal, as in double-track signaling.

Ballast is rock and gravel, affording good drainage; ties are untreated oak and cedar; rail is A.S.C.E. 80-lb. and 100-lb.; all rail joints, including insulated joints, are of the continuous type; two 44-inch E.B.B. bond wires connect adjoining rails at each joint. The length of track circuits varies considerably according to the distance between successive signals; the average length is approximately 2,000 feet and the maximum length about 4,000 feet.

The track battery consists of two cells of Columbia 600 ampere-hour, high internal resistance type, housed in 8-ft. cast-iron battery chutes. Track relays have a resistance of four ohms; front contacts are platinum to graphite, and back contacts platinum to platinum. These relays are housed in a cast-iron relay box which is mounted on the signal mast or on a cable post, depending upon the particular location. Wire used for track-circuit connections is No. 9 B. & S. gauge, rubber-covered. All connections may be identified by means of fibre tags on which appear the proper letters and figures.

The signal control wires are No. 9 B. & S. gauge, weatherproof, copper-clad and are supported on a separate cross-arm below the telegraph line which was practically reconstructed before the signal wires were strung. Wires extending from line to function are No. 14 rubber-covered, and are formed into a cable held together with marline and supported by messenger wire. Line circuits are operated under the polarized line control system which requires one less line wire than a similar neutral control system. Ordinarily there are three line wires extending from sidings, and five line wires extending through sidings.

Line and local relays have a resistance of 670 ohms; front contacts are platinum to graphite, and back contacts platinum to platinum. These relays are ordinarily housed in a cast-iron relay box mounted on the signal mast. All relays and other mechanisms likely to be affected are protected by G. R. S. lightning arresters to which are attached suitable connections to ground.

The Line of the Toronto, Hamilton and Buffalo Railway.

The railway company furnished and installed in place all insulated joints, insulated switch rods and connections, also all line-wire supports. The General Railway Signal Company manufactured and installed in place all signals and signal appliances. Most of the material was delivered by work train. Signals were erected by means of a derrick which was also used in setting the concrete battery wells. Mr. R. L. Latham, chief engineer of the T. H. & B. Railway, had general charge of the installation, which was performed under the immediate supervision of Mr. A. A. Hurst, supervisor of signals. Mr. A. C. Holden was engineer in charge for the signal company.

The results obtained by the automatic signals may be briefly summarized as follows:

(1) Under proper observance of the indications, the signals provide, for opposing as well as following movements, a definite space interval which practically eliminates the liability of collisions.

(2) Misplaced switches, broken rails, or any breaks in the continuity of the track cause the display of a stop indication at the signal governing entrance to the block, and thus greatly reduces the liability of derailments.

(3) The signals increase the traffic capacity of the line, as one train can follow another as soon as the first train passes the first signal in advance, which is accomplished in considerably less time than the prescribed time interval of the telegraph block.

(4) The signals afford maximum protection at meeting and passing points, serving as a check on dispatchers' orders, also as a reminder to trainmen at scheduled meeting and passing points.

(5) The signals more than double the safety factor in connection with flagging, as an approaching train would, in most cases, meet a caution or stop indication before the flagman could go out far enough to insure adequate protection.

GERMAN "IRIDIUM" STEEL.

The gradual development of the cutting power of Mushet's pioneer type of steel proceeded by cumulative improvements from 1880 to 1912; it was influenced in 1900 by the discovery in what is now the University of Sheffield of the influence on steel of relatively small quantities of the somewhat rare element vanadium, an influence which, unlike that of tungsten, extended also to structural steels. In connection with the latter it was found that the vital factor of structural steel, known as the elastic limit, could be almost doubled without an undue sacrifice of toughness and ductility. By reducing the carbon in the original Mushet steel from 1.8 to 0.7 per cent., much increasing the tungsten and chromium, largely reducing the manganese, and adding 1 per cent. vanadium, the thermal stability of the cutting hardness was easily doubled, rising from 300° C. to well over 600° C. In fact, such steel can be run for several minutes cutting cleanly at a red heat. The net result of the researches in British cutting-steels which were made between 1740 and 1912 has been in certain cases an improvement in cutting-power of about 900 per cent. As an example of German jealousy of British supremacy in the science of manufacturing high-speed tool steel, the following is interesting: A German firm not long ago added to the composition of standard Sheffield steel the element cobalt, and under the authority of a certificate from Charlottenburg claimed that the new German steel was twelve times as powerful as the best British product. This obviously absurd statement was challenged by both British and German steel-makers, and researches in Sheffield University have since shown that the claim is without foundation in fact, because upon the cutting power of the best type of high-speed steel the element cobalt has no influence whatever. It is interesting to know that this German steel was largely advertised as "iridium" steel, possibly because in its composition iridium was conspicuous by its absence.

Canada's total production of marketable coal for the year 1914 comprising sales and shipments, colliery consumption and coal used in making coke or otherwise used by colliery operators, was 13,594,984 short tons, valued at $33,433,108, as against 15,012,178 tons, valued at $37,334,940 in 1913, showing a decrease of 1,417,194 tons or 9.4 per cent. in quantity and of $3,901,832 or 10.4 per cent. in total value.

ESSENTIALS OF AN ENGINEERING OFFICE ORGANIZATION.

By Wilfred G. Astle.

Records kept in a haphazard way, or not kept at all, don't mean "less office expense"; they mean chances missed, business lost, efforts wasted. . . . In the game of modern business, as in the game of baseball, it is the man who keeps score on results who follows most closely the progress and the profits of his work.

ANY organization—whether it be an engineering, a factory or a political organization—is composed of three elements, which are men, equipment, and a field of operation or what might be called, for lack of a better term, space. In a large corporation, these elements are highly developed. The workers number in the thousands, and the factory or plant has the most advanced kind of machinery and the field of operation or the space (of the internal organization) has been carefully analyzed, selected and arranged.

In an office organization will be found these same three elements, consisting of the workers, equipment, such as appliances, desks, cabinets, etc., and the office space. The first step in building up an efficient office organization is to combine in proportions that are right, such of these elements as have been carefully selected and perfected for the particular work to be done.

In its usual sense the office is the part of a business establishment in which the administrative and clerical work is performed. Generally speaking, a business is divided into four basic departments—the production, the sales, the financial, and the accounting departments. The production department supplies the article to be sold, the sales department is concerned in selling it, the financial department collects and disburses the money involved in the conduct of the entire business and the accounting department records all the transactions, summarizes the facts and presents the results in statements and reports for use in further operations. From a management point of view, then, the office may be defined as that part of a business organization which performs the purely clerical work necessary in the conduct of the whole business. The head of any one of these divisions has, theoretically, no right to supervise the work of any of the others, and as Mr. J. William Schulze, expert on office organization and management, illustrates this by comparing these four basic divisions to the four wheels of a wagon. The left fore-wheel does not control the hind-wheel, but each has its own work to do. If the left fore-wheel should cave in, it might still be possible to move the wagon by dragging it along on the remaining hub, but the resulting progress would be a slow, wearying process which could not be continued indefinitely. The office is the fifth wheel, it being a necessary part of the running gear, without which, it would be impossible to steer.

In other words, the factory manager, the sales manager, the treasurer and the controller should have nothing to do, theoretically, with office details. That is a function almost as far removed from their real duties as those of the color sergeant are removed from the duties of the army general. They should call upon the office for the work they want done—not upon individual clerks in that office. The office manager or chief clerk or whatever may be the title of the person in charge of the office, is the individual to be held responsible for its efficient conduct. It is his function to understand the details of office organization and management.

The First Essential Element.—The most elusive factor in any organization, whether it be in an office, factory or construction outfit, is the man element, and the many articles and books published on the art of handling men, hiring and dismissing employees, are evidences of this fact.

Directing an office force so that it will work harmoniously and with maximum efficiency is a hard problem to solve, because, unlike the manufacturing end of the business, the employees of an office cannot be placed upon a strictly scientific management basis. Their work is too varied, requires the exhibition of more individual intelligence and is dependent upon too many indeterminable factors but yet the principles of efficiency are as capable of application in the management of an office as they are anywhere else.

The most important point to deal with is the selection of the employees, which should be given a great deal of consideration. Many of the very large corporations have approached this problem in a pseudo-scientific manner, that is, every applicant for a position is carefully tested before they are employed, and in addition to that, they are thoroughly trained in the company's policies, plan of organization, the nature and scope of its work and the specific duties he is to perform.

Experts tell us that, on the average, it costs about one hundred dollars to "break in" a new office employee, which includes the cost of the time devoted to the purpose by higher-priced employees, the material wasted, and the mistakes that are made. Therefore, it should be worth spending a few dollars to apply definite, prescribed tests to every applicant for an office position, and to train them after employment. This course of training will naturally depend upon the size of the office and nature of the work. It may consist of an office manual or a rule book which is given to the new employee to study, preparatory to a written or oral examination, or it may consist of a training school such as some of the large companies use. After all, there is nothing very complex about properly selecting and training employees for an office. It is a simple, commonsense procedure which will mean the probable saving of 90% of this hundred dollars.

Coupled with the selection of employees is the importance of assigning to them the duties which they are by nature best fitted to perform. In cases where there is an original examination it is only a matter of carrying the process a step farther and determining what qualifications are necessary to perform a given kind of work. For example, in the mailing department, it has been established that an active, nervous girl can turn out more work than a calm, self-contained girl, even though the latter may move decisively.

There are a great many business men who forget that a human being is not a man-made creation. When clerks are found who are not capable of doing the work assigned to them, it is wrong to glare at them and make them feel as if they had committed a crime, because, in most cases, it isn't the clerks' fault. The fault usually lies, either in selecting the wrong kind of employee for that particular office organization, or in selecting the wrong kind of employee for that particular task. If no error has been made in either of these respects, in all probability the employee hasn't received the right kind of training.

The Second Essential Element.—There is only one way to be modern, and that is to avail yourself of every essential modern device that offers you greater potentialities and facility in your work. It isn't enough that you can "get the work done" with the methods of yesterday; that attitude makes for retrogression. So, in order to produce the volume of work demanded in a modern office, in order to insure speed and accuracy, you will have to keep up with the times, and you must do away with human energy whenever you can replace it profitably with machine energy.

Even to-day there are many business men who will not use dictating machines, sealing and stamping devices, duplicating machines, addressing machines and other office appliances, but let it be remembered that all production is the result of some kind of energy. You can write a letter on a piece of board, using a piece of chalk, and you can write the same letter, in much less time, doing a neater job, with the use of a piece of white paper, pen and ink, but you can still do a much better job with a greater saving of time by the use of a typewriter.

Modern office practice has developed many wonderful time and labor-saving devices, and it isn't sufficient to call a new device "new fangled" and let it go at that, because there are very few office appliances now in existence that do not deserve at least an analysis as applied to your own office problems. It isn't good business to use a variety of desks and filing cabinets to do the same kind of work, because there is always one style, one method, one kind of operation that is more efficient than others. It is the executive's business to select the one best way and to apply it wherever it should naturally come into play. And that is what is known as standardization. This problem of equipping an office with machinery, cabinets, desks, etc., that will help cut out useless space and economize time is the second factor to be studied in the creation of a result-producing office organization.

The Third Essential Element.—The problem of laying out the office floor space is hardly suitable for discussion at length in an article of this kind. Economy and dispatch are very important factors in office work, therefore it is necessary to give careful attention to the arrangement of office furniture so that the floor space will not be wasted, and that time and energy will not be consumed in long trips about the office. Economy, the first mentioned factor, is secured by a layout of desks and office fixtures which makes use of every available foot of floor space, letting nothing go to waste in useless aisles and unoccupied corners. Convenience demands that the office force should be grouped by departments, with clerks near the persons from whom they take orders, and filing cases near the desks of the men by whom they are used.

In plotting a room for office work, arrange the desks from the centre and work outward towards the walls, for wall space is better used for filing cases than for desks. In a large office, a neat alignment of desks in rows, with regular aisles, will secure the greatest economy of space with an appearance of order.

Partitions should be used sparingly, if at all; even railings impede the free movement of an office force, and the space taken up by them, and the necessary aisles on each side, could be put to more profitable use. An office without partitions brings the entire force under the eyes of the office manager.

And finally, there is the effect upon visitors to be considered. It makes all the difference in the world to your reputation as an efficient, progressive business or engineering organization whether customers and salesmen who call at your office leave with a good or bad impression.

Combining the Elements.—We now come to the final element in building up an office organization—that of combining the three elements already discussed into an efficient organization. That is a problem in departmental organization that is different in each case. You must analyze the whole situation and, in some form, have before you a map, plan or schedule of all the different kinds of work to be done, and you must know the capacity of your workers, also the approximate time required to handle each kind of work. Only then can you proceed to assign duties so that they will be promptly and accurately performed.

Draw up a chart that will clearly show the relation of every employee to the organization as a whole, and specify his authority. A chart of this kind, when distributed or placed in a position where everyone can see it, will avoid any amount of friction and misunderstanding.

One way to create a smooth working organization is to have it conducted by a number of committees, which plan can be carried out throughout the entire concern. In an ordinary office there should be an executive committee, a factory committee, an advertising committee, an office committee, an office appliance committee, an office system committee, etc. The executive committee is usually composed of all the active heads; that is, the heads of the five divisions already referred to. The office manager and his chief clerks usually form the office committee, and this committee in turn appoints members to the office appliance committee and to the office system committee. The minor committees decide questions within their scope and suggest improvements to the higher bodies. The office manager should be the final authority on matters pertaining to the office except as they affect the policies of the house. His committee and the minor committees act in an advisory capacity, and this is as it should be, because the office manager is held personally responsible for the success or failure of his organization.

Along these lines a really efficient office organization can be built, but this, however, is only half the problem. There is still the important task of guiding and directing the organization so that it will produce the results required of it, which comes under the head of office management.

A competent supervising organization is worth more to a business than money, equipment, and market, because perfect organization can secure all these.

WATER PURIFICATION WITH BAUXITE.

A FORWARD step in water purification is announced in a paper read at the annual convention a few weeks ago of the American Waterworks Association by Mr. C. P. Hoover, chemist, Columbus waterworks. He describes a new process, perfected there, which is claimed to be an improvement over the present largely used process of coagulating water by applying a solution of ammonium sulphate, previously prepared by dissolving crystal alum in water. In the new process syrup of alum is fed directly into the water supply. The following paragraphs explain the method and compares it with the old.

Lump alum is a combination of bauxite (a clay containing from 58 to 60 per cent. alumina, the aluminum being present as $Al_2O_5H_4$) with sulphuric acid. By mixing the two in lead-lined tanks and boiling for a period of from six to eight hours, the first step in making the alum is taken. The following reaction takes place:

$$Al_2O_5H_4 + 3\ H_2SO_4 = Al_2(SO_4)_3 + 5\ H_2O.$$

The resultant solution is a mixture of aluminum sulphate and silica, and must be filtered to obtain the clear aluminum solution. The filtering process is perhaps the most costly, tedious, and annoying step in the whole procedure of alum making, because the finely divided particles of silica present in crude sulphate solution quickly clog the pores of the filtering medium to such an extent that it is often necessary to force the material through the presses under considerable pressure. After being filtered the alum solution is boiled to expel the excess water. The expense of concentrating the syrup must be taken into consideration, because the density is increased from between 25 and 30° Be. to a density of between 58 and 60° Be. The solution is then discharged into trays, and on cooling crystallizes to the alum cake. Then crushed or pulverized cake is shipped either in bulk, in barrels or in sacks.

In the new process bauxite and sulphuric acid are boiled in lead-lined tanks until a basic solution of aluminum sulphate is obtained. The solution is then diluted with water (usually enough water is added to make 500 gal. of the solution, equivalent to 1 ton of 17 per cent. Al_2O_3 alum), and measured as needed into alum solution tanks, where it is diluted with sufficient water to make a standard solution, which is then applied to the water under treatment. By this process five distinct steps in alum making are eliminated—filtering, concentrating, crystallizing, grinding, and redissolving.

The plant comprises two lead-lined boiling tanks, two alum-measuring tanks, one acid-measuring tank, one sludge tank, one storage tank for sulphuric acid, one crusher and one pulverizer for the bauxite, conveying, elevating and transmission machinery, bauxite storage bins and weighing device, piping, valves and fittings. This plant, some features of which have been made the basis of patent application, has been in continuous operation since the middle of January. The plant was finished and the first alum made on December 25, 1914, but experiments had been carried on for two years.

The requisite installation cost $12,000 and the annual saving to the city has been estimated, conservatively, at $6,000. Between 800 and 1,000 tons of alum will be made at Columbus this year at an approximate cost of $10.50 per ton.

The crude alum solution containing silica or other inert material from the bauxite, probably better defined as chemical mud, is applied to the water under treatment, the chemical mud mixes with the suspended particles present in the water and finally becomes entrained or coagulated by the precipitated aluminum hydrate and settles out in the settling basins. The crude solution, containing the chemical mud in suspension until the metallic sulphate has been converted into hydroxide, has a function not possessed by alum solution prepared by the old process, namely, forming a matrix or nucleus for starting the coagulation. This feature produces not only more efficient results with less coagulant, but also affords the process universal applicability irrespective of any lack of natural turbidity.

TESTS OF BEAM CONNECTIONS.

A SERIES of tests on beam connections was recently made in the college of civil engineering, of Cornell University in co-operation with the American Bridge Company, on pieces, 18 in number, being 15, 12, 10, 8 and 6-inch I-beams, 4 feet long, with clip angles shop riveted to their webs. The clip angles, attached to two of the beams of each size, were the American Bridge Co.'s old standard connection angles. Two beams of each size except the 6-inch were fitted with special connection angles with simpler symmetrical web connections and fewer web rivets. The outstanding legs of the standard and special angles were in all cases the same for each size beam. Some of these special connections have since been adopted as standard by the company.

The purpose of the tests was primarily to determine whether or not satisfactory beam connections could be made with fewer web rivets than were required by the old standards. Numerous observations of deformation were made with an 8-inch Berry strain gauge at different points and the deflection of the beam itself was measured in order to determine the slip of the angles relative to the beam web and the support and to discover the effect of the deformation of the beam on the strength of the connection.

Twenty-four 8-inch gauge lines were laid out on each beam and the deflection apparatus was suspended from points at each end of the lower flange.

All web connections were made with ¾-inch shop rivets in 13/16-inch punched holes. The outstanding legs were connected to the supports by machined bolts turned to make what was practically a drive fit in the holes. The latter were punched 11/16-inch, and reamed to 13/16-inch. The beam supports were made of steel plates and angles riveted together to provide two rigid vertical faces between which the beam to be tested was bolted. These two supports were bolted securely to the cross-beam of the 400,000-lb. Riehlé testing machine.

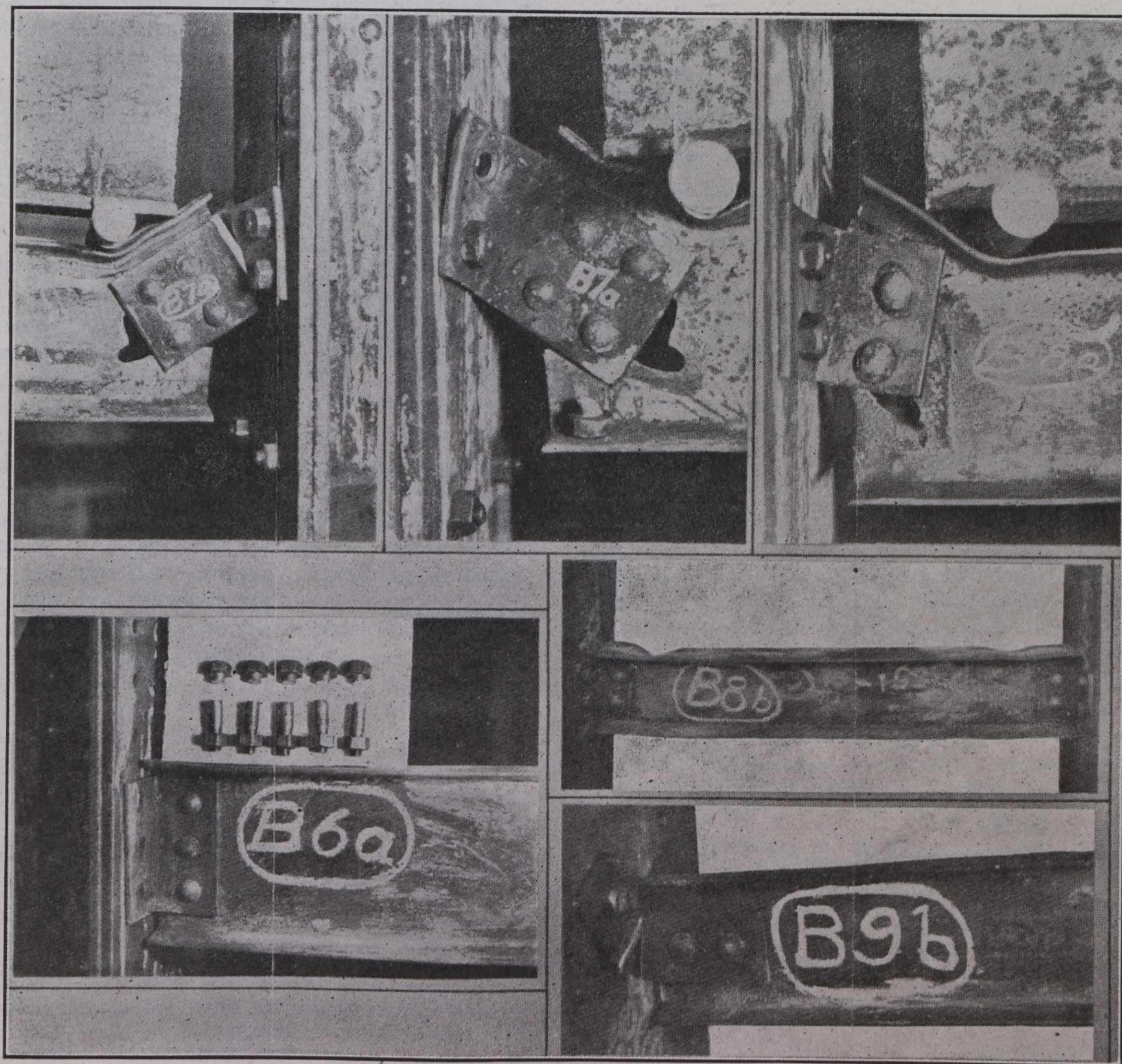

Fig. 1.—Showing Method of Applying Load and Manner of Failure of Test Pieces.

The load was applied to the upper flanges of the beams through 1½-inch steel rollers. In the majority of cases, steel bearing plates 6 inches long were placed under the rollers to distribute the load on the beam flange, and where they were not used the beam was badly buckled. Beam 7b was loaded at the quarter points, but it buckled under the load points without causing the connections to fail. All the other beams were loaded at points three feet apart, six inches from the ends. The load was applied in increments of about one-twentieth of the total estimated ultimate strength of the two end connections.

The action of clip angle beam connections is so complicated and indeterminate that a close calculation of the stresses is impossible. For this reason, an artificial average stress, computed by considering all forces vertical and neglecting eccentricity is used as a measure of the strength of the connections. The value of the average rivet shear, bolt shear, and web bearing for each beam tested, computed from the ultimate load, are shown in the accompanying table which, along with this description of the tests, form a recent paper in the Cornell Civil Engineer. The values show clearly the great importance of the eccentricity as the more eccentric joints fail at lower average unit stresses.

The final failure of the connections of beams 1a to 6b was due to shearing of the bolts. Special connections show nearly as much strength as the standard, the ultimate strength bearing no direct relation to the number of rivets in the web.

The connections of beams 7a and 8a failed in the web bearing, the strength of 8a being considerably less than that of 7a, but not in proportion to the number of web rivets because the eccentricity of 7a was greater. In every case the decreased effect of eccentricity of the special connections tended to offset the decrease in the number of rivets.

The special connections on the 15, 12, and 10-inch beams gave very satisfactory results. They are more economical than the corresponding standard connections because they are symmetrical and require fewer rivets. Their strength should be sufficient for all ordinary cases (for which a standard connection must be designed) as they are capable of developing the full flexural capacity of I-beams except for spans so short that the beam web is in danger of buckling. All standard details must be used with caution in exceptional cases.

The 8-inch beam tests indicate the inadvisability of decreasing the number of web rivets in the light connections because the web is the weak point and the connection must be made as stiff as possible to decrease the very high stresses due to eccentricity.

Summary of Tests on Beam Connections.

					Total Area (Both Ends).					Maximum Average Stress.		
No.	Beam.	Connection Angles.	No. of Web Rivets.	No. of Flange Bolts.	Web Bearing. Sq. In.	Rivet Shear. Sq. In.	Bolt Shear. Sq. In.	Safe Design Load.[3] Lbs.	Total Max. Load. Lbs.	Web Bearing. Lbs. per sq. in.	Rivet Shear. Lbs. per sq. in.	Bolt Shear. Lbs. per sq. in.
B1a	15″-42 lb.	6×4×½	6	8	3.69	10.60	7.08	70,800	360,000	97,500	34,000	50,900[1]
B1b	"	"	"	"	"	"	"	"	368,250	99,800	34,700	52,000[1]
B2a	"	4×4×½	4	8	2.46	7.08	7.08	"	341,000	138,700	48,200	48,200[1]
B2b	"	"	"	"	"	"	"	"	354,220	144,000	50,000	50,000[1]
B3a	12″-31.5 lb.	6×4×½	6	6	3.15	10.60	5.30	53,000	265,000	84,100	25,000	50,000[1]
B3b	"	"	"	"	"	"	"	"	277,600	88,100	26,200	52,400[1]
B4a	"	4×4×½	3	6	1.575	5.30	5.30	47,250	254,000	161,200	47,900	47,900[1]
B4b	"	"	"	"	"	"	"	"	257,000	163,200	48,500	48,500[1]
B5a	10″-25 lb.	6×4×7/16	4	6	1.86	7.08	5.30	53,000	257,170	138,200	36,300	48,500[1]
B5b	"	"	"	"	"	"	"	"	236,700	127,400	33,400	44,700[1]
B6a	"	4×4×7/16	3	6	1.395	5.30	5.30	41,850	245,000	175,600	46,300	46,300[1]
B6b	"	"	"	"	"	"	"	"	246,850	177,000	46,600[1]	46,600[1]
[4]B7a	8″-18″ lb.	6×4×7/16	4	4	1.62	7.08	3.54	35,400	132,000	81,500[1]	18,650	37,300
[4]B7b	"	"	"	"	"	"	"	"	85,000[2]	52,500	12,000	24,000
[4]B8a	"	4×4×7/16	2	4	.81	3.54	3.54	24,300	117,000	144,400[1]	33,100	33,100
[4]B8b	"	"	"	"	"	"	"	"	111,300	137,500[4]	31,450	31,450
[4]B9a	6″-12.25 lb.	6×4×7/16	2	2	.69	3.54	1.768	17,680	44,000	63,800[4]	12,430	24,900
B9b	"	"	"	"	"	"	"	"	48,400	70,200[4]	13,690	27,400

[1] Manner of final failure. [2] No failure of connections. [3] Computed from safe web bearing of 30,000 lbs. per sq. in. and safe bolt shear 10,000 lbs. per sq. in. [4] No bearing plate under load.

BRITISH COLUMBIA'S MINERAL RESOURCES.

Activity in the mining industry in British Columbia may result in attention being given propositions in the province that are easily worked. Some of these require only a small amount of capital.

There are old lake beds from which crude chemicals can be obtained in large quantities. Infusorial earth of an excellent quality may be had in quantities. Magnesium sulphate, Epsom salts, can be shovelled out which will test 98 per cent. pure and its raw state pass the pure drug act. Glauber's salts are another product. There would be little difficulty in having the owners of these deposits co-operate with people of moderate capital in exploitation. The market for these products is available and prices are strong and have advanced considerably during the past few months.

The fact that there are such deposits available indicate the potentialities of the province.

Inquiry is being made for such ores as antimony, tungsten, molybdenite and manganese zinc. Molybdenite has increased in price from $600 to $1,600 per ton. Victoria people control a deposit of this mineral, for which they ask $35,000.

Attention is being more and more directed to the mineral resources of the province, and while copper mining requires a large amount of capital, there are smaller propositions that will give satisfactory returns.

COAL MINING OR OIL IMPORTS?

Members of the Vancouver board of trade are not unanimous regarding the levying of a duty on crude oil brought into the province for fuel purposes. The suggestion for a duty has come from those interested in coal mines on Vancouver Island and the mainland.

Statistics show that in 1911, 200,000 tons of coal were mined in the Cumberland district of Vancouver Island, and in 1914 only 70,000 tons. The wages paid were about $1,000,000 and $300,000 respectively. In 1911, the imports of oil were 7,250,000 gallons, while in 1914 the amount was 110,000,000 gallons.

Independent members of the board argue that the question is altogether one of economics, whereas those knowing the coal mining industry declare a big industry is seriously threatened.

Editorial

ENCOURAGING TRANSFORMATION OF CANADIAN TRADE.

The war has had the effect in Canada of creating a common incentive in her industrial East and agricultural West towards practical co-operation with a view to securing a sound economic basis for the increased output which it has caused. From the viewpoint of trade, it is proving a blessing in disguise, as it has resulted in a considerable reduction of the great disparity between the value of imports and exports. For the year ended March, 1913, the former exceeded the latter by $298,711,000. Last year saw this figure reduced to $171,625,000, not as an outcome of the war, of course, as it had not developed then, but rather as the result of trade contraction which preceded it. Imports have shown a great decline in the intervening time, and exports have actually overtaken them. The figures for April, 1915, show that imports have fallen off to $28,391,000 for the month, while exports of merchandise have increased to $28,691,000. Of this merchandise, over $13,000,000 related to manufactured articles against $4,000,000 in April, 1914. The total exports of the products of the farm amounted to $3,312,000 as against $1,860,000 for the same month last year.

While we look to agriculture to make pronounced advances in bringing the development of the country as a whole into line, it is even more gratifying to note the returns from the manufacturing industries. Now as never before it should be kept in mind that a most important feature of Canadian growth is the comprehensive development of her natural resources along strictly scientific lines in order to establish greater production, to avoid overproduction in one direction or a shortage in another.

WATER-POWER CONSERVATION AND USE.

The policy of conservation, as applied to water powers, should be recognized as the policy of promoting, as rapidly and as extensively as possible, within the law, the utilization of the perpetual and inexhaustible resources afforded by every water power in the country, the development of which is, or can be made, economically feasible.

It has been said that the water powers of Canada are among its most unique resources, in that they are not diminished by use or conserved by non-use. While this is quite true, their development has an enormous influence on our other resources, among the most important of which are the fuel supplies of the country. The drain upon these supplies and the importation of fuel in some provinces are lessened in accordance with the utilization of water powers. It can be shown that it takes about five tons of coal to produce energy to the extent of one horse-power per year, hence every horse-power of energy which runs away unused in a water-fall in an inhabited country is equivalent to the depletion of coal resources of the country to the extent of five tons annually. In addition, while it is a good and economical steam plant which will utilize 10 per cent. of the energy of the fuel, the hydro-electric plant can make available as much as 70 per cent. of the energy of a waterfall. One of the best informed electrical engineers in Canada, Dr. L. A. Herdt, of McGill University, is credited with having made the following statement in this connection:—

"It is, I believe, within reason to hope that the use of coal for the production of power in our large cities will before long be almost entirely abandoned and that hydro-electric power, economically transmitted and distributed, will in time light every home and drive the machinery in every factory in this country."

It is pointed out by Prof. Herdt that the importance to Canada of effectively and economically utilizing these water powers cannot be over-estimated. He advises the formation of a definite comprehensive policy with respect to the nation's vast water-power resources. He cautions us that this great asset of raw material from which the finished product is made by the expenditure of money and brains, should not be given away unless the power is developed and placed at the service of the people. Reasonable encouragement, however, should be given to power schemes, bearing in mind that a water power undeveloped is like unmined gold. It takes money to place it at man's service. The water powers should be developed in such a way as to render available, in a profitable manner, the energy which is now going to waste and at the same time, conserve for future generations our other natural resources.

It is of great advantage to Canada that there is so little hostility between the interests of conservation and the interests of water-power owners. That these should be at variance is a fallacy which is unfounded, and which must be swept entirely away before a conservation of water powers, whether through federal or provincial legislation, will ever be wholly realized. This same fallacy has been the cause of many erroneous and futile attempts in other countries to solve the problem of water power conservation. The fallacy generally sprang from a failure on the part of both classes of interests to appreciate the underlying principles involved. We are told that the advocacy of hasty and extreme measures, inimical to the property rights of private owners and rendering hazardous the necessary investments of capital, has tended to create a hostile attitude on the part of private interests toward the carrying out of a conservation policy. This hostility, in its turn, incites a further spirit of antagonism on the part of the forces of conservation. The questions of conservation become confounded with questions concerning monopoly, competition, and the relations between the producer and the consumer. But those representing the two classes of interests involved, those representing the public and those representing investors, are now realizing, more than ever before, the fact that real advantage to any locality or to the public at large lies upon the same lines as real advantage to the holders of investments in water-power development. Both should recognize the feasibility of getting together on some basis which will, at the same time that it admits of adequate protection to the public, also provide an attractive field for investment. Public-utility companies should become convinced that a proper and fair restriction and regulation in the operation of their properties are reasonable and necessary, and evidently promotive of their own best interests. They should be convinced, as they are more and more, that reasonable concessions, even if beyond the limit of their exact legal obligations, assure to them a readiness on the part of legislative bodies to yield also something in return, including a more certain tenure and safer and more comprehensive protection, through legislation, and of beneficial use belonging to them as proprietors.

No one can say that the Dominion has not made rapid strides during recent years or that the public interest is not being safeguarded against improper schemes of development. The work of the Water Power Branch, Department of the Interior in the western provinces, the Hydrographic Survey of British Columbia, the Public Utilities Commission of Manitoba, the Hydro-Electric Power Commission of Ontario, the Quebec Streams Commission of Conservation, and, as referred to last week, the joint investigations of the Nova Scotia Water Powers Commission and the Dominion Water Power Branch, bespeak a scientific solution, entirely in the interests of the people of Canada. It is certainly to be hoped that the work of investigation will suffer no retrenchment and that the work of power development will go on apace, as the disuse of our water powers means so much energy going to waste.

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BOOK REVIEWS.

Direct-Acting Steam Pumps. By Frank F. Nickel, Department of Mechanical Engineering, Columbia University. Published by McGraw-Hill Book Co., New York. First edition, 1915. 258 pages; 218 illustrations; size, 6x9 ins.; cloth. Price, $3.00. (Reviewed by A. J. McDougall, Department of Mechanical Engineering, Toronto Power Co.

This book commences with an interesting chapter on the early history of direct-acting steam pumps. Next, there is a chapter which thoroughly deals with rules for factors attending operation, suction and discharge sizes and velocities, pump speeds and efficiencies. The third chapter classifies the pumps and then describes several makes of single-acting pumps, ending the description with an outline of their defects, practically the only one being the pulsation due to the pause resulting from change in direction at the end of each stroke. This the makers endeavor to obviate by means of an air-chamber. The reviewer does not agree with the author's explanation of the physical changes occurring to the water in the pump and air-chamber. The objectionable statement is this: "If the air molecules are considered as filling the interstices in the water, it is evident that after compression additional room is made for more water." There is no change in volume of the air after compression unless there is entrained air in addition to dissolved air. There will be no space left in the interstices, as the air and water, in addition to being compressed, have most of the heat of the work in them; so that air at the same pressure would have to overcome not only pressure, but heat. There are two laws to take into consideration. First, saturation increases with pressure; second, saturation decreases with heat. I think it will be found that if the water is saturated at atmospheric pressure it will not take up air after compression until it has lost its heat of work, and that all the benefits of the air-chamber come from a supersaturated water (i.e., one with entrained air), and that a saturated water does not take up or give up air in the air-chamber.

The author dismisses the single-acting pump with this difficulty and proceeds to discuss very thoroughly the duplex pump, first the water end, then steam from simple to compound, and then to triple expansion, direct-acting pumps. The chapter finishes with pumps having compensating gears to allow the use of steam expansively in the high-pressure cylinders. One is interested in this last type of pump on account of its mechanical ingenuity, but when the reviewer is in the market for a pump with a steam cutting-off he would go to the expense of the crank and flywheel pump.

Chapters 4 and 5 go into pump and steam end details and will be found a great help to those buying pumps. There are so many pumps on the market and competition is such that some manufacturers are liable to have some portions not as ample as necessary. In this connection the articles on disc valves, disc-valve pressures and valve deck calculations will come in very handy.

In service conditions vs. various types, Table 17 is good. It varies considerably from tables in pump catalogues, but the reviewer would prefer it. Pump-makers generally rate their pumps at too high a piston speed. I do not agree that high economy is not an advantage in boiler-feed pumps, as the steam is utilized to heat the feed water. If one were to figure one power plant with economical auxiliaries and another with uneconomical auxiliaries, the total number of B.T.U's. to operate will be less in the plant with the economical auxiliaries. In a less elaborate plant there is generally enough steam to heat all the feed-water without an uneconomical feed-pump.

Pumps for various requirements are also described, ending with deep well pumps. The last chapter takes up duty.

One would have liked to have seen power displacement pumps taken up in this book, and it would also have been convenient if a short standard specification could have been given to aid in purchasing. However, one can write a very good pump specification from the matter contained in the book as it is.

Preventing Losses in Factory Power Plants. By David Moffat Myers. Published by the Engineering Magazine Co., New York. First edition, 1915. 560 pages; 68 figures, including 10 folding plates; size, 5 x 7½ ins.; cloth.

(Reviewed by L. M. Arkley, Lecturer in Mechanical Engineering, University of Toronto.)

In the preface the author divides his book into two parts, the first nine chapters being written expressly for owners and managers of manufacturing plants, while the remaining ten chapters were written chiefly for mechanical superintendents and factory engineers.

Chap. 1 deals with the methods of determining existing losses in the power plant, and in order to give some standard of comparison, attainable efficiencies and ordinary wastes are indicated in Chap. 2.

Chaps. 3 and 4 treat of preventable losses in the boiler plant, while the subjects of boiler tests, combustion, surface combustion, natural gas as a boiler fuel and the economic combustion of waste fuels are treated in subsequent chapters. This means that approximately one-third of the book is devoted to different phases of boiler plant design, equipment and operation. The importance of the boiler plant fully justifies this exhaustive treatment, and it is remarkable how few factory managers realize this fact.

Chaps. 7 and 8 are of live interest as they treat of the heating system, and it is impossible to divorce this problem from that of the power plant, if efficiency is the end in view. One of the cheapest forms of available power is that which may be obtained as a by-product of the heating system, and this point is emphasized in these chapters.

Chap. 9, called "The human factor," is regarded by the author as the most important one in the book; in fact, he states in the preface that if it were necessary to omit any he would prefer to leave out any six of the other chapters rather than this one. It may be summarized briefly as follows: A fireman in a steam plant may waste or save about one-quarter of the coal fired by him per year, and ordinarily the management has no way of telling whether he is firing efficiently or not; therefore, the author advocates that a method of weighing all coal burned and water evaporated be installed, so that the efficiency of the boiler plant may be determined at any time, and in this way a check kept on the firing. To encourage the fireman to do good work a bonus system, based on the efficiency of the plant, is suggested. The latter part of the chapter contains some good advice in regard to safety devices to be installed, such as stop and check valves on boilers and safety stops on engine.

Furnaces suitable for the burning of such fuels as spent tan bark. sawdust, bogosse and culain are described in the chapter on "The economic combustion of waste fuels." This chapter should be of interest to those with such problems to solve.

Chap. 18 describes some of the recent developments in prime movers, including Stumf's unaflow steam engine, the modern locomobile and the Diesel oil engine.

On the whole, the book contains a lot of useful information brought together from various sources, and while little of this is startlingly new, it is convenient to have it in compact form. The book should prove very useful to men in charge of steam power plants, especially those who are progressive and wish to operate their plants at highest efficiency.

Railroad Field Manual for Civil Engineers. By William G. Raymond, C.E., LL.D., Professor of Civil Engineering, University of Iowa. Published by John Wiley and Sons. Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1915. 398 pages; 31 figures; 83 tables; 4½ x 7 ins.; morocco. Price, $3.00 net.

The author's previous works, including Railroad Field Geometry and Elements of Railroad Engineering, have made him well known to Canadian railway engineers. The new publication should interest them a good deal. The outstanding feature to attract their attention is the fact that throughout the manual the degree has been divided decimally instead of sexagesimally, the author being convinced that it will be found a time-saver as well as less liable to error. It is a change which will undoubtedly meet with ultimate favor in the minds of many of our railroad men, although considerable opposition may confront it at first.

The text begins with a chapter on simple, compound and vertical curves, with complete explanation and tables. The spiral is next dealt with, and is followed by a chapter describing the use of logarithms and trigonometric functions, including common logarithms and logarithms of sines, tangents, cosines, cotangents for each 0.01 degrees of the quadrant. This is followed by a table of versed sines and external secants and others of a similar nature.

Chapter 4 deals with location theories and tables of velocity heads, train resistance, tractive effort, grades and grade angles, etc. Estimating and construction tables are taken up in chapter 5, where a table is presented of volumes of triangular prisms 50 ft. in length, and others of level section volumes with various slopes, and numerous others in which such subjects are dealt with as middle ordinates for curving rails; drainage areas; cost curves; timber trestles; ballast estimates, etc.

Chapter 6 deals with turnouts and cross-overs. Chapter 7 with azimuth, latitude and time. This is followed by tables for metric curves and miscellaneous tables of trigonometric formulas, stadia functions, barometric elevations, etc.

A very useful chapter deals with the adjustment of the transit, the levels, both dumpy and wye. The closing chapter gives sexagesimal trigonometric functions. Blank pages are included in the back of the volume for engineer's notes.

The use of the decimal of the degree instead of the minute and second is very fully explained, and the user should have little difficulty. The list of tables is very complete, and the explanations of common field problems will be found quite sufficient by those not drilled in them by long experience.

Plain and Reinforced Concrete Arches. By Prof. J. Melan, 1912; translated from the German by Prof. D. B. Steinman, and published by John Wiley & Sons, Inc., New York; Canadian selling agents, Renouf Publishing Co., Montreal. 153 pages of text, 44 text figures and one plate; size, 6 x 9 ins.; cloth. Price $2.00.

(Reviewed by David A. Molitor, C.E.)

The book is a translation of Prof. Melan's article on arches, contained in F. von Emperger's Handbuch fuer Eisenbetonbau, second edition, Berlin, 1912.

While freely admitting the leading position of the author in the field of structural design, it does not follow that the present treatise adds very much to our knowledge of arches and the translator certainly overestimates the value of this work to American engineers.

Both analytic and graphic methods are given, though as a general criticism the latter should have received a more comprehensive treatment to enable one to handle these problems in the most proficient manner.

Several of the claims made by the translator in the preface are not justified by the contents of the book. Thus, the statement that "the graphic methods which are given, permitting the use of influence lines, will be found very practical, although new to American designers" is wholly unjustified. In the first place, only about 15 pages deal with applications of influence lines, and unless the reader has already acquired a knowledge of this subject from other sources, he will receive little enlightenment from the present treatise. The statement is, furthermore, not very complimentary to American designers, because anyone who has enough ambition to learn can readily acquire a most comprehensive knowledge of influence lines for all classes of structures, including arches in all forms, by consulting the leading American books on this subject.

The translator would also have us believe that the book abounds with "simple approximations and short cuts" for preliminary and less exacting designs, also easily applied formulae "for determining in advance the best curve for an arch and the required dimensions and reinforcement." While 21 pages are devoted to the derivation of approximate formulae, it is doubtful if any time can be saved by their use. The approximate crown thickness can easily be found by Tolkmitt's formula (see p. 306 Kinetic Theory), and the best way to obtain the economic shape of an arch ring is undoubtedly to draw the equilibrium polygon through the centres of the crown and springing, for a load consisting of the total dead load plus half the uniform live load distributed over the whole span. This is better than any analytic investigation, for preliminary purposes, and a three or five centre curve can always be fitted to the polygon so obtained, which is close enough for all purposes.

The calculus is freely made use of, although this is not mentioned for the benefit of the prospective reader who might or might not be supplied with this working tool.

Castigliano's theorem or differential derivative of the work equation is employed as the solution for the redundant conditions and leads to the same identical results as Mohr's work equations, but by a more circuitous process. These general work equations were published in *The Canadian Engineer* for April 30, 1914, p. 679, in a review of "Suspension Bridges," by Prof. Burr, and afford the most complete solution for any structure involving redundancy in any degree.

On p. 21 it is stated that "the more exact investigation of large bridge arches demands the consideration of the critical loading for each individual arch-section, and the problem of moving concentrations may also occur." At the bottom of the same page it is advocated to analyze the stresses in terms of the normal thrust and bending moment instead of by two different influence lines for the core points, claiming this to be a saving. The last sentence of the top paragraph, p. 22, then admits, "It is, therefore, necessary to determine the influence lines for M and N."

Two influence lines are always necessary to determine the stresses in any section, whether these are derived for the thrust and one moment or for two moments about the core points. The influence lines for the core point moments, being similar, are easily drawn. Also, since there are only a few sections where the stresses become maximum, the work of analysis can be reduced to a minimum by dealing with these critical sections only. That makes in all 3 pairs of influence lines for the symmetric arch and five pairs for the unsymmetric arch to accomplish a complete analysis by the most exact method ever given. Referring now to the example of the graphic analysis given on p. 142, for a 96-ft. arch, the author employs 28 influence lines. As the location of the critical section is not mentioned or discussed, the reader is advised to examine "each individual section," which apparently involves much unnecessary work.

Comparing the two methods of subdividing the arch ring for the purpose of the analysis, it should be mentioned that the equal divisions on p. 45 are preferable to the unequal divisions given by Schoenhoefer on p. 46.

Referring to temperature stresses on p. 55, the Austrian and Swiss specifications are offered. They provide for + or — 27° F. from the unstressed condition. In this country it will be found far better to provide for a rise of about 20° and a drop of about 40 to 50°, since the mean temperature during construction will usually be around 70° in summer and the low winter temperature is always responsible for cracks, if they occur.

It should be pointed out that steel reinforcement is a costly remedy for overcoming tensile stresses in an arch ring of improper shape. Therefore, the designer is always warranted in giving considerable attention to this important feature of design, limiting the tensile stresses to those produced by temperature, and choosing the arch axis so that the tension in extrados and intrados shall be nearly equal.

The book contains 8 minor examples and two larger examples, and might be characterized as somewhat deficient in this respect.

The contents of this volume is largely a repetition of what is given in Melan's "Theory of Arches and Suspension Bridges," also translated by D. B. Steinman, though more attention is here given to concrete and reinforced concrete. The publishers have maintained their characteristic excellence in the production of this book, yet it contains little or nothing that is not already accessible and perhaps more exhaustively treated elsewhere in American literature.

Practical Irrigation and Pumping. By Burton P. Fleming, Department of Mechanical Engineering, State University of Iowa. Published by John Wiley and Sons, New York City. Canadian selling agents, Renouf Publishing Co., Montreal. First edition, 1915. 226 pages; 62 illustrations; 5½ x 8 ins.; cloth. Price, $2.00 net.

This book deals with water requirements, methods of irrigation and analyses of cost and profit. The subject of irrigation is considered principally from the standpoint of the pumping plant, the author pointing out that irrigation by this means is now reaching a greater importance each year in the United States, due to the rapidly diminishing area now susceptible of irrigation by gravity canals.

The chapter headings are: The amount of water required; sources of supply; flow of underground water; strainers; well sinking; pumps, pumping machinery and appliances; centrifugal pumps; different types of their installation; typical plants not using centrifugal pumps; cost of pumping; reservoirs; prime movers; the central station pumping plant; windmills.

Generally speaking, the subjects are dealt with both from standpoints of design and operation. The author makes many helpful suggestions for contractors specializing in pumping plant machinery. The discussion is quite general, considering the nature of the subject. It is to be noted that the author spent eight years in irrigation work with the United States Department of Agriculture, and the book reflects a good deal of his professional knowledge and experience in the matter of irrigation pumping and questions connected with it.

Centrifugal Pumps. By R. L. Daugherty, M.E., Assistant Professor of Hydraulics, Sibley College, Cornell University. Published by McGraw-Hill Book Co., New York. First edition, 1915. 192 pages; 111 illustrations; size, 6 x 9 ins. Price, $2.00.

(Reviewed by A. J. McDougall, Department of Mechanical Engineering, Toronto Power Co.)

This book covers the centrifugal pump, and commences with a history and general description of the various types, with illustrations of some well-known American makes. One might wish for a little deeper analysis of pumps with opposed impellers than that which is given. Complicated passages alone should not be sufficient to prevent a general use of a pump having an almost perfect balance.

In describing the operation of pumps in parallel a more thorough description would be better. There is a slight hint of the difficulty in the statement that centrifugal pumps in parallel should have identical characteristics. It seems to the reviewer that this is a condition where the displacement pump is superior to the centrifugal, as with the former each pump will deliver in accordance with its displacement, while with the centrifugal the stronger pump will "hog" the load, and in some cases shut the weaker pump off entirely.

There is an analysis in the fourth chapter of the general theory, specific theory and characteristics of centrifugal pumps. The chapter starts with a very good system, which, it is hoped, may be generally followed. It is that the notations are all together. It is aggravating to have to hunt through several pages for notations, or to have one notation in one place and in another place another notation.

An analysis of the effect of differing percentages of entrained air in the water and its effects on the efficiency of the pump until the air stopped the suction or discharge would be interesting, as it is the custom of some engineers, in order to prevent heating, to run their glands loose, and in that condition there is probably some air being drawn in.

In centrifugal pumps vs. displacement pumps there is a statement that with a centrifugal pump "It is possible to shut off the flow of water entirely without causing the pressure to rise above a certain value." The reviewer would not like to operate a centrifugal pump very long under those conditions. This difficulty is met with in operating centrifugal pumps for boiler feed, viz., constant head, constant speed and a discharge running from zero to maximum. Under these conditions the wear and tear on a centrifugal is high on account of the low efficiency under low discharge, in many cases causing considerable noise. In filtration there is one advantage of a centrifugal pump over a displacement pump. It is that a centrifugal pump, on account of its non-pulsating suction, can draw water direct from the filter without injuring the sand bed or affecting filtration. On the other hand, a displacement pump under the same conditions will injure the sand bed, affect filtration and draw sand into the suction.

Chap. 12 on pump-testing is a valuable one. Chap. 13 is on costs. In Canada allowance would have to be made on account of local conditions.

On applications of centrifugal pumps one would wish a little fuller description of deep-well centrifugal pumps. If the pump is efficient it is capable of very wide use.

The seeming simplicity of the centrifugal pump has led many engineers into errors as to its use. This book, with its explanation of the physical laws involved in the operation and construction of the centrifugal pump will tend to correct those errors, increase efficiency and extend the use of this type of pump.

Engineering Economics. By J. C. L. Fish. Published by McGraw-Hill Book Co., New York. First edition, 1915. 217 pages, 10 tables, size 6x9 ins., cloth. Price, $2.00 net.

(Reviewed by J. M. Gibson, B.A.Sc., Department of Street Cleaning, City of Toronto.)

The book is prepared as a textbook for students of the economic principles to be considered before proceeding with the design of structures. The early part defines the various terms used throughout the book, followed by interest and sinking fund formulae.

The author then deals with conditions affecting the first cost of a structure, the items entering into the calculation, and contingencies to be provided for. Under "Salvage Value" he treats the conditions affecting the "scrap" value of a structure, and compares five methods of calculating depreciation, followed by a summary to obtain yearly cost of service. The chapter on Estimating is an outstanding feature of the book. The author outlines methods of obtaining a close result which will prove a valuable guide to the engineer. In conclusion, he works out numerous examples in economic selections, which clearly illustrate the principles set forth in the work.

In appendices, he gives a bibliography of works published on this, and allied subjects, and one of particular value is a tabulation of the depreciation rates and life tables of materials entering into structures of all classes. The book on the whole warrants the attention of engineers in laying out work on a comprehensive scale.

PUBLICATIONS RECEIVED.

Canadian Society of Civil Engineers.—Vol. 28, Part II., Transactions, October to December, 1914. 303 pages, illustrated, size 6x9 ins.

Sewage Disposal, Fitchburg, Mass.—The 8th and 9th semi-annual reports (1914) of the Sewage Disposal Commission, City of Fitchburg, Mass.

Clay and Shale Deposits of the Western Provinces.—By H. Ries and J. Keele. Memoirs No. 65 and 66 of the Geological Survey, Department of Mines.

Chemical and Biological Survey of the Waters of Illinois.—University of Illinois Bulletin. Prepared by Edward Bartow. 478 pp.; illustrated; 6x9 ins.; paper.

Mineral Production of Canada, 1913.—Annual report of John McLeish, B.A., chief of the division of mineral resources and statistics, Dept. of Mines. 363 pp.; 6x9 ins.

Clay Deposits Near McMurray, Alta.—A 16-page report, prepared by Sydney C. Ells, B.Sc., for the Mines Branch, Department of Mines, giving location and results of tests of many clay samples.

Moose Mountain District, Southern Alberta.—Memoir 61, Geological Survey, Department of Mines. Prepared by D. D. Cairns, relating to coals, natural gas and oil, general and descriptive geology, etc. 62 pp. with maps.

Trinidad and Bermudez Lake Asphalts.—By Clifford Richardson. Issued by Barber Asphalt Paving Co., Philadelphia. A 29-page illustrated booklet describing the source and nature of these asphalts and their use in highway construction.

Lands, Forests and Mines, Ontario.—Report of Minister for year ending October 31st, 1914, containing reports of surveyors, park superintendents, etc., and the report also of J. F. Whitson on the construction of roads in Northern Ontario.

Metallurgical Treatment of Low Grade and Complex Ores of Utah.—A preliminary report, U.S. Bureau of Mines, dealing with the problem of Utah's low grade ore; situation and extent; chemical characteristics and metallurgical treatment. 39 pp.

Investigation of the Peat Bogs and the Peat Industry of Canada, 1911-1912.—By A. B. Anrep, Mines Branch, Department of Mines. This bulletin covers detailed examination of nine peat bogs in Quebec and preliminary investigation of several near Sudbury and Sellwood in Ontario. Fully illustrated with photos, maps and drawings.

Hydro-Electric Power Commission (Ontario).—7th annual report for year ended October 31st, 1914, dealing with the construction and operation of the transmission systems; details of municipal service and contemplated projects, and hydraulic investigation and construction. 432 pp.; 6x9 ins.; fully illustrated with charts, photos and maps.

The Condensation of Gasoline from Natural Gas.—By G. A. Burrel and others. U.S. Bureau of Mines, Bulletin 88. It deals with the occurrence of oil and gas; the production of gasoline in various parts of the United States; chemistry of natural gas; testing for gasoline; plant methods; equipment, etc.

An Extension of the Dewey Decimal System of Classification Applied to Engineering Industries.—A revised edition of Bulletin No. 9, Engineering Experiment Station, University of Illinois. It explains the decimal system, its uses and advantages and gives a full classification and relative index with its variations and modifications. 117 pp.; 6x9 ins. Price, 50c.

National Domain in Canada and Its Proper Conservation.—By Dr. Frank D. Adams, McGill University. His presidential address before the Royal Society of Canada, 1914. It gives a general statement concerning the physical features and natural resources, and further statements respecting agriculture, forest products, water powers, mines and minerals, fisheries and fur trade. 48 pp.; illustrated; 6x9 ins.

Willans & Robinson, Limited, Rugby, Eng.—39th annual report presented at general meeting of the company on May 6th, showing net profit of about $85,300; announcing that what disturbance the war caused in their usual business had been early and largely supplanted by engagement in government service, and observing that up to April 27th about 20% of the company's male employees had joined H.M. forces.

CATALOGUES RECEIVED.

When a Fuse Blows.—A 72-page booklet issued by the Cutter Co., Philadelphia, describing I-T-E circuit breakers of various types and capacities, with illustrations of numerous installations.

Oil Engines, Diesel Type.—A 16-page illustrated bulletin issued by Canadian Allis-Chalmers, Limited, describing their oil engine, which is of the horizontal type using the open fuel injection nozzle.

Automatic Water Finders.—Leaflets issued by Edwin A. Mansfield & Co., New Brighton, Cheshire, England, relating to testimonials from users of their patent automatic water finders in the United States and Canada.

Wooden Pipe Tanks, Etc.—A 32-page illustrated catalogue issued by the Vancouver Wood Pipe and Tank Co., describing wooden pipe in service, specifications for it and the construction also of wooden tanks and silos.

Air Compressors.—Leaflets 69 and 70 of Reavell & Company, Limited, Ipswich, England, descriptive of hand, oil engine, or electrically driven air compressors for gas engine starting, motor garages, high pressure testing, etc.

Single Roll Coal Crusher.—Bulletin No. 141, issued by the Jeffrey Manufacturing Company, of Columbus, Ohio, giving views, drawings, specifications and prices of this machine designed for use in various industries, chiefly power houses, railway coaling stations, etc.

Wagon and Truck Loaders.—Bulletins Nos. 165 and 166, containing illustrations, specifications and prices of standard and heavier types of loaders for various materials, including coal, crushed stone, sand, gravel, clinker, fertilizer and ashes. Types described are portable and self-propelling.

Cranes.—A 16-page illustrated catalogue issued by Henry J. Coles, Limited, London Crane Works, Derby, England, descriptive of steam traveling, portable, stationary, stacking, shunting, gantry and other types of cranes of different sizes and capacities. Also gas and oil engine and electrically driven cranes.

Shale Bed to Road Bed.—A handsomely illustrated booklet issued by the Metropolitan Paving Brick Co., Canton, Ohio, describing the successive processes in the manufacture of paving brick, illustrating the machinery and plant involved and giving numerous views of streets where the product has given many years of service.

The Pitometer Co. announces the removal of its office from 220 Broadway to larger quarters at 25 Elm Street, New York City, corner of Duane Street. The shop formerly located at 1 West Broadway has also been removed to the new address.

VALUE OF SCIENTIFIC RESEARCH.

When the Wright brothers were experimenting with their gliders, observes C. J. Barton in "Metallurgical and Chemical Engineering," they were considered as "eccentric nuts" with a mania for flying. Nobody doubts now the future commercial value or possibilities of the aeroplane.

Henry Ford was the target for ridicule in Detroit when he was "monkeying" with his first model. A few years later when cars were pretty reliable, although considered an expensive luxury, a very prominent business man was heard to remark that they might be a toy for the rich but they would never be used for trucking or other commercial purposes.

The above well-known examples are typical of many other cases which have and will open fields of untold wealth to society. Many manufacturing institutions produce more wealth than gold mines for an equal amount of capital invested. This great earning power was made possible by the plodding research of some pioneer who single-handed had courage enough to venture out a little and match his starving along against his possible success. Then the miserly pittance that some of these same large firms give to further research work should shame their narrow grasping methods.

A prominent railroad after having been plundered time and again by financial pirates was in the receiver's hands. Then, and not till then, was an attempt made to improve the efficiency of the road. Now real road tests of the locomotives are being made by test cars placed between the locomotives and the train. The advice of the efficiency engineers will no doubt be followed and the earning power of the road will increase, the large as well as the small leaks will be stopped, and the road will get back on its feet again. Why should it be necessary for a railroad to get into a receiver's hands before steps are taken to increase the general efficiency and earning capacity of the road by employing efficiency engineers and experts to do research work?

A few of the larger concerns are spending many thousands to build and equip experimental laboratories to carry on experimental work along their particular line and find that it pays extremely well. Many others have contributed to The Mellon Institute of Industrial Research for scholarships. This manner of promoting investigation along new lines has proven very satisfactory to all concerned. For this method of providing means to carry on research work we are indebted to the foresight of the late Robert K. Duncan.

People are hunting to the farthest corners of the earth for radium-bearing ore, especially since prominent authorities claim its value in the treatment of cancer. Thousands of dollars are being spent in this search and justly so. Money carefully spent in developing new industries or in improving old ones is likewise well spent and yields a wealth to society which cannot be estimated.

A new jetty in the Bassin de l'Arsenal, in the western harbor of Alexandria, is being constructed with five reinforced concrete caissons each 20 metres (65.62 feet) long, 9 metres (29.53 feet) wide over all, two being 5.40 metres (17.72 feet) high and the other three 7 metres (22.97 feet) high. The caissons were constructed on shore, run into the water on launching ways and towed into position.

COAST TO COAST

St. Polycarpe, Que.—The Glengarry and Stormont branch of the C.P.R. will be open for traffic on May 31st.

Toronto, Ont.—Work has commenced on the construction of the new trunk sewer system for the northern section of Ward 7.

Fredericton, N.B.—A preliminary survey is now being made for the construction of a connecting link of the St. John Valley Railway from Victoria Mills to Queen's Park.

Hamilton, Ont.—The Board of Trade will hold a town-planning conference on June 4th. Mr. Thomas Adams of the Commission of Conservation will be one of the speakers.

Esquimalt, B.C.—Work commenced two weeks ago on the installation of the large sewerage system in section A of the municipality, comprising over five square miles of district. It will take several months to complete this portion.

Mimico, Ont.—The council proposes to purchase its water supply from New Toronto, to construct water mains under the local improvement plan, and to instal meters. It is estimated that the village will require about 50,000 gallons per day.

Peterborough, Ont.—Walter J. Francis, C.E., of Montreal, was in town at the request of the Board of Works last week to report upon a suitable site for the location of a pumping station in connection with the sewage disposal plant.

Montreal, Que.—The city engineer of railways, Mr. G. R. MacLeod, has submitted to the Board of Control an estimate of $4,860,000 for elevating the track of the Grand Trunk Railway west of Bonaventure Station. This is $3,140,000 below the estimate of the Grand Trunk Railway Co. Some thirty streets will be affected by the track elevation.

Edmonton, Alta.—Last year an appropriation of $5,000 was made for a temporary sewage pumping station on the South Side. This station, which was partly built last year, and likely to be completed this year, is of the usual type, being equipped with vertical centrifugal pumps in duplicate, automatically started by a float operated by the rising sewage.

Brooks, Alta.—The C.P.R. aqueduct, 2 miles in length and with a working capacity of 900 cu. ft. per second, has recently been completed. It has been built to supply water to 135,000 acres of irrigable land beyond the watershed dividing the Bow and Red Deer Rivers. It has been under construction for two and a half years and cost about $650,000. In one place the aqueduct crosses a railway line and as there is not sufficient clearance for an overhead structure, the water is carried underneath the track by means of an inverted siphon.

Ottawa, Ont.—Recognizing the importance of the movement in favor of good roads throughout Canada, the Geological Survey will have several parties in the field this summer engaged in mapping deposits of materials suitable for the surfacing of roads. One party will operate in the district adjoining the Rideau River and lakes, between Ottawa and the St. Lawrence River. The party will be under the direction of Dr. L. Reinecke of the Geological Survey staff, who will have as assistants F. H. McCullough and K. A. Clarke, of Toronto. The district to be explored is not well supplied with gravels or other materials for the construction of good roads, and it will be of especial value to have those that occur there examined and mapped.

PERSONAL.

T. L. LANDERS has been appointed resident engineer at Truro, N.S., for district No. 3 of the Intercolonial Railway.

E. R. CLARKE, for a number of years a partner in the contracting firm of Clarke and Monds, has been appointed manager of the Thor Iron Works, Toronto.

L. G. IRELAND, B.A., Sc., has been appointed manager of the Brantford Street Railway in addition to the office which he has previously held as manager of the Hydro-Electric System of Brantford.

OBITUARY.

The death occurred in Toronto last week of Charles Leonard Weisner, at the age of 50 years. The deceased came to Toronto from Buffalo about ten years ago and founded the National Fireproofing Co. of Canada, Ltd., of which business he was general manager.

MOTOR TUG FOR HUDSON BAY.

The Polson Iron and Shipbuilding Co. is at present constructing at its yards in Toronto a very unique type of gasoline-motor tug, for the Hudson Bay Co. It is to be used for lightering vessels which cannot reach the docks at Fort Churchill. It is built after the manner of a submarine and is to be operated entirely from the inside, in order to cope with the heavy seas through which it is to do service. The tug is constructed of steel above the water line, and rock-elm planking below. It is 40 ft. long, 10 ft. wide and 6 ft. in depth, and will be divided into four compartments by steel water-tight bulkheads.

Four lighters, each 50 ft. long, 15 ft. wide and 6 ft. deep, with a carrying capacity of 60 tons at a speed of 7 miles an hour, are being constructed for use in connection with the tug.

A recent announcement in an English contemporary calls attention to the retirement of Mr. Edward Ellis, of Leeds, a well-known engineer of the Great Northern Railway. Mr. Ellis had been in active railroad work for over forty years, and is known to a goodly number of railway men in Canada.

A suggestive paper contributed to the annual meeting of the American Concrete Institute by Mr. N. C. Johnson dealt with microphotography as applied to the examination of concrete, with the object of obtaining better knowledge of the structure of the material itself. A fact particularly mentioned by the author was that all specimens of concrete examined by him possessed a surprisingly large quantity of unhydrated cement, a feature he attributes to the difficulty in diffusing the water completely during the process of mixing. The voids revealed by the microscope also emphasizes the importance of scientific grading and thorough mixing.

RE A.R.E.A. COMMITTEES.

In our issue of May 13th the names appear of Messrs. L. W. Baldwin, J. M. Egan, D. W. Thrower, L. A. Downs, A. S. Baldwin, D. J. Brumley, F. B. Oren, H. C. Brown, F. L. Thompson, Maro Johnson, Thos. Quigley, A. L. Davis, Wm. Vandersluis, W. G. Arn, Chas. Chandler, J. M. Johnson, E. H. Bowser, all of whom are referred to as being officers of the I.C.R. This should have been the I.C.R.R., referring to the Illinois Central and not to the Intercolonial. In addition, the names of H. R. Safford, Wm. McNab, Howard G. Kelley, T. T. Irving, A. S. Going and H. B. Stuart should have read "G.T.R." rather than "G.T.P." This is in connection with the list of Canadian railway engineers on the personnel of the various committees of the American Railway Engineering Association.

COMING MEETINGS.

NATIONAL CONFERENCE ON CITY PLANNING.—June 7-9. This year's Conference to be held in Detroit, Mich. Secretary, Flavel Shurtleff, 19 Congress Street, Boston, Mass.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—Annual meeting to be held at the Iowa State College, Ames, Iowa, June 22nd to 25th, 1915. Secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Annual meeting to be held in Atlantic City, N.J., June 22nd to 26th. Secretary, Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Annual convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Charles Warren Hunt, 220 West 57th Street, New York.

INTERNATIONAL ENGINEERING CONGRESS.—To be held in San Francisco, Cal., September 20th to 25th, 1915. Secretary, W. A. Catell, Foxcroft Building, San Francisco, Cal.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—Annual convention to be held in San Francisco, Cal., October 4th to 8th, 1915. Secretary, E. B. Burritt, 29 West 39th Street, New York.

AMERICAN FORESTRY ASSOCIATION.—Special meeting to be held on October 20th at the Panama-Pacific International Exposition, San Francisco, Cal. Secretary, P. S. Ridsdale, Washington, D.C.

Last week a number of members of the Cobalt Branch of the Canadian Mining Institute visited the Porcupine Mining Camp and spent several days looking over the mines and milling plants. This was followed by a visit to the new plant of the Abitibi Power and Paper Co. at Iroquois Falls. Among those who participated in the trip were Frank L. Culver, president, and William Moffat, mine manager of the Beaver and Temiskaming Companies; Thos. W. Finucane, of McKinley-Darragh; Charles Watson, of Nipissing Mines; Thomas Jones, of Buffalo Mines; Col. Hayes, of McIntyre and Tretheway mines; R. P. Rogers, of Coniagas, and John A. Black, of the Porcupine Power Company.