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MISSING

The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, SEPTEMBER 3rd, 1909. No. 10

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

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Present Terms of Subscription, payable in advance:

Canada and Great Britain:		United States and other Countries:	
One Year	**$3.00**	**One Year**	**$3.50**
Six Months	**1.75**	**Six Months**	**2.00**
Three Months	**1.00**	**Three Months**	**1.25**

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London Office: 225 Outer Temple Strand T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

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Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

PRINTED AT THE OFFICE OF THE MONETARY TIMES PRINTING CO., LIMITED, TORONTO, CANADA.

TORONTO, CANADA, SEPTEMBER 3, 1909.

CONTENTS OF THIS ISSUE.

THE BEHAVIOUR OF DUCTILE MATERIAL UNDER TORSIONAL STRAIN.

A very interesting paper on this subject was read at the Winnipeg meeting of the British Association for the Advancement of Science by Mr. C. E. Larard, M. I. Mech. E.

The experiments were carried on at the Northampton Institute, London, Eng., and the material used varied in size from half an inch to three inches, and consisted of Staffordshire wrought iron, mild steel, and an alloy steel containing about three per cent. nickel.

Some of the results obtained are of peculiar interest, because they are different to what was expected.

It was found that there was not, in ductile material, a well-marked yield-point for torsion as there is for tension.

It was also found that when maximum torque is reached failure takes place by shear, the shear commencing on the surface of the specimen and extending inwards.

For homogeneous materials the work done is found to be proportional to the volume, no matter what the diameter or length.

The elastic limit and the elastic resilience of material may be raised above the primary limit, which is purely an artficial one, produced by manufacturing operations, by (a) overstraining, with full recovery of elasticity to a higher limit by heat treatment at low temperatures. (b) By indefinitely long rest after overstraining. (c) By continuous stressing of material at a fairly constant load above the primary elastic limit. (d) In manufacturers' works by scientific straining with subsequent heat treatment. (e) Considering the forms of iron and steel, by the addition of a small percentage of some other element. Any one of these methods increases the ratio of elastic limit to maximum load, and the ratio of elastic resilience to the total work which has to be done on the specimen to destroy it.

A comparison of the results of the tests on wrought iron and steel shows the great superiority of steel as compared with wrought iron for shafting.

As a practical outcome of these experiments Mr. Larard drafted a set of specifications for torsion tests.

THE TELEPHONE AND ITS SERVICE.

Next week the Canadian Independent Telephone Association will meet in Toronto. The problems of the independent companies are just as vital as they ever were. The difficulty of arranging exchange of messages, long distance messages, and of maintaining a highly efficient line at low cost and without excessive capital expenditure is still a question with them.

The number of independent companies is increasing, and the number of Bell-controlled companies is also increasing.

Canada and the United States have now over 6,500,000 telephone stations, operated by 24,000 companies. The Bell system control 32 companies and 3,215,245 stations.

The telephone and its service has become such a part of our everyday and business life that we sometimes forget these companies have grown up within the last thirty years. And the end is not yet.

The number of companies and the number of new stations is growing steadily. The business is being placed upon a more permanent basis than formerly. Users and companies are co-operating, and the number of stations and miles of line are almost sure to double within the next five years.

CONSERVATION OF NATURAL RESOURCES.

The last session of the Dominion Parliament authorized the appointment of a Commission on Natural Resources. That Commission has been appointed, and its personnel will meet with general approval.

The Commission will investigate, report and make recommendations, and the chairman, Hon. Clifford Sifton, will be the administrative head, and will be expected to see to the enforcing of the Commission's wishes.

The establishing of this Commission should lead to practical and immensely valuable results. A policy of conservation and utilization of our natural resources will be worked out and a permanent organization will, under governmental direction, give continuity and purpose to these plans.

The industrial and commercial prosperity of Canada depends on the conservation and utilization of Canada's natural resources; and it is well that the matter is receiving such attention.

EDITORIAL NOTE.

The value of the mineral output of British Columbia last year showed a decline. This was expected, since the price of metal was low in 1908. The figures are: 1907, $25,882,560, and 1908, $23,851,277.

CANADIAN TELEPHONE ASSOCIATION.

The third annual convention of the Canadian Independent Telephone Association, will take place in the City Hall, Toronto, on Wednesday, September 8th next, at 10 a.m. sharp.

The programme is as follows:—10 a.m., meeting called to order; address of welcome; reports.

Papers and addresses.—Independent Telephone Situation in Canada, by F. Dagger, Dr. Demers, T. R. Mayberry, M.L.A. Is the Telephone a Natural Monopoly? by F. Dagger. Good Construction. Proper Rates for Rural Service. Collections. Independent Telephones in Railway Stations, by C. Skinner. Exchange Directory, by Dr. Doan. Reasonable Toll Connection Relations. Good Operating. Forced Physical Connection.

THE AMERICAN MUNICIPALITIES CONVENTION.

The thirteenth annual convention of the League of American Municipalities opened in the Windsor Hotel, Montreal, Aug. 25th, under the presidency of the Hon. Silas Cook, Mayor of East St. Louis, Ill. About five hundred delegates and friends were present.

In the absence, through ill health, of Mayor Payette, the visiting delegates were welcomed to Montreal by Ald. Sadler, who, during discussion, defended the city against the imputation that it has the highest taxes in America.

The president, in his address, said the people at large did not know enough about the internal workings of their own city government. His experience convinced him that the first step towards exalting municipal conditions was to take the public into the governing body's confidence.

Mr. John McVicar, the secretary, claimed that the hand of the League was shown in the improvement in municipal bookkeeping, civic annual reports and the extension of practical civil service.

Mr. Thomas J. Crittenden, Mayor of Kansas City, said he believed what was most needed was uniformity in civic affairs. He made a plea for lenient dealing with the drunkard and the youthful offender.

Dr. W. H. Atherton described the aims of the City Improvement League, which was, he said, designed to unite the efforts of all citizens seeking to make Montreal cleaner, healthier, more comfortable and more attractive. Their programme included a campaign of education, the teaching of citizenship to the young, and the formation of a federation of boys' clubs, with the view of making them realise the importance of public spirit.

PRESIDENTIAL ADDRESS.

(Continued from page 272.)

siderable risks if they think that silence is beneficial to their business interests. Even if it were true that in the earliest applications of the new system economic results had not been obtained equal to those realized in reciprocating engines which have been gradually improved during half a century, that circumstances should not be regarded as a bar to acceptance of a type of engine that admittedly possesses very great advantages in other ways, but should be regarded as an incentive to improvements that would secure greater economy of coal. The evidence available, however, does not confirm the adverse view, and those familiar with the facts do not admit its truth. One example may be cited as it affects the Canadian service. In June 1907 it was authoritatively stated that in the Allan Liner "Virginian" the reports which had been circulated respecting the excessive coal consumption were unfounded, that the vessel was making passages at speeds of 17⅝ to 17¾ knots, as against the 17 knots estimated, and the rate of coal consumption was really about 1.4 lbs. per indicated horsepower which would have been required to attain this speed if the vessel had been fitted with reciprocating engines. This result compares well with the consumption in ordinary passenger steamers running at high speeds in proportion to their dimensions, although in large cargo steamers and vessels of the intermediate type, working under much easier conditions and at very low speeds, in proportion to dimensions, lower rates of consumption may be obtained. With these latter vessels the fair comparison is the combination system and not the pure turbine type which is adapted for high speeds.

The crowning triumph of the marine steam turbine up to the present time is to be found in the great Cunard steamships "Lusitania" and "Mauretania." The passages made this year by the latter ship since she was refitted have been marvellously regular, and the 25 knots average across the Atlantic, which was the maximum contemplated in the agreement between the Government and the Cunard Company, has been continuously exceeded. As one intimately concerned with the design of the "Mauretania," who has had large experience in ship design, has made a life-long study of the laws of steamship performance, and had the honour of serving on the committee which recommended the employment of turbines in these great ships, the writer ventures to assert that equal results could not possibly have been obtained with reciprocating engines in vessels of the same form and dimensions. Contrary opinons have been expressed, but they have been either based upon incorrect data or have omitted consideration of the fact that in vessels of such great engine-power it was necessary to have time to perfect the organization of the staff in order to secure uniform conditions of stoking and steamp roduction, and to bring the "human element" into a condition which would ensure the highest degree of efficiency in working the propelling apparatus. This necessity for time and training has been illustrated again and again in the case of new types of Transatlantic steamers, including some which held the record for speed prior to the appearance of the Cunarders. In the "Lusitania" and "Mauretania" the engine-power is fully 60 per cent. greater than that of their swiftest predecessors, yet no similar allowance appears to have been thought necessary by some critics, who assumed that performances on the earlier voyages represented the maximum capabilities of the vessels. Subsequent events have shown this view to be fallacious and have justified the recommendation of the Turbine Committee and the action of the Cunard directors. Allegations made in regard to excessive coal consumption have also been disproved by experience; and in this respect the anticipations of the committee and of Mr. Parsons have been fully realized.

The marvellous regularity maintained by the "Mauretania"on a long sequence of consecutive Transatlantic passages—made under varying and in many cases very adverse conditions of wind and weather, and sea—illustrates once more, and on an unprecedented scale, the influence which large diemensions have upon the power of maintaining speed at sea. Starting from the eastward passage, beginning on February 3rd last, and taking twelve passages (westward and eastward) which followed, the average speed for the thirteen passages, approaching 40,000 sea miles in length, has been 25½ knots; the lowest average speed in the series has been 25.2 knots, the highest average speed 25.88 knots. Many of the winter passages in this series were made in winter weather against strong winds and high seas, which would have considerably reduced the speed of her predecessor, but had small influence on the "Mauretania." In many instances delays have been caused by fogs.

On seven consecutive passages made since the beginning of last May the average speed of the "Mauretania" in covering about 20,000 sea-miles has been 25.68 knots, the minimum speed for the passage having been 25.62 knots and the maximum 25.88 knots. On her contract trials, the "Mauretania" maintained an average speed of 26.04 knots for a distance somewhat exceeding 1,200 knots, the steaming time being rather less than forty-eight hours. On the passage when she averaged 25.88 knots, she ran 1,215 knots from noon on June 17 to noon on June 19 (about forty-six hours), at an average speed of 26.23 knots, and by noon on the 20th had covered 1,817 knots at an average speed of 26.18 knots for sixty-nine hours. The ship has, therefore, surpassed on service her performance on the contract trial.

In view of the foregoing facts and of others of a similar nature, it is reasonable to assume that as experience is enlarged and information is accumulated in regard to forms of propellers likely to prove most efficient in association with quick-running turbines, sensibly improved performances will be obtained. At present, in comparisons made between the efficiency of reciprocating-engined ships and turbine-engined ships, the former have the great advantage attaching to long use and extended experiment; but this is not a permanent advantage, and it may be expected that good as the position is to which the marine steam turbine has attained in the brief period it has been in practical use, that position will be gradually improved. Whether or not other forms of propelling apparatus in their turn will surpass the steam turbine it would be unwise to predict. Internal combustion engines are regarded in some quarters as dangerous and probably successful rivals to steam turbines in the near future. Within certain limts of size, internal combustion engines no doubt answer admirably; but as dimensions and individual power of the engines are increased, the difficulties to be overcome also rapidly increase, and the fact is fully recognized by those having the best knowledge of those types of prime movers. On the whole, therefore, it seems probable that the turbine will not soon be displaced, whatever may happen eventually.

All branches of engineering have been and will be drawn upon freely in the execution of this great task. Mining and metallurgy assist by the production of materials of construction; mechanical and electrical engineers contribute machines and appliances required in shipyards and engine factories, as well as guns, gun-mountings, and mechanical apparatus of all kinds required in modern warships in order to supplement and economize manual power; marine engineers design and construct the propelling apparatus, and constantly endeavour to reduce the proportion of weight and space to power developed; naval architects design and build the ships; constructional engineers are occupied in the provision of docks, harbours, and bases adapted to the requirements of the fleet; and other branches of engineering play important, if less prominent parts. The progress of invention and discovery is increasing, rapid changes occur unceasingly, the outlay is enormous, the task is never ending, but its performance is essential to the continued well-being of the Empire, and it must and will be performed.

PERSONAL.

MR. T. A. FRANCOMBE of Windsor, has received the appointment as chief engineer of the Gilchrist Transportation Company, who maintain and operate the largest fleet of boats on the great lakes, next to the United States Steel Corporation. Mr. Francombe has been with the Gilchrist Line for ten years.

MR. WYN MEREDITH, an electrical engineer of high repute, who supervised the construction of the Coquitlam dam and the big power plant at Lake Buntzen, has arrived in Victoria, having been engaged by the B. C. Electric Railway & Lighting Company to construct their contemplated works at Jordan river.

MR. R. R. KELLY, M. Can. Soc. C.E., and formerly city engineer of Edmonton, Alta., has been appointed Professor of Electric Engineering in the Nova Scotia Technical College, Halifax.

MR. C. H. MITCHELL, of Messrs. C. H. and P. H. Mitchell, consulting engineers, Toronto, has just left for Prince Albert, Sask., where he will report on a power plant.

MR. J. A. McLARDY, St. Thomas, Ont., for some years trainmaster of the G.T.R.-Wabash, has been appointed trainmaster of the G.T.R. at Stratford, to succeed Trainmaster Bowker, going to London as superintendent.

FREE ENGINEERING ADVICE.

Sir,—Most municipal engineers spend a great deal of time in answering enquiries on engineering subjects. The following reply might be considered as a standard but it would be interesting to know the opinion of other engineers on this question.

Yours,

T. S. Scott.

Toronto, September, 1909.

Dear Sir,—I have your recent enquiry, and am sorry to say that similar enquiries are so numerous that I have recently decided that my department will furnish information as a matter of professional courtesy to properly accredited engineers, and to them only.

I find that in many cases gratuitous information is used either to confute local engineers under quite different local conditions, or to altogether avoid paying for the services of local engineers.

Visiting or corresponding engineers will be treated with every courtesy and information gladly given. Other enquirers will, in future, be answered on the written understanding that services are to be paid for and a professional estimate or opinion will be furnished when asked for on that basis. It should be remembered that my time and that of my subordinates, in office hours, belongs to the City of ..... and not to other municipalities. Our time after office hours we are entitled to devote, within certain limits, to outside professional work, but feel that engineering advice should be paid for in quite the same way as legal and medical advice.

Yours truly,

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Aug. 28 1909	EARNINGS Week of Aug. 28 1908	STOCK QUOTATIONS TORONTO Price Aug. 27 '08	TORONTO Price Aug. 20 '09	TORONTO Price Aug. 27 '09	TORONTO Sales Week End'd Aug27	MONTREAL Price Aug 27 '08	MONTREAL Price Aug. 20 '09	MONTREAL Price Aug. 27 '09	MONTREAL Sales Week End'd Aug27
Canadian Pacific Railway	8,920.6	$150,000	$100	....	....	177	....	184¼	350	176¾ 176½	....	186 185	930
Canadian Northern Railway	2,986.9	....	....	....	....	....	....	....	....	....	....	....	....
*Grand Trunk Railway	3,536	226,000	100	....	....	....	*1st. pref. 107½, 3rd pref. 58⅞, ordinary 24¾					....	....
T. & N. O.	334	(Gov. Road)	....	....	....	....	....	....	....	....	....	....	....
Montreal Street Railway	138.3	18,000	100	80.013	71,335	....	....	....	....	180 178½	....	213 212½	30
Toronto Street Railway	114	8,000	100	77,434	68,556	....	....	124½ 123	88	105½ 105	....	124⅜ 124	229
Winnipeg Electric	70	6,000	100	....	....	167 165½	....	190 187	2	....	....	186	....

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

STEAM RAILWAY EARNINGS.

At the time of going to press, the earnings of the steam railroads for the last week in August are not to hand, as the figures for the last day have to be included. They will be published in our next issue.

RAILWAY EARNINGS.

Total gross earnings of United States railroads reporting for the three weeks of August, are $17,186,996, an increase of 10.8 per cent, over last year and a loss of only 1.4 per cent. compared with the corresponding period in 1907. Considerable gains are reported by a number of roads over a year ago, and the small loss compared with 1907 shows how nearly railroad traffic is back to normal. In the following table is given earnings of United States roads reporting for the three weeks of August and the same roads for a like period in July; also the more complete reports for July and the two preceding months.

	Gross Earnings 1909.	Gain.	Per Cent.
August, 3 weeks	$17,186,996	$1,669,364	10.8
July, 3 weeks	19,909,497	979,028	5.2
July	51,929,280	4,248,856	8.9
June	53,640,787	5,695,673	11.9
May	52,641,574	6,934,543	15.2

Total gross earnings of United States roads included in the classified statement for July, are $51,929,280, an increase of 8.9 per cent. over last year. All classes of roads contribute to the increase, Eastern Trunk lines and other Eastern roads showing considerable gains. The statement is printed below:—

July—	Gross Earnings 1909.	Gain.	Per Cent.
Trunk East	$ 6,950,872	$1,228,767	21.4
Trunk, West	5,707,005	308,914	5.7
Other Eastern	823,510	150,881	22.1
Central West	6,264,183	294,905	4.9
Granger	1,711,950	133,151	8.4
Southern	13,324,467	586,344	4.8
Southwestern	17,147,293	1,545,894	9.9
United States roads	$51,929,280	$4,248,856	8.9
Canadian	7,004,000	808,000	13.0
Mexican	4,422,621	209,000	4.9
Total	$63,355,901	$5,265,856	9.1

—Dun's Review.

MONTREAL STREET RAILWAY

Month of July.

	1909.	1908.	Increase. Amount.	Increase. P.C.
Passenger earn.	$334,237.57	$313,353.20	$20,884.37	6.66
Miscell'ous earn.	11,335.99	13,171.19	*1,835.20	*13.93
Total earn.	$345,573.56	$326,524.59	$19,049.17	5.84
Operating exp'es	180,412.11	162,413.90	17,998.21	11.08
Net earn.	$165,161.45	$164,110.49	$ 1,050.96	.64
Total chrgs.	$ 49,883.51	$ 49,344.99	$ 538.52	1.09
Exp's % of earn.	52.21	49.74	....	2.47

October 1st to date—ten months.

	1909.	1908.	Increase. Amount.	Increase. P.C.
Passenger earn.	$3,064,270.17	$2,939,601.00	$124,669.17	4.24
Miscell'us earn.	73,276.66	59,686.92	13,589.74	22.77
Total earn.	3,137,546.83	$2,999,287.92	$138,258.91	4.61
Operating exp's	1,894,815.41	1,814,428.44	80,386.97	4.43
Net earn.	$1,242,731.42	$1,184,859.48	$ 57,871.94	4.88
Total chrgs.	$ 359,774.71	$ 368,908.56	*$9,133.85	*2.48
Exp's % of earn.	60.39	60.50	....	*.11

*Decrease.

C. P. R.'S NET GAIN MONTH OF JULY

Canadian Pacific Railway Company's statement of earnings and expenses for the month of July:

Gross earnings	$7,140,029.93
Working expenses	4,660,159.20
Net profits	$2,479,870.73

In July, 1908, the net profits were $2,274,573.25. The gain in net profits over the same period last year is, therefore, for July, $205,297.48.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

TORONTO.—The freight yards of the G.T.R. have been moved from York to Mimico, 13 miles, with the object of saving time and equalizing the work as it affects employees.

Alberta.

CALGARY.—Fourth avenue is being torn up preparatory to having the rails for the street railway laid from Centre street to 4th street east.

CALGARY.—The C.N.R. and the G.T.P. are having a speed contest in the line of railway construction from the main line of both railroads to Calgary. Seventy-five miles of railroad grading completed within six weeks of the day of starting is the record of the contractors on the Vegreville to Calgary branch of the C.N.R. The steel has been laid to within half a mile of Ryley where work had to temporarily cease owing to lack of rails at that point. The graders are hard at work between Ryley and the Battle River which is six miles south of Camrose. South of the river the most of the work is done for thirty miles and a few days will see all the gaps closed up to within twenty miles of Stettler.

EDMONTON.—The C.P.R. have proposed that the city unite with the railway in the construction of a combined traffic and railway bridge over the river at a cost of $1,428,793. A railway bridge alone would cost $842,727. The structure exclusive of approaches, would be 2,687 feet long, 25 feet wide, and 2,953 feet above water level.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

SEWAGE DISPOSAL.

Removal of Putrescibility.

With reference to the cost of land intermittent filtration, this necessarily varies considerably, depending on many local conditions. The cost of the land, the suitability of the grade are chief factors. The* Royal Commission have to say: "Assuming that really suitable land can be purchased at $500 per acre, land treatment of sewage is probably cheaper than artificial biological filtration, but when the soil is not suitable and on which only a comparatively small volume of sewage can be treated per acre, the cost of land treatment would probably be greater than most of the artificial processes." The Commission give the following comparative figures of cost, comparing cheap suitable land filtration with percolating biological filtration: Intermittent filtration with little cropping at $0.14 per head of population drained as against $0.25 for percolating biological filters. In Germany the cost of land treatment varies from $40 to $150 per acre, viz., for preparing and laying out the land and tank construction works. The total cost for preparing the land at the Berlin and Breslau farms, however, ran to $200 per acre. The Framingham, Mass., works cost at the rate of $600 per acre, utilized apart from pumping plant; while the Brooklin works cost at the rate of $470 per acre utilized.

Referring again to the Royal Commission some instructive figures are given of the cost of land intermittent filtration, assuming a good soil and little cropping subservient to purification.

Total area of land required to treat a dry weather flow of one million gallons at the rate of an acre to each 25,000 gallons:

Forty acres of land at $500 per acre........	$20,000
Five acres for sludge disposal, per acre....	2,500
Cost of laying out land, including levelling, grading, underdrains, carriers, etc....	22,445
Cost of settling tanks	11,150
Total cost	$56,095

The above figures work out at a rate of $1,240 per acre.

It will at once be seen that no definite figures can be given for land intermittent filtration. It is possible at times to obtain just the kind of land suitable which is naturally so graded, that practically no levelling is required and very little work of any kind apart from laying the carriers It is in cases of the latter character that it behoves the engineer to give every consideration to the question of land treatment, before adopting any of the artificial methods, which at their very best may equal land intermittent filtration in the removal of putrescibility but cannot equal it in bacterial removal efficiency. Before closing this chapter, stress may again be laid on the great importance of the removal of as great an amount of the suspended solids as possible before the liquor is applied to the land; on this depends the continued success of the filtration and freedom from land pore clogging.

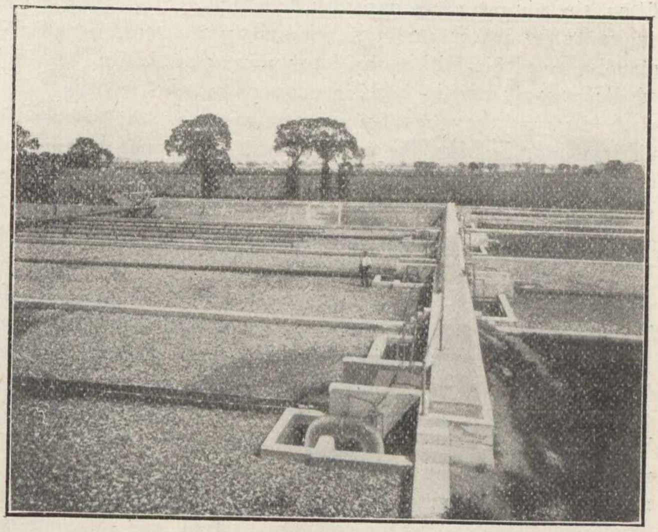
* These articles are specially prepared for this review by Mr. T. Aird Murray, Consulting Engineer, Toronto, Ont.

Chapter IV.

Contact Beds.

Having reviewed the subject of the removal of putrescibility by means of land intermittent filtration; it is now our purpose to enquire more particularly into artificial structures, which are designed to carry out the same process as that of land, but occupying much less area.

We have seen, that, in order to maintain an equilibrium between the processes of absorption, retention of organic matter and its oxidation or mineralization; that even with ideal sand land, an area is required of about one acre for every 30,000 gallons of sewage treated per day. If this rate is increased, we find, that, gradually the amount of nitrites and nitrates in the effluent decreased, showing a diminution in oxidation and consequent low degree of purification. This means the retention, in the soil pores, of undigested organic matter; which, by gradual accumulation, causes, what is termed sewage sickness in land. The only remedy is a long period of rest, breaking up the land by ploughing and allowing thorough oxidation. The original purifying power of land may thus be restored. Sewage sickness in land is, also, further accelerated by the inability of land, owing to its fine porosity, to pass off a characteristic product in sewage purification of colloidal character. These colloids are gelatinous in character; and, although they escape and are are flushed from large grain filters, are retained by land.



Croydon Bacteria Beds. Adam's & Co., (England), Automatic Syphons.

We have seen, that, areas of land equal to one acre per 30,000 gallons per day, are not easily obtained of the suitable porous character required. Allowing a water supply per head per day of 60 gallons, this means an acre for each 500 of population, or 20 acres for 10,000 people.

The inability of land to treat sewage at any other but such low rates of filtration, is mainly due to the small size of the particles of material composing the soil. We have seen that soils with a suitable effective size and uniformity co-efficient value have a water retention capacity of about 18 per cent. of the volume occupied by the soil. When the water retaining capacity is deducted from the volume occupied by the pores, we have what is termed air capacity. When a soil has a water retaining capacity almost equal to the volume of the pores, then air capacity almost ceases to exist; and purification or oxidation practically ceases to exist.

Now it must be obvious, that, the greater the effective size and uniformity coefficient value of the filter particles the less becomes the water retaining capacity in proportion to the total volume, and the greater becomes the air retaining capacity in proportion to the water retention volume.

With a low effective size and uniformity coefficient it means, that, a dose of sewage is capable of being held up by capillary attraction in every pore of the filter, and, that, practically all the air is driven out of the filter.

Now, the greater the supply of oxygen throughout a filter, the greater is its efficiency, therefore, the higher the effective size and uniformity, coefficient of the material, the greater becomes the volume of oxygen, which the filter is capable of retaining. There must, however, be practical limits to the increase in the size of the filter particles, as it has been shown that it is not only a question of oxidation (or nitrification); but, it is a question of the ability of the filter to retain and hold up, within itself, matter in suspension, as well as absorb from the sewage organic matter in solution. These matters are not oxidized even after they have been retained, or absorbed, in the space of a few minutes, or even of a day. The oxidizing process of nitrification is no sudden effect, but intricate and prolonged.

How can the difficulty be got over? We must have a filter, the air retention capacity of which is high with a consequent low water retention capacity; and yet, it must be possible to retain within the filter pores practically the whole of the organic matter both in suspension and solution, until such time as they are fully acted upon by the process of nitrification, so that the effluent will show not albuminoid ammonia but its oxidized equivalents of nitrites and nitrates.

It was very early shown that the purifying process in sewage by land was not due to any peculiarly inherent attributes of soil; nor, was the purifying process due to any plant life grown on the soil surface; as plant life has no use for the organic compounds contained in sewage until they are mineralized or oxidized. Filters composed of pebbles, stone, or, in fact, most hard material in cubes, were found to be as effective in purifying sewage as soil. The whole problem became, therefore, one of substituting some other filtering material, rather than soil; the latter providing too small an air retaining capacity in proportion to its water retaining capacity. With the water carriage system, the total amount of sewage proper as compared with the volume of water is small. By substituting a material which will retain within itself sufficient oxygen to treat the sewage and yet pass off the large volume of water at high rates is the problem of artificial treatment.

The earliest experiments in the above lines which were carried out in England were in connection with the London County Council. The Massachusetts observations and results were the basis of the experiments; which, were conducted with settled London sewage at Barking. The work was under the direction of Santo Crinip (engineer to the County Council) and Mr. Dibden (chemist). The first experiments in 1890 were conducted with four tanks giving a superficial area of 1-200 acre. The tanks were respectively filled with coke breeze, sand and gravel, stones and burnt clay of the size of peas. These tanks were filled with sewage, which was allowed to stand for eight hours, so as to give ample opportunity, as was thought, for nitrification to take place. The sewage was then drawn off, and air allowed to take its place in the filter. During the three months that these tanks were in operation, non-putrescible effluents were obtained. The results being considered, so far satisfactory; an experiment was commenced in 1892 with a larger filter, an acre in area and 3 feet 3 inches deep, of 3 feet coke breeze and 3 inches gravel on top. This filter, at first, was not a success. It was operated precisely as the smaller tanks had been, viz., an eight hours period, standing full of sewage, followed by a period for oxidation or rest. After six weeks the effluents showed a diminution of nitrates and nitrites. In fact, the filter became clogged, the sewage standing on the surface; clearly showing, that, an equilibrium between retention, absorption and oxidation had not been obtained. The filter was retaining more matter than it was capable of digesting.

Although, the above were based on the Massachusetts observations, the experiments were not analogous. Intermittency was more frequent at Massachusetts; where, in fact, the sewage was supplied in doses at periods of twenty to thirty minutes. The results, even with the preliminary experiments at Barking never equalled those made in the States. Dibben acknowledged, that, the experiments failed through lack of intermittent treatment, and, because, of a too high rate of filtration; consequently, in 1894, the filter, having recovered after a prolonged period of rest, it was again put in operation, being allowed to stand full for two hours instead of eight. Good results were now obtained. The filter, showing every promise of maintaining an equilibrium, Dibden advised the Sutton authorities, after some preliminary experiments with the sewer there, to adopt the system.

This system, first adopted in 1894 at Sutton, Surrey (England), came to be known as the Contact Bed System, because, of the period of contact allowed, during which the sewage was supposed to undergo purification. An illustration of these beds is given in our issue of August 6th. The beds were alternately filled with and emptied of sewage. The filtering material was composed of coke breeze on the same principle as the London experimental filter. The sewage was successfully treated at a rate of 750,000 gallons per acre per day, with the result, that an oxygen absorbed efficiency of 86.5 per cent. reduction was obtained; the effluents being rendered non-putrescible.

Sutton abandoned, altogether, chemical treatment, and land filtration; and many other towns commenced to follow its example. It was calculated at Sutton, that, 77 tons of sludge were retained in seventy-six days by the biological contact beds, and it was believed, that, this sludge was changed to gas and water and harmless mineral salts.

Contact beds were accepted, for the time, as the final solution to the sewage disposal question. It was argued, on every hand, that, these beds provided perfect homes or workshops in which the nitrifying organisms could carrry out and maintain their work of decomposing and changing the chemical organic combinations in sewage liable to putrescibility. Instead of an acre of ideal land (perhaps impossible to obtain) treating sewage at the rate of 30,000 gallons per day, here was an acre of filter, which could be constructed anywhere, independently of the porosity of the land, capable of treating 750,000 gallons per day, or at twenty-five times the rate on land.

At first, it was the custom to measure contact beds, with reference to rate of treatment, by their superficial area; now, however, all artificial biological methods of filtration are generally measured by their cubic capacity. With land, it was a question of acreage, with tanks enclosing the filtering material at certain depths, lengths and breadths, it is a question of capacity. Accordingly, the Fifth Report of the Royal Commission on Sewage Disposal have departed from the old custom and now use the cubic yard as the unit of measurement of capacity with reference to rate treatment. This applies to both contact beds and percolating filters.

At the time of (and for a considerable time after) the introduction of contact beds at Sutton, it was taken for granted that the period of contact was utilized by bacteria for breaking up the organic compounds in the sewage. The period of rest was looked upon as one of recuperation and for supplying the necessary oxygen required for nitrification. This explanation of the working of a contact bed is, however, not in accordance with recent investigation and knowledge.

It will be apparent to anyone giving a moment's consideration to the matter, in the light of newer knowledge, that, while the contact bed is standing full of sewage, conditions are provided exactly similar to those in the septic tank, and, although, a certain amount of decomposition may take place with a production of carbon dioxide just as in the septic tank, the process which takes place cannot be one of nitrification, owing to the fact, that, the oxygen which is necessary to nitrification is displaced from the filter bed by the sewage. Nitrates, and nitrites, the products of nitrification, are, however, found in the effluents. The only other conclusion possible is, that, nitrification takes place, no during the period of contact, but, during the period of rest and that with reference to sewage purification this is the most important period in the contact bed cycle. In Chapter II., dealing with the rôle of bacteria and oxygen we fully dealt with the process of absorption and oxidation as now understood. The purification effected by a contact bed is now explained as a process of absorption during the period of contact by a material filter, and further oxidation of the absorbed matters retained after the liquid is drawn off. This point is one of great significance, leading up as it does to the modern and improved form of process known as the percolating biological filter.

The Fifth Report of the Royal Commission on Sewage Disposal states, page 51, par. 99: "Our knowledge of the action of a contact bed is very incomplete, and little is known as to the manner in which the organic substances of sewage are broken down during the first stages of fermentation into carbon dioxide, ammonia, etc. The purifying agents seem to be not only bacteria, but also worms, larvae, insects, etc., and we can offer no opinion as to the respective amount of work done by each set of agents. It probably differs to some extent according to the nature of the sewage. It has been observed that at some places large numbers of worms are present, while at others, there are comparatively few. Little is known of the kind of bacteria essential for purification, or as to their mode of action, and we are not able to state whether they act chiefly during the period of contact or during the period of rest, or aeration, after the filter is emptied. Ther are grounds, however, for thinking that the resting period is the more important phase of the cycle."

"The generally accepted theory as regards nitrogenous matter seems to be that the ammonia is extracted from the liquid during the period of contact and oxidized during the period of rest, and that the resulting nitrate and nitrite are diffused through the liquid of a subsequent filling. All the ammoniacal nitrogen, however, does not appear in the effluent in the oxidized state, for there is always loss of nitrogen, as nitrogen gas during the process.

"The withdrawal of suspended and colloidal matter from the sewage during its passage through the bed appears not to be a simple mechanical effect of the material, for a matured contact bed, not clogged, will withdraw more suspended matter from the sewage than another bed similar in all other respects, but not matured."

Although it appears, that, the Royal Commission do not commit themselves to any definite theory of the purification process of contact beds, it is apparent, that, they do not give much weight to the contact period relative to the process of purification.

Professor Dibden's experiments and conclusions, published since the Commissioners report, leave little doubt that Dibden's theory on which he based the contact bed has no scientific basis.

(To be Continued.)

Erratum.—Owing to Mr. Murray being out of Toronto last week, he had no chance of going over the proofs of the last article. Attention is called to the word "now" which occurs frequently, and which is printed as "more." It will be noted that this has the effect of entirely transposing the intended meaning of several sentences.

(Ed. San Rev.)

AIDS TO NAVIGATION NEAR BELLE ISLE.*

P. E. Parent, B.A. Sc., M. Can. Soc.†

I believe there are very few of you gentlemen who have, in your travels, visited a gulf, river or lake, with the special object of studying the aids to navigation established for the benefit of mariners in particular, and the country in general.

In this paper, I shall confine myself to the works in that part of the Quebec District which begin at Portneuf, above Quebec, and terminate at Belle Isle, comprising the whole of the north coast, Anticosti Island, the Strait of Belle Isle, the western coast of Newfoundland, the group of Magdalen Islands, the North Shore of Baie de Chaleur, Gaspé Basin, Gaspé Coast, South Shore of the St. Lawrence up to Platon, Saguenay River and Lake St. John. I also wish to state that I could not possibly, this evening, enter into any technical details of construction, our time being limited. This paper will treat of general outlines and is to be considered more as a narration than a professional study.

The aids to navigation in the Quebec District, as elsewhere, consist mainly of buoys, lighthouses, fog alarms, submarine bells and wireless telegraph stations.

Buoys are generally placed in shallow water to indicate channels, entrances to harbours or isolated shoals. Spar buoys are made of long cedar posts so shaped as to allow of their receiving a certain number of weights at their lower ends, which cause them to float perpendicularly in the water when anchored. These buoys are used in minor channels or are put in place of gas buoys in the fall when these costly buoys might be damaged by ice.

Wooden buoys of a conical shape, made on the principle of a tub, with staves and hoops, are very little in use now, having been supplanted by steel buoys.

Steel buoys are made cylindrical or conical in shape, as they are designed for use on the port or starboard side of a channel, and of all sizes, according to the requierments. The most important buoys now used are gas buoys. They are made of steel, are huge in size and of special designs. In the body of these buoys a large quantity of gas is compressed if Pintsch gas is used, or they are loaded with carbide if an acetylene light is to be shown. On the top of these buoys the illuminating apparatus is installed with its complicated and delicate machinery, allowing only a limited quantity of gas, at a regulated pressure, to reach the burners at a time, and showing an occulting light when necessary. These buoys are placed to mark each side of the main channel at spots known as dangerous for ships.

The gas buoys have to be inspected quite frequently, as the slightest defect in the mechanism of the illuminating apparatus or leakage of gas may cause the extinguishing of the light, and thereby become a source of accidents. Few gas buoys have been known to work perfectly during six months without requiring a new supply of gas or carbide.

There are also enormous bell and whistling buoys that are used to mark shoals far out from land, and in localities too far away to be frequently inspected. These buoys are of steel and carry a bell or a large whistle which is operated by the swells of the sea.

Lighthouses. There is a large variety of lighthouses, but all have the same object in view: guiding the mariner through channels, harbor entrances, or as sentries indicating to him the presence of a known coast, cape, island, etc., from which the course of a vessel can be verified or a new one shaped. The general term "lighthouse" means a tower over which a lantern and illuminating apparatus are erected, the power of the illuminating apparatus alone being taken into consideration in the classification.

*Paper read before the members of the Quebec Branch of the Canadian Society of Civil Engineers, on the 19th February, 1909.

†Engineer of the Department of Marine and Fisheries for the District of Quebec.

The least important lights, as to their construction, consist of poles, at the upper extremity of which mast-anchor petroleum lamps are hoisted every night, the dioptric lenses of the lantern showing a white or red fixed light that can be seen at distances varying from five to ten miles. These poles are placed at the outer ends of wharves or on land, and sometimes in range to indicate the entrances to minor ports through rocks, boulders and shoals.

Then come lighthouse towers built either of wood, cast iron, steel, brick, stone or reinforced concrete. These towers vary in size and height, according to the elevation of the ground and the distance from which the light is to be seen at sea.

The wooden towers are either square, hexagonal or octagonal in shape, with sloping sides. The stout framing is sheathed with tongued and grooved lumber, generally covered with shingles.

The cast iron ones are circular in plan, carrying their full diameter to the top. They are built of sections bolted together and the joints made in putty.

The steel towers consist of skeletons made of angle iron with diagonal rod bracing.

towers, lanterns are built to receive the lenses, which vary in size, power and description. These lanterns are made of wood with glass panels for fixed lights of minor importance, and of cast iron or steel and copper with huge glazings when apparatus of the first, second, third or fourth order are to be placed therein. The largest lanterns measure fourteen feet in diameter by thirty-five feet in height from floor to top of roof.

The illuminating apparatus is classified into seven different grades or orders, according to their illuminating power. The following figures are only approximate and depend upon the climatic conditions, as well as upon the height of the light above the water.

Order.	Distance Seen.	Candle Power.
Hyper-radial.	70 nautical miles.	Special.
1	50 " "	3,000
2	40 " "	1,500
3	30 " "	1,200
4	20 " "	700
5	15 " "	300
6	10 " "	200
7	6 " "	100

Cast Iron Light, Cape Bauld.

Many stone and brick towers were built by the British Government under the supervision of the Trinity House, before Confederation. They have proved to be everlasting structures, requiring but a few minor repairs to keep them in good order. These towers have the shape of a frustum of a cone with bases twenty feet to thirty-five feet in diameter. The masonry walls at the level of the ground measure from five to seven feet in thickness, according to the height, and at the level of the lantern floor are about two feet thick. Within the past few years the Government of Canada has constructed, amongst others, a few reinforced concrete towers, and up to now this mode of building has given entire satisfaction. These are cylindrical in shape and measure a out ten feet in diameter with walls six to eight inches thick, varying with their height. The towers, measuring from sixty to seventy-five feet high, have been strengthened by buttresses, which improve their appearance a great deal.

In a general way, all the lighthouses are designed not only strong enough to carry the lanterns and illuminating apparatus, which sometimes weigh close on to fifteen tons, but also to stand the pressure of the winds without any vibration whatever. This is absolutely necessary for the good and steady working of the light. On the top of these

The lights are either fixed or revolving. When revolving they give flashes of short duration and eclipses of a known number of seconds. Each light has its own characteristic which makes it easy to be distinguished from others. For instance, Greenly Island shows a flash every two seconds, while Cape Norman gives a group of three flashes every thirty seconds (flashes at intervals of six seconds followed by an eclipse of seventeen seconds).

The illuminating apparatus of a revolving light generally consists of a solid cast iron pedestal carrying a basin containing mercury, a burner and mantle. The basin receives a cast iron base floating in the mercury, and this carries the dioptric lenses, which is made to revolve by huge clockwork operated by a heavy weight descending to the ground through a shaft. The basin and float are so designed as to require a comparatively small quantity of mercury (about 600 lbs.) to carry the aggregate weight of the casting and the lenses, which is 7,000 pounds for a first order installation.

In some illuminating apparatus the lenses are fixed, and a thin sheet iron diaphragm fitted to the float travels between the burners and the lenses, causing the flashes and eclipses. Such lights are called occulting.

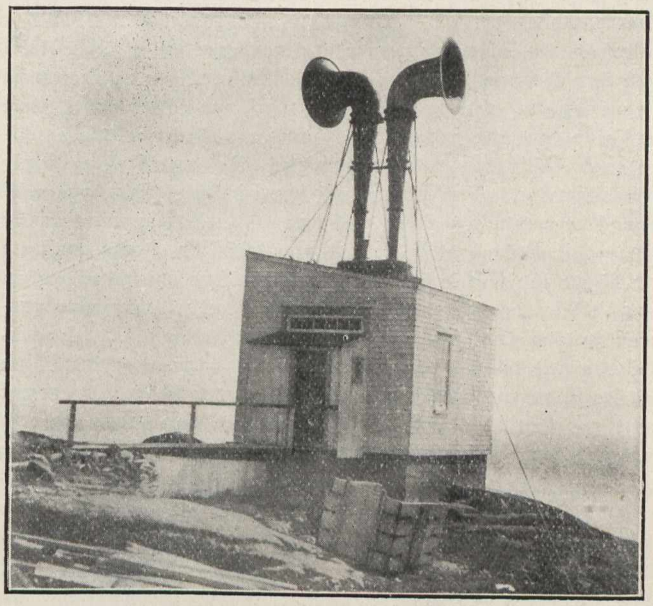
When the light is fixed, the apparatus is greatly simplified, the clockwork, basin and float being dispensed with.

The lighthouses have to be operated from early spring to late fall, and render incalculable service to navigation during clear weather, but during fog they become about useless. To obviate this, many sound signals have been tried with more or less success.

Guns, Etc. At some stations guns are fired or gun cotton cartridges exploded. When the sound is heard by a ship it indicates land at short range. These are no longer used at our principal stations. After this came the steam whistle, which gave satisfaction until a more modern fog alarm was found on the market.

Fog Alarms. The latest installations consist of machines operated by steam, oil engines or water power compressing air to a working pressure of 30 pounds in large steel tanks, from which it is conveyed to a diaphone. When the diaphones are in operation a piston of special description vibrates inside, producing a deep sound, which is amplified by a large cast iron horn or resonator placed outside of the building.

The small plants, such as established at Bicquette, Ste. Félicité, Seven Islands, Bird Rocks, etc., produce sounds that are heard three to ten miles from the station. As to the large plants, such as those of Martin River, Cape Magdalen, Fame Point, Cape Rosier, Cape Ray, Cape Anguille, Greenly Island, Point Amour, Cape Norman, Cape Bauld, Belle Isle, South-West, and Belle Isle, North-East, they emit sounds heard ten to twenty miles away, according to the atmospheric conditions of the weather and the direction of the wind.



Siren House and Resonators, Belle Isle, S. W.

Now, gentlemen, I have given you a general description of the lighthouses and fog alarms established in the Quebec District. I would consider the object I have in view far from being satisfactory if I did not describe more thoroughly a certain number of lighthouse stations.

A small ravine, decked with timber and deals, about fifteen feet above the sea, serves as a landing place at South-West Belle Isle, and has to be reached by climbing over uneven rocky steps and narrow wooden stairs secured by ring bolts. These wooden works are sometimes carried away two or three times during the same summer season by heavy seas, and are to be replaced by permanent concrete works in the near future.

From the landing wharf the road takes us to a shed where the supplies are sheltered as soon as landed, then to a building called the power house. This is where you find the air compressors, which are driven either by the water wheel or the oil engine, each fifteen H. P. strong. The Pelton water wheel is fed by a 12″ cast iron pipe, having its inlet at the discharge of a small lake on the top of the hill behind the building. The lake was dammed so as to store as much water as possible, and its level is 176 feet above the water wheel. The cast iron pipe also supplies water to cool the compressors when in operation, this being done by water circulation in a jacket around the cylinder.

The oil engine is kept as a standby in case the hydraulic plant becomes defective. Duplicate plants will be found at every fog alarm station, this being an absolute necessity to ensure an uninterrupted service.

Large tanks full of compressed air are here, but not the sirens and resonators; these are over a mile away, south. A four-inch pipe conveys the compressed air to the horn house and is laid on the ground on the border of the road.

The horn house is a building about ten feet square, in which is installed a first-order double siren, operated by compressed air, and the sounds are amplified by the two enormous funnels or resonators you see above the roof. The emission of the sounds is governed by a timing device which causes the sirens to give blasts of high and low notes alternately, thus: Low note 2½ seconds; silence 2½ seconds; high note 2½ seconds; silent interval 112½ seconds, making two blasts every two minutes. During this period, 400 cubic feet of air are used, each blast requiring 200 cubic feet. The compressor in the power house maintains the pressure in the air tanks, as it compresses one cubic foot of air per stroke, and has a speed of 200 revolutions per minute.

The individual characteristic of each fog alarm being known to all the mariners, it becomes very easy for them to locate their position as soon as they hear the sounds, and to steer their vessels accordingly.

The sirens and horns were located here so as to face the track followed by the steamers, whereas this would not be so if the plant were concentrated at the power house. On the other hand, the power house was located where it is so as to benefit by the hydraulic power and be within easy reach of the landing, the transportation of fuel, such as coal or petroleum up and down steep hills being most difficult and expensive.

The lighthouse is located on the top of the southern head, 467 feet above the sea. The tower is built of solid masonry, as well as the keeper's dwelling, which nestles alongside of it. The house is large, well lighted, thoroughly clean, in fact cosy enough to indicate the presence of an industrious wife. (Most of our lighthouse keepers are married and live at their stations with their families). From the house we reach the interior of the tower through a short covered passage, and begin to ascend the long winding stairs, which take us to the lantern floor, sixty feet above the ground. We are in a first-order French revolving light. Another short flight of stairs will take us to the level of the lenses, burner, etc., in fact in the very heart of the lighthouse. The lantern will permit the whole party to stand inside if not numbering more than twenty. Petroleum vapour is burned under a mantle and produces a blinding light of 3,000 candle power.

At night it is really dazzling to be here and watch this illuminating apparatus slowly revolve around its axis in a silence, disturbed only by the hum of the fan regulating the speed of the clockwork and the buzzing of the gas burning in the mantle. It is also most impressive to stand on the outer balcony when the air is calm, or during storms, and watch the enormous rays of light scrutinizing the horizon through the darkness, and seeming to search for lonely vessels to bid them a happy voyage or welcome their return to our waters.

Fog is very capricious; it will sometimes rest heavily on the surface of the ocean, leaving the tops of hills entirely clear; at other times float in the air in large clouds, hiding tops of mountains and lighthouses highly situated. Owing to its isolated position in the midst of the ocean Belle Isle is particularly subject to the latter phenomenon. To remedy this to a certain extent a second light was installed on a concrete foundation, 350 feet below the light we have just visited, and on the very brow of the cliff, 117 feet above the sea level. Under ordinary circumstances one of the lights can be seen, when not both.

Here are the storehouses, sheds and stables, for the keeper's use, and a little farther, this long, low building that you see, is used as the quarters of the Marconi wireless telegraph operators. These operators spend all the summer season at the station and are removed in the fall as soon as navigation closes. Their work consists of signalling and reporting vessels, transmitting messages, etc.

Besides these operators, the lighthouse keeper and his family, there is not a single human being at this end of the Island. Twelve miles north-east, at the other end of the Island, you will find another lighthouse station and a keeper living under the same conditions.

Fame Point. Old and New Light.

There are over 350 small lakes on this island, but you would see practically no vegetation. The rocky surface is covered with thick moss with occasional patches of poor soil where short brush grows. This is due, I suppose, to the shortness of the summer season and the severity of the winters. Besides this, during storms, the wind blows with such velocity and force that trees of any size would be uprooted and carried away.

Please notice that not a grain of sand is to be found; this, together with the absence of other construction materials, will explain to you the reasons why it is so costly to carry out construction work at stations such as these. Everything has to be brought here by steamers, unloaded with surf boats, hoisted on the landing platform with derricks and hauled to the place where required, over a rough road, up and down hills.

Tradesmen and laborers, with food and complete camping outfit, horses or oxen with feed, trucks, carts, etc., have also to be brought from elsewhere, and this for a space of about four months only, July to November, work being impossible before or after these months.

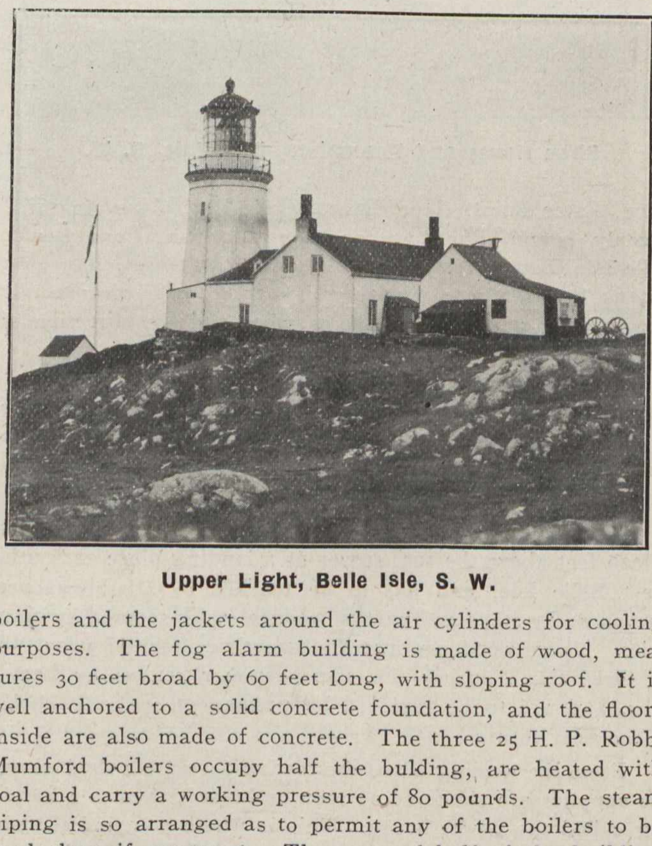
Cape Bauld is the most north-easterly point of Newfoundland, practically as much outside of communication with the rest of the world as Belle Isle. On the top of the Cape you see the lighthouse, the fog alarm building, the keeper's dwelling and dependencies, which, at a distance, show as so many white spots on a dark grey background. The lighthouse, 60 feet high, built of cast iron sections, carries a third-order revolving apparatus that dominates the surrounding peaks and boldly throws its flashes on the ocean. The fog alarm, more modest in appearance, seems to await its turn to prove its usefulness. Built on the crest of the Cape, it is always ready at a moment's notice to cry out to the ships to keep away from the rocks. The plant of this alarm, being exactly the same as those of Cape Norman, Point Amour and Greenly Island, will be described later.

At Cape Norman where the lighthouse and other buildings resemble those of Cape Bauld, the great problem is to find means of gathering a sufficient quantity of fresh water to feed the boilers of the alarm plant. This is true of many other stations.

In the rocky formation of these Capes, natural springs are very seldom found, and the only way of getting water is to store surface water in depressions of land by building concrete dams, thereby obstructing its escape. It is also found advantageous to conduct by spouts into a large cistern under the boiler-room, the water coming from the roof of the fog alarm building.

Point Amour or Forteau is 60 nautical miles from Belle Isle. The station is built on comparatively low land with a range of sloping hills to the north-west. There you will see a tower of the same style as that of Belle Isle. The Marconi telegraph office of this station is continually in direct communication with Belle Isle and Point Rich, reporting passing vessels and transmitting messages.

Greenly Island, small in size, is situated on the north side of the strait, only three cables to the west of the boundary line dividing the Canadian Labrador from Newfoundland territory. It is one of the most important fishing stations of the Gulf, cod being generally plentiful during the summer season. Newfoundland fishermen arrive in the spring and return home in the fall with the produce of their labors. This island is low and of a very peculiar shape. This island has a small bay that has a bright appearance with its long sandy beach and dozens of small white wooden houses built close to the shore. It is from here that most of the sand is loaded on the supply steamer and transported to Belle Isle, Cape Bauld, Cape Norman, Bird Rocks, etc., for concrete and masonry work. As we follow the road, we notice on the left hand side that the ground is swampy in a certain place particularly. This was taken advantage of to establish a supply of fresh water. The lowest portion of the swamp was well cleaned by removing about two feet of thick grass and sandy soil to the surface of the rock, and building a low concrete dam about 100 feet long, to prevent the free escape of water. A small lake is thus formed and fed by rain and water produced by fog that filtrates through the soil and slowly descend towards the artificial pond. A 2″ galvanized iron pipe with its inlet in the dam conducts the water for a distance of about 700 feet to a large cistern built in solid rock next to the fog alarm building. From there it is pumped into the



Upper Light, Belle Isle, S. W.

boilers and the jackets around the air cylinders for cooling purposes. The fog alarm building is made of wood, measures 30 feet broad by 60 feet long, with sloping roof. It is well anchored to a solid concrete foundation, and the floors inside are also made of concrete. The three 25 H. P. Robb-Mumford boilers occupy half the bulding, are heated with coal and carry a working pressure of 80 pounds. The steam piping is so arranged as to permit any of the boilers to be used alone if necessary. The seaward half of the building contains two large double-action compressors with steam and air cylinders measuring 10″ diameter and 12″ stroke. These machines run at a speed of about 80 revolutons per minute, each compressing 150 cubic feet of air to 30 pounds pressure during that period. The timing device is operated by a strap running on a small pulley fitted to the shaft of the fly wheels and regulates the admission of compressed air to the diaphone by means of a small wheel with cams, raising a lever that opens a valve, and this exactly in accordance with the characteristic of this plant, which calls for a blast of five seconds every minute. The horn or resonator is placed outside of the building at the gable end. It is made of cast iron ½" thick, measures four feet long, 15" at its opening and 4" at the end connected to the air pipe from the diaphone.

It must not be forgotten that generally only one boiler and one compressor are operated at a time, the others being standbys, in case something goes wrong with the parts in use.

The engineer in charge of this plant is well equipped with tools to enable him to keep the machinery in good order and execute minor repairs. He always has spare pieces on hand, such as pistons, diaphones, valves, wrought iron pipes, etc. The fuel used in the boilers is stored in a large coal shed near the landing as soon as landed, and thence carted, as wanted, to a smaller coal shed adjoining the boiler room.

At this station, the lighthouse and keeper's dwelling form but one building, with a tower rising from one of the corners. It is built of wood sheathed with shingles painted white, and stands on the highest level of this end of the island. The tower is octagonal in shape and carries a second-order dioptric illuminating apparatus, flashing every two seconds.

Greenly is not so isolated in the summer as the stations described previously, Newfoundland coasting steamers calling here about twice a month at fixed dates, and the presence of a large number of fishermen with their families and fishing outfits being a source of comfort and benefit to the keeper.

Cape Anguille station, which is 15 miles north of Cape Ray, is located about 20 feet above the sea on a large plateau bounded in the rear by a high range of mountains advancing towards the sea in the north. It was established only a few years ago to command that part of the gulf between Cape Ray and Cape George. The keeper's dwellng and fog alarm building are built of wood and resemble constructions already visited, more particularly the fog alarm which is almost a duplicate of that of Greenly Island. The remarkable feature here is the lighthouse tower, built of reinforced concrete and measuring ten feet in diameter, 90 feet in height, with walls 8" thick. It is built on a solid mass of concrete resting on shale three feet below the level of the ground. This immense column is steadied by six large flying buttresses, 1' x 4' at the base, diminishing in size as they rise up, until they measure one foot square under the flooring of the balcony. Please note that the buttresses do not form a solid body with the tower, but are only connected to it in three places. In the construction of these works, expanded metal was replaced by horizontal and vertical iron rods from ½" to 1" in diameter, well connected and tied together with wire. The winding stairs inside are also made of concrete moulded as the work progressed. The lantern floor was strengthened by two 12" I beam so placed as to carry the weight of the illuminating apparatus, which is of the third order, and weighs about four tons.

The concrete was made with the following ingredients: International cement, one measure; clean and crisp sand, two measures; four measures of broken stone with a small proportion of gravel, and sufficient fresh water to obtain a thick mortar. When the moulds were removed, the concrete surface was brushed with two coats of thin cement mortar to give it a smooth appearance.

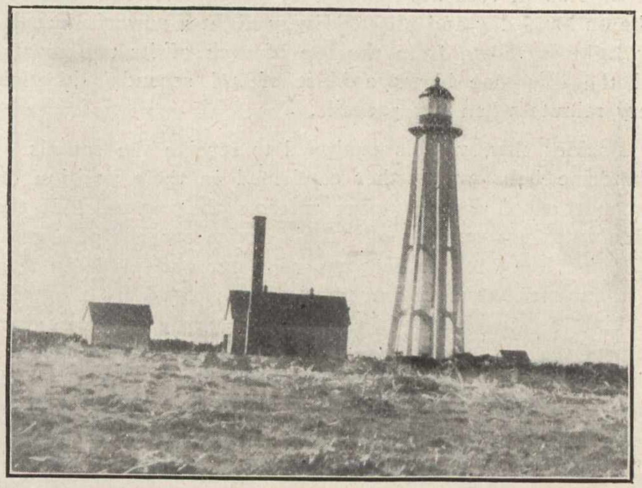
As I have said before, these towers look very well and are absolutely steady, showing no signs of vibration during wind storms, otherwise the mantles would be quickly destroyed and the mercury in the basin scattered in the lantern.

I am sure you are anxious to learn why the Government of Canada is expending money in establishing costly stations on strange land. It would seem that this should be done by our friends, the Newfoundlanders, who already possess and maintain a large number of harbour and coasting lights.

In my opinion, the present arrangement is the most equitable, Newfoundland being more interested in its coasting trade than in ocean navigation. If you glance at a chart of the gulf, you will see that the Canadian lighthouses are built mainly for the benefit of Transatlantic trade, to serve as guides to vessels sailing for or from Canadian ports.

Those who see the Bird Rocks for the first time are quite astonished to find such a small island practically lost in the middle of the gulf. Owing to its peculiar aspect I believe it will be interesting to give here a condensed extract of a report made in 1903 by Mr. J. Obalski, Mining Engineer of the Department of Lands, Mines and Fisheries, Quebec, on the geological formation of this group:

"Bird Rocks, together with the two very small peaks a quarter of a mile to the north-west, forms part of the group of the Magdalen Islands. This group consists of 13 islands of different sizes, and must have formed part of the continent at some period of their geological history, and must have been connected with Prince Edward Island, situated 50 miles to the southward. The geological formation of these islands thus presents great uniformity, and what may be said of one applies to the others. It consists of beds of



Cape Anguille Light and Fog Alarm.

grey or reddish sandstone, generally broken up and resting on the eruptive rock, which has been called diabase and dolerite, but which presents a variety of basic rocks probably of rather recent origin. The aspect of these rocks is, moreover, variable according to their more or less advanced state of decomposition. It is quite possible also that there have been several periods of eruption, or rather that an ancient eruption has been brought to light by a more recent one, which would explain the fact that compact diorite is found in the vicinity of the diabase or even the trap which, on contact with the atmospheric elements, disintegrates and decomposes, forming banks of clay of various colors. The sedimentary formation of these islands, as well as that of Prince Edward Island, had been classified by the Geological Survey in the lower carboniferous, characterized by limestones containing fossils and surmounted by the sandstone above mentioned."

This rock is about 8800 feet long and about 400 feet wide, with its shore cliff 120 feet high and almost perpendicular. All around you see natural cornices and small grottoes, inhabited by myriads of white sea birds.

When construction work began on this rock it was no small undertaking to send men to the top to haul up the materials for the erection of a derrick, which was used for many years in hoisting men and materials in connection with the building and maintenance of the station. Later, some blasting was done for the installation of an inclined railway, over which a small car is made to travel by a steam winch. At the foot of this railway a small cribwork wharf has been built to receive the materials and supplies brought in surf boats from the steamer. Alongside of this railway line are stairs that you may climb up if you are not affected by vertigo.

At the top you see the keeper's dwelling, an ordinary wooden house, requiring no special description. Then comes the lighthouse, built of wood. It was raised some fifteen feet last year, and now rests on a reinforced concrete chamber of hexagonal shape with sides 10 feet wide by 15 feet high.

Close by, on the brow of the cliff, is the fog alarm building, 30 feet square, containing the two 7-H. P. oil engines operating the two air compressors, timing device, diaphone, etc. This plant is not so powerful as those we have already visited, but gives entire satisfaction. It gives one blast of five seconds' duration during every two minutes. As at Greenly Island surface and roof water is gathered for cooling and domestic purposes.

At the east end of Anticosti Island shoal water extends far seaward and is dangerous for vessels during bad weather, when it is not always possible to discern the light. To render navigation safe in these waters a lightship, equipped with a fog alarm and a submarine bell, is anchored eight miles south-east of Heath Point light station during the season of navigation.

This small vessel is manned by a complete crew that has to be on hand day and night. Every night a powerful occulting light is shown from the top of each of its two masts, and the diaphone blows a blast of 4½ seconds' duration every minute when fog prevails.

Besides this, vessels equipped to receive the sounds of submarine bells are further confirmed in their position on the chart when their receiver informs the master that the lightship is not very far off. This device consists of a good sized bell hung in ten fathoms of water and made to ring by a hammer which is pneumatically operated by a special machine installed partly in the bell and partly in the engine-room of the lightship. Like lighthouses and fog alarms, the submarine bells have known characteristics, that is, emit definite numbered sounds divided by silences of certain duration. For instance, this lightship, being known under No. 15, rings once, is silent for 4½ seconds, then rings five times in succession at intervals of one second, and then becomes silent for 10 seconds, thus giving out its number.

All the 175 lights of the district are supplied once, when not twice, a year, with everything necessary, such as oil, fuel, and provisions of all kinds, for the proper working of the station, by the Maintenance Department of the Quebec Agency, and that the Inspector has to visit them yearly to see that the keepers do their duty in every way.

PRESIDENTIAL ADDRESS BEFORE THE ENGINEERING SECTION OF THE BRITISH ASSOCIATION AT WINNIPEG.*

By Sir W. H. White, K.C.B., Sc.D., LL.D., F.R.S.

On the present occasion, when the meetings of the British Association for the Advancement of Science are held in the heart of this great Dominion, it is natural that the proceedings of the engineering section should be largely concerned with the consideration of great engineering enterprises by means of which the resources of Canada have been and are being developed and the needs of its rapidly increasing population met. It will not be inappropriate, therefore, if the presidential address is mainly devoted to an illustration of the close connection which exists between the work of civil engineers and the foundation as well as the development of British Colonies and Dominions beyond the seas.

British colonies and possessions have started from the sea-front and have gradually pushed inland. Apart from maritime enterprise, therefore, and the possession of shipping, the British Empire could never have been created. An old English toast, once familiar but which has of late years unfortunately fallen into comparative desuetude, wished success to "Ships, Colonies and Commerce." A great truth lies behind the phrase: these three interests are interdependent, and their prosperity means much for both the Mother Country and its offspring. As colonies have been multiplied, their resources developed, and their populations increased, over-sea commerce between them and the Mother Country has been enlarged; greater demands have been made upon shipping and over-sea transport of passengers, produce and manufactures; there has been a growing necessity for free and uninterrupted communication between widely-scattered portions of the Empire, the maintenance of which has depended primarily and still depends on the possession of a supreme war-fleet, under whose protection peaceful operations of the mercantile marine can proceed in safety, unchecked by foreign interference, but ever ready to meet foreign competition.

Now that our colonies have become the homes of new nations it is as true as ever that the maintenance of British supremacy at sea in the mercantile marine and the war-fleet is essential to the continued existence and prosperity of the Empire. The trackless ocean supplies the cheapest and most convenient means of transport and intercommunication; continuous improvements in shipbuilding and marine engineering have abridged distances and given to sea-passages a regularity and certainty formerly unknown. It is a literal fact that in the British Empire the " seas but join the nations they divide." Every triumph of engineering draws closer the links which bind together its several parts. Greater facilities for frequent and rapid interchange of information of what is happening in all sections of the Empire and of knowing each other better should lead, and has led, to increased sympathy and a fuller realization of common interest in all that affects the well-being of the Empire. Within the last few years the events of the Boer War have given remarkable proofs of the practical interest of the colonies in Imperial concerns and their readiness to share its burdens. The present year will always be remembered as that in which generous offers of assistance from the colonies in the task of strengthening the Royal Navy at a critical period have led to a conference whose labors should produce important pratical results and make our future secure. Organized co-operation between the Mother Country and the Dominions beyond the seas in the maintenance of an Imperial Navy adequate for the protection of vital interests is essential to that security; and at last, there is a prospect that this end will be attained.

While claiming for the shipbuilder and marine engineer an important place in the creation and maintenance of the Empire, it is recognized that the work of other branches of civil engineering has been equally important. The profession of the civil engineer was described in the Charter granted to the parent institution in 1828 as " the art of directing the Great Sources of Power in Nature for the use and convenience of man; as the means of production and of traffic in states both for internal and external trade, as applied in the constitution of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange; and in the construction of ports, harbours, moles, breakwaters and lighthouses; and in the art of navigation by artificial power for the purposes of commerce; and in the construction and adaptation of machinery and in the drainage of cities and towns." Since this description was penned there have been great and unforeseen developments in many directions, including those relating to improvements in the use of steam, the generation and practical applications of electrical power, the manufacture and extended employment of steel. The main ideas expressed eighty years ago, however, still remain applicable to the beneficient work of the civil engineer. His skill and enter-

* Slightly abbreviated.

prise, backed by adequate financial provision, are continuously being applied to improve and extend means of production, internal and external means of communication, inland and over-sea navigation, the use of mechanical power and appliances, the acceleration and cheapening of transport, the development and utilization of natural resources, and the direction of the sources of power in nature for the use and convenience of man. One of the chief fields of engineering operations at the present time is to be found in the Dominion of Canada, whose governing authorities have appreciated the fact that bold enterprise and generous financial provision for the execution of great engineering works are essential to the progress and prosperity of the country. Its vast extent, its magnificent lakes and rivers, its agricultural and mineral riches, its forests, its unrivalled water power, and many other potential sources of future wealth and progress, furnish exceptional incentives and opportunities to the engineer. From an early period in the history of Canada this fact has been realized, and attempts have been made to utilize natural advantages; while the same policy has been energetically adopted since the Dominion was established forty-two years ago. It is impossible in this address even to enumerate the great engineering works which have been accomplished or are in process of execution; and it might be thought impertinent if the attempt were made by one who has only an outside knowledge of the facts. On the other hand, it may be of interest to illustrate by means of Canadian examples the truth of the general statement that civil engineering has exercised and must continue to exercise great influence upon the well-being and development of the British Empire.

By the kindness of the High Commissioner of Canada, Lord Strathcona—who has himself done so much for the development of the Dominion, including a great part in the construction of the Canadian Pacific Railway—the writer has been favored with official reports and statistics bearing on the subject. These have been freely used in the statement which follows:

The subject is so extensive and the time available for this address so short that it will be necessary to omit detailed reference to important applications of engineering which are necessarily made, under modern conditions, in all great centres of population. Amongst these may be mentioned building construction, sanitation, water supply, heating, lighting, telegraphy, telephony, tramways, electric generating stations and their plant, and gas manufacture. No attempt will be made to deal with the important assistance given by engineers to the operations of agriculture, mining and manufacture, or to the utilization of the splendid forests of the Dominion; although the demands for machinery and mechanical power are in these respects exceptionally great, owing to the sparseness of the population and the magnitude of the work to be done. Notwithstanding the large immigration and rapid increase of population, these demands will certainly continue and will probably become greater as the area under cultivation is increased, as manufactures are developed, and the natural resources of the country more largely utilized. The example of the United States places this anticipation beyond doubt, and demonstrates the great part which the engineer must continue to play in the development of Canada.

Even when the limitations described have been imposed upon the scope of this address the field to be traversed is a wide one; and without further preface an endeavor will be made to describe a few of the most important services which the engineer has already rendered to the Dominion and will render in the immediate future.

Railways.

It has well been said that the great problem of to-day in Canada is that of providing ample and cheap transport for her agricultural, mineral, and forest products from the interior to the sea, and so to the markets of the world. Important as inland navigation may be as an aid to this enterprise, it cannot possibly compare with railway development in actual and potential results. Apart from that development the one united Dominion must have remained a dream; thanks to the rapid and efficient intercommunication furnished by railways, widely scattered provinces are knit together in friendly and helpful union, literally by "bonds of steel" which stretch from the Atlantic to the Pacific, and reach farther and farther north each year. Regions which would otherwise have remained inaccessible and unproductive have been turned into new provinces, whose fertility and future development it is not easy to forecast, and practically impossible to exaggerate.

In this department successive administrations (both Federal and provincial) have realized the facts and possibilities of the position, and have given substantial assistance to private enterprise in the execution of great engineering works. Progress in railway development has been remarkable since Federation was accomplished forty-two years ago. During the preceding thirty years the total railway mileage in operation had been raised to 2,278 miles; in 1887 it was 12,184 miles; in 1897, 16,550 miles; in 1907, 22,452 miles. The number of miles of railway actually under construction in 1907 was officially estimated at 3,000, exclusive of lines projected but not yet under contract. In 1906, when the lines in operation were 21,353, it was estimated by competent authorities that the railways under construction, and projects for extensions likely to be carried into effect in the immediate future reached a total of at least 10,000 miles, while probable further extensions of about 3,500 miles were under consideration. Further, it was estimated that the capital expenditure required to complete these schemes would be about 60 millions sterling. These figures may need amendment, but there are others representing ascertained facts which equally well illustrate the magnitude of the railway interests of the Dominion.* The total capital invested in Canadian railways in 1907 was officially reported to be about £234,390,000; the aid given to railways up to that date by Dominion and Provincial Governments, and by municipalities, considerably exceeded £36,000,000 sterling in money; the land grants from the Dominion Government approached 32 million acres, while the Provincial Governments of Quebec, British Columbia, New Brunswick, and Nova Scotia had granted about 20½ million acres. The Governments have also guaranteed the bonds of railway companies to the extent of many millions of dollars. The capitalization per mile of railway lines owned by the Governments (amounting to 1,890 miles) is reported as being £11,400; this is practically the same amount as that for Indian railways, that for the United States being £13,600, and for New South Wales and Victoria about £12,600. For British railways the figure given is £54,700 per mile. The freight carried by Canadian railways in 1907 amounted to nearly 63,900,000 tons (of 2,000 lbs.), which included about 14,000,000 tons of coal and coke, nearly 4,500,000 tons of ores and minerals, 10,250,000 tons of lumber and other forest products, nearly 7,900,000 tons of manufactures, and 2,309,000 tons of merchandise. In 1875, when 4,800 miles of railway were in operation, the corresponding freight-tonnage was 5,670,000 tons; so that while the length of railway increased nearly 4.7 times, the tonnage increased nearly 11.3 times. During the same period passengers increased from 5,190,000 to 32,137,000. For twenty-eight railways making returns the average revenue per passenger per mile was 2.232 cents, and for the four principal railways was 2.07 cents. For freight fifty-nine railways showed an average rate of 2.328 cents per ton-mile; and for the five principal railways it was .702 cent per ton-mile. The average distance travelled by a passenger was 64 miles, the corresponding figure for the United States being 30.3 miles. The average distance a ton of freight was hauled was 183 miles, as against 132 miles for the United States. In Canada, as the official reporter remarks, there

* Most of these statistics are taken from the valuable report for 1907, presented to the Minister of Railways and Canals by Mr. Butler, Deputy Minister and Chief Engineer of the Department.

is a small amount of suburban railway traffic and a low density of population. The following table is taken from the official Canadian Railway Statistics for 1907.

	For each mile of Railway.	
	Population.	Square miles of territory.
United States	381	13.61
United Kingdom	1,821	5.29
France	1,590	8.46
New South Wales	686	146.09
New Zealand	358	43.42
Victoria	360	25.89
India	10,119	61.09
Canada	289	161.8

Canada has therefore the highest mileage measured against population, and the lowest against territory.

The earliest great railway system of Canada, the Grand Trunk, had its beginnings in 1845; in 1907 it was working about 3,600 miles within the Dominion. In association with the Government it is now engaged on the construction of the Grand Trunk Pacific Line, which will cross the continent wholly in Canadian territory, and have a length of 3,600 miles, exclusive of branches.

The story of the Canadian Pacific Railway is well known, and need not be repeated; the influence which its existence and working have had upon the prosperity of the Dominion has been enormous and beneficial since its opening in 1885, and experience of its effect has led to the promotion of other Trans-continental lines. In June, 1907 the total length in operation was nearly 9,000 miles, and the company owned in addition great lines of steamships employed on Atlantic and Pacific services.

The Canadian Northern Railway system represents one of the most striking examples of recent railway development in the Dominion. In 1907 it was working nearly 2,600 miles in the North Western provinces, about 150 miles in Ontario, 500 miles in the Province of Quebec, and 430 miles in Nova Scotia and Cape Breton, making a total of nearly 3,700 miles. In 1908 its mileage on the main system was reported to have increased to nearly 3,400 miles, and the total length in operation had become 4,800 miles. The North Western Provinces have given substantial assistance to this great system, and its promoters are said to aim at a complete Transcontinental route, as well as the development of railway communication to Hudson's Bay and the establishment of a line of steamships therefrom to Great Britain.

Besides these three great railway organizations, which in 1907 controlled about 75 per cent. of the mileage in operation, there are a large number of smaller companies, making up a total of about 80. Their total earnings in 1907 amounted to £29,350,000, the total working expenses being £20,750,000. Earnings from freight service were (in round figures) £19,000,000; from passenger service £7,837,000; from express services £655,000; from mails £325,000, the balance coming from miscellaneous items. The total number of persons employed by the railways was 124,000; their salaries and wages amounting to £11,750,000. It was officially estimated that if to the railway employees were added persons employed in factories for rolling stock and railway materials, as well as those engaged in the casual service and shipping, with an allowance for their families, ' quite 25 per cent. of the population win their daily bread from the carrying trade ' of the Dominion.

The equipment of the Canadian railways in 1907 included 3,504 locomotives, 3,642 passenger cars, and 113,514 freight cars. In the opinion of the official reporter on railway statistics, based chiefly on a comparison of the proportion of rolling stock to mileage in Canada and the United States, a considerable increase of rolling stock is required, and there is a possibility of greater efficiency being obtained in the utilization of existing freight cars. The manufacturing resources of the Dominion are declared to be fully capable of meeting all requirements, as in 1907 they produced 227 locomotives, 397 passenger cars, and 13,350 freight cars. A reduction of grades and curvatures has been carried out on the principal railways in recent years, and this has permitted the hauling of heavier loads. It is estimated that in 1907 the average earnings per ton of freight hauled were $1,472, and the average earnings per passenger carried were $1,219. The earnings per train mile were $1,953, and the working expenses $1,381. The total earnings per mile of railway were $6,535.64, and the working expenses were $4,620.9. The working expenses were divided as follows in the official report:

Maintenance of way and structures	20.13	per cent:
" equipment	20.88	"
Conducting transportation	55.25	"
General expenses	3.74	"

Allowing two cords of wood fuel to be equal to one ton, 5,609,000 tons of fuel—of which 5,578,000 tons were coal—were consumed by Canadian railway locomotives in 1907 in running 100,155,000 miles. The total cost was about £3,027,500, equal to 14.59 per cent. of the working expenses.

From this brief summary of facts some idea may be gained of the rapid development of Canadian railways, their immense capital value and traffic, and the remarkable influence they have had upon the progress and population of the Dominion. It is a matter for satisfaction that British capital and engineering skill have contributed in no small measure to produce this development, and it may be hoped that in the future they may render even greater service.

Inland Navigation.

The most important system of inland navigation which Canada possesses is primarily due to the existence of the Great Lakes and the St. Lawrence River; but the utilization of these natural advantages and the construction of a continuous navigable channel from the sea to the head of Lake Superior is due to the work of engineers. The importance of such a navigable waterway leading to the heart of the Dominion was recognized long ago by the Government. The first canal is said to have been opened in 1821, and from that time onwards the canal system has been developed, but the greatest progress has been made during the last forty years under successive administrations. Up to March 31, 1907, the capital expenditure on Canadian canals, exclusive of outlay by the Imperial Government, has approached £18,350,000 sterling, of which more than ten millions have been spent on enlargements. Besides minor canal systems, many of which are important, a great '.trunk system ' of water-transit has been created from Montreal to Port Arthur, at the head of Lake Superior, this all-water route being nearly 1,300 miles in length, having a minimum depth of 14 feet and effecting a total vertical rise of about 600 feet from tidal water in the St. Lawrence to Lake Superior. In order to effect this rise forty-nine locks are provided, most of which are 270 feet long and 45 feet wide, enabling vessels 255 feet long to be accommodated. Out of the total length of more than 1,200 miles only 73½ miles consist of artificial channels. The Welland Canal, connecting Lakes Erie and Ontario—with a total rise from lake to lake of 327 feet, effected in twenty-five locks—is 26¾ miles long. This canal dates from 1824; its enlargement to present dimensions was begun in 1872, and occupied fifteen years; the total expenditure on the canal has been nearly five and a-half millions sterling. Another important section of the waterway is the Sault Ste. Marie Canal—about 6,000 feet in length and from 142 to 150 feet wide between the pier-ends, with a lock 900 feet long, 60 feet wide, having 20¼ feet of water over the sills. The difference of level between Lakes Superior and Huron is 18 feet. Commenced in 1888, the Sault Ste. Marie Canal was opened for traffic in 1895, the cost being about £930,000.Like its predecessor on the United States' side of St. Mary's River—the so-called ' Soo ' Canal affords free passage for the ships of both countries. In 1908 about two and three-quarter millions represented the tonnage of vessels passing through the Canadian Canal, and of this total about 403,000 tons was in Canadian vessels. In 1907 the total tonnage had risen to 12,176,000 tons, of which 2,288,000 was in Canadian vessels. The Soulanges Canal is fourteen miles long, with a rise of 84 feet effected in four locks. Commenced in 1892, it was opened for traffic in 1899, and cost nearly £1,400,000. The Lachine Canal was commenced in 1821, enlarged in 1843 and 1873, and, as completed in 1901, is 8½ miles long, has 45 feet rise, effected in five locks, and has cost from first to last about £2,300,000.

In the construction of this great waterway many difficult engineering problems have been solved, and every modern improvement has been introduced; electricity has been utilized in its equipment, both for power and lighting, so that navigation can proceed by night as well as by day. For the years 1903-7 the canals were declared free of tolls; but it is estimated officially that if tolls on the ordinary scale had been collected the revenue for 1907 would have exceeded £91,000. In these five years the water-borne traffic of the Dominion increased from 9,204,000 tons in 1903 to 20,544,000 tons in 1907; in the same period the increase in Canadian railway traffic was from 47,373,000 tons to 63,866,000 tons. The official reporter justly remarks that 'these results are exceedingly encouraging.'

It was recognized long ago that the utilization of the waterways of Canada from the Great Lakes to the sea would yield considerable advantages by facilitating cheap transport of agricultural products of the fertile regions from the great North West, but the Canadian portions of that territory were then regarded as 'a great lone land.' Subsequent developments of the corn-growing regions of Canada have emphasized the value of the water route and its great potentialities. In his 'History of Merchant Shipping' (published 1876) Lindsay dwelt upon this point, and foresaw that if the waterways of Canada were made continuously navigable a struggle for supremacy in over-sea trade must arise between New York and the Canadian ports of Montreal and Quebec. This struggle is now in full force, so far as the grain trade is concerned, and it is likely to grow keener. The quantity of grain passed down the whole length of the St. Lawrence navigation to Montreal increased from about 450,000 tons in 1906 to 685,000 tons in 1907, while the quantity carried to Montreal by the Canadian Pacific Railway was about 387,000 tons for 1906 and 384,000 tons for 1907. On the other hand, the quantity carried by canals in the United States to New Pork fell from 294,500 tons in 1906 to 230,800 tons in 1907.

An important addition to the Canadian canal system has been proposed, and its execution will probably be undertaken when great works now in progress have been completed. This route extends from Georgian Bay on Lake Huron to the St. Lawrence, and would utilize Lake Nipissing as well as the French and Ottawa Rivers. The distance to be traversed would be 450 miles, less than that of the present all-water route. On the basis of careful surveys it has been estimated that a canal having 20 feet depth of water could be constructed at a cost of twelve millions sterling, upon which capital a reasonable dividend could be paid, even if the charges made for transport were one-third less than the lowest rates of freight possible on United States routes to New York. It would, of course, be most advantageous to have the available depth of water increased from 14 to 20 feet, thus making possible the employment of larger and deeper draught vessels between the lakes and Montreal. Considerable economies in the ratio of working expenses to freight earnings would be effected, break of bulk in transit to the sea would be avoided, and the cost of transport greatly reduced.

The magnitude of the grain trade and its growth may be illustrated by the following figures for recent years:—In 1897 the grain cargoes passed down the Welland Canal to the ports of Kingston and Prescott numbered 377 and represented 515,000 tons; for 1907 the corresponding figures were 518 cargoes, weighing 841,000 tons. As to the elevators and mechanical appliances for handling economically these huge quantities of grain, nothing can be said here, although they involve the solution of many difficult engineering problems and have greatly simplified and improved as experience has been gained.

The bulk of the canal traffic, of course, moves eastwards and outwards from the interior provinces. For example, of the total quantity of freight (1,604,321 tons) passed through the whole length of the Welland Canal in 1907 about 75 per cent. moved eastwards, and more than 62 per cent of the 2,100,000 tons which passed through the St. Lawrence canals moved in the same direction.

Water Power.

Canada has unrivalled resources in water power, and its extent and possible utilization have been made the subject of investigation by engineers for many years past. One of the most important memoirs on the subject was presented to the Royal Society of Canada in his presidential address of 1899 by Mr. Keefer, C.M.G. In recent times many other engineers have studied the subject and carried out important works. Exact knowledge of the total power represented by the water falls and rapids of the Dominion is not available, nor can any close estimate be made of the power which may be employed hereafter in factories, mills, or industrial processes, because profitable employment obviously depends upon commercial considerations, which must be governed largely by the localities in which water power may be found, and the cost of works and of transmission of energy to places where it can be utilized. It has been estimated that on the line from Lake Superior through the chain of lakes and rivers leading to Niagara and thence through the St. Lawrence to the sea eleven millions horse power may be developed.* Mr. Langelier has estimated that in the Province of Quebec the water power aggregates more than eighteen millions horse power; other provinces all possess large resources of the same kind as yet untouched. The most striking example of the utilisation of water power is that on the Niagara River, which the writer had the good fortune to visit in 1904, during his presidency of the institution of Civil Engineers; the works on the Canadian side were then in full progress, and at a stage which enabled one to realize completely their great difficulty and immense scale. The three companies whose works are near the Falls on the Canadian side have provided for a total ultimate development of over 400,000 horse power, and a fourth establishment lower down the river, intended chiefly for the use of Hamilton, is to develop 40,000 horse power. In the construction of the works, in the electric generating plant, the arrangements for transmitting power over long distances, and other features of importance remarkable engineering skill and daring have been displayed. American capital and enterprise have much to do with these undertakings, as they have with many other important Canadian enterprises; but it may be hoped that British capital will keep its lead and be freely employed in the development and utilisation of all the resources of the Dominion, including that magnificent asset its water power. The applications of water power are already very numerous, including not merely the creation of electrical energy and its use for lighting and power in towns and factories situated at considerable distances from the Falls, but for manufactures and industrial processes carried on near the Falls. Amongst these manufactures, that of aluminium and carbide of calcium may be mentioned, while paper and pulp mills and saw mills constitute important industries. Great advances have been made in the transmission of electrical power over long distances, and very high pressures are being used. Electric traction on railways and tramways also derives its power from the same sources, and is being rapidly developed. In 1901 there were 553 miles of electric railways, and in 1907 815 miles.

Over-sea Trade and Transport.

It was remarked at the outset that a great truth is embodied in the old toast of 'Ships, Colonies and Commerce,' and the efficient and economical transport of passengers, produce, and manufactured goods between the Dominions beyond the seas and the Mother Country is essential both for the development of colonial resources and for the continued prosperity of the United Kingdom. The British mer-

* The Times Financial Supplement, April 2, 1906, contains a valuable article on this subject, from which many of the above figures are taken.

cantile marine commands the larger portion of the carrying trade of the world; its earnings constitute a valuable item in the national income; it forms one of the strongest bonds of union between the various parts of the Empire. This general statement may be illustrated by reference to the over-sea trade of Canada and to the shipping engaged therein.

The total value of the imports and exports of the Dominion in 1898 was close upon 61 millions sterling; in 1908 it exceeded 130 millions sterling, having more than doubled within ten years. During the year ending March 31, 1908, the vessels which were entered at Canadian ports (inwards from the sea) carrying cargoes were classified as follows in the official returns:—

Ship		Tons register	Freight Carried Tons weight	Freight Carried Tons measurement	Crews
British	2603	4,539,256	1,306,822	254,373	165,078
Canadian	2,803	718,490	202,939	1,449,054	44,594
Foreign	4,132	2,211,605	1,454,787	538,499	88 093
Totals	8,284	7,016,295	2,396,915	1,740,045	295,965

The corresponding figures for ships entered outwards for sea carrying cargoes were:—

Ship		Tons register	Freight Carried Tons weight	Freight Carried Tons measurement	Crews
British	2,533	4,258,960	2,706,334	714,085	136,614
Canadian	3,557	1,041,053	616,248	291,480	45,658
Foreign	4,132	2,211,605	1,454,787	538,499	88,093
Totals	10,222	7,511,618	4,777,369	1,544,064	270,365

Taking the combined over-sea traffic inwards and outwards, is employed 18,506 ships of 14,528,000 tons, whose cargoes aggregate 7,174,000 tons dead-weight and 3,284,000 measurement tons, the crews exceeding 576,000 officers and men.

Of the 2,603 British ships entered there came from Great Britain 852 ships of 3,392,000 tons, carrying as cargoes over 860,000 tons dead-weight and 153,600 tons measurement; while there came from British Colonies 399 ships of nearly 381,000 tons, carrying cargoes of 236,000 tons dead-weight and 44,000 tons measurement. Of the 2,533 British ships entered outwards there proceeded to Great Britain 732 ships of 2,529,-000 tons, carrying cargoes of 1,635,000 tons dead-weight and 509,000 tons measurement; while there sailed for British Colonies 648 ships of nearly 400,000 tons, carrying cargoes of 259,000 tons dead-weight and 76,500 tons measurement.

It will be seen, therefore, that the British ships entered inwards carrying more than 54 per cent. of the total dead-weight cargoes and 14½ per cent. of the measurement goods, while foreign ships carried about 37 per cent. of the dead-weight and rather more than 2 per cent. of the measurement goods. British ships entered outwards carried more than 56 per cent. of the total dead-weight, and more than 46 per cent of the measurement; whereas foreign ships carried only about 30 per cent. of the dead-weight and not quite 35 per cent. of the measurement.

The trade from and to ports in the British Empire amounted to 45 per cent. of the grand total dead-weight freight; and ships carrying the British flag—excluding Canadian vessels—carried about 56 per cent. of the grand total dead-weight, and nearly 30 per cent. of the measurement goods. Including Canadian vessels, the British Empire can claim possession of 67½ per cent. of the total dead-weight, trade and 82½ per cent. of the measurement goods. The average tonnage per ship for the British was about 1,700 tons; for the Canadian vessels less than 300 tons; for the foreign ships a little more than 900 tons.

It may be interesting to add a few figures showing the magnitude of the coasting trade of the Dominion. In 1908 there arrived and departed 104,527 steamers aggregating nearly 42,857,000 tons, and 50,710 sailing ships aggregating 7,673,000 tons. The sailing ships included nearly 50,200 small schooners, sloops, barges, canal boats, etc., averaging about 150 tons each. The grand totals for the coasting trade were 155,237 ships of 50,530,000 tons, and of these 151,873 ships of 47,356,000 tons were classed as British in the official returns. It will be obvious that great importance must attach to every detail of the business involved in carrying on a shipping trade of the magnitude indicated by the foregoing figures, and still more is this the case in regard to the immensely greater transactions of British shipping considered as a whole. No pains must be spared in promoting economy or improving procedure, and even minute savings on particular items must be secured, since their aggregate effect may be of vast amount.

Since the introduction of iron for the structures of ships and of steam as the propelling power marvellous economies have been effected in the cost of over-sea transport. The chief causes contributing to this result have been (1) improvements in steam machinery, leading to great reductions in coal consumption, (2) considerable enlargements in the dimensions of ships, and (3) the supersession of iron by steel for structures and machinery. It is unnecessary, and would be impossible on this occasion, to deal in any detail with these matters, which have been illustrated repeatedly by many writers, including the speaker. On the other hand, it would be improper to leave altogether without illustration the remarkably low cost of sea transport under existing conditions, since it has great influence on the commerce of the British Empire and of the world.

Rates of freight, of course, vary greatly as the conditions of trade and the stress of competition change. At the present time these conditions remain unfavourable, although it may be hoped that there are signs of improvement, after long and severe depression. It will be preferable, therefore, to give facts for more normal circumstances, such as prevailed five or six years ago. Coal was then carried from the Tyne to London (315 miles) for 3s. 3d. a ton; to Genoa (2,388 miles) for 5s. a ton; to Bombay (6,358 miles) for 8s. 6d. a ton, including Suez Canal dues. The corresponding rates of freight were .111, .025, and .016 of a penny per ton-mile.

Grain was brought across the Atlantic for 9d. per quarter in large cargo steamers, whereas in former times, when it was carried in small vessels, the charge was 9s. 6d. Goods were carried 6,400 miles eastward via the Suez Canal in tramp steamers at an inclusive charge of 25s. to 30s. a ton, the freight rate averaging about .05 of a penny per ton-mile. It was estimated at that time that the average railway rate per ton-mile in Great Britain for cost of transport and delivery of goods was about thirty times as great; but the moderate distances travelled, local and national taxation, high terminal charges, and the immense outlay involved in the construction, equipment, and maintenance of railways account for much of the great difference in cost of transport. The ocean furnishes a free highway for the commerce of the world.

Economy of fuel-consumption has played a great part in the reduction of working expenses in steamships. Fifty years ago from four to five lbs. of coal per indicated horse-power represented good practice in marine engineering for screw steamships. At present, with quadruple expansion engines, high-steam pressures, and more efficient reciprocating engines from 1¼ to 1½ lb. is common practice, and better results are claimed in some cases. A cargo steamer of the tramp type, carrying 6,500 tons dead-weight, can cover about 265 knots in twenty-four hours in fair weather for a coal consumption of 27 tons per day, representing an expenditure on fuel of £20 to £25. A larger vessel carrying about 12,000 tons dead-weight, driven by engines of similar type, would consume about 45 tons in covering the same distance at the same speed. This increased economy in fuel per ton-mile is the result of an increase in dimensions from 365 feet length, 47 feet breadth, and 24½ feet draught of water to a length of 470 feet, breadth of 60 feet, and a draught of 27½ feet. The first cost of cargo steamers is small in relation to their carrying capacity and possible earnings; varying, of course, with the current demand for new steamships. In the present depressed condition of shipping, about £5 10s. per ton dead-weight is named as a current rate; in busy times the price may be 40 to 45 per cent. higher; even then it is small in proportion to earning power. Working expenses are kept down also by the use of efficient appliances for rapidly shipping or discharging cargoes, and so shortening the stay of ships in port. As an example a case may be mentioned when a ship of 12,000 tons dead-weight and 800,000 cubic feet measurement capacity had her full cargo discharged at an average rate of 300 tons an hour, a fresh cargo put on board at the rate of 250 tons an hour, and 1,600 tons of coal shipped between 7 a.m. on Monday and noon on the following Friday—that is, in 101 hours. In another case a cargo weighing 11,000 tons was discharged in 66 hours. "Quick dispatch" in dealing with cargo is now universally recognized as essential, and it has been asserted that a saving of one day in discharging or loading a tramp steamer when she finds full employment may involve an expense equal to 1 per cent. on her first cost.

The "intermediate" type of steamer in which large carrying capacity is combined with provision for a considerable number of passengers and moderate speed—is of comparatively recent date, but it has been developed rapidly and is subject to the universal laws to which all classes of shipping conform. Increase of size is adopted in order to favor economy in working and greater earning power, while increase in speed is made in some cases. Vessels like the "Adriatic" or "Baltic" of the White Star Line, the "Carmania" and "Caronia" of the Cunard Line, and the "George Washington" of the Hamburg American Line illustrate this statement; while its latest and greatest examples are found in the two steamers now building for the White Star Line by Messrs. Harland & Wolff, which are said to be 45,000 tons, to be intended to steam 20 to 21 knots, to provide accommodation for a great number of passengers, and to have large capacity for cargoes. In mail and passenger steamers of the highest speed increase in dimensions is devoted chiefly to provision for more powerful propelling apparatus and for a correspondingly large quantity of fuel, and the cargo-carrying capacity is relatively small; but the law of increase in size and cost is obeyed, and will be followed up to the limit, which may be fixed by the vast outlay necessary in order to provide suitable harbours and dock accommodation with an adequate depth of water, or by commercial considerations and the possibility of securing a suitable return on the large capital expenditure. Growth in dimensions of ships will not be determined by the naval architect and marine engineer finding it impossible to go further, for there are even now in view possibilities of further progress if the shipowner so desires. Invention and improvement have not reached their ultimate limits.

The wonderful progress made during the last seventy years is well illustrated by the history of shipping trading between Canada and Great Britain, and it may be of interest to recall a few of the principal facts. For a long period trade and communications were carried on by wood-built sailing ships, many of the finest being Canadian built; but at a very early period Canadians had under consideration the use of steamships. One of the first steamers to cross the Atlantic was the ".Royal William" paddle-steamer, built near Quebec in 1831. She was 160 feet long, 44 feet broad, of 363 tons burden, sailed from Quebec on August 5, 1833, and reached Gravesend on September 16, a passage of more than forty days, in the course of which sail-power was largely used. Cabot, in 1497, crossed in the good ship "Matthew," of 200 tons burden, which was probably from 90 to 100 feet in length; so that three centuries of progress had not made very great changes in size of the ships employed. Wood was still the material of construction, and sails were still used as a motive power, although the steam-engine was installed. In 1839 it was a Canadian, Samuel Cunard, who secured—in association with two British shipowners, Burns and McIver—the contract for a monthly transatlantic service from Liverpool to Halifax and Boston. The four steamers built were wood-hulled, driven by padle-wheels, had good sail-power, and were of the following dimensions: 207 feet long, 34½ broad, 1,150 tons burden, and about eight knots speed. A rapid passage to Boston then occupied about fourteen days.

Another Canadian enterprise, the Allan Line, started about fifty-six years ago. The first steamer built for the company was appropriately named the "Canadian." At the time of her construction she ranked among the most important mercantile steamers in existence, and was quite up to date. Her dimensions were: Length, 278 feet; breadth, 34 feet; burden, 1,873 tons. She had inverted direct-acting engines, driving a screw propeller, and a full sail equipment.

The Tranatlantic service to New York, as was natural, rapidly surpassed that to Canadian ports, but the latter has been continuously improved, and its development has been marked by many notable events. For example, the Allan Line was amongst the first to use steel instead of iron for hulls, and in their two largest steamers now in service, dating from 1903, they were the first to adopt steam turbines for ocean-going ships, although their lead of the Cunard Company was not long. The "Virginian" and "Victorian" are 520 feet long, 60 feet broad, of 10,750 tons, and their maximum speed is 18 knots. The Canadian Pacific Railway authorities added shipowning to their great land enterprises at an early period in their career by building for the Pacific service in 1891 three important steamers, each 456 feet long, 51 feet broad, of 5,950 tons, and 17 knots speed. These vessels continue on service, and have done splendid work as a link in the "all red" route. Since this step was taken the Canadian Pacific Railway has become possessed of a large fleet of Atlantic steamships, and quite recently has placed on the service from Liverpool to Quebec passenger steamships nearly 550 feet in length, 66 feet in breadth, of 14,200 tons, with a maximum speed of 20 knots.

The latest addition to the Canadian service has been made by the White Star Line in the form of two steamers, the "Laurentic" and "Megantic," of 15,000 tons, 550 feet long, about 67 feet broad, and 17 knots speed. In the "Laurentic" an interesting experiment has been made—Messrs. Harland & Wolff having introduced a combination of reciprocating engines and a low-pressure turbine. This system was patented as long ago as 1894 by Mr. Charles Parsons, to whom the invention of the modern steam turbine and its application to marine propulsion are due. Mr. Parsons foresaw that while the turbine system would prove superior to reciprocating engines in ships of high speed and with a high rate of revolution, there would be a possibility of getting better results by combining reciprocating engines with low-pressure turbines in ships of comparatively slow speed, where a low rate of revolution for the screw-propellers was necessary to efficient propulsion. His main object, as set forth fifteen years ago, was to "increase the power obtainable by the expansion of the steam beyond the limits possible with reciprocating engines," and subsequent investigarians led Mr. Parsons to the conclusino that it would be possible to secure an economy of 15 to 20 per cent. by using the combination system as compared with that obtainable with efficient types of reciprocating engines. Many alternative arrangements have been designed for combining reciprocating engines with low-pressure turbines; that now under trial associates twin-screw reciprocating engines, in which the expansion of the steam is carried down to a pressure of 9 to 10 lbs. per square inch when working at maximum power, and then completed to the condenser pressure in a turbine. Triple screws are employed, the central screw—driven by the turbine—running at a higher rate of revolution than the side screws, which are driven by the reciprocating engines. The "Laurentic" has been but a short time on service, and few particulars are available of her performances as compared with those of her sister ship, fitted with reciprocating engines. It has, however, been reported that the results have proved so satisfactory that the combination system will probably be adopted in the two large White Star steamers of 45,000 tons now building at Belfast. This favourable view is fully confirmed by the performances of the "Otaki," built by Messrs. Denny, of Dumbarton, for the New Zealand Shipping Company, and completed last year. That firm, as is well known, have taken a leading part in the application of the Parsons type of steam turbine to the propulsion of mercantile and passenger steamers, and they possess exceptional experience as well as special facilities for the analysis of the results of trials of steamships, having been the first private firm to establish an experimental tank for testing models of ships and propellers on the model of that designed by Mr. W. Froude and adopted by the Admiralty. Messrs. Denny have generously placed at the disposal of their fellow-shipbuilders the principal results obtained on the official trials and earliest voyages of the "Otaki," and have compared them with similar results obtained in sister ships fitted with reciprocating engines.* The "Otaki" is the first completed ship fitted with the combination system and subjected to trial on service, and as the successful application of that system to cargo steamers and steamers of the intermediate type would result in a considerable economy in the cost of oversea transport, it may be of interest to give some details of her recorded performance. She is 465 feet long, and 60 feet broad, and of 7,420 tons (gross). Her dead-weight capability is about 9,900 tons on a draught of 27 feet 6 inches, and the corresponding displacement (total weight) is 16,500 tons. The vessel was designed for a continuous sea-speed of 12 knots when fully laden, and the contract provided for a trial speed of 14 knots with 5,000 tons of dead-weight on board. The trials were accordingly made at a displacement of about 11,700 tons. Her installation of boilers is identical with that of her sister ship, the reciprocating-engined twin-screw steamer "Orari," which is 4 feet 6 inches shorter than the "Otaki," but generally of the same form. On the measured mile the "Otaki" obtained a speed of 15 knots, while the "Orari" reached 14.6 knots. In order to drive the "Orari" at 15 knots about 12 per cent. more horse-power would have been required, and this is a practical measure of the superiority of the combination system over the reciprocating twin-screw arrangement in the "Orari." The total water consumption per hour of the "Otaki" at 15 knots was 6 per cent. less than that of the "Orari" at 14.6 knots. If the "Otaki" also ran at 14.6 knots, the water consumption would have been 17 per cent. less than that of the "Orari" at the same speed. On the voyage from Liverpool to New Zealand the "Otaki" averaged about 11 knots, which would have required on the measured mile only about 40 per cent. of the power developed when running 14.6 knots. With the ship laden more deeply, the average development of power on the voyage was about one-half the maximum developed on the measured mile, and this was disadvantageous to economy in the combination. Even in these unfavourable conditions the "Otaki" realized an economy in coal consumption of 8 per cent. on the voyage from Liverpool to New Zealand and back as compared with her reciprocating-engined sister ship; this represents a saving of about 500 tons of coal. Ordinarily the ship would leave England with sufficient coal on board for the outward passage, so that 250 tons less coal need be carried and a corresponding addition could be made to cargo and freight-earning. Probably as experience is gained the actual economy will prove greater than that realized on the maiden voyage; but even as matters stand there is a substantial gain, and a prospect of the extended application of the steam turbine to vessels of moderate and low speed. In view of results already obtained, the New Zealand Shipping Company have decided to apply the combination system to another vessel just ordered from Messrs. Denny.

In designing turbine machinery for vessels of moderate or low speed there must necessarily be conflicting claims. For maximum efficiency in steam turbines a high rate of revolution is necessary; whereas at moderate or low speeds it is antagonistic to propeller efficiency to run at this high rate of revolution. Engineers are at present much occupied with the study of arrangements by means of which these conflicting claims may be harmonized and greater total efficiency of propulsion obtained. Having regard to the enormous capital invested in cargo steamers of moderate speed, and the importance attaching to their economic working as influencing the cost of oversea transport, it will be obvious that it is most desirable to find an arrangement in which the high speed of the rotor may be reduced by means of some form of gearing or its equivalent, so as to enable the screw shaft and its propeller to be run at a speed which will secure maximum propeller efficiency. Many proposals have been made, including mechanical gearing and hydraulic or electric apparatus for transforming the rate of motion. Some of these are actually undergoing experimental trials, and are said to have given very promising results. One of the most important trials is that undertaken by the Parsons Marine Steam Turbine Company, which has purchased a typical tramp steamer, and is carrying out on her a series of trials in order first to ascertain accurately what are the actual conditions of steam and coal consumption with the present reciprocating engines, and then to ascertain the corresponding facts when those engines have been removed and a steam turbine with its associated gearing has been fitted. It is interesting to note in passing that in the earliest days of screw propulsion with slow-running engines it was found necessary to adopt gearing in order to increase the rate of revolution of the propellers, whereas at present interest is centred in the converse operation. Furthermore, if any system if gearing-down proves successful it may be anticipated that its application will be extended to swift turbine-driven steamships, since it would enable good propulsive efficiency to be secured in association with rapidly running turbines of smaller size and less weight than have been employed hitherto.

* See a paper by Engineer Commander Wisnom, R.N., in the Proceedings of the Institution of Engineers and Shipbuilders in Scotland for 1909.

The Marine Steam Turbine.

The rapid development of the marine steam turbine during the last seven years constitutes one of the romances of engineering, and the magnitude of the work done and the revolution initiated by Mr. Charles Parsons will be more justly appreciated hereafter than it can be at present. In some quarters there is a tendency to deal critically with details and to disregard broader views of the situation as it stands to-day. In May 1909 there were 273 vessels built and under construction in which steam turbines of the Parsons type are employed, the total horse-power being more than three and a half millions. In the Royal Navy every new warship, from the torpedo-boat up to the largest battleships and armoured cruisers, is fitted with turbine engines; and the performances of vessels which have been tested on service have been completely satisfactory, in many instances surpassing all records for powers developed and speeds attained. In the war-fleets of the world this example is being imitated, although in some cases it was at first criticized or condemned. In the mercantile marine as a whole, while the new system has not made equal advance, many notable examples can be found of what can be accomplished by its adoption. It is now admitted that steam turbines enable higher speeds to be attained in vessels of given dimensions; and in steamers built for cross-channel and special services, where high speed is essential and coal consumption relatively unimportant, turbines have already ousted reciprocating engines. For oversea service and long voyages an impression has existed that the coal consumption of turbine-engined ships would considerably exceed those of ships driven by triple or quadruple expansion reciprocating engines. Critics have dwelt on the reticence in regard to actual rates of coal consumption practised by owners of turbine steamships. Naturally there are other reasons for reticence than those which would arise if the coal consumption were excessive; but pioneers in the use of turbine machinery may reasonably claim the right of non-publication of results or trials in the making of which they have incurred large expenditure and taken con-

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CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS.

New Brunswick.

ST. JOHN.—Tenders will be received until 3rd Sept. at noon for the placing of piles at the approaches to the west side dock of the steam ferry in the harbor, according to plans to be seen in the office of William Murdoch, city engineer.

Quebec.

RIVER BEAUDETTE.—Tenders will be received until 6th September for the erection of a steel bridge over the River Beaudette, with concrete piers. Fabrien Bissonnete, Secretary-treasurer.

THREE RIVERS.—Tenders will be received until Thursday, Sept. 16th, for supplying and installing pressure filters with a capacity of two million gallons per 24 hours. L. T. Desaulniers, Secretary-treasurer.

THREE RIVERS.—Tenders will be received up to the 16th Sept., for the construction of a reinforced concrete or iron bridge, of 16 feet wide, on Ste. Marguerite Road, to be finished before the 16th Nov. Each tenderer must furnish his plans and specifications. L. T. Desaulniers, secretary-treasurer. City Hall, Three Rivers, 28th Aug., 1909.

MONTREAL.—Tenders will be received up to noon on Tuesday, 14th September for the enlargement of the city's aqueduct, by widening and deepening the same on a length of about 27,300 feet. The work comprises about 1,176,000 cubic yards of earth excavation and about 400,000 cubic yards of rock excavation, also the formation of the slopes and banks of the widened aqueduct, the transporting to a distance of excess of excavated material, the construction of syphon culverts, the construction of dry stone wall lining in the slopes, etc., etc., the whole according to plans, cross-sections and specifications, to be obtained from George Janin, superintendent and chief engineer of the Montreal Waterworks, City Hall. (Advertised in Canadian Engineer.)

Ontario.

LEAMINGTON.—Tenders for electric wiring and fittings for the Public Building, will be received until Thursday, September 16. G. Roach, Clerk of Works, Leamington; T. A. Hastings, Clerk of Works, Customs House, Toronto. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

FENWICK.—Tenders for building public school will be received up to Friday, Sept. 10th. Plans to be seen at the office of Charles M. Borter, Niagara Falls South, Ont. B. A. Pattison, Secretary of Public School Board.

HAMILTON.—Tenders will be received up to Sept, 3rd for constructing pipe sewers, according to plans and specifications, which can be seen at the office of the city engineer. S. H. Kent, city clerk.

NIAGARA FALLS.—Tenders are being called for one thousand feet of nine-inch sewer and fourteen hundred feet of eighteen-inch sewer. J. C. Gardiner, B. A. Sc., City Engineer.

PRESCOTT.—Tenders will be received up to September 11th, 1909, for the delivery of the coal required at the lighthouse Depot, Prescott, Ont., during 2 years. The coal must be first-class bituminous screened steam coal. The quantity required will be about 1,800 tons. G. J. Desbarats, Acting Deputy Minister of Marine and Fisheries.

TOTTENHAM.—Tenders for boring and piping an artesian well will be received up to the 7th September. Separate quotations required for a 4, 6 and 8-inch pipe. A. P. Potter, Reeve.

TORONTO.—Tenders will be received until Tuesday, Sept. 7th, for 15 tons of copper conductor. (Advertised in the Canadian Engineer).

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Monday, October 4th, for erecting the Wilton Avenue Bridge. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Tuesday, 5th October, for 1,080 lengths of 16-inch cast iron pipe and 16-inch valves. Joseph Oliver, mayor. C. H. Rust, city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders are invited until Tuesday, Sept. 7th, for construction of asphalt, vitrified block, brick and bitulithic pavements, concrete curbs, concrete walks and sewers. Joseph Oliver, mayor. C. H. Rust, City Engineer.

TORONTO.—Tenders will be received up till Sept. 14th, for all the various trades required in the erection and completion of an 8-storey fireproof building on the south-east corner of King and Jordan Streets, Toronto, for the Standard Bank. Darling & Pearson, 2 Leader Lane, Toronto, architects.

THOROLD.—Tenders will be received until 5 p.m. Tuesday, September 7, 1909, for the construction of 1,290 feet of 18-inch tile sewer and all appurtenances. D. J. C. Munro, Town Clerk. Norman D. Wilson, Engineer, Logan Building, Niagara Falls, Ont.

VICTORIA HARBOR.—Tenders will be received up to September 7 for the brick work on the power house at the C.P.R. elevator, amounting to about 325,000 brick. All material and water will be furnished by the Company. Contractors to furnish labor only. John S. Metcalfe Co., Victoria Harbor, will furnish plans and specifications.

WHITNEY.—Tenders will be received until Wednesday, September 8th, for the erection of a steel bridge on stone abutments across the Madawaska River. H. F. McNaughten, Secretary Department Public Works, Toronto.

Saskatchewan.

HANLEY.—Tenders will be received for the construction of about 25 miles of metallic circuit, rural telephone line in the Hanley district, to be constructed as soon as possible. Hanley Rural Telephone Co., W. E. Hall, secretary.

SASKATOON.—Tenders will be received until Wednesday, September 22nd, for the construction of a subway under the tracks of the C.N. Ry. here. Geo. T. Clark, City Engineer. J. H. Trusdale, City Clerk. (Advertised in The Canadian Engineer).

MOOSEJAW.—Tenders will be received until Monday, Sept. 6, for 1—72" x 20' Robb-Mumford Boiler, complete with smoke connection, containing 161—3" tubes. 2—66" x 14' Water Tube Boilers each with 72—3½" tubes. 1—D. D. Pemberthy Injector. 1—Small Boiler Feed Pump. John D. Simpson, City Clerk. J. Darlington Whitmore, City Engineer.

British Columbia.

CRANBROOK.—Tenders will be received by the Cranbrook Electric Light Co. for (1) boilers, (2) engines and (3) electrical equipment generally.

VANCOUVER.—Tenders will be received up to Monday, September 6th, for grading and bridging of the Alberni branch of the Esquimalt and Nanaimo Railway Company from the 108th mile to Alberni (27½ miles). See Mr. Bainbridge, Division Engineer E. & N. Railway, Victoria; Mr. H. J. Cambie, Chief Engineer, E. & N. Railway, Vancouver, for plans, etc. R. Marpole, vice-president.

VICTORIA.—Tenders are invited until September 15 for the supply of about nine hundred tons of cast iron socket pipes and special castings. T. Lubbe, secretary, Esquimalt Waterworks Company.

NEW WESTMINSTER.—Tenders will be received by the Hon. the Minister of Public Works up to 11th September, for the erection and completion of a new highway floor system over the bridge across the Fraser River. F. C. Gamble, Public Works Engineer, Public Works Department, Victoria.

CONTRACTS AWARDED.

New Brunswick.

ST. STEPHEN.—Hon. John Morrissy has awarded the contract for the Maxwell Crossing bridge at St. Stephen to Frank L. Boone, of Gibson, the contract price being about $1,600.

Ontario.

BADEN.—The Hamilton Bridge Co. have secured a contract at $2,297, for the erection of a new steel bridge, abutments, arch culvert, etc.

BERLIN.—The Berlin Light Commission held a meeting on Friday, at which the tenders for machinery necessary for the distribution of Niagara power were received from the Canadian General Electric Co., Toronto, the Canadian Westinghouse Co., Hamilton, the Bullock Electric Co., Buffalo; the Canadian Fairbanks Co., Montreal, and the Western Electric Co., Chicago. After a careful comparison, it was found that the figures of the Canadian General Electric Co., and the Westinghouse Co., were the lowest and the Commission decided to accept the lowest tender for each of the items in the specifications. The tenders were divided as follows:—No. 1, Rotary Converter, three transformers and switchboard—Canadian Westinghouse Co., $5,748. No. 2, 3 transformers, 100 k. w., Canadian General Co., $2,760. No. 2, 3 transformers, 150 k. w., Canadian Westinghouse Co., $2,748. No. 4 and 5, Switchboard panel, Canadian General Electric Co., $1,118. No. 6, 7 and 8, Frequency changer set and switchboard, $7,400. No. 9, Switchboard, Canadian Westinghouse Co., $595. No. 10, 3 transformers, 200 k. w., Canadian General Co., $927.60. All the machinery must be shipped to Berlin and ready to be installed inside of four months.

COBALT.—The contract for cast iron pipe and special castings has been awarded to the Canada Foundry, at $7.842.40; for steel stand pipe to the Canada Foundry at $2,540.00; for vitrified tile pipe and junctions to the Toronto Sewer Pipe Co., for $1,800.00; cast iron manhole covers to the London Foundry Co., at $526.50, and the contract for labor and certain materials for the construction of waterworks and sewers to Wm. Newman & Co., Winnipeg, Man., at $38,584.10

LINDSAY.—Mr. William Henley will make proposed alterations to the Collegiate Institute for $13,960.

NIAGARA FALLS.—The Westrumite Co., of Brantford, Ont., have been awarded the contract for 4,000 sq. yds. of paving at $2.20 per sq. yd. and 2,800 lineal feet gutter, at 55 cents per lineal foot. J. C. Gardner, B. A. Sc., City Engineer.

TORONTO.—The contract for a reinforced concrete bridge over the Humber River between Purpleville and Kleinburg, has been awarded by the Vaughan Council to Contractor Hicks, at $3,600. The structure will be 16 feet above the water and will have a span of 50 feet. Mr. Frank Barber, York County Engineer, Toronto, prepared the plans.

British Columbia.

VICTORIA.—A recent meeting of the city council the purchasing agent and the water commissioner submitted a report on the tenders recently received for gate valves and cast-iron pipe. In connection with the offer of J. H. B. Rickaby, for Mannesman weldless steel tubes, a committee will pass on the merits of this particular tender. The tender for valves will be awarded to A. J. Forsyth & Co., of Vancouver, at $2,759.50. The lowest tender for cast-iron pipe was that of R. Angus, at $48,969, and for pig lead, Robertson, Godson & Co., at 3.45 per pound. Mr. Rickaby's tender for the same quality of cast-iron pipe was $9,394 less than Mr. Angus', while the weight of the tubes is 483 tons, compared with 1,346 tons of the cast-iron pipe. Here are tenders for cast-iron pipe: R. P. Rithet & Co., $50,930; W. G. Winterburn, $49,892; Stavely Coal & Iron Co., $49,592; Robertson, Godson & Co., Vancouver, $50,131; A. Rickaby, $44,190; Robert Ward & Co., $51,191; R. Angus, $48,969; Findlay, Durham & Brodie, $51,776; M. & L. Samuel Benjamin Company, $54,381.

LIGHT, HEAT, AND POWER

Ontario.

GOW GANDA.—The first electric light plant at Gow Ganda will be ready in a few days on the Bartlett Mines. thus enabling it to operate its staff in two shifts, night and day.

KINGSTON.—The city council has appointed Robert A. Ross, of the firm of Ross and Holgate, consulting and supervising engineers, Montreal, as the city's experts in the arbitration asked for the Street Railway Company to determine the cost of power provided the company from he city plant.

RENFREW.—Mr. John B. McRae, consulting engineer, of Ottawa, has been engaged by the town of Renfrew, Ont., to make a report on the advisability of installing a plant for the development of the water power recently purchased by the town.

LONDON.—In connection with the installation of Niagara power, the idea of underground transmission wires was favored at a meeting of the Council, held on Tuesday. Estimated cost, $70,000.

ST. CATHARINES. — Ridgeville Electric Light and Power Company, Ltd., has just been formed, and its capitalized at $40,000. The object is to supply electric light and power to places in the townships of Thorold, Pelham and Gainsboro. A franchise has been obtained in the two townships first named. Behind the company are Geo. Arnold, Ridgeville; Hugh A. Rose and Frank W. Houston, Welland; J. C. Stoat, Fenwick, and H. S. Arnold, Toronto.

TORONTO. — The Consolidated Electric Co., Limited, announce that they are now permanently located at 129 Queen Street East.

Alberta.

CALGARY. Over twenty new street lights were put up in ward four by the city light department last week. The majority of the lamps were arclights, but a few were Tungsten incandescents.

British Columbia.

VICTORIA.—The final plans for the Coquitlam Dam to be constructed by the Vancouver Power Company, Ltd., have been filed. The Executive Council will meet on Wednesday, September 1st for final decision in the matter.

CEMENT—CONCRETE.

Quebec.

RIVER BEAUDETTE.—Concrete will be the material used for the piers of a bridge for whose construction tenders are now invited by Fabien Bissonette, secretary-treasurer.

Ontario.

BADEN.—A new bridge with concrete floor will be erected here by the Hamilton Bridge Co., for $2,297. H. J. Bowman is county engineer.

ST. CATHARINES.—Whether or not the construction of numerous concrete walks will be commenced this year is to be decided by the council at a meeting on the 13th inst.

STRATFORD.—An option has been secured by the National Cement Co., Durham, on Horseshoe quarries, St. Mary's, and it is expected that the Durham company will take over the quarries upon the expiration of the present lease, held by St. Mary's men. The intention is that stone will be shipped to Durham and there manufactured into cement.

TORONTO.—On Tuesday, Sept. 7th, a meeting will be held to hear appeals in connection with proposed local improvements, which include concrete sidewalks, sewers, pavement and gutters.

TORONTO.—A reinforced concrete bridge, with a span of 50 feet, will shortly be erected over the Humber, on the 8th concession, Vaughan Township. Mr. Hicks secured the contract at $3,600. Mr. Frank Barber, York County Engineer, prepared the plans.

PETERBOROUGH.—George A. Begg & Company, of St. Catharines, will probably build the new reinforced concrete bridge here at a cost to the municipality of $28,699.

British.

LONDON (ENG.).—It is understood that £1,000,000 preference shares in the cement combine have been underwritten for issue. Later, bonds will be allotted as payment to the groups entering the combine.

FINANCING PUBLIC WORKS.

Quebec.

JOLIETTE has sold $200,000 debentures to Hanson Bros., of Montreal.

COATICOOK.—The ratepayers have authorized the borrowing of $14,000 for a new dam, a new power house and new electrical plant.

NOTRE DAME DE GRACE.—Tenders will be received till September 7th, for $50,000 debentures, the proceeds of which are to be used for the opening and widening of streets. L. Descarris, secretary-treasurer, Notre Dame de Grace.

THREE RIVERS.—Bids are invited for the construction of a reinforced concrete bridge, 16 feet wide, by L. T. Desauliners, secretary-treasurer.

Ontario.

ARNPRIOR has sold $2,506 debentures to S. A. Stimson & Company, of Toronto.

CHIPPEWA.—On September 22nd the ratepayers will vote on a by-law connected with the establishment of an electric smelting concern.

LONDON.—The City of London will shortly have $400,000 in debentures for sale. The Niagara Power bonds aggregating $235,000 have not yet been sold.

ORILLIA.—The Town Council offered to loan the Tudhope Carriage Company $50,000 upon learning of their decision to rebuild here.

VICTORIA.—On August 26th the ratepayers passed a by-law to enter into an agreement with the British Columbia Electric Company relative to the development of power on the Jordan River. The company will spend $1,500,000. The proposition to expropriate the Esquimalt Waterworks Company's agreement was turned down.

British Columbia.

PEACHLAND.—This municipality offers for sale until September 13 $9,500 waterworks debentures, $7,300 electric light debentures, $3,000 road debentures, and $1,000 5 per cent. s.-a., 20-year fire protection debentures. H. McDougall is the clerk.

VANCOUVER.—The ratepayers may vote on a by-law to purchase the water rights of the Burrard Power Company. They may also vote on a Great Northern Railway by-law this fall.

SEWERAGE AND WATERWORKS.

Ontario.

PETERBOROUGH.—The city Board of Works have recommended the acceptance of the tender of George A. Begg & Co., of St. Catharines, for $28,699, for building a reinforced concrete bridge over the river at Smith street.

Manitoba.

PORTAGE LA PRAIRIE.—Messrs. Smith, Kerry & Chace, of Winnipeg and Toronto, are making a report on the advisability of constructing a dam or a water-wheel in connection with the waterworks here.

Alberta.

CALGARY.—The water mains have now been laid through the tunnel under the Bow and the gravity system will be connected with the Hillhurst mains this week. For some time a water supply has been kept up by a pipe line over the Louise Bridge, but this will be disconnected now that the mains under the river have been laid.

EDMONTON.—Work is now in progress on the laying of the new water main from the power house up Second street to the north end of the city. The main has been completed as far north as Saskatchewan Avenue. Below the hill steel pipe will be laid, and above, the pipe will be of galvinized iron. This pipe will be the largest in the city and will be the source of supply for the G. T. R. yards.

British Columbia.

FERNIE.—Messrs. Broley and Martin, the contractors who, under the supervision of the city engineer, Mr. Potter, are putting in the pipe line to carry water from Fairy Creek to the city, are making good progress with the work. The pipe is being laid from the town end of the ditch and a considerable portion is now in the ground. The bridge over the Elk River is progressing, but at the present time the contractors are having considerable trouble with the logs brought down by the river, and which by piling up against the false work of the bridge, would, unless helped on their way by pike poles and peavies, injure it. The centre pier is not quite finished, but as soon as this is done it will be only a comparatively short job to lay the stringers and complete the work.

RAILWAYS.

Foreign.

CHICAGO.—The Northern Pacific recently received 13 new locomotives from the Baldwin Works and 17 more have been ordered. They are all of the Pacific passenger type, and those received have been assigned to passenger service on the various divisions. The combined weight of each engine, with its loaded tender, is 376,000 pounds, the tenders having a capacity of 12 tons of coal and 7,000 gallons of water. The engines have a 22 by 26-inch cylinder and 69-inch drivers. They are capable of an average speed of 60 miles an hour with a train of 8 cars. In the North Coast Limited service a speed of 70 miles an hour and over is often made for considerable distances.

INDIANAPOLIS.—Contracts for the improvement and reduction of grades on the Vincennes division for the Pennsylvania line in Indiana have been let to Charles H. Stevens & Son, of Cleveland. The contract calls for the completion of the work in 90 days.

TELEPHONY.

Ontario.

WATERLOO.—The establishment of an independent system of telephones is being discussed by the Waterloo Board of Trade.

Manitoba.

WINNIPEG. — The extension of the Government telegraph lines north from Athabasca Landing to Lesser Slave Lake is expected to reach the lake this fall. The right-of-way has been cleared and the poles have been erected.

WINNIPEG.—A complete change in the method of the management of the Manitoba Government telephone has been decided on. The arrangement will be similar to the arrangement by which railway companies are governed, the business being divided into several departments, each of which is independent of the others. The province will be divided into districts. The management will be under three heads—commercial agent, superintendent of plant, and superintendent of service. One important new post will be created, that of general superintendent of plant for the province.

British Columbia.

VICTORIA.—A telephone connection with Strawberry Vale has been decided on. The Telephone Company has agreed to commence work immediately.

MARKET CONDITIONS.

Montreal, September 2nd, 1909.

Advices from the United States confirm the prediction that records might be broken, presently, in the pig iron production of that country. It is claimed that the production last week sets a new high record, exceeding even that of 1907, which has hitherto been referred to as the high record year. In addition to the activity thus indicated in the pig iron trade, huge orders for steel rails are now being placed, for delivery next year. Other railway material, such as steel frogs and switches, are being ordered in very large quantities, and one company has just booked an order for 16,000 tons of structural steel for bridge work. There is consequently every reason to look forward to an increasingly active season. Steel bars are now quoted at a minimum of $1.35 per 100 lbs., Pittsburg, structural steel being $1.40, with a tendency to higher prices for future delivery. Bessemer, this year's delivery, is quoted at $16.50, Valley, being an advance of about 50c. recently, large quantities having been sold at the higher figure. For delivery for the first half of next year, the price is $17, these being minimum prices. Basic pig is now quoted at $15.25, but is expected to advance immediately. No. 2 foundry has been dealt in at $16, Valley, and as high as $16.25 has been paid. Foundry iron is difficult or impossible to obtain at less than $15.25, furnace.

Mail advices just received from Glasgow, refer to an advance of 1s. 6d., and say that a very large business has been done in pig at the advance mentioned. Shipments are showing a very considerable increase. Malleable iron castings have advanced 7s. 6d. per ton.

Locally, demand is good, generally speaking, for pig iron, and demand for castings and for general material is also better, it is claimed. Consumers are buying for fall and winter delivery, and it is expected that some good, big orders will be booked in the next ten days. There is a decided scarcity in the hands of smaller people, and even importers, who usually carry small lots around their warehouses, have been entirely cleaned out lately, owing to the demand from small consumers. Prices are advancing slightly from time to time as a result. If the English and Scotch markets continue to advance, as they have been doing, corresponding advances will be made for delivery here.

Prices of finished and semi-finished material have been about steady here during the past week, and practically no changes have taken place in the usual list, after the somewhat frequent alterations reported the previous week.

Antimony.—The market is steady at 8¾ to 9c.

Bar Iron and Steel.—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.90 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

Copper.—Prices are strong at 13¾ to 14c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strentgh, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.20; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized).

Iron.—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50; Midland or Hamilton pig is quoted at $20 to $20.50, Montreal. t is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron soft, $19.25.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.55 to $3.65.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

Nails.—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

Pipe.—Cast Iron.—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Plates and Sheets,—Steel.—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

Steel Shafting.—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

Tin.—Prices are unchanged, at 32 to 32½c.

Zinc.—The tone is steady, at 5¾ to 6c.

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Toronto, August 26th, 1909.

The now almost certain prospect of good crops in the North-West, the general success of Canadian farmers in securing good prices for their products, are reflected in the earnings in other departments of the country's industry. Business of all kinds is more active and prices are in many cases looking up, metal being a notable example. It is regrettable to learn of the disablement, at a time of increased production and very active orders, of one of the furnaces of the Hamilton Iron & Steel Works. The loss which the company must suffer is placed at a high figure.

In Great Britain, the price of iron for future delivery is advancing, and there is greater buoyancy in the trade. In the United States, as we note elsewhere, there is a genuine improvement, not bolstered by special interests.

Toronto finds business active, especially so in the way of house-building, which is in a great danger of being overdone, if not already so. The Industrial Exhibition promises to be a good one this year, and the retail activity will be thereby increased.

An experienced New York observer says there is every appearance of a sound actual revival in business in the iron and steel trade, which may be expected to grow and spread to other lines. "With the tariff now out of the way, and a bumper crop promised, basic conditions are now sound and promising.". If, it is added, a reduction should come in the shape of a decline from the extravagant prices to which some securities have been forced in Wall Street, it would make very little impression on the generally favorable mercantile position and prospects in the U. S.

In harmony with this prediction of greater general activity, is the appearance of a circular from an important shipping house to its Canadian clients, dated 24th August, which says:

"We beg to advise that there is a serious car shortage impending which the railroad people now regard as certain between the present time and the coming winter, and we inform you of this so you may anticipate your requirements in our line as much as possible, sending in your specifications for immediate and future shipment."

When it is remembered that hundreds of thousands of cars were reported lying idle only a month or two ago, the significance of the announcement is great.

Antimony.—Demand inactive, market unchanged at $9 per 100 lbs.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Toronto, September 2nd, 1909.

An improved demand from the country exists in such goods as building felt and building papers, pitch, tar, and roofing goods. Bricks, too, are active for city trade, but the same cannot be said of cement. In