The Canadian Engineer

INDEX TO VOL. VII.

PAGE

Accidents of the month.........164, 209
Acetylene Lighting, Progress of.... 214
" Gas Machine Patent in Court, An 247
" for Cooking 323
Aluminum, The Advance in 42
Amalgamating Apparatus, A New.... 15
Arc Lamps, Long Burning Enclosed 97
Armstrong Planer Tool, The........ 253
Architects' Association, Quebec..165, 209
Asphalt Block, The 146
Automobile Progress 22
" Trip, A Remarkable.... 41
" Notes 279
" Boom 65
" Electric 81
" Steam Power for 98, 185
" The McLachlan Electric & Gasoline Motor Co......... 134
Axes and Saws, An Exhibition of... 70
Battery, The Improved Samson...... 82
Bearings, Ball and Roller 320
Bicycle Combination, The Canadian. 140
Bit, An Improved 46
Blue Process Paper 329
Boiler Compounds, The Use of..307, 317
Brief but Interesting 29, 58
Building Regulations 35
" Laws, Toronto 293
Calcium Carbide at Chicoutimi 330
Canadian Engineer, Good Work Appreciated 165
" Engineer 224, 254
" " Abroad, A............ 70
" Mining Institute 325
Canadian Pacific Ry., New Windsor street Station of 220
" Rand Drill Co., New Shops of the 252
" Asbestos Co, The 322
Canal, Ottawa Valley 46
Canals of Canada, The 245, 266
Carbide Works, Ottawa, Explosion at the Dominion 253
Carbon duties, Discrimination in..... 195
Catalogues, New 45, 112, 192, 232, 256, 276
Catch Basin, The Robertson 230
Cement Industry, The 127
" Beaver Portland 251
" Some Experiences with Portland 237, 255
Central Station Accounting from a Business Standpoint 102
Chain Blocks, Yale 45
Civil Engineers, Canadian Society of 14, 42, 230, 278, 294, 323
City Engineer, Victoria, B.C. 6
Clutch, Arnold Magnetic 302
Coal Seams, Notes on the Deposition and Development of the Glace Bay 305
Coke Works, The Everett 202
Combustion 273
Concrete, The Compressive Strength as Determined by Tests made at McGill University 156
Compressed Air Fizzle, That 127
Coupling, The Dart Union 111
Coke from Nova Scotia for Use on Railways 231
Copper Co., The Great Lakes........ 165
Correspondence Schools in Toronto, The International 229
Cranes, Electric Traveling 302
Culverts and Bridges 7
Dam Building 18, 51, 111
Distillation of Pan Dust, Destructive 213
Dodge Mnfg. Co. of Toronto........ 51
Draughting *197*
Drill Grinder, The Yankee 141
Drill and Ratchet Screw Drivers, New Reciprocating 199
Drill, A New 50
Economizer, Green's 47, 192
Electric Currents, The Protection of Low Tension Wiring against Dangerous High Potential 95
" Power, Possibilities of the Ottawa Valley 94
" Railway, A Revolution of the Present System by the Advent of the Elevated 121
" Railway, Isle of Man Tramways 137
" Light Co.'s Works on the Chaudiere River, Canadian..... 159
" Lighting and Power Plant of the Victoria Hospital, London, Ont., The 300
" Flashes 28, 54, 77, 117, 142, 175 [208, 234, 260, 284
Electrical Association, Second Annual Convention of Maritime 20
" " Canadian.......60, 84
Engine, The Peerless Self-Oiling Automatic 224
" The McEwen Automatic.... 319
" Large Compound 329
Engineer, Toronto, Report of the City 189
Engineers' and Electricians' Hand-Book, Reference Directory, The 201
" Club, Toronto, The....39, 301
Engineering and Maintenance of Way Association, American 330
Estimates, The 17, 301
" of the Dominion, Supplementary 83
Exhaust Head, A New Form of...... 189
Fire, The Tall Building Under the Test of 218
Fires of the Month..30, 60, 83, 112, ...146, 210, 232, 262, 277
Fireproofing; A New System of...... 30
Firemen's Association, Ontario Volunteer 136
Fire Prevention Committee, The British 201
Fly Wheel Design, Improvement in, Cast Iron 19
Gas Engine, General Principles of.... 226
Gas Works, The Boston 313
Generating Set, A Substantial Type of Marine 222
Good Roads 251
Grate Bar, The Cyclone............. 250
Grand Trunk Railway, Portland Terminus of the 127
" Trunk Railway Locomotive... 51
Great Britain, Hatred of, in Europe. 276
" " Markets of Canadian Goods in 277
Greening Wire Co., Ltd., 'Origin of the B........................... 200
Hanger, Brantford Adjustable Drop, with Roller Bearings 323
Heating, Hot Water 17, 38, 113
" and Ventilation, School.... 278
" " " 226
Hudson Bay 156
Ice Breaking 163
Imperial Oil Co 156
" " " and the Standard *Oil Co* *185*
Industrial Notes 23, 53, 75, 115, 141, [173, 203, 233, 256, 281, 308, 331
Indicators, Speed 321
Iron Bounties, The 83
Iron and Steel, Canadian 65
" " 207, 236
" Production 19
" Methods, Swedish vs. Canadian. 11
Lachine Rapids Hydraulic and Land Company 123
Lake Levels 264
Liquefaction of Air, The 5
Literary Notes 30, 52, 112, 140, 165, [198, 231, 256, 278, 312
Lubricators for Compound Engines.. 19
McDonald's Generosity, Sir William. 210
McGill Prizemen in Applied Science '99.............................. 45
Manual Training in the Public Schools 270
Marine Engineers, The 278
" News 26, 57, 81, 118, 145, 177 [205, 262, 286, 310, 335
Measures and Rules 288
Metal Imports from Great Britain... 7
60, 83, 114, 148, 165, 197, 237, 288, 304
" *Polish* *14*
Mechanical Draft, A test of 229
" " Upon the Ultimate Efficiency of Steam Boiler, The Influence of 48, 138
Meters and Meter Rates 66
Metric System, The 190
Mechanical Trades, Mathematics in the 241
Mineral Wealth of Newfoundland.... 221
Minerals, Ontario 277
Mineral Productions in 1898, U.S.... 135
" " of Nova Scotia..... 41
" Industries of Ontario, The.. 160
Mining Matters 27, 56, 80, 118, 144, [177, 205, 236, 287, 311, 335
Mica in Quebec 46
Motor, The Deisel Heat 186
Motors, Direct Connected to Machine Tools, Slow Speed 321
Navigation in Canada, Lake 6
Nernst Lamp, The Proper Efficiency of Incandescent Lamps for Central Stations, Including a Description of the 99
Nickel Production, Canadian 33
" Extraction by the Mond Process 166
" Steel, Canadian 292
" " The Properties of.......... 304
Oil Stones, How to Use and Select Them 275
Ontario, A New 213
Patents, Canadian 312
Pavements Between Street Railway Tracks 199
Peat as Fuel in Canada............. 292
Personal 29, 57, 81, 119, 145, 178, 206, [237, 259, 284, 335
Plumbers and Steam Fitters of Canada, The Nat. Asso. of Master 84
Power 158
Power Question, The Niagara 35
Practical Man, The 22, 53, 96, 163, [191, 232, 248, 271
Pulp Grinder, A New................ 330

PAGE

Pumping Machinery 254
Pumps, Interchangeable Oil 274
Railway Building in Manitoba 274
" Engineering 111, 141, 249
" Matters 27, 57, 79, 119, 144, 179, 206, 230, 261, 286, 312, 333
" Subsidies 119, 137
Reed Mnfg Co. of Erie, Pa, The 105
Richelieu and Ontario Company's Steamer "Toronto" 73
Royal Electric Co., Ltd., The 112
St. Lawrence Levels 240, 264
" Route, The Beginnings of the 1, 31, 61
Sandstone, Artificial 39
Sanitary Necessities 181
Sanitation in Schools, Modern 34
Scales, Suspension 23
Separators, The Austin Steam 159
Sewage Disposal, The Royal Commission on 15
" Disposal Works, Brockton, Mass 314
" Treatment, Septic Tank System of 192
Sewers of the City of London, Ont., The Construction of the Main Intercepting 43, 70
Smelter for Toronto 34
Smoke Consumption 111, 221
South Africa: Its People and Its Trade ...154, 182, 211, 265, 291, 314
Stationary Engineers, Canadian Association of.....84, 193, 231, 276, 301
" Engineers, Tenth Annual Convention of Can. Asso 114, 128
" Engineers, Ontario Asso. of 83
Steam Trap 272
Steam, Advantages of Coke over Coal as a Fuel for Generating 195
" Turbine, Direct Connected, Parson's 169
Steel, Overstrain in 223
" For Building Construction, The Manufacture of 225
Stoker Co., American vs General Engineering Co 180, 277, 306
Surveyors, New Land 306
" Ontario Asso. of Land 304
Technical School, The Toronto 312
Temperature 248, 277
Toronto Exhibition Notes 164
Torsional Strains, Instruments for Measuring Small 9
Transformer Economy 89, 102
Trap, The Interception 289
Trust Formations in the United States 41
Turbine Steamers, The 289
Vats, Leaking 111
Ventilating, Heating and 226
" " " One Story Buildings 158
" Fan, A New Type of Electric Propeller 96
Vise, Hough's Extra Heavy Combination Pipe 141
Water Curtain, The 192
Watermain Scraping 231
Waterpower and Its Electrical Production in Relation to the Undeveloped Resources of the Dominion, Canadian 91, 124
Water Supplies 3, 36, 151, 239, 263
" " Sand Filtration of Public 39, 71, 148, 171, 196
" Works, Toronto 47
Witwatersrand, Milling the Gold Ores of the 215

Workmen's Compensation for Injuries Acts 35
Wrench, The V. & B. Pipe 111

CORRESPONDENCE.

Baillairge, Chas.—"Dam Building" 18
Correspondent—"Water Pressure" 205
Diamond Saw and Stamping Works—"Canadian Engineer" 254
Engineer—"Excessive Heating in a Corliss Engine" 180
Fielding, John S.—"Dam Building" 51
Fordyce, Jas.—"Canadian Engineer" 254
Green Fuel Economizer Co.—"Green's Economizer" 192
Hamilton, G. A.—"Canadian Engineer" 306
Hegan, James B.—"Canadian Engineer" 254
Hodgins, J. George—"Red Cross Fund" 307
Malmgren, Henry—"Heirs Wanted" 277
Murphy, J. F.—"Canadian Engineer" 254
National Carbon Co.—"Discrimination in Carbon Duties" 195
Petrolian—"Petrolia and the Standard Oil Co." 209
Robbins, J. M.—"An Impoverished Philosopher" 224
Ronald, J. D.—"Canadian Engineer" 254
Roy, Alex.—"Canadian Engineer" 254
Vessot, S. & Co—"Canadian Engineer" 254

PORTRAITS.

Beckett, F. G 15
Bertram, Surgeon-Lieut. T. A 114
Black, Wm A 75
Colpitts, W. W 45
Dion, A A 88
Esford, Capt. H. 74
Gildersleeve, C. F. 74
Gossler, P G. 88
Grier, A. G. 45
Hutchison, W. S. 45
Hyde, Geo. T. 45
Kirkpatrick, S. F. 45
McLean, W. B. 45
Moseley, Chas. 133
Oelschlager, W. 132
Smith, Archibald W. 114
Trowern, P. 42

BIOGRAPHICAL SKETCHES.

Beckett, F. G 15
Bertram, Surgeon-Lieut. T. A. 114
Black, Wm. A. 75
Bunsen, The Late Prof. 189
Durley, R J., B.Sc. (London) 47
Esford, Capt Henry 74
Gildersleeve, C. F. 74
Gossler, P. G. 88
Killey, The Late J. H. 135
Moseley, C. 133
Oelschlager, W. 132
Smith, Archibald W. 114
Trowern, P 42

CONTRIBUTORS OF SIGNED ARTICLES.

Anderson, W. B.—"The Compressive Strength of Concrete as Determined by Tests made at McGill University." 156
Ardagh, A. G.—"Peat as Fuel in Canada." 292
Ashbridge, W. T.—"The Construction of the Main Intercepting Sewers of the City of London, Ont." 43, 70
Baillairge, C.—"The Boston Gas Works." 313
Baillairge, C.—"The Asphalt Block" 146
Cary, Albert A.—"The Use of Boiler Compounds." 307, 317
Cary, E. E.—"The Proper Efficiency of Incandescent Lamps, Including a Description of the Nernst Lamp." 99
Campbell, A W.—"Culverts and Bridges." 7
Coker, E. G.—"Instruments for Measuring Small Torsional Strains" 9
Davis, A.—"Revolution of the Present Railway System by the Advent of the Elevated Electric Ry. 11, 12
Detwiler, J. B.—"Roller and Ball Bearings." 320
Dion, A. A.—"Meters and Meter Rates." 66
Drummond, Geo. E.—"Iron Production." 19
Eldridge, W. K.—"Some Experiences with Portland Cement." 237, 255
Freeman, Arthur C.—"Advantages of Coke over Coal as a Fuel for Generating Steam." 195
Hartranft, Wm. G.—"Beaver Portland Cement." 251
Hart, P. H.—"Central Station Accounting from a Business Standpoint." 102
Kindl, F H.—"The Manufacture of Steel for Building Construction" 225
Kirkpatrick, S. F.—"Notes on the Deposition and Development of the Glace Bay Coal Seams." 303
Keefer, Thos. C.—"Canadian Water Power and Its Electrical Product in Relation to the Undeveloped Resources of the Dominion." 91, 124
Lea, R. S.—"Sand Filtration of Public Water Supplies." 39, 71, 148, 171, 196
Leonard, F. H., jr.—"Transformer Economy." 89, 102
Morgan, C. E.—"Pumping Machinery" 254
Parsons, H. deB.—"The Tall Building Under the Test of Fire." 218
Plaskett, J. S.—"Mathematics in the Mechanical Trades." 241
Plews, W. J.—"The Protection of Low Tension Wiring Against Dangerous High Potential Currents". 95
Rust, C. H.—"Brockton, Mass., Sewage Disposal Works." 314
Rust, C. H.—"Pavements Between Street Railway Tracks." 199
Robert-Austen, Sir William Chandler, "Nickel Extraction by the Mond Process." 166
Snow, Walter B.—"The Influence of Mechanical Draft Upon the Ultimate Efficiency of Steam Boilers." 48, 138
Trowern, P.—"Measures and Rules." 288
Trowern, P.—"Power." 158
Trowern, P.—"Hot Water Heating" 17, 38, 113
Turbayne, Wm. A.—"Long Burning Enclosed Arc Lamps." 97
Watson, W. M.—"The Interception Trap." 289
Watson, W. M.—"Sanitary Necessities." 181
Watson, W. M.—"Water Supplies." 3, 36, 151, 239, 263
Weir, Arthur.—"The Beginnings of the St. Lawrence Route." 1, 31, 61

The Canadian Engineer

Vol. VII.—No. 1. TORONTO AND MONTREAL, MAY, 1899. PRICE, 10 CENTS / $1.00 Per Year.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

Subscription—Canada and the United States, $1.00 per year; Great Britain and foreign, 6s. Advertising rates on application.

Offices—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,

E. B. Biggar Address—Fraser Building,
R. R. Samuel Montreal, Que.

Toronto Telephone, 1892. Montreal Telephone, 2589.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensure insertion.

CONTENTS OF THIS NUMBER:

	Page		Page
Air, The Liquefaction of	5	Lubricator for Compound Engines	19
Amalgamating apparatus, A New	15	Literary Notes	30
Automobile Progress	22	Metal Polish	14
Beckett, The Late F. G.	15	Maritime Electrical Association, The Second Annual Convention of the	20
Borrowed Plumes	6	Marine News	26
Brief but Interesting	29	Mining Matters	27
Culverts and Bridges	7	Practical Man, The	22
Canadian Society of Civil Engineers, The	14	Personal	29
Dam Building	18	Railway Matters	27
Electric Flashes	28	Sewage Disposal, The Royal Commission on	15
Estimates, The	17	St. Lawrence Route, The Beginning of the	1
Fly-wheel design, Improvement in	19	Suspension Scales	23
Fires of the Month	30	Torsional Strain, Instruments for Measuring Swivel	9
Iron Methods, Swedish or Canadian	11	Water	3
Iron Production	19		
Industrial Notes	21		
Lake Navigation in Canada	6		

THE BEGINNINGS OF THE ST. LAWRENCE ROUTE.*

There is a river which contains more salt water than fresh, which has a seaport almost a thousand miles from any ocean, a river that twice in the day flows backwards. At one season it affords navigation to the largest vessels, and at another it has upborne upon its crystal surface a train of loaded cars, with busy locomotives. It flows past virgin woodland, past cultivated fields, and past cities, is sentinelled for hundreds of miles by the oldest mountains in the world, expands into vast lakes, swept by sudden storms, and contracts in narrow gorges, toothed with rock, where its wrath and strife are titanic. It penetrates a continent like a wedge, and makes a maritime people where the phenomenon of the tides is wanting. It has been the haunt of pirates, of smugglers, the route of heroes and of savages, the scene of wreck and the arena of glory. It is to the Canadian what the Tiber is to the Roman, the Nile to the Egyptian, the Rhine to the German; for that river is the St. Lawrence.

The St. Lawrence gives the Province of Quebec a seacoast of 2,500 miles or 500 miles more than that of England. From the Straits of Belleisle to Duluth it has a length of 2,384 statute miles. Montreal, at the head of ocean navigation, is 986 miles from Belleisle, and the river is salt as high as St. Thomas, 766 miles from the ocean, while the tides are regular as high as Three Rivers. The great lake system with connecting waterways has an area of 98,000 square miles, a coast of 2,112 miles and the basin area of the system is 330,000 square miles, a generally fertile country capable of accommodating 108,500,000 inhabitants if as densely populated as the United Kingdom. From the ocean to Quebec the river varies from seventy to ten miles in width, with a proportionate depth. It is, however, dotted with reefs and islands and subject to fluctuating currents and summer fogs, which render necessary the present magnificent system of lighthouses, sirens and buoys. From Quebec to Montreal the river is rarely less than two miles in width, and its depth is never less than thirty feet, except where a score of shoals aggregating fifty miles in length have had to be dredged, giving at present a navigable channel of 27.5 feet.

The current of the river is usually gentle, but in its descent of 235 feet from Lake Ontario it traverses a series of steps creating about forty miles of rapids, which have had to be overcome by the construction of some seventy odd miles of canals. The continuity of navigation on the great lakes is interrupted by the Niagara Falls, to overcome which a canal nearly 28 miles long has been constructed, and by the Sault Ste. Marie, where there is a canal, short, but otherwise on a gigantic scale, to accommodate vessels almost as large as those that brave the tumult of the Atlantic.

The St. Lawrence route in whole or in part is the natural outlet of the interior of the continent to the Atlantic seaboard. Its headwaters are equi-distant between the Atlantic and the Pacific, and engineering work of an easy nature might render continuous navigation possible from the foot of the Rockies to Montreal. The old canoe route by way of Georgian Bay, Lake Huron, French River, Lake Nipissing and the Ottawa, while studded with difficulties, is even shorter than the Great Lakes and St. Lawrence route for traffic originating west of Lake Huron, but would use the St. Lawrence from the mouth of the Ottawa downwards. A short distance below Montreal the Richelieu enters the St. Lawrence, giving access to Lake Champlain and the Hudson Valley, and to New York, the distance from Montreal to the United States metropolis being 457 miles by this route, of which 372 miles would be natural navigation. The present objections to the St. Lawrence route are several. In the first place there is no Canadian lake harbor sufficiently equipped or deep enough to compete for trade with the United States lake ports, many of which have been deepened at large expense. Secondly, the river cannot be said to be open more than seven or eight months in the year. And thirdly, the existence of tolls militates against the natural advantages of the route. The competition of railroads and of the Erie Canal, which is free of tolls, render the advantages of the St. Lawrence route almost useless to stay the tide of traffic by way of the United States. Of course, the Erie Canal is not navigable in winter.

Champlain's escapade on the lake named after him, in which he shot an Iroquois chief, closed the St. Lawrence

*Abridged by the author, Arthur Weir, B.Sc., from a lecture delivered before the Applied Science students of McGill University, Montreal, January, 1899, and published exclusively in The Canadian Engineer.

against the French until 1653, and in that year it was open only for a short time.

In Champlain's day, Tadousac was the leading harbor of Canada, subsequently being displaced by Quebec and then by Montreal, for it is a rule of trade that it will ever go to the head of navigation.

During the French regime the St. Lawrence was the centre and not the boundary of Canada. Her trappers had over-run the country south to the Gulf of Mexico, had skirted the flanks of the Rocky Mountains, and d'Iberville had performed feats of valor against the British posts on Hudson's Bay. Lake Mistassini was known, and there was scarcely a pellucid stream west of the Alleghanies which had not rippled to the paddle of the courier de bois. The trade of Canada was chiefly in furs, and but for the expenditures from the military chest the country would have been in a state of chronic bankruptcy. Foreign trade was prohibited, and anyone engaged in it was treated as a pirate. Huguenots were forced to leave the country every fall, the more important trades were always in the hands of a monopoly, prices of commodities were fixed by Government officials; as also were freight rates. Non-resident merchants were not permitted to trade with the Indians, and could do business only below Quebec, and then only during three months of the year. But there was nevertheless some traffic in the country. The fur trade just before the outbreak of the war of the Conquest averaged from 200,000 to 300,000 livres per annum, and in 1615 there were, according to the Jesuit Biard, fully 500 French ships engaged in the fur, whale and codfish trade. Licenses for the fur trade were ultimately issued, costing from 500 to 1,000 livres at first hand, and good for one canoe. In 1754 the trade with the western posts amounted to 90 canoes. According to Lt. Gov. Miles the beaver trade never exceeded £ 140,000 stg. per annum, and it was not half that in 1754 and 1755. In 1688 Canada produced 101,000 bushels of wheat, increased by 1734 to 738,000 bushels. The exports of wheat at the latter period were about 60,000 bushels. At the close of the French period the exports were still only raw materials, furs of all kinds, porpoise oil, cod, salmon, eels, lumber, and such like, while even bacon and flour were imported, the imports amounting to about 8,000,000 livres, against 2,500,000 of exports. During 1759 the requirements of the colonists were met by 12,000 tons of shipping, although they were in the throes of war and depending almost entirely upon external support. I may here remark that these figures are not entirely reliable. The science of statistics did not come to anything like perfection in Canada until after Confederation. The imports of 1765 are placed by a memorial of the time at 4,000,000 livres and the exports at 1,500,000. I give the figures I find to hand, merely because they will in a measure give some idea of the early trade via the St. Lawrence.

The intendant Talon, to whom all honor, came to Canada in 1665 and may be looked upon as the father of commerce in Canada. He established a brewery that the money the people spent on liquor might at least be kept at home, a principle which is at the root of commercial progress. In 1667 he built the first Canadian built ship at Quebec, the beginning of a very important trade, carried to particular extent in the Maritime Provinces. This ship he sent to the West Indies to open a trade with those islands. It carried out salt cod, pease, salmon, eels, fish oil, staves and planks, and brought back sugar. Later, wheat was exported, of which 54,000 bushels were sent out in 1685. Attempts were also made to establish an export trade to France, exclusive of peltry. The season of navigation on the St. Lawrence has been placed at about eight months. During the French regime it was only four months, the ships from France arriving in July, August and September, and sailing again in November. The duration of a voyage in those days was uncertain. The Jesuits Biard and Masse were four months between France and Canada, from January to May. Talon himself was 117 days en route, and de Levis was to be congratulated in crossing the ferry in 56 days in 1756. Sometimes the ships were blown back to France after sighting America, as was de la Roche in 1598; sometimes they became plague stricken, as was the "Rubis" in 1740; and wrecks were frequent, that of "la Providence" in 1718, "le Chameau" in 1725, "l'Elephant" in 1729, the "Beauharnois" in 1731, "la Trinite" in 1752, and the "Chamelion" in 1753. The ships of the day rarely equalled 200 tons, and Champlain crossed in one of 12 tons. One could wash in the sea from the deck of the vessel of "la Roche."

The cost of a passage in one of these ships was 33 livres in 1664, increased to 40 livres by 1672. In 1740 freight charges were 25 francs per ton. Every ship coming to Canada from France, and it might come only from a French port, had to conform to the tariff of prices in selling its cargo, had to bring out, if desired, one immigrant for every ton of its burden, refrain from trade with the Indians, and carry a certain proportion of salt, iron and coal, although the St. Maurice forges were in operation and the outcrops of coal in Acadia were utilized by the French in that district. From the Gulf of St. Lawrence to Quebec during the French regime there was not a single friendly light to guide the mariner through the sometimes tortuous channels. And the Gouffre and the Traverse, still somewhat boisterous at certain stages of the tide, were then as dangerous as the maelstrom. These once dangerous spots, a little below Quebec, have now been largely silted in, and are of small consequence to vessels of to-day. In the days of sailing vessels, however, many a wreck took place there and the first buoying of the St. Lawrence was done at the Traverse.

As already stated, the lower portion of the St. Lawrence is a seacoast with all the dangers of one; and it was early charted. There is a chart of the river in the Archives Department at Ottawa, bearing date 1695. It was, however, between 1717 and 1737 that the charting of the St. Lawrence was first developed to any extent. In 1723, l'Hermite, the father of charting on the river, began his labors. He and Richardiere, harbor master at Quebec, took soundings in the Gulf and river, and in 1737 the latter was busy cutting landmarks for the mariner. In the same year was first lit the fire tower of Louisburg, the only beacon that flamed along those shores for maritime purposes during the French regime. In passing, I may mention that the Indians in early times in crossing from Cape North to Newfoundland and back were wont to light beacons upon that towering mass, which they called Sakpeediah or Smoky Point in consequence.

Above Quebec there were no impediments to the vessels of the day, as far as Montreal, although Jacques Cartier ran aground in Lake St. Peter. The usual means of conveyance was by canoe and subsequently by rude batteaux, which were days and sometimes weeks upon the trip. The usual duration of a voyage between Quebec and Montreal was six days, Three Rivers being the midway point. It was customary to land each night and billet upon some seignory. The luxurious Bigot had a most sumptuous barge with silken awnings when he made his customary visits to the future metropolis.

The only important engineering work begun in connection with the St. Lawrence route during the French regime was the attempt to construct a canal between Montreal and Lachine, to overcome the Sault St. Louis or Lachine Rapids. In 1700 a contract was signed by Dollier du Casson on the one part and Sieur de Catalogne on the other to construct a canal some twelve hundred feet long and twelve feet wide from Lachine to connect with a little lake, called St. Pierre, which in turn connected with two streams, one of which ran through what is now Craig street. The work was interrupted in 1701 by the death of Du Casson, and although many attempts were made to complete it, the Seminary spending some 20,000 francs in work begun in 1717, a heavy rock cutting that was encountered finally brought all operations to a standstill.

It may be interesting to remark in view of the present endeavor to find a winter outlet for the St. Lawrence that during the French regime the harbor of Bic was designed to be improved and fortified to make it what Louisburg was to Acadia and what Halifax is to-day, a naval depot and winter port for trade. French shipping on the great lakes began as we all know with the journey of LaSalle, who built a vessel to navigate Lake Ontario, left it at the upper end of the lake, passed Niagara and on Lake Erie built the "Griffon" in 1679. She made one trip into Lake Michigan, and was lost on her return journey. As early as 1700 there were two or three brigantines on Lake Ontario, and in 1756 from six to ten schooners and brigs, as well as a number of large batteaux.

I will close this sketch of the French regime by remarking that the priesthood, who do all things decently and in order, had a series of regulations regarding travel which read quaintly to-day. They were to tuck up their robe on getting into a canoe, and were not to wear their shoes or stockings, though they might don these when portaging. Above all, they were to be careful that they took no sand into the canoe upon their feet and that the brim of their hat should not annoy the savages, an item which might bear quotation to-day in theatres, although the alternative that they should wear their nightcaps because there is no such thing as impropriety among savages, might be asking too much of the ladies.

(To be continued.)

WATER.

BY W. M. WATSON, TORONTO.

On page 39 of the June issue of this paper for 1897 I discussed public water supplies and their construction, and now propose to continue the subject in a more detailed form. No doubt it is generally known that Henry Cavendish, an English chemist, in 1781 proved that rain water, the source of all water supplies, was a composition of two parts of hydrogen and one part of oxygen gases. Thresh states that pure water may be classed as a chemical curiosity, because when it becomes exposed to the atmosphere, or when passing over rocks, earth, vegetation, or when it comes in contact with any oxidizable metals or ores it becomes partly incorporated with them. Water will attract foul gases from the air, and often attract such a quantity of chemicals or metals as to change its taste and make it unsafe to use for drinking or indeed for any domestic purpose. Bacteriology has proved that both food and water contain microbes. Professor Richardson shows in his lectures that a single grain of good cheese contains 300,000 living germs. Microbes are useful and necessary to carry out the laws of creation. There are a large number of classes, each class having its appointed duty. Several varieties assist the growth of things. These are sometimes referred to as friendly bacteria, because all their work is done for the benefit of mankind. There are also numerous classes of microbes whose duty it is to rot, to destroy, to decompose, and help everything to decay.

Strictly pure water contains very few microbes, either friendly or unfriendly, on that account it may be taken to be a risky kind of water to distribute, because just as soon as it comes in contact with air, it will rapidly absorb any foul gases that may be in the surrounding atmosphere, which also means that it attracts microbes whether friendly or unfriendly, so that if the volume of water be surrounded by uncleanliness or foul atmosphere, the water itself becomes the receptacle of dangerous germs, and unfit for use for domestic purposes. Dangerous germs are always found in connection with decaying matter, they are discharged through the pores of the skin, by the intestines, and sent into the air by the respiratory organs. A few drops of sewage that has had dirty clothes washed in it may contaminate water sufficiently to pass a quantity of deadly germs into many human systems. But we have a safeguard provided, but that safeguard is not in pure water, because pure water does not contain a sufficient quantity of the friendly bacteria to protect it from becoming the hunting ground or receptacle of the dangerous and unfriendly microbes. On the above grounds it will be obvious that it is necessary to break up into small particles and thoroughly areate all deep well water, and in many cases spring water in a pure atmosphere as quickly as possible after it is received from the springs or wells, so that the water can attract a large number of the friendly microbes from the pure air. The germs of the friendly class enter water to seek carbonaceous substances, of nitrogenous substance (which Parks says is reduced to nitrite by their growth), which they devour for food. They are rated as high breed bacteria because (they similar to man) cannot live without air. They can live in fluids as long as the fluids contain oxygen, which almost all waters do, but if the fluid be not repeatedly aerated, then they will die for want of air, which they should never be allowed to do until the supply of water intended for consumption in the town finally enters the closed water mains, and it becomes impossible for any dangerous death-dealing germs to enter the fluid and contaminate the supply. This shows the necessity of aerating all drinking water in a clean and pure atmosphere as often as the circumstances and arrangements of a waterworks plant will permit. The families of unfriendly and dangerous bacteria, as a rule, exist without air or oxygen, and when exposed for a time to the atmosphere will be destroyed. The more a town's water supply secures clean, pure aeration the better the quality and the clearer the color, therefore the more suitable for manufacturers and dyers.

To make this subject easily understood I may say that I can point out two large towns whose boundaries join each other, both collect their water from the same table land, their reservoirs and conduits are similarly built and constructed, but when the water reaches the consumer there is a marked difference in the quality, because they had different engineers. One engineer had conveyed the water without break or interruption the whole fifteen miles, the other took advantage of the high level of the collecting ground and the broken state of the land between the large collecting reservoir and the well where the head of water was established for distributing the water to the town. Between these two points two or three miniature cascades were established which aerated the water. Then when the water entered the air-tight distributing mains it was necessarily of a superior quality to the water of the neighboring town that received no aeration. As the majority of places needing waterworks contain a population of about 5,000 inhabitants I will confine my subject to the necessities of such places.

The waterworks plant of a small town will cost more per capita than larger towns, but those who have yet to secure a supply have the advantage of avoiding the mistakes of previous towns which have already got their plants constructed. We find that several of our older cities are in the hopeless condition of water wasters, and the quality of water delivered would have been considerably superior had the plants been properly constructed and managed from their commencement. The waste and misfortunes of the large cities can be avoided, and the cost per head largely decreased by using reasonable judgment and engineering skill. The improvements made in pumping appliances lately have so far reduced the cost of lifting water, that the cost of pumping a town's water supply need not form much of an objection. In fact a good engineer might supply all the heat necessary to work the pumps from the refuse and garbage thrown away by the water consumers, and by so doing would not only pump the water without buying any fuel, but also dispose of a very grave nuisance at the same time by cremating the garbage. When pumps are used to secure a water supply, the carrying pipe from the pump-house to the water tower, or to the point where the distributing mains commence to branch off, should be laid on a rising grade the whole way, avoiding any dips where grit or dirt may accumulate, or bending over small hills, thus creating hogbacks in the line of pipes where pockets of air will lodge and cause a resisting pressure that jars the pipes, loosens the joints, producing sudden water hammers, vibrations, etc., which sometimes damage the line of pipes, besides taking more fuel to drive the pumps. If a waterworks plant be well constructed and designed twenty-five imperial gallons per head per day is abundant for strictly domestic purposes. For trade purposes, for public baths and other extraordinary requirements an extra supply should be provided. Probably a daily supply of 150,000 gallons would answer for all purposes for a population of 5,000.

It has often been proved a greater economy to tunnel or bore a road for the water mains under small hills, than to bend the pipes over the crown of the hilltop, also to bridge over a narrow ravine, and construct a frost-proof viaduct to pass the water mains over, than to make a quick and sudden depression. Because the extra cost is afterwards more than covered by the reduction in the general repairs and the smoothness that is established in working the appliances throughout the whole plant. When water mains are placed under shallows and a depression is made in the line of supply pipes a proper cleanout valve placed at the lowest point is essential, and when the main pipe is bent over the crown of a hill it is absolutely necessary to place an automatic air-escape valve at the very highest point, or the water will not always flow freely through the pipes, because pockets of atmospheric air will repeatedly lodge.

There is no advantage in placing supply pipes down in the streets larger than is necessary to carry the maximum quantity of water to serve the section or district at any hour of the day for domestic purposes, because the water creates a growth of calcareous formation all around the walls inside the pipe, that will continue to reduce the size of the bore until it becomes reduced to the size necessary to easily pass the maximum quantity used. By using good judgment in arranging the position of the main pipes, cleanout valves, and air escape valves, and if the supply be afterwards intelligently cared for, the formation of obstruction can be avoided. The 8 and 10-inch pipes may be dispensed with where 6-inch pipe is ample to serve for domestic purposes, because the whole force of the water supply of the town may be made to concentrate to any part of the town when necessary to extinguish a large fire. We dwelt fully on the subject of laying pipes in our article of June, 1897, and need not repeat it here. It is a wise policy to secure a supply of water that will serve the town by gravitation if possible, even if it should cost fifty per cent. more to provide the plant. I gave several reasons for this statement in 1897 and may here repeat that it saves the cost of pumping and the risk of a breakdown of the machinery just when a supply is most needed. There are also sanitary grounds that weigh in favor of gravitation schemes, besides the works are always cheaper to manage after they are fully completed. The rainfall is the source of all water supplies, though the supply may be secured in the indirect way of being drawn from wells, springs, rivers, or fresh water lakes. If the substance of the water is changed by passing through moss and other vegetation, it is called surface water, and often moorland water, thus the quality of water is generally named by the chemical or mineral strata it passes through and which it incorporates. The water from springs is not always suitable for a town's water supply on account of its hardness or because it is impregnated with chemicals or minerals. It is possible by mechanical means to remove the hardness, and often by processes of aeration to remove the chemical or mineral gases the rain water may have absorbed. When rain falls on to high table land and hills it percolates through the soil and the rocky strata to a depth often of over 100 feet to hollow caverns, with large reservoirs holding in store immense quantities of water that has filtered through. If the reservoirs had no overflow outlet to keep them from rising beyond a certain level, then the whole cavern would fill with water, and form such a heavy hydraulic pressure that an earthquake or shock would occur as soon as the water and the pressure of the water was able to weaken the side walls of the hill. Generally, each underground water-collecting reservoir has an overflow, and many of these overflows travel a great many miles before they burst forth out of the land and secure the name of spring water ; of course, the point where the water issues forth is at a lower level than the surface of the water in the underground reservoir. Spring water is often far superior in quality to deep well water, because it has gone through similar processes of filtration by passing through the earth's stratums, and also got further improved by a thorough aeration in the draughty caverns under the hills.

There are two counties in England that possess such water-bearing caverns that fortunately have a passage from the outside to the interior. I have been over a mile into the heart of those caves, I found that they contained flowing rivers, water falls, numerous small cascades spraying water, and domes and massive arches forming the roof that extended beyond what my eye could see with the aid of a torch, and many of the domes would exceed in height any of our tallest towers. Hanging from the roof were thousands of stalactites, each delivering a large drop of water at short periods. Our guides assured us that the caves could be traversed for many more miles, but a novice on his first attempt of exploring the bowels of the earth is generally fully satisfied with going one mile and spoiling his clothes. But there was plenty of air in rapid circulation in both the caves. I have spent considerable time down at the bottom of deep coal mines, where the best of appliances are kept going to provide the workings with fresh air, and once was within five minutes' time of losing my life for the want of air, having wandered into an old working void of air currents, but I never felt the air of a coal mine to be so fresh, so sweet, and so much of it as there was in each of the caves I visited, yet no artificial means was used to supply it. Each cave gave a lasting and high-class object lesson showing how spring water was secured and why it is generally so wholesome to drink. A few weeks after I visited the cave I went to the foot of the same mountain at the east end, and witnessed a large volume of water gushing from an opening between two rocks. This volume of water forms the head of that noble river called the Aire in England. Might not the water be a portion of the broad river which I saw in the cave. When a town is fortunate enough to possess a good spring of water it may be accounted rich, because it will form a constant supply even in the driest seasons. It is a storage reservoir, a filtering plant, and an aerating apparatus all combined, that cannot possibly be injured or tampered with. If a spring can be secured, say about 300 feet above the level of the town, the water may be piped direct to the consumers, because the pressure will be about right for working, viz., about 140 lbs. to the square inch; if the level be higher then the pressure would need reducing, and the water might be conveyed to a small well or reservoir situated at the proper level, to create the pressure of water called for by the council of the town, to be placed in the mains, and arrangements could be made so that as the water travels from the spring to the well head (or reservoir placed at the head of the distributing mains) to break up the stream of water, and give it another and further aeration before it enters the closed pipes.

The pressure of water should not be less than 100 lbs. to the square inch, and need not be over 150 lbs. A town having a working pressure of 150 lbs. to the square inch, and possessing a plentiful supply, may run all the small machinery, such as hoists, turning lathes, sewing machines, washing machines, the bellows of organs, and any machine not requiring more than 10-horse power, with their water supply at a nominal cost. The chief difficulty with towns' water supplies is to arrange and manage them so that they are not damaged by frost. We have often read items stating that during the past winter large fires occurred because the hydrants were frozen, which delayed the firemen and prevented them from extinguishing the fire while it was confined to limited area. Then several of our cities and towns have provided steam boilers on wheels that have gone from street to street thawing out house services that would become hard frozen again immediately if the water was not allowed to run during the time the cold snap continued, thereby wasting more value of water than would be paid for, for the whole year's supply. This is certainly a ridiculous state of things that can be avoided by using practical judgment and paying proper attention to the small details during the installation, and intelligent management after the works are completed. Few men, however clever, can correct errors of construction. Our present pattern of hydrants could be improved, because they are heavy and clumsy, often so given to leaking that they keep the earth which surrounds the vertical column always wet, and many of them leak enough to keep the interior of the column filled with water to the street line, and when that is the case the slightest frost affects them and they become useless. The valve arrangement at the bottom should be improved. But if the hydrants were always perfect and tight they would be subject to freeze if the vertical columns were surrounded with wet earth and there were no drain at the foot to remove the surplus water.

It is almost idle to believe that any town or village, wherever situated, cannot have a good supply of water at a reasonable cost. If the waters of lakes, rivers or springs supplying wholesome water are not to be secured at a reasonable cost, then take advantage of the water-bearing strata under the earth, they exist in abundance, and mechanical skill has provided reliable means at a trifling cost to bring the water to the surface. Some fifteen years ago I got a 4-inch hole bored down through the earth's crust to a depth of thirty yards, when water of the very best quality for domestic use rushed up through the bore hole to a height of twenty feet into the air, and it cost me quite as much to bring that stream under control and provide a drain to remove the surplus as it did to bore the hole through the earth. I lowered a 3-inch galvanized iron pipe through the earth to the depth the drill had cut then puddled round the outside and fixed a turnover bend on the top that I could attach a fire hose to, and a grated gully underneath to carry off the water, which completed the expense, and from that time to the present the flow continues the same. But a force of water similar to that can be met with but very seldom. There are persons that have the gift of pointing out the exact place where suitable water can be found, and if the bore hole is cut down as little as five yards from the place pointed out perhaps not a drop of water could be secured. Persons used to visiting mines and caves deep down in the earth can easily understand why.

THE LIQUEFACTION OF AIR.

A great deal of attention has recently been attracted to C. E. Tripler's experiments with liquid air. These have been extensively described in more or less popular magazines and yellow journals. We have not yet, however, been given any clear statement of the case by Mr. Tripler himself, nor has his process of liquefaction been made public to any degree. We have been pleased to receive from Norman W. Henley & Co., New York, a new volume on liquid air and the liquefaction of gases, by T. O. Sloane, Ph.D., which contains a great deal of interesting information on the subject. A general discussion of the physics and chemistry of air, etc., together with an outline of previous experiments in liquefaction, take up the first 300 pages of the book, and these chapters are a most interesting resume of progress in this direction. A very full description, with illustrations of Mr. Tripler's experiments with liquid air, is given and they are very varied and most interesting, but chiefly from the spectacular standpoint. A description of the laboratory in which the air is liquefied is given, and while complete details of the air compressor, which is a Norwalk straight-line compressor, are to be obtained, there is no information practically as to the construction of the liquefiers, which, as the author remarks, "has not been fully divulged." We quote that, "they appeared as long felt-covered cylinders. Inside the felt wrappings are cylindrical cases containing coils of copper pipe. At the bottom of the coil of pipe is a special valve, the invention of Mr. Tripler. The compressed air escapes from the valve, and, expanding suddenly, experiences a drop in temperature. Some of the cooled air works its way up through the chamber and cools the coil of pipe. Thus there is established an intensive or accumulating action. The air entering the liquefier at a normal temperature is cooled by the reverse flow of expanded air. It escapes from the valve at the bottom at a temperature which constantly grows lower until air begins to liquefy and collects in the bottom of the liquefying chamber. Now all is in working order, air is liquefying and collecting, and in a short time liquid air can be drawn off by the gallon just like water. Three or four gallons of liquid air are produced in an hour in the usual operation of the plant."

The chief interest is not in Mr. Tripler's experiments, however, but in the economy or lack of it which characterizes his production of liquid air. He seems to claim to be able to operate his apparatus with a portion of the liquid air which he produces. This is not perpetual motion, but its amplification would be unlimited power at infinitely small expense. We await with interest a complete demonstration of Mr. Tripler's methods. In the meantime it would seem that a mysterious motor is about to occupy that position in the public regard which was so long and successfully filled by the famous Keeley motor.

LAKE NAVIGATION IN CANADA.

The first move in the direction of constructing ships suited to the changed conditions of lake navigation in Canada caused by the enlarging of the St. Lawrence canals, has been taken by the organization of the Canadian Inland Transportation Company, whose application for incorporation is now before the Dominion Government. Among the promoters of this company are Geo. H. Bertram, president of the Bertram Engine Works, Ltd.; J. K. Osborne, vice-president of the Massey-Harris Company, Ltd.; Senator Forget, president of the Richelieu and Ontario Navigation Company. The proposed capital is $4,000,000, and the company will carry grain. For this purpose it is proposed to build ten steam barges, each of which will be capable of carrying 75,000 to 80,000 bushels of wheat, as well as to erect adequate terminal facilities in the shape of elevators, etc., at Port Colborne, Montreal, and Quebec. Pending arrangements for the completion of the organization, one steel barge of 78,000 bushels capacity will be built; in fact the work of construction has already begun at the shipyard of the Bertram Engine Works Company, Ltd.

BORROWED PLUMES.

There is something lacking in our municipal system. The aldermen are allowed too complete control of the professional heads of departments during their tenancy of office and they have too great latitude in dismissing and appointing. The recent amazing performance of the city council of Victoria, B.C., which appointed a Toronto carpenter to the most important office in its gift, that of city engineer, is a complete demonstration of the folly of present methods. The aldermen of Victoria dismissed the former engineer, A. E. Wilmott, a member of the council of the Canadian Society of Civil Engineers, without a moment's warning. Such a dismissal by such an aggregation is a testimonial to Mr. Wilmott's ability and integrity which is the more complete when viewed in the light of the fact that out of twenty five applicants for his position the first choice of the council was a carpenter, whose friends insist that mental disturbance is the cause of his actions, not a deliberate desire to defraud. Be that as it may, W. B. Ferguson obtained the appointment through copies of testimonials whose originals have never so far as we are aware been seen by mortal eye. As will be seen from his most extraordinary letters to this journal which we publish herewith, he claims to be a graduate of the Royal Military College, Kingston. There is no such name, however, on the books of that institution, nor could anyone be persuaded that the writer of these letters had graduated even from the public school.

The day before his departure for Victoria, Mr. Ferguson called on the editor of THE CANADIAN ENGINEER, and stated that he had been appointed city engineer of Victoria, B.C. His statements were so various that they roused more than usual interest. He had been appointed sole arbitrator in the Point Ellice bridge claims; he was going to spend $300,000 on harbor improvements in Queen Charlotte Islands; he had spent the last five years in travelling in the United States and South America examining engineering works.

Of course when the new city engineer arrived at Victoria and failed to produce the originals of his testimonials, even the Victoria aldermen thought there was something wrong. Had he been possessed of some papers to show those sagacious judges he would have been loosed upon the city to work his own sweet will upon the public works so far as the aldermen would permit it. Just how far that would be may be seen when the clause in his letter is considered in which he states that he has not been twenty-four hours in the city and every alderman has explained the situation to him.

One very peculiar feature of the affair is that Mayor Shaw, of Toronto, wrote a letter introducing Mr. Ferguson to Mayor Redfern. Now, Mayor Shaw has a right to introduce anyone to anyone else if he sees fit and even if he himself knows neither of the parties implicated in the ceremony, but he should be more careful in the language employed in these valued communications. In his favor to Mr. Ferguson Mayor Shaw stated that he "understood Mr. Ferguson was recommended" by a certain engineer, Now, Mr. Shaw understood nothing of the sort. Mr. Ferguson stated that such was the case and Mayor Shaw had no other reason for any understanding in the matter than that. What a basis that was for any statement we believe we have already shown. It should be stated that Mr. Ferguson had some years ago been employed as a foreman on street paving work in Toronto, and also that he unblushingly assured the editor of this paper that he had been the engineer-in-charge of the conversion of the Toronto Railway from horse-cars to an electric trolley system. We append the letters referred to:—

Victoria, B.C., Mar. 30, 1899.

Office Canadian Engineer Toronto

Messrs Sir

I promised to write to you when I arrived here—well I got here last night very tired—for I was one week on the road—but as comfortable as can be under the circumstances—I visited His Worship the Mayer of Victoria - Chas. E Redfern, Esq. —a very plesant nice person—an he took me—through the Hall and introduced me to the City Officiols—and also explained to me an outline of proposed works in contemplation there will be a great amount of work here in street paving and reconstruction there has been very little of that line done here then the drainage is inadequate and will be entirely remodelled as well as the present Water Supply. I have not had any chanct to examine into the present existing systim Myself for I am not 24 hours here as yet—but as you know every one of the City Alderman has their story to tell—about what it is and the remedy—well I have got to listen to all and say nothing untill I examine everything myself I will have a very busesy time of it this season—but will find time to write you a few lines now and again how things are going here and how it is done There is one thing here which will need a thorough reform and that is the present method of collecting and disposal of the city Garbish the method here now in use is for every person to get it away the best he can—And it looks rather Ancient to see a number of Chinaman with long sweep over their shoulders and two large baskets one at each end of the sweep or pole filled with the Garbage of the city carring it on their shoulders away to the dump—and no person to look after or direct the disposal of them—or direct the affairs of that department. In some of the yards of the Chineese Portion of the City the accumulation of Garbage are considerable—the Water here is not the Best. Victoria is a very Beautiful City Easily drained some very fine Buildings but the streets all need completely remodelling. They have a very good Electric car service and Electric light system. Victoria is a Stiring City in fitting out parties going to the Gold Region and it is a very fine climate—the coldest time last winter was 10° Frost and now the Grass is green—the Flowers are out in full bloom and trees partly out in leaf most of the Grain is sown now and some are coming up through the ground. Please send Canadian Engineer to Wm. B. Ferguson, City Engineer Victoria B.C. and oblige—I will write you mor later on.

Yours

W. B. FERGUSON.

P.S.—I enclose cliping from a local Paper—the gentleman says the he frequently had occasion to see me in my earilier days when I was working hard at my calling and also—when I was attending the Military College—and that he will be here in about a month and call on me I am given to understand that my appointment was unanimous in the council. W. B. F.

"Among the arrivals from the East who registered at the Dominion last evening was W. B. Ferguson, C.E., of Toronto, Victoria's newly elected city engineer. Mr. Ferguson is a veteran in his profession and has had long experience in sewerage, waterworks and kindred municipal problems. He is prepared to enter upon the duties of his new position immediately."

Victoria, April 5th, 1899.

Editor Canadian Engineer

Toronto

Dear Sir

Things are not what I would like here and so I sent in a commucation to the council declining to accept the Position of City Engineer here under the Existing Conditions unless the Conditions are greatly modified and changed—the terms are such that—an Engineer to have charge of the work must have controll of the men and here he has not, when I declined to accept the position every one was down on me then—because—by me wanting to have entire control of the men—deprived the alderman from power of putting on men whenever they wished so I seen I was going to have trouble so I quit—so post nothing up here to me at present I am now going north up the Island and will write you then—later on—I remain you

W. B. FERGUSON.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports into Canada from Great Britain of interest to the metal trades for the month of March and the three months to March, 1898 and 1899:—

	Month of March,		Three Months to March,	
	1898.	1899.	1898.	1899.
Hardware	£2,032	£1,733	£5,270	£4,387
Cutlery	2,947	3,368	9,559	11,188
Pig iron	689	284	2,541	1,046
Bar, etc.	411	545	1,823	1,791
Railroad	..	..	6,922	..
Hoops, sheets, etc.	697	2,287	3,450	4,030
Galvanized sheets	1,875	741	4,393	1,561
Tin plates	6,722	9,658	24,590	21,205
Cast, wrought, etc., iron	1,981	1,904	5,552	4,344
Old (for re-manufacture,	323	..	403	..
Steel	5,295	2,774	15,922	8,463
Lead	1,090	1,505	2,608	2,527
Tin, unwrought	1,838	2,274	2,758	4,907
Alkali	2,593	1,924	5,457	4,320
Cement	81	508	1,955	759

CULVERTS AND BRIDGES.*

BY A. W. CAMPBELL.

The majority of Canadians, when visiting Europe, are impressed with the durability and solidity which characterizes the structures of that country. Private residences are built to withstand the wear of centuries. Cathedrals, public halls, libraries, and similar civic institutions are constructed, not merely for the present, but for future generations. Among the works marked by this durability are to be classed the public highways with all that pertains to them. Canada, in this regard presents a very unfortunate contrast.

It can justly be argued that Canada is a very young country, and that England is a very old country; that Canada is not a wealthy country, and that England is a very wealthy country. While England is, in a way, a very old country, yet it is not so much older than this country in the arts of civilization, which should teach our citizens and municipal councils the necessity for and the means of wisely spending money in permanent improvements. And while England is a richer country than Canada, that greater degree of wealth has been brought about, to some extent, by the very durability which we have so long avoided. Permanent improvements are the cheapest. Structures which need props and repairs within a year or two after they have been built, seem to be in a chronic state of starvation, with a ravenous appetite for money. Canadians have not yet outgrown the idea that they live in a pioneer land where the needs of the present entirely overwhelm the future. In nothing is this temporary building more apparent than in our highways; and in no detail of our highways is it more striking than in the matter of bridges and culverts. At the same time there is no portion of the making of a road that offers more scope to the road maker than in providing substantial and permanent waterways. Instead of the handsome stone and concrete arches that span so many of the streams intersecting the highways of England, there are to-day in this country scores of wooden boxes and trusses—flimsy, disjointed, unsafe; the constant source of accident, and the bottomless pit into which councils are annually throwing money in a vain endeavor to keep them in repair.

Considerable attention is generally paid to the selection of a good site for a bridge, and an effort is made to decide in the interest of economy, usually with a considerable measure of success. There is, how' [illegible] a tendency to cling to the line of original survey, rather t[illegible]n deviate the road slightly, when by doing so, much would be gained in lessening the dimensions of the bridge, securing firm foundations for piers and abutments, reducing cuts and fills of the approaches of the bridge; all of which, while they may not decrease materially the first cost, very frequently are of the utmost consequence with regard to maintenance, and may decide for good or bad, the usefulness of the entire roadway. The utility of a road with respect to hauling heavy loads, is not governed so much by the condition of the best section as by the worst; not so much by the level portion as by the steepest grade. Bridges, forming, as they do, a means of crossing valleys, are intimately associated with the problem of judiciously choosing between directness of route, easy gradients, and details of construction. The location of culverts is a matter of very common error. Water should be disposed of in small quantities, along natural watercourses, before it gathers force and headway. Instead of this principle being followed, water is frequently carried long distances by the roadside, past watercourse after watercourse, rather than build a culvert or culverts to carry it away without injury to the road. Where culverts are needed, they should pass directly across the road and carry the water away from it.

The size of bridge or size of culvert involves nice discrimination, in which local circumstances and the class of construction introduce various factors. For the size of waterway, no hard and fast rule can be given. Many existing culverts and bridges were at one time of sufficient size, but the clearing and draining and cultivating of the land now permits the water, after a rainfall, to reach the watercourse in a shorter time with increased volume, causing submerged roadway and flooded roadsides, while culverts and bridges are swept away. The best guide to a proper size of waterway, is an intimate acquaintance with the locality or the evidence of others who are, with respect to maximum rainfall, height of water line, previous experience as to floods, form and inclination of the stream and area to be drained, kind and condition of the soil, and similar details. Talbot's formula, proposed more as a guide to the judgment than as an unalterable rule, is at times very useful:

Area of waterway in sq. ft. $= C \sqrt[4]{(\text{Drainage area, in acres})^3}$

C. is a variable co-efficient, and the values given are: "For steep and rocky ground, C varies from 2-3 to 1, etc. For rolling agricultural country subject to floods at times of melting snow, and with the length of valley three or four times its width, C is about 1-3; and if the stream is longer in proportion to the area, decrease C. In districts not affected by accumulated snow and where the length of the valley is several times the width, 1-5 or 1-6, or even less, may be used. C should be increased for steep side slopes, especially if the upper part of the valley has a much greater fall than the channel at the culvert."

*Extracted from a paper read beford the Associat ion of Ontario Land Surveyors.

Waterways should be neither needlessly large, nor of too small dimensions, involving on the one hand unnecessary expense for first construction, and on the other hand, injury to the road, washouts, expensive repairs, and delay to traffic.

The materials available for culvert construction in addition to timber, are sewer pipe, concrete pipe, iron pipe, brick, stone, and concrete. Culverts are sometimes made of one of these materials alone, or of two or more in combination. When the dimensions of a bridge are reached, concrete and stone abutments and piers, with iron or steel superstructure; or stone, brick or concrete, alone or in combination, are the materials gaining favor.

For the small culverts, sewer pipe is very economical and durable if well laid. To render them secure against the test of a Canadian climate, they should be laid with a good grade, and the ends protected with concrete, stone or brick headwalls with deep aprons. The joints should be made water tight with cement. These precautions will provide against the action of frost, and will prevent the culvert being undermined by water passing along the outside of the pipe, either from the ends or through the joints. Care should be taken to excavate a concave bed for the pipe to rest in, always laying the spigot ends up grade. The pipe at the outlet should be set flush with the surface of the ground. If set higher than the surface the fall of water will wash out a depression and will in time undermine the end of the culvert. A too rapid grade will cause the same result. It is frequently well to cobble-pave the outlet, where this undermining action is likely to occur.

Excellent culvert pipe of concrete can be manufactured cheaply in any gravel pit under the immediate direction of the municipal engineer. The pipes are three or four inches in thickness according to diameter; which latter may safely and conveniently reach three feet. The implements required are of the simplest kind. The most important are two steel, spring cylinders, one to set inside the other, leaving a space between the two equal to the thickness of the finished concrete pipe. By "spring-cylinder," it may be explained, is meant such a cylinder as would be formed by rolling an iron plate into a tube without sealing the joint. With the smaller of these cylinders the edges overlap or coil slightly; but are so manufactured that the edges may be forced back and set into a perfect cylinder.

These two cylinders with joints flush, are set on end, the one centrally inside the other, and on a firm board bottom. The concrete made of first-class cement and well screened gravel, is then tamped firmly but lightly into the space or mould between the two cylinders. The tamping-iron used to press the concrete into place is so shaped as to fit closely to the cylinders. The concrete is allowed to stand in the mould for a few hours, when the cylinders are removed; the outer and larger cylinder by inserting an iron wedge into the joint, and forcing the edges apart; the inner cylinder, by inserting the wedge into the joint and turning the edges so as to allow them to again overlap, returning to the shape of a coil. The outer cylinder having thus been made larger, and the inner one smaller, they can readily be taken away, and the concrete pipe is then left until thoroughly hardened. Just such a number of pipes as are actually required for the season's work need be manufactured; the implements required are inexpensive, and the pipe may be made by the municipality for actual cost, which, after a little experience, can be reduced to a very small amount. Culverts of concrete pipe are laid in a manner similar to those of sewer pipe.

There is no departure which would more enrich the highways than the general use of stone and concrete for the construction of bridges and culverts. They cost more in the first instance, but the longer life, the fewer repairs needed, the greater convenience, the lesser liability to accident, render them in every way desirable. Concrete and stone are the only materials with which really permanent work of this nature can be constructed. Bridges and culverts of rubble masonry have existed in Scotland and Ireland with scarcely any repairs for more than a century, since before the time of Telford and Macadam. Concrete bridges and roadbeds built by the Romans nearly 2000 years ago are still in use in spite of efforts to destroy them in military operations. The cost of this class of work is constantly decreasing through the cheapening and improving of cement, through the lessened expense of procuring stone and crushing it, and through growing experience in the use of cement. In Scotland it is common for farmers to contract for rubble concrete bridges, provide the stone, and hire masons to do the work. In this way the entire expenditure is kept in the locality, among the people who pay the taxes, and is therefore, in spite of a slightly greater cost, not unpopular. Up to forty foot spans, this construction is not difficult.

In the construction of a stone arch, the first consideration is the foundation. The depth to which the excavation must be made will depend chiefly upon the span of the arch, and the nature of the natural soil on which it will rest. The chief object is that it shall be secure. If bed-rock comes to the surface it may be safe to rest the base of the arch upon it without any further excavation. A firm hardpan may exist a short distance below the surface of the ground. But a quicksand, or other insecure footing, may necessitate the sinking of piles, or the placing of a wide, and perhaps deep, concrete base. But the foundation must be sufficient to provide that the washing of water cannot undermine it, that the lateral thrust of the embankments cannot move it, nor that the weight of loads cannot cause it to sink. No more definite rule can safely be given than to make the most of local circumstances, with always a fair margin for safety. Full-centre arches, that is, entire semi-circles, are easily formed, possess great strength, and have little lateral thrust, but with wide spans, they necessarily rise to a correspondingly great height, and cannot always be employed. A segmental or flat arch will lessen the rise, but has a considerable lateral thrust which necessitates very strong abutments. A compound arch, made up of a number of different circles, when rightly proportioned, combines the advantages of the two, reducing the height, and at the same time having an excellent appearance. The thickness of the arch and abutments depends on a number of details, the chief of which are: The form and size of the arch, the quality of the material composing it, and the character of the workmanship. The haunches or shoulders should be built from the spring of the arch half way to the top.

With regard to the masonry, first-class hydraulic cement should be used. The arch stones should be full-bedded in cement, and each course afterwards thoroughly grouted. Each stone should be cleaned and dampened before being placed in the arch. Improperly dressed stones should be re-cut, as no hammering should be allowed after the stones are set. The ring-stones should be dressed into a wedge shape, so that they will radiate truly from the centre of the circle, and should be so dressed that the joints need not exceed three-eighths of an inch in width. The ring-stone should be of such thickness as to expose ten inches on the inside or face of the arch. The exterior of the arch should be flushed with a one inch coat of cement and surface then smoothed off.

Arch-culverts and bridges of cement-concrete can be more cheaply constructed than can masonry arches, and, if careful workmanship is employed, are quite as serviceable. They are formed by constructing a curbing and thoroughly ramming the concrete into it in successive layers. The manner of mixing the concrete depends on the character of the cement used, some cements being slow setting, others quick setting; some will set well in water, while others will not; some will allow a considerable proportion of water to be used in forming the mortar, while other cements should be but slightly moistened. One feature in connection with concrete culvert work is that, with the curbing and centres in place, any intelligent workman can, by following the instructions of the engineer, lay the concrete. Manufacturers complain that masons, in the great majority of cases, entirely disregard the instructions given them with respect to the mixing of cement, and follow their own methods of mixing common mortar; while a man totally unaccustomed to work of this description will obey instructions carefully and minutely. Concrete cannot be mixed and put in place like common mortar, and by overlooking this fact, much concrete work has failed, and has brought the material into disrepute in some localities.

The most substantial substructures of bridges are of either stone or concrete. In their construction sufficient excavation must at first be made to properly contain the abutment, and this earth may be refilled again so as to form approaches to the bridge. The excavation completed, when concrete is used in whole or in part, the portion thus constructed must be boxed and curbed in a substantial manner the exact size and shape required. After the concrete has set this boxing is removed and earth filled in solidly around the face of the abutments. Hammer dressed stone should crown the concrete to form a bridge seat.

Concrete should be composed of first-class cement; a clean sharp silicious sand, entirely free from earthy particles and coarse enough to pass through a twenty mesh and be retained on a thirty mesh sieve; clean screened gravel, the largest not to be more than two and one-half inches in diameter; or in place of gravel, broken stone that will pass through a two inch ring. These materials should be mixed in the proportion of one of cement, two of sand, and three of gravel or broken stone, with just sufficient water to form a plastic mass. The sand and cement should first be thoroughly mixed when dry, then water added to make a thick paste, and this thoroughly mixed again. This mortar is then spread out, and the stone or gravel added, when the whole is mixed together until every stone is thoroughly coated with mortar. When this is done the concrete may be put in place and should be spread out and pounded until the excessive moisture appears on the surface.

The design of iron or steel bridges commonly erected may be classified under: The plain beam or girder; the beam truss; the suspension truss, and the bowstring or arch truss. The first of these is well understood; the second comprises those trusses in which both bottom and top chords are essential; the third includes those in which the upper chord only is necessary, in which the horizontal tie takes the place of fixed abutments. The style chosen should be governed by circumstances and economy; but apart from this any design is good so long as it can be accurately analyzed as to the character and amount of strain in all its parts. On the other hand any design which cannot be so analyzed should not for a moment receive consideration. The course pursued by some, indeed most municipalities, in erecting iron bridges is likely, however, to result disastrously, and throw iron and steel into disrepute. A council advertises for tenders. The companies responding supply their own plans and specifications. Thus far the procedure is entirely satisfactory. The difficulty arises when the councils accept the lowest tender without obtaining the advice of an experienced builder of iron bridges as to the plans and specifications submitted. Cases have occurred in which a difference of five dollars has influenced a council to accept a tender for a bridge which manifestly, to a man of experience, was worth less than the other by several hundred dollars: and which was indeed unsafe, offering every likelihood of failure, with attendant loss of life, and great expense for reconstruction. It is difficult to understand the action of councillors, shrewd in other matters, in the construction of bridges and other public works proceeding with such apparent disregard for the true interests of those whom they represent. A small sum in securing reliable advice is as much a matter of economy in public as in private affairs.

INSTRUMENTS FOR MEASURING SMALL TORSIONAL STRAINS.*

BY E. G. COKER, B.A., B.SC., M.I.M.E.,
(Late Scholar of Peterhouse, Cambridge)

The advances made within recent years in the scientific testing of engineering materials have caused great attention to be paid to the design of instruments for measuring small strains. By far the greater number of such instruments have been devised for measuring the small strains of extension or compression in bars subjected to a direct pull or push, and but little attention has been paid to instruments, for the use of engineers, in the measurement of the small strains in a bar subjected to twist. The object of the present paper is to describe two arrangements of apparatus intended for use in engineering laboratories and testing houses for measuring such strains, and for the determination of the modulus of rigidity. Each instrument is wholly supported by the test bar, being secured thereto by screws, which grip the bar at two transverse sections separated by a known interval, and the relative angular displacement between these two sections is measured directly. The instruments are adapted to measure both large and small strains, and are self-contained, while they can be used in a horizontal, vertical, or inclined position.

One form of the apparatus is shown by Fig. 1, and consists of a graduated circle A, mounted upon a chuck plate B, provided with three centering screws adjustable by hand. A ring C, secured to the test bar by set screws at a known distance away, carries a swivel arm D in which slides a tube E, so that

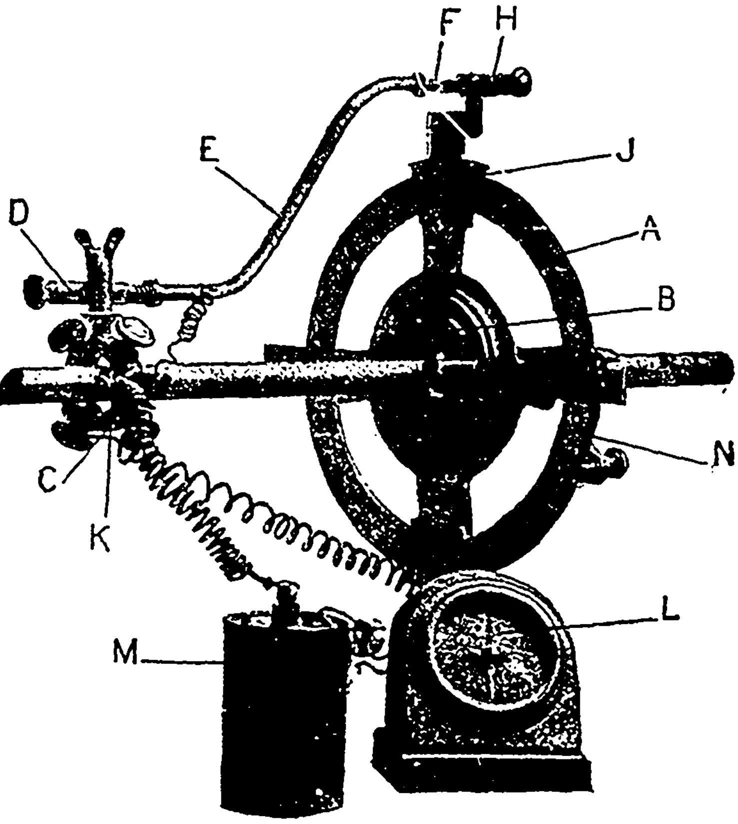


FIG. 1.

the contact ball F at its outer end can be brought into position touching the centre of the faced end of a screw micrometer gauge H provided with a divided head. This micrometer screw is mounted upon a vernier plate J of the graduated circle, and can be clamped in any position, the final adjustment being effected by a screw N. A silk covered wire connects an insulated binding screw K upon the ring with the contact ball, and this wire is joined up in circuit with a simple form of galvanometer L and cell M to a second uninsulated binding screw on the ring. If the contacting pieces are touching, a circuit is completed through the test bar, and the galvanometer needle is deflected. If now a twisting movement is applied to one end of the test bar, the contacting pieces are separated, and the micrometer screw must be advanced until the circuit is again completed as indicated by the galvanometer needle. The number of divisions through which the screw has been turned affords a measure of the angular displacement, and it only remains to calibrate these readings in terms of angular measurement.

The calibration is effected by reference to the graduated circle and vernier plate. The micrometer screw is set tangentially to the radial arm, and therefore its indications are nearly proportional to the tangent of the angle moved through but if the faced end of the screw is always maintained at or about its central position, the error introduced by taking the readings as directly proportional to the angular displacement is relatively small compared with the quantity under measurement, and may be neglected. To calibrate the instrument it is therefore only necessary to measure the number of divisions corresponding to a small angular displacement of say 10', and this is easily accomplished by setting the instrument in position with the circuit complete, and afterwards following up a known angular displacement of the vernier plate by the micrometer screw. A simple form of detector galvanometer, in circuit with a single dry cell, has been found to be a convenient arrangement for indicating when contact takes place, and the feeble current required does not injure the contacting surfaces. It is essential that the graduated circle be set accurately upon the bar, with its plane perpendicular thereto, and its centre coinciding with the longitudinal axis of the bar. An arrangement

* A paper read before the British Association for the Advancement of Science.

has been devised to effect this, consisting of two similar and equal clamp bars, the eyed ends of which take over outwardly projecting cones arranged diametrally upon the chuck plate and ring. Each main piece has one degree of freedom with respect to the clamp bars, and therefore two degrees of freedom with respect to the other, these degrees of freedom are suppressed by projecting plates fitting against corresponding projections on the main pieces, and this connection makes the apparatus a rigid whole. The bar is now inserted, and the screws adjusted by hand as accurately as possible.

The clamp bars are afterwards removed, leaving the two main pieces accurately spaced on the bar, while the graduated circle remains perpendicular thereto, and very approximately centred. The light contacting arm is then clamped in position, and the bar may now be set in the testing machine. An improved clamp described with reference to the second form of apparatus may be used instead of the arrangement described above, and the hand operated chuck plate may be replaced by a form of self-centering chuck described below. An example of tests made with this apparatus is given below. The test bar was adjustably secured at one end, and a balanced lever of fixed length secured upon the free end, and hung from the arm of a scale beam. The load was applied by placing equal weights in the suspended pans of the balanced lever and scale beam, so that bending movement was as far as possible eliminated. Before making a reading, the torsion arm was brought to a horizontal position by aid of a spirit level. The mean of the calibration tests gave 18.6 divisions of the micrometer screw as corresponding to an angular displacement of 1 minute of arc. Turned bar of Bessemer steel, length under measurement = 10.25 inches, diameter = 0.747 inches, torsion arm = 15 inches, a constant. The figures in the first column give the load in the pan at the end of a constant arm—

Load—lbs.	Reading.	Differences.
0	0	
1	26	26
2	51	25
3	77	26
4	103	26
5	128	25
6	154	26
7	179	25
8	205	26
9	231	26
10	256	25
11	283	27
12	307	24
13	333	26
14	358	25
15	384	26
16	410	26
17	435	25
18	460	25
19	485	25
20	510	25

If l = length of the bar.
d = diameter.
Tl = twisting movement.
θ = relative angular displacement.
C = modulus of rigidity.
Then for bars of uniform circular section—

$$C = \frac{32\, T\, l}{\pi\, d^4 \theta}$$

and we have for this test bar

C = 11,700,000 lbs per square inch.

A second test gave almost identically the same results. The performance of the instrument is limited by the accuracy of the micrometer screw, and in the present instrument the smallest angular displacement capable of measurement is about four seconds of arc. As the contracting bar is not heavy, no difficulty is experienced in balancing it, and therefore its length may be considerable. This form of instrument is therefore adapted for measuring the strains in long test bars. The second form of apparatus differs from the preceding in employing a reading microscope to observe the relative angular displacement of a radial line upon the vernier plate. The edge of a thick wire is a very convenient line for observation, and has been used with notable success in an extensometer designed by Professor Ewing (Proc. Roy. Soc., May, 1895). The instrument is shown by Fig. 2, in which A is the graduated circle mounted upon a chuck B, and furnished with a vernier plate J, an arm O of which carries a wire P. A reading microscope is carried in the sleeve R of an arm S mounted upon

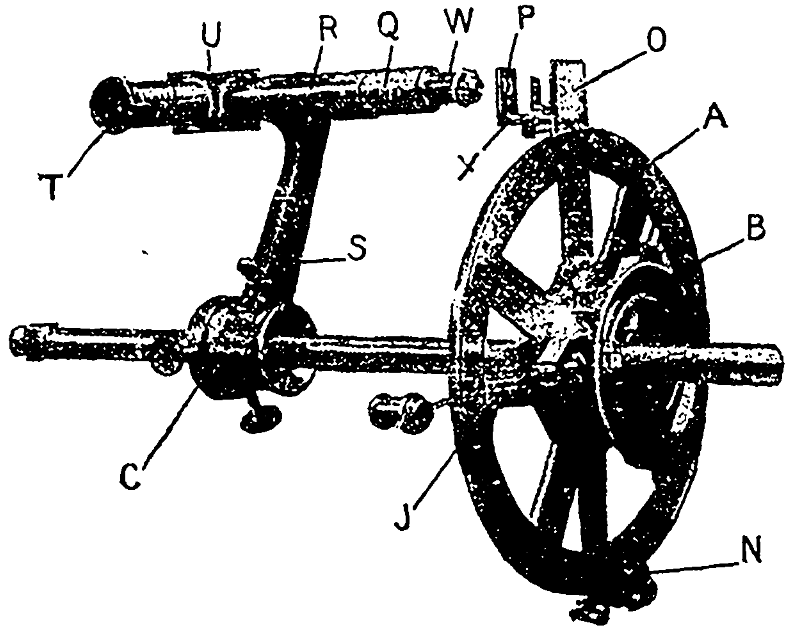


FIG. 2.

the short cylinder C, which latter is gripped upon the test bar by screws. The reading microscope has an eye-piece T provided with a glass scale, and a right-angled prism U is interposed between this and the objective W, so that readings can be easily taken. The tube Q is free to slide or rotate in its guide R, but, in order to readily focus the wire, this latter is carried in a frame X, pivoted upon the vernier plate J, and adjusted by a screw. The microscope arm S is secured to the cylinder C by a divided collar, the two halves of which are pivoted on one side and the free ends are clamped by screws. If it is desirable that the telescope be turned round or released altogether the screw may be thrown out of engagement. Since the difference between an arc and its corresponding chord is an infinitely small quantity of the third order, when the arc is an infinitely small quantity of the first, the readings of the microscope scale may be taken as directly proportional to the angular displacement, and the calibration is effected by moving the wire through a definite angle of 10', and noting the equivalent reading of the micrometer eye-piece.

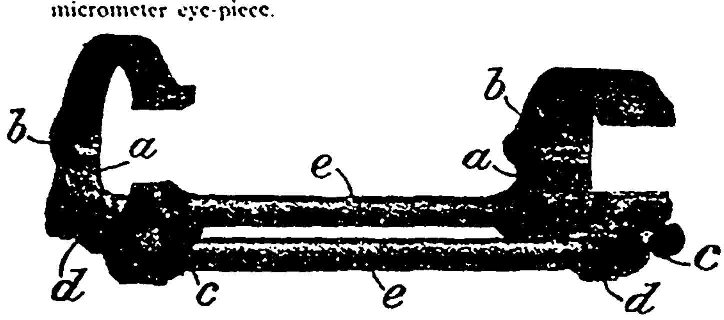


FIG. 3.

This instrument is furnished with an improved form of clamp, Fig. 3, consisting of a pair of divided collars *a*, the halves being pivoted together at *b*, and secured by nuts *c*. The collars are wedge-shaped in radial section to engage with corresponding wide-angled grooves upon the chuck plate and cylinder, only the angled sides being in contact, so that the collars are readily fixed when required. The lower halves *d* of the divided collars are connected by one or more distance pieces *e*, so that when the former grip their respective grooves each piece has one degree of freedom with respect to the clamp, and this can be suppressed by a pin or by the frictional grip of the collars, thereby causing the parts to act as one rigid whole for setting the instrument on the bar.

The graduated circle of this instrument is carried by a self-centering chuck of somewhat novel form, and a section through this is shown by Fig. 4, while a perspective view of the arrangement is shown by Fig. 5. There are three centering screws A', the outer cylindrical ends of which are supported in guides B', and prevented from rotating by pins C' engaging with slots S', cut in the screws. The screws work in rotating

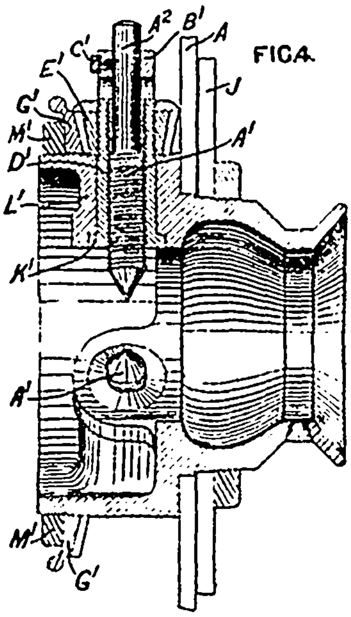


FIG. 4.

nuts D', provided with bevel pinions E', gearing with a hand operated bevel ring G', so that all the screws are advanced or receded together. An additional pinion H' is provided, operated by a key fitting on its squared spindle J', so that the screws are firmly gripped upon the bar. The inner ends of the nuts have a collar bearing K', so that the stresses are borne by the body L' of the chuck, and the bevel ring is prevented from seizing by bearing-plates and an adjustable ring M' at the back. This bevel ring can be slid back to allow any screw to be separately adjusted. Other modified arrangements

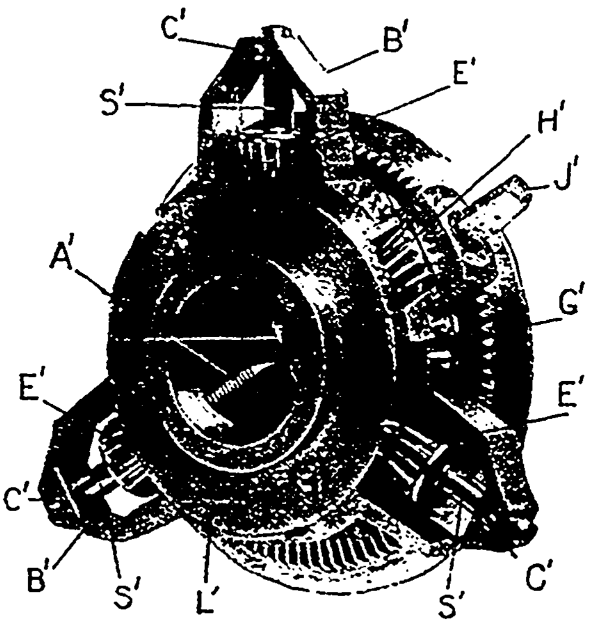


FIG. 5.

of the chuck have been tried, in which the guide pins have passed bodily through slots cut through the inner ends of the screw, and the screw pairs have been inverted, but these modifications have not answered well. An example of tests made with this form of apparatus is appended, the same Bessemer steel bar being used. Mean value of calibration test—1 minute of arc corresponds to 36 divisions of scale. Length under measurement 8 inches, diameter 0.747 inches, torsion arm 15 inches, a constant.

Load—lbs.	Reading.	Differences.
0	800	
1	759	41
2	718	41
3	677	41
4	636	41
5	596	40
6	555	41
7	513	42
8	471	42
9	430	41
10	389	41
11	349	40
12	309	40
13	267	42
14	225	42
15	283	42
16	143	40
17	103	40
18	62	41

and we have for this test bar C = 11,850,000 lb. per square inch. A second test gave very approximately the same result. Angular displacements of 1 inch can be measured with this form of apparatus. As the overhanging arm carrying the microscope is necessarily heavy, to afford the requisite stiffness, the length under measurement is limited.

For the purpose of making the angular displacements visible to an audience a magnifying arrangement is used, consisting of a tilting mirror, supported upon a tripod. Two legs of the tripod are supported by a hole and slot carried upon the vernier plate, and the third leg is supported upon a plane attached to the other main piece. The spot of light reflected from the mirror is caused to move over a fixed graduated scale, and the angular displacement is thereby made visible.

SWEDISH VERSUS CANADIAN IRON METHODS.*

Iron, its production and its manufacture, is even more essential to the industrial progress of a nation than sulphuric acid. The former is the bone and sinew of the mechanical arts, the latter of the chemical. The vitality of the nations of the world may be gauged by the amount of these they can absorb and assimilate. Tried by this standard, Canada is certainly not conspicuous for energy. The most cogent apology for the inferior position she occupies in the list of iron producers is found in the absence of coal in Quebec and Ontario. But, as these sections are supposed to contain iron ore of exceptional purity, to be covered with almost boundless forests, and to possess sulphur ores rich enough for export, a comparison is irresistibly suggested with Sweden, where exactly similar conditions exist, and which is, nevertheless, one of the most notable iron-producing and manufacturing centres of the world.

By all accounts Canada has large deposits of manganiferous iron on Hudson Bay, and still larger deposits of higher grade ore on Ungava Bay. The Newfoundland iron ore beds are notable for size and accessibility. If ores from the hyperborean forests of Sweden can be profitably procured to feed the furnaces of Europe why not the Canadian as well? For, to the modern sailor, the Atlantic is no wider than the Baltic Sea or German Ocean.

It is not to those iron ores which Sweden exports, but to those she treats at home, and to the methods she employs for overcoming her metallurgical deficiencies that I want to draw your attention. Through Central Sweden with a general trend to southwest and northeast is a band of Azoic rocks, the equivalent of our Huronian, about 100 miles wide and 200 long. Forest covers most of this tract. Within it are the mines, which, during the 17th and 18th centuries, produced the ore that made Sweden one of the most important factors in the iron and copper markets of the world. When cheap coal and coke became the fuels of the iron and steel makers, Sweden's prominence waned. For a time after Bessemer's great invention was introduced, Sweden's pure manganiferous pig iron was almost the only material to which it could be successfully ap-

*Extracts from a paper read by James Douglas, New York, President of the American Institute of Mining Engineers, before the Mining Convention, Montreal plied. But improvements in the process, and subsequently the adoption of basic converter lining, deprived Sweden of the advantages which, in this respect, her ores offered. Yet nothing daunted, Swedish industry and metallurgical skill prevailed, and to-day she has resumed, not her former position as one of the largest of iron and steel manufacturers, but her former importance, as the manufacturer on a large scale of the purest grades of those metals in the world. The intelligence and the flexibility with which Swedish ironmasters have adjusted themselves to new conditions and new requirements, is one of the most interesting phenomena of modern industrial life, and one well worth studying by Canadian metallurgists Again and again Sweden has led the way in certain directions, and been diverted from that path by the invasion of her markets by more favorably situated competitors, and yet she has often found a new outlet for her energies and her wonderful products. To-day, more than ever, quality, not quantity, is the aim of her ironmasters.

The ore in the central zone of Sweden is not all of exceptional purity, or equally low in low sulphur and phosphorus, and high in iron. Moreover, the mines which yield the present ores are not the largest, and the exceptional excellence of the product is secured, not only through the purity of the raw material, but also by dint of infinite care in the manufacture. The mining and metallurgical operations of even the largest concerns are conducted on what would be regarded on this side of the Atlantic as an insignificant scale. The furnace and plants generally are on a comparatively diminutive scale. The charcoal furnaces are small, the height being from 11 to 18 meters, or 36 to 59 feet. The average annual product of each blast furnace is 4,800 tons, or only 13.1 tons a day, and that of the largest 40 to 45 tons daily. It speaks well for the steady growth in production of the country that the figures for every decade since 1830 show not only a gain in production, but a reduction in exports, and, therefore, a healthy development of its internal resources. All the furnaces in Sweden make yearly only as much pig iron as one of Carnegie's great Duquesne stacks pours forth weekly. And yet, so intimately interwoven is the iron trade of Sweden with other of her staple industries, that the wealth of that thrifty little land, with a population (4,824,150 on December 31, 1893), rather less than that of Canada, depends in no small measure upon it.

Sweden's present prosperity is in great measure due to the association of three great branches of industry under common management, namely: 1. Iron and steel making; 2. Lumbering, and 3. Wood pulp manufacturing. Dissimilar as these pursuits seem they are in reality closely allied. The high character which the product of the furnace possesses, is attributable to the use of wood fuel alone. Not a breath of sulphur gas is allowed to taint the iron and steel during its reduction or subsequent manufacture. The iron companies which treat the purest ores find it more profitable to make a moderate output of extraordinary quality with wood as fuel, than to treat large quantities with mineral fuel. But in order to secure wood good enough for metallurgical purposes at a permissible cost, the iron companies own large forest reserves and convert the better grade and larger sizes of timber into dimension lumber and wood pulp. As an example: The largest works in Sweden are those of the Kopparberg Co. (the Stora Kopparberg Bergslags Aktiebolag) whose property is situated in the province of Dalicorlia The company produces about 1-10 of the total output of iron and steel of Sweden. The forests cover an area of 736,000 acres. Its sawmills are on the Baltic at Shutskar There the highest grade of lumber goes to the pulp mills, the second quality to the lumber mills, and only inferior and small lumber to the charcoal kilns for use in the blast furnaces, while mill refuse and sawdust are converted into gas for other metallurgical purposes. In 1896 the company's mills turned out 57,369 St. Petersburg standard = 113,590,620 feet broad measure and 5,500 tons of pulp. The pulp is made by both the sulphite and mechanical processes, the latter being possible through the possession of water power of 15,000 h p. capacity The sulphurous acid for the sulphite process, comes from the old Falun copper mines, from whose ores, in addition to the sulphurous acid for the pulp mills, over 2,000 tons of sulphuric acid are made annually

But the lumber trade of the company's activities is insignificant compared with its iron and steel operations. These are best described in the company's own circular, prepared for the Stockholm Exhibition in 1897:

In the year 1733 the company built their first iron works, Svartnas, based on the then discovered iron mines at Vintjarn. One iron work after the other was, later on, added, each intended for its own particular specialty, so that the company has manufactured iron at some 20 places in all. So many difficulties met, however, in economically carrying on the manufacture at so many places, on account of the expensive communications existing, that it was decided about 1870 to concentrate the iron manufacture, and for that purpose build new works, for which a place was selected at one of the big waterfalls of Dala river. This new works is Domnarfoet, which is the largest iron works in Scandinavia, and the largest in the world, based on charcoal as fuel. To it belongs 160 iron mines and a number of waterfalls, together capable of developing abcut 50,000 h.p., of which, however, only a small part at present is utilized. The works consist of the following departments:

Charcoal-making plant, eight large kilns. Blast furnace plant, with five blast furnaces, six Westman's roasting furnaces, regenerative blast heating stoves, etc. Bessemer works with five converters, etc. Siemens-Martin works with four furnaces of 15 tons each. Rolling-mill plant for sheet iron and plate, wire rods, rails, beams, channels, angles and all kinds of merchant iron. Forge for hammering tool steel and miscellaneous tools. Plate-pressing works for boiler heads and similar articles. Horse nail factory. The whole iron and steel manufacture, as stated, is based on charcoal, by the aid of which it is produced from the purest ores. The highest grade of steel for cutting and other tools, for springs, coining dies, etc.

The principal manufactures at Domnarfoet are: Pig iron, extra pure. Ingots, blooms, billets, and slabs of Bessemer and Siemens-Martin steel. Billets specially made for seamless cold drawn tubes. Projectile steel in large quantities for the English and other armies and navies. Bars in various shapes and steel and wire nail rods, wire rods, rivet rods of Bessemer and Siemens-Martin steel and Swedish Lancashire iron. Hammered bars of Swedish Lancashire iron. Rails. Boiler and ship plates. Sheet iron, corrugated and smooth. Pressed and flanged work of plate. Machine-strengthened shafting. Hammered steel (miners' drill steel, tool steel, shear steel, spring steel, file steel, pin steel, machine steel, file blanks, etc). Stone-cutting tools, hammers, anvils, etc. Horseshoe nails, etc.

The products of Domnarfoet are, to a large extent, exported to the great countries of Europe, to America, Austria, the East Indies, China and Japan.

The company also own two other works, Korsa and Ag, where especially soft Swedish wrought iron is made. The annual production of iron and steel is: 55,000 tons pig iron; 35,000 tons Bessemer ingots; 26,000 tons Siemens-Martin ingots; 4,000 tons charcoal iron blooms; 47,000 tons rolled and hammered iron and steel of all kinds; 1,000 tons horseshoe nails, bolts, nuts, spikes, etc.

The works yearly use 450,000 cubic metres of charcoal, 150,000 cubic metres of this being made in the kilns at Domnarfoet and Shutskar. It is by thus combining these reciprocally related interests that it is possible to make all three remunerative. Yet, even thus, the life of all would be short; in fact, the iron trade would have been extinguished long ago, but for the practice of strict economy in the consumption of the vegetable fuel and the application of the rules of scientific forestry. Only about 13 per cent of the total area is under cultivation and yet she exports to Britain $8,000,000 worth of dairy produce In traveling through the country the farms are so scarce and so hidden away in the valleys of the vast forest clad ranges, that one wonders where even the 50,000 kilometers of agricultural land are, and still more, how what there is can be made to yield such a balance of agricultural exports, considering how large a proportion of the population is engaged in mining and manufacturing pursuits, and is therefore a home consumer. By far the most extensive forests are in the north, and are not available for the fuel supply of the great metallurgical establishments of the middle zone.

The forests within reach of the furnaces have, therefore, been replanted and recut many times over during the centuries of mining and metallurgical activity. It is found that the most economical life of the coniferous trees is 40 years, within which period they attain a diameter of from eight to ten inches; you seldom or never see a larger tree in Sweden or Norway. Calculating from the statistics alone, to make 55,000 tons of pig iron and charcoal blooms at the Kopparberg furnaces, there are consumed 450,000 cubic metres of charcoal, or approximately nine cubic metres to the ton of ore, or one ton of charcoal to the ton of iron of both grades; for one cubic foot of pine charcoal weighs five lbs. to seven lbs., say six lbs., therefore, one cubic metre weighs 210 lbs., and if 55,000 tons of iron ore are made at the Domnarfoet works with 450,000 cubic metres of charcoal, each ton of iron consuming 8.2 cubic metres of charcoal, or 1,722 lbs, one cubic foot of pine weighs 18.9 lbs., and therefore, a cubic foot of charcoal weighs approximately 33 per cent. of the weight of one cubic foot of the same wood, but, taking the reduction of bulk into account, the charcoal from one cubic foot of wood weighs only from 20 to 25 per cent. of the weight of the original wood, or 5.04 lbs. Akerman (in Swedish Mining Industry Iron and Steel Institute, 1898), gives the consumption of charcoal per ton of pig iron at from 4.8 to 8.2 cubic metres, a very large margin of difference for different ores, different charcoals, and different establishments.

Only in very favorably situated districts can large quantities of iron be made with charcoal. Such a district would seem to be the original seat of the iron smelting industry of the old regime on the St. Maurice, Province of Quebec, whose waters are said to drain 200,000 square miles of forest land, and at the same time literally breed bog ore, so that the mineral and the fuel to reduce it grow simultaneously side by side. (Griffen T. of A. I. of M. E., XXI., 974). Yet, if there be pure iron ore accessible to a territory covered by good timber, and intersected by waterways and provided with abundant water-power, the establishment of such a combination of enterprises would confer a national benefit and should be profitable, for the value of such iron and steel is not to be measured by the price of common pig or ordinary steel. At present, the price of most Bessemer pig in the United States has been about $10 at the furnace, whereas Swedish charcoal pig iron is worth £5 c.i.f., Swedish malleable iron bars are quoted £9 5s. c.i.f., and hollow steel ingots, such as are used for bicycle-tube making, are quoted at $120 duty paid into the United States.

But such complicated enterprises as those of Sweden can nowhere be carried out profitably unless the same economical methods are adopted as those applied in Sweden. If they can be duplicated, it is surely in Canada, for Canada, like Sweden,

No.	Name of Mine.	Sesqueoxide of iron.	Peroxide of iron.	Pretoxide of iron.	Pretoxide of manganese.	Magnesia.	Lime.	Alumina.	Silic acid.	Sulphur.	Carbonic acid.	Iron.	Phosphorus.
1	Johannisbergs grufvan	61.57	.....	5.34	5.96	4.68	2.20	0.44	0.60	.....	12.10	53.80	0.003
	Johannisbergs grufvan	64.42	.....	6.13	6.88	4.72	1.62	trace	1.30	0.36	13.60	51.42	0.002
2	Bispbergs Stor grufva I	89.64	4.48	.....	0.14	0.78	0.60	0.32	4.46	.....	.....	68.05	0.003
3	Bispbergs Stor grufva II	73.75	6.54	.....	0.13	0.94	0.60	1.60	16.20	0.013	.....	58.00	0.008
4	Norbergs parish D: o Lilla Bads tugrufvan	.....	79.25	.....	0.05	0.15	0.50	1.00	18.80	0.009	.....	.....	0.021
5	Norbergs faltet new Skacelbergs grufvan	.....	8.51	.....	trace	0.11	1.30	0.18	13.00	0.076	.....	.....	0.011
6	D: o Old Stora By grufvan	.....	69.05	.....	0.05	0.30	1.65	0.60	28.25	0.021	.....	.....	0.034
7	Risbergs faltet speltal	.....	71.35	.....	0.15	0.10	2.25	0.50	25.70	0.006	.....	.....	0.003
8	*Hull Bed ore	.....	66.20	17.78	.....	0.45	3.42	....	10.46	.2180	.....	58.76	.015
9	*Hull Black ore	.....	73.90	.....	.....	1.88	....	.61	20.27	.085	.....	.....	.027
10	*North Crosby	.....	90.14	.....	.....	.84	.82	1.33	5.25	.120	.....	64.90	.007
11	*Belmont	.....	72.80	.....	.....	6.46	2.75	....	14.73	.....	.....	52.41	0.35
12	*Madoc	.....	89.22	.....	.....	....	....	....	10.42	0.73	.....	.....	0.12
13	*McNab	.....	84.42	.....	.....	1.04	5.40	....	7.16	0.65	.....	.....	.030
	Harrington, 1873-74—												
14	Bristol	.....	65.44	14.50	.....	....	....	....	11.45	1.40	.....	58.37	.....
15	†Levant	.....	63.73	.....	.....	....	....	....	4.466	0.032	.....	.....	0.028
16	†Glendower	.....	62.32	.....	.....	....	....	....	10.67	0.39	.....	.....	0.01

*Hunt's iron & iron ores, 1866-1869. †Rhodes & Co., A.I. of M.E. XX. 411.

This, therefore, rather conforms to above calculations of 8.2 cubic metres per ton of pig and charcoal blooms, at the works of the Kopparberg Co. American practice agrees with these figures, for instance: 1,922 lbs. of charcoal is consumed to the ton of pig in the Bay Farm Furnace, Michigan; 1,911 lbs. of charcoal to the ton of pig on the Morgan Farm, Michigan; 2,456 lbs. of charcoal to the ton of pig on Deer Lake, Michigan; 1,760 lbs., or 80 bushels of 22 lbs. each, make one ton of iron at the Hinkle furnace. Birkenbine in T. of A. I. of M. E. VII., 149, tries to reduce the consumption of charcoal to the standard of cordwood and arrives at the conclusion that four cords of soft wood will make one ton of pig iron. If therefore, only one cord of wood, as he states, is the yield from an acre of replanted timber land, and four cords are considered as making one ton of pig, to make the output of 500,000 tons of pig 2,000,000 acres must be cut over annually. In fact, however, when a large quantity of charcoal iron was made in the United States the forest lands around the furnaces were stripped and yielded about 30 cords to the acre. Forest conservation and careful cutting and replanting are not practised.

possesses boundless forests, intricate waterways, immense water-power, pure iron ores and sulphur mines. But, should the fuel or iron ore not be available for work on such a scale as the operations of the Kopparberg Co., there are ores accessible to the Ottawa, in treating which the sawdust and waste lumber of that river might be used. Whether the iron ores of Ontario and Quebec within easy reach of the Ottawa are as abundant as some claim, I cannot, of course, decide, but the analysis published certainly represents ores of such remarkable purity that they compare favorably, not with the best, but with the average of Sweden's and Bessemer ores. In the annexed table, 1, 2, 3 are examples of the Domnarfoet Bessemer ores; 4, 5, 6, 7 of good Swedish ores of second grade, and 8 to 16 are examples of Canadian ores from Quebec and Ontario:

Analyses are given of other ores. They indicate ores even lower in phosphorus. The amount of pyrites in these ores seems to be well within the limit of Swedish practices, where owing to the methods of firing in charcoal hearths, the percentage of S must, nevertheless, be small. This is attained by roasting. The gas calcining furnace of Westman is largely used.

The Canadian ores represented by the above analysis come nearly up to the standard of Swedish ores from the Norbergs district, Vestmanlands, and are purer than much which is sold as Bessemer ore from Lake Superior, taking the following as examples:

	Fe.	Ph.
Mountain iron	64	.045
Homer	64	.055
Tubal	62	.065

It is estimated that 700 to 800 tons of vegetable matter go to waste daily at the mills on the Ottawa, or, say, 450 tons of dry wood. If half of this, or say, 200 tons, could be converted into charcoal, in the Ljungberg kiln, it would yield 55 tons of charcoal and make over 60 tons of pig iron, while the sawdust would make gas enough to convert the pig into steel and to manufacture the steel into specialized forms. This amount of iron may seem insignificant, yet, it is more than one-tenth of Sweden's output. At present it is costly disposing of this valuable matter as waste, yet, in Sweden, every grain of sawdust, all the bark, and whatever will smoulder is carefully collected and turned into gas. Fish are abundant in rivers which turn half a hundred sawmills. Even if the law permitted of the pollution of the rivers, self-interest would forbid. Attempts have already been made in the United States to utilize sawmill waste in iron making. The Plattsburg, or Norton furnace, was built in 1877, as an auxiliary to Norton's sawmills, for the treatment of Chateauguay ore, but without much success. The appliances and metallurgical experience were at that date, however, vastly inferior to those now available. The Kopparberg company, for instance, now uses the Ljungberg continuous kiln, in which refuse wood is burnt into charcoal at 33 per cent. less cost than in heaps, and with 22 per cent. higher yield. The company reports that the yearly output per kiln is 200,000 hectoliters (=550,000 bushels) of charcoal. The kiln is charged by means of hoisting and conveying machinery. The work is mechanically discharged into pockets, when it is conveyed by rope transportation to the top of the blast furnace. The company exhibited at Stockholm, tar, acetate of lime, methylated alcohol, and other by-products of charcoal kiln.

Waste such as sawdust, shavings, bark, etc., too small or unfit for conversion into charcoal, is gasified in producers of peculiar construction. If the charge be sufficiently open to allow the free passage of air, the charge in the producer is 12 feet deep, if compact, as when sawdust is being burnt, six feet in depth. In the latter case, forced blast is introduced, on a level with the solid hearth, for no grates are necessary, there being clinkers, but very little ash. Formerly it was considered necessary to condense the moisture and the tar before the gas was burnt; but now the ligneous fuel is dried before being thrown into the producer, and the gas, if the producer be no further than 50 feet from the furnace, is burnt as it is made. The introduction of the wood gas producer enables charcoal iron to be made into open hearth steel, and this to be manufactured into articles which require high or accurately controlled heat, and the gas is made out of material whose disposal elsewhere entails cost and serious inconvenience to the lumberers.

If the circumstances in Canada be as supposed the methods pursued in Sweden are certainly well worthy of study by Canadian lumbermen and iron miners. To the combination of the two great industries of lumbering and iron smelting is largely due the prosperous condition of both in Scandinavia. To practice conservative forestry is what every enlightened economist and lumberman on both sides the line preaches, and what no one practices on a large scale, nor I fear will anyone practise it until obliged by law to do so. It requires no argument to prove that a perennial blessing is better than an annual one; but before the full benefit of scientific forestry can be achieved a large immediate sacrifice must be made, and afterwards the lumberman would, I suppose, have to be satisfied with a lower average scale of profits. To associate pulp making with sawmilling is doing no violence to either industry, but it would certainly strain the versatility of our most enterprising lumber merchants, were they to undertake as an adjunct the delicate task of iron smelting, steel making and tool manufacturing. Such complex industries must be the product of growth. But the first step towards the realization of such a system of exhaustive and economical utilization of nature's resources might be the establishment, if necessary under independent management, of iron and steel works, conveniently situated to the sawmills of the Ottawa, and under contract with the sawmill owners to supply mill waste. The failure of such old enterprises as the Hull furnace need not deter the promoters of such an enterprise, if they are satisfied of an abundant supply of pure ore; for a revolution in iron and steel making has taken place within the last 25 years. Moreover, charcoal, iron and steel are even rarer products than they were then; for, in 1875, the United States produced 515,700 tons of charcoal pig, whereas the output fell to 255,211 tons in 1897.

The production is never likely to be in excess of the demand. Such iron furnaces and mills need not be on the immense scale of the great coke and coal iron and steel plants. The famous Sandvik works, of Sweden, which supply the United States with the finer bicycle steel for tubing, turn out only 20,000 tons of finished product annually. Another company which exhibited its products in a separate pavilion at Stockholm, the Finspong, makes only 6,000 tons of open hearth steel ingots, 6,000 tons of open hearth steel castings, 600 tons of wrought iron blooms and 2,500 tons of manufactured articles. Compared with the enormous production of the United States, for example, whose blast furnaces made, in 1898, 11,900,000 tons of pig, the largest stacks touching 700 tons per day, Sweden's output, if measured by quantity, is almost inappreciable. Nevertheless, by adhering to the principle of never sacrificing quality to quantity, her comparatively small contribution of iron and steel to the world's total, owing to its unique excellence and its wonderful properties, maintains Sweden in a prominent position among the metallurgical powers. Her enviable position and bright example are, therefore, worthy of being taken to heart by Canadian miners, metallurgists and lumbermen.

METAL POLISH.

The makers of the U. S. Metal Polish state that it is the only polish that does not shrink, become rancid, gummy, tough, sticky or hard. They have the contract for furnishing the U. S. Government, and the polish was awarded four highest medals at the World's Fair, Chicago. The polish is claimed to be a perfect, easily-applied and non-injurious metal polish, producing a quick, brilliant and lasting lustre; warranted free of acid or grit. It removes stains and produces a brilliancy equal to new. It is unequalled for polishing and cleansing gold, silver and plated ware, show cases, scales and store fixtures, brass, nickel, copper, zinc and tinware, band instruments, locomotive and machine mountings, headlight reflectors, carriage and harness mountings, dairy and kitchen utensils, metal street signs and everything in planished metal. This polish paste is non-injurious to the metals or other substances it comes in contact with, or the person using it, and quickly produces, with little effort, the highest and most lasting brilliance. "U. S." Metal Polish Paste is put up in 3 oz. boxes, 1 lb. boxes, 5 lb. buckets, or in bulk, at lower prices, and on gross, great gross, bucket and bulk lots at large discounts. Trial sample sent on receipt of 2c stamp by the Aikenhead Hardware Co., Toronto.

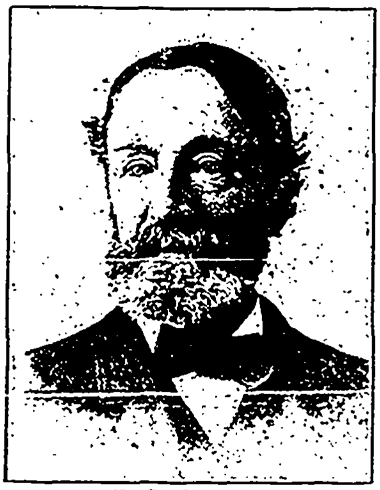
THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

At a regular meeting of the Canadian Society of Civil Engineers, under the presidency of Duncan McPherson, H. Irwin read a paper written by W. T. Ashbridge, on the construction of the main intercepting sewers of the city of London, Ont. It proved very interesting to those present, and a vote of thanks was unanimously adopted to both the writer and reader.

Mr. Irwin also criticized a paper read at a previous meeting, and written by W. B. Anderson, student. Mr. Irwin said that tests on the compressive strength of concrete were interesting, especially as concrete was so often used in foundations, though even where used for that purpose it was seldom subject to its full capacity for resistance to compression except on rock. There were some instances in the paper where a fuller explanation would save trouble in getting at its exact meaning. For instance, the method of measuring the proportions of the cement, sand and stone should be given, and in the column headed "percentage of water," it should be stated whether this percentage is of weight or volume. As regards the "first assumption," the cost of sand and stone could hardly be ignored under any conditions, since the sand would have to be handled, and the stone, if broken, could not well cost less than 3½ cents per cubic foot, or 95 cents per cubic yard. The remarked decrease in strength of the samples with three of sand and 1 of cement must be noted—as the voids in sand amount to about half its volume, such a result is to be expected. It does not seem quite clear that the compressive strength increases as the proportion of stone increases beyond the proportion of one of cement to five of stone, to such an extent as to warrant adding more stone to get greater strength. As no engineer would like to strain concrete up to the yielding point it would be more interesting to give the load at this point also.

THE LATE F. G. BECKETT.

By the death of F. G. Beckett, which occurred, as noted in our last issue, at the residence of his daughter in Inglewood, New Jersey, Hamilton, Ont., loses a valued and esteemed citizen. Mr. Beckett, who was always very active and energetic, left home in January to spend a short time for rest and recreation with his relatives in the United States, and was ready to come home when he contracted a severe cold, which


F. G. BECKETT.

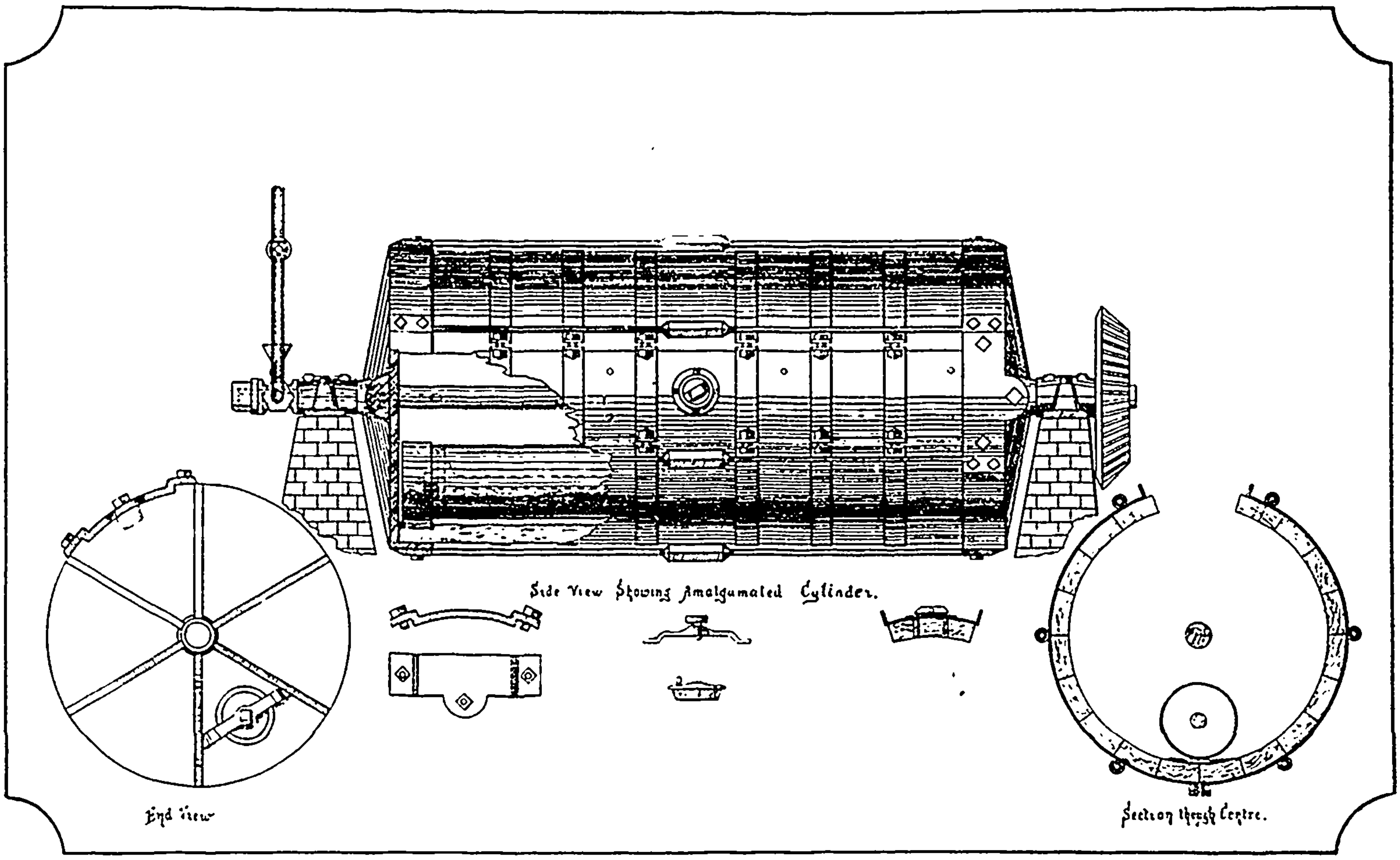
speedily developed into pneumonia and proved fatal after a short illness. He was born in Manchester, England, 68 years ago, where he served his apprenticeship as a machinist, coming to Canada about 45 years since, and locating in Hamilton. He obtained a position in the engineering shops of the old Great Western Railway. His ability was readily recognized, and he soon rose to a prominent place. After serving the railway for a few years he started in business in a small way at the corner of Macnab and Simcoe streets, on part of the site now occupied by the Canadian Colored Cotton Mills Co., where he manufactured engines and boilers. At that time there was very little engineering work done in Ontario, and Mr. Beckett was one of the most instrumental as well as one of the pioneers in introducing many improvements in engines and boilers. He was also the first to introduce and manufacture the portable threshing machine engines now so generally used in this country. Horse power was then almost universally used for threshing purposes. The business grew and prospered, and in 1865 the factory at present occupied by the Canadian Colored Cotton Mills Co. was built. The firm then employed some 300 men, and was one of the largest engineering establishments in the province. After that came a great depression in trade, and this, together with several heavy losses, seriously embarrassed the company. Mr. Beckett then removed to San Francisco, California. In a few years he was appointed chief engineer in the United States Mint. He was compelled to resign this position in consequence of an order from Washington, which prevented the employment of any but American citizens. Being too loyal a British subject to become a naturalized American he resigned and returned to Hamilton, and again went into the engineering business in partnership with J. H. Killey, under the firm name of the Killey-Beckett Engine Co., by which name it is still known. While Mr. Beckett was well known in engineering circles he was probably better known to the citizens of Hamilton as the originator of the Beckett Mountain Drive, and the promoter of the Hamilton, Ancaster and Brantford Electric Railway. Just prior to his death it was generally understood that arrangements had been made for financing and constructing the line to Brantford. The drive, which extends along the face of the mountain from Hamilton to Chedoke Falls is admitted to be one of the most picturesque in America. Socially on account of his high moral character Mr. Beckett was greatly respected, and by reason of his kind-heartedness and genial disposition was liked by all with whom he came in contact.

THE ROYAL COMMISSION ON SEWAGE DISPOSAL.

Enquiries are heard from time to time as to the progress which is being made by the Royal Commission on Sewage Disposal. The commission has had over twenty-five expert witnesses before them, including chemists, bacteriologists, biologists, medical officers of health, and engineers, some of these witnesses having occupied the time of the commission for two days each. Members of the commission have visited the works of sewage disposal at the following places: Exeter, Yeovil, Manchester, Rochdale, Chorley, Sutton, Doncaster, Dewsbury, Bradford and Leeds. They have also been engaged in determining a number of important questions relating to the desirability or not of laying down chemical and bacteriological standards which should be obtained by effluents, whether in the case of domestic sewage only or of such sewage combined with trade refuse. For this purpose they have employed experts of their own, and it is understood that the staff of chemists and bacteriologists has just been increased, so that the effluents from works of different character can be systematically studied almost hourly by day and by night under varying conditions of temperature and rainfall. No statement can as yet be made as to the term over which these experiments must extend, but it is quite clear that they are at present only in an initial stage, and that, in so far as bacteriological results are concerned, the commission are dealing with a subject as to which little expert evidence is available, and that the matter will have to be examined very deliberately and exhaustively before useful inferences can be drawn. These experiments are being carried out under the supervision of a committee of the Royal Commission, consisting of Sir Richard Thorne, F.R.S., Professor Michael Foster, F.R.S., and Professor Ramsay, F.R.S.—The "Lancet."

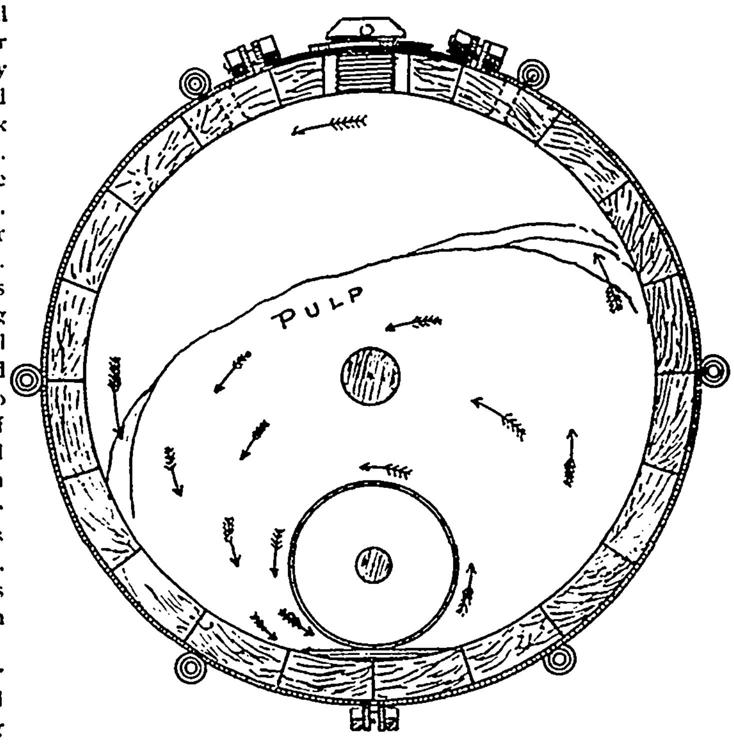
A NEW AMALGAMATING APPARATUS.

When a stamp or other mill crushes ores to a pulp that will pass through screens of a given number of meshes to the inch, the maximum size of the particles is indicated, but much of the mineral is reduced to smaller sizes, and amongst this is the fine and leaf gold generally known as float gold. Much of this is caused by abrasion, which takes place during the crushing of the ore, as can be readily demonstrated. If a ring or any metallic article be taken and rubbed across a piece of quartz or stone, it will be found that a streak of metal is left thereon. Upon examining this with a magnifying glass this will be found to consist of small particles, which, when liberated, are so fine that it is practically impossible for them to settle through the pulp, as they leave the battery and rush over the plates, the agitation of the water alone being sufficient to keep these small particles in suspension. Hence they are lost. All practical mill men are aware that great loss is caused by failure to catch this float and flake gold, and to overcome it R. H. Ahn, M. E. proposes the following treatment: After the ore leaves the stamps and passes over the mercury tables, by which means all the coarser particles of gold are collected, the pulp is to be conveyed to a pulverizing barrel, which reduces it to a much greater degree of fineness, from 100 to 150 mesh. The object in grinding to this fineness is to liberate from the coarser particles of rock and sulphurets (concentrates) all the very fine particles of gold. By using the pulverizing barrel, invented and patented by Mr. Ahn, it is claimed that all the concentrates, or sulphurettes, are ground much finer than the rock matter before they are discharged, thus liberating any gold they may contain and placing it in a condition to be readily amalgamated. By this means separate concentrating plants are made unnecessary,



also chlorination and cyaniding plants, the whole of the ore and its contents being subject to only one treatment. As the finely pulverized ore leaves the grinding barrel it passes into small bins or hoppers, each containing the exact charge for the amalgamating barrel. These bins, or hoppers, are so constructed and arranged as to receive their charge automatically and filter off any water above what is necessary for the proper consistency of the pulp when charged to the barrel. Any water so filtered from the bins or hoppers is conveyed into a receiving tank from which it is pumped into the tank supplying the stamps, thus saving the possibility of losing any fine gold that may be carried through the filters. The ore is crushed and ground dry, the bins require no filters and the moisture, either chemical or plain water, is added while the amalgamating barrel is in motion.

When the ore is ground to the desired degree of fineness it is charged into the amalgamating barrels from a bin containing the right amount for each charge, through a small circular opening at one end of the barrel, and when this is done the opening is fastened up by a plug which is held in place by a clamp, in the centre of which is a screw, thus making a water tight joint. The barrel is then started in motion by a friction clutch, carrying a pinion which works into the bevel gear fastened at one end of the shaft running through the barrel. At the opposite end of this shaft is attached an apparatus by means of which either water, steam, mercury or chemicals can be added in any quantities while the barrel is in motion, and if necessary the barrel can be so constructed so as to receive the ore without stopping. To empty the charge from the barrel, when it is sufficiently treated, the plug is removed from the opening, and the barrel turned down so that the opening is at the bottom; the opening being placed at such a point as not to allow any of the free mercury or amalgam that may be at the bottom of the barrel to escape. When the barrel is emptied it is so turned that the opening is again at the top and a fresh charge inserted. The charge for a full sized barrel, 8 x 4 feet, is one and one-half tons, and two and one-half hours is the time necessary for the treatment of each charge. Allowing half an hour for the discharging and charging of each lot it will be seen that one barrel will treat about six tons of ore per day of ten hours. The largest size barrel is four feet in diameter, and is made to revolve fifteen times per minute. A quantity of free mercury, specially prepared, is placed in the barrel, and as the barrel revolves, the mercury stays at the bottom of the barrel and thus gives an exposed surface of mercury during the two and one-half hours



equal, it is said, to ten miles. The amalgamated cylinder, which is part of the invention, is inserted in the barrel and revolves as the barrel revolves, gives an exposed amalgamated surface equal to that of the inside of the barrel, so that during two hours and one-half an amalgamated surface of over ten miles for each charge is exposed. By reference to the illustrations it will be seen that by the revolution of the barrel and the cylinder, the pulp is drawn down between the cylinder and that part of the barrel where the free mercury is, so that the pulp containing the gold is practically rolled into the mercury, or in other words, the pulp of each charge is exposed to an amalgamated surface of over ten miles, under pressure.

SECTION THROUGH THE CENTRE OF THE AMALGAMATING BARREL.

The second part of my invention is so constructed as to give a slight rub to the pulp as it passes under the cylinder just sufficient to break the surface of any small globules of mercury or amalgam that may have become coated, and thus render them more liable to be collected either by the free mercury at the bottom of the barrel or the amalgamated surface of the cylinder. The free mercury can be withdrawn from the bottom of the barrel at any time through the screw plug in the centre of the lid of the barrel. The cylinder can be taken out of the barrel, by removing the lid, and thus allow of the amalgam adhering thereto being removed, in a similar manner to the inside plates, or the outside apron plates of a stamp battery. The pulp is only moistened sufficiently during the early part of its treatment to allow it to flow easily, but not so as to allow anything to float therein, by this means all the pulp must be drawn down under the cylinder and forced into the mercury. A short time before the barrel is emptied, an extra supply of water can be added through the shaft at one end, without stopping the barrel, thus thinning the pulp sufficiently to allow any small particles of mercury that may be separated and carried up with the pulp to settle. By the arrangements at one end of the shaft running through the barrel, steam, water, mercury or any chemicals can be added to the pulp under treatment while the barrel is in motion. By reference to the drawing, which is a cross section through the centre of the barrel, the action of the pulp in connection with the cylinder will be readily understood.

This apparatus is to be placed on the market by Jas. Cooper, Montreal, and Fraser & Chalmers, Chicago.

THE ESTIMATES.

The estimates were laid before the House of Commons April 24th. The following are the amounts to be voted for various public works:

CANALS.

Soulanges Canal—Construction	$334,000
Sault Ste. Marie Canal—Construction	20,000
Lachine Canal—Enlargement	126,000
Lake St. Louis Channel—Deepening and straightening.	3,500
Grenville Canal—Enlargement	25,000
Lake St. Francis—Hamilton Island Channel, St. Regis Channel	35,500
Cornwall Canal—Enlargement	70,000
Farran's Point Canal—Enlargement	90,000
Rapide Plat Canal—Enlargement	92,500
Galops Canal—Enlargement	688,400
North Channel—Deepening and straightening	55,000
Galops Rapids—Removing obstructions	50,000
St. Lawrence River and reaches—River, reaches, canals	50,000
Trent Canal—Construction	845,000
Welland Canal—Deepening entrance at Port Colborne.	350,000

ONTARIO HARBORS, ETC.

Bowmanville harbor	$ 5,000
Bruce Mines wharf	10,000
Burlington channel, repairs to piers	40,000
Collingwood harbor	60,000
Goderich—Reconstruction of breakwater	46,500
Goderich—Dredging	20,000
Hawkesbury—Dredging	5,000
Kincardine—Repairs to pier and dredging	1,500
Kingston—Harbor and dredging	10,000
Little Bear Creek—Dredging	2,000
North Bay—Pile wharf	8,000
Oakville—Repairs to piers and dredging	45,000
Oshawa—Repairs to piers, providing harbor is transferred to municipal corporation, who will maintain it in future (revote)	8,000
Owen Sound—Dredging and pile work	$ 19,600
Picton—Dredging	5,000
Port Burwell—Harbor	45,000
Port Elgin—Construction of Groyne.	5,000
Port Hope—Repairs to pier and dredging	25,000
Port Stanley—Repairs to pier and dredging	13,000
Rainy River—Improvements to channel	1,500
Ottawa River—Improvements to steamboat channel	7,200
Saugeen River—Dredging	3,100
Southampton—Dredging	2,000
Sydenham River—Dredging	5,000
Thornbury—Dredging	3,000
Toronto—Harbor, works at eastern entrance, etc	75,000

QUEBEC RIVERS AND HARBORS.

Anse a Beaufils—Improvement of entrance to harbor	$ 7,000
Anse au Gascons (Port Daniel East)—Breakwater	4,500
Anse St. Jean—Pier repairs	500
Baie St. Paul, Cap aux Corbeaux—Extension and repairs to wharf	10,000
Berthier (en bas)—Heavy repairs to wharf and reconstruction of 470 feet of superstructure	5,000
Cap Sante—Removal of boulders	800
Grosse Isle—Repairs to wharf	2,000
General repairs and improvements to harbor, river and bridge works	10,000
Iberville—Wharf	2,000
Lake St. John—Piers, including improvement of approaches	2,500
Riviere a la Pipe—Wharf on Lake St. John near mouth of river	2,500
Les Eboulements—Repairs to wharf	2,800
L'Islet—Wharf	1,150
Lower St. Lawrence—Removal of rocks	3,000
Magdalen Islands—Breakwater	10,000
Maria—Wharf	10,000
Matane—Extension of training pier southwardly	4,000
River Cap de Chatte—Pier	2,000
River Chateauguay—Dredging	5,000
Riviere du Loup (en bas)—Wharf, repairs and shed	3,600
Riviere du Loup (en haut)—Dredging channel from Lake St. Peter to Louiseville	6,000
Riviere Richelieu—Beloeil channel—Guide piers	4,000
Riviere Saguenay, below Chicoutimi—Dredging	8,000
Riviere St. Maurice—Channel between Grandes Piles and La Tuque—Dredging	3,500
St. Alexis, Baie de Ha ! Ha !—Pier	4,000
St. Alphonse (Bagotville)—Landing pier repairs; shed	600
Ste. Anne de Sorel—Ice piers and connecting one pier with the shore	1,000
St. Anne du Saguenay wharf—Works of construction, etc	1,500
St. Fulgence—Pier and improvements	1,500
St. Jean des Chaillons—Improvement of harbor	5,000
St. Laurent—Repairs to wharf	4,500
St. Nicolas—Construction of a public wharf	1,300
St. Roch des Aulnaies—Wharf	3,500
Sillery Cove—Wharf at Pointe a Pizeau	5,000

HOT WATER HEATING.*

BY P. TROWERN.

This is a very important mechanical subject, heating with warm and hot water. I hope to be able to impress it on your minds with sufficient clearness. The elements involved in this are, air, water and heat. The third element cannot be resolved into its component parts as can air and water. We know by feeling that it warms us, but we cannot see it nor can we separate it from any substance as a gas or liquid; neither can we weigh it as air or water, we can measure it by the thermometer, but not by the gallon. Take 220 lbs. of water, i.e., 22 gallons, and heat it with fire, up to 212°, then weigh it again, and you will find it weighs the same as before, but now measures 23 gallons owing to the expansion caused by heating. It has therefore gained one gallon. You have all proved this by filling your kettle and not allowing room for the water to expand, then it runs over, the heat expands each molecule or grain, for nearly all substances, gas and matter, is composed of

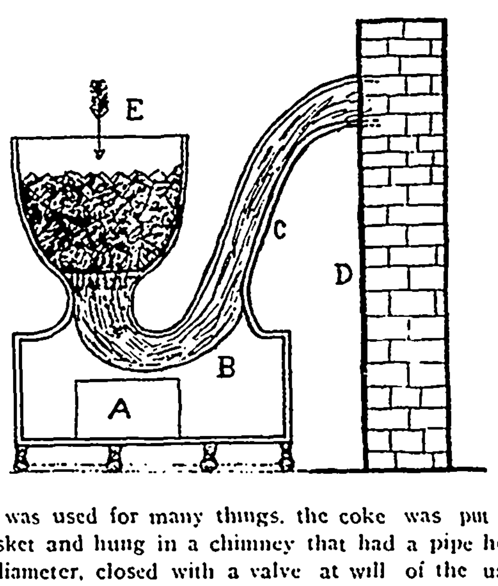
*From a paper read before the Canadian Association of Stationary Engineers.

grains; take a piece of iron, weigh it when cold, make it red hot, then weigh it again, it has not increased in weight but it has in size. Heat is always present and a portion of it is found in every substance; latent or hidden heat it is called, and is said to be a form of motion, or life in fact. Our thinking men are at a loss to know how to describe it or understand its nature, it must have come from the sun, and at first the world took it in, but now gives it out again by the coal, wood, oil, and other substances, the same as the light is given to the moon to be imparted to us for our benefit, while the sun is giving us light and heat to the other part of the world.

A knowledge of the elements we have to deal with should guide us in our choice of the best material, and plans to bring about or produce the best article for heating our houses. We are told that in Piedmont, in Italy, in the year 1347, fireplaces with overmantels were built in the houses, much the same as in our country houses of to-day, in which they burned wood on andirons, and the heat given out into the rooms was not more than 6 per cent., so much was allowed to escape up the large chimney. In the year 1624 chimneys were greatly improved so that they gave out 16 per cent., and it was found that it took 16 cubic feet of air to burn one pound of wood; it was also found that a room 20 feet long, 16 feet wide and 10 feet high, containing 3,200 cubic feet of air, required 20 lbs. of wood to raise its temperature 2½°. In the year 1713 it was found that a sheet-iron stove placed in the fireplace with six pounds of wood in it greatly raised the temperature, and that a cast-iron stove with four pounds of wood in it did the same as the sheet iron one. Each one had a pipe connected to it, and put into the chimney hole to prevent the heat of the room from passing away up the chimney.

In the year 1716 Sir Martin Friewald, a Swede, residing at Newcastle, England, made a boiler and pipes to heat his greenhouses with warm water. In the year 1777 brick flues and furnaces were introduced, the bricks would keep warm through the night, but soon gave way for cast and wrought-iron boilers; in some places copper was put into pipes and boilers but was found not to answer as well as cast-iron, and was more expensive.

Peat, charcoal and wood were the principal fuels used in early days, as coal made too much smoke. In the year 1626 Sir John Hacket made a basket to be put into the chimney to burn sea coal or coal that was brought by vessels over the sea from Wales and Scotland. About this time coke was made and



the gas was used for many things, the coke was put into an iron basket and hung in a chimney that had a pipe hole of 8 inches diameter, closed with a valve at will of the user. In 1678 Prince Rupert made a basket, standing on brass legs in the chimney, with brass handle, poker and tongs to stir the fire and keep it going; in 1680 a fire pot was made like a tea cup, small in the bottom with bars in it, so that the smoke could pass through, it was placed in an iron ash box with an iron door to take out the ashes, the air entered the fire from the top and passed down through the coke into the ash box, and then left the box at the far end through a pipe up the chimney; this plan was called the down-draught fire-basket, the fire bellows was brought into use about this time. In 1744 Dr. Franklin invented different plans with the downward draught. In 1753 Mr. Durns made a furnace or stove for burning coal. It was a round iron basket with bars of iron 15 inches wide, 5½ inches deep and 5½ inches wide; this kept a room 14 feet square at a temperature of about 62° for 13 hours, with one peck of coal; while it was 4° below freezing outside. In the year 1815 a Mr. Cutler made a stove and put it into the chimney to heat the room. In a few years from this time Dr. Arnott calculated that it cost the inhabitants of London more than two and a half millions of pounds for keeping their houses as clean as before coal was introduced.

In 1818 the Marquis of Chabonne, in France, found that to warm his greenhouse a 4-inch cast-iron pipe expanded one and one-half inches per 100 feet, and that a 1-inch pipe has four times more friction than a 4-inch pipe, and that water raised from 100° to 150° will expand from 30 to 40th part of itself, which must be provided for when setting the boiler and putting them together, and that one foot of surface in the boiler over the fire will supply 50 feet of 4-inch pipe. Isaac Watt tried an experiment at heating his room by having a coil of copper pipes made and put into his fire basket; the pipes connecting it were put around his room, with an expansion vessel up near the ceiling; it worked well for a time, but the copper pipes and joints were not strong enough, and besides, it became likely to freeze some cold night. In the year 1822, the year in which the writer was born, Mr. Bacon introduced his plan for a house two or three stories high; he found that a pipe 34½ feet high would give a pressure of 15 lbs. to the square inch, and that a boiler 3 feet long and 2 feet wide and 2 feet deep, with a pipe 28 feet high above the boiler would have a pressure of 30 tons, which led him to see that it must be strong and not have flat sides, to contain 75 gallons of water; he also found that two pipes, standing up 18 inches above the boiler, the hot or flow pipe would be 178°, and the return one at 170°, the difference of 8° will keep up a good circulation of water and heat the room. In the year 1830 Mr. Perkin invented this plan, and when the Asylum for the Insane in London was built this plan for heating the building was put into practice, and when the Toronto Asylum was ready Mr. Howard, the architect, copied the plan, and put it in to that building. In 1851 the British Museum was heated with it, as well as the Bank of England, postoffices and other large buildings in London. Two of the cottages in connection with the Toronto Asylum are now heated with this plan. I put them in about the year 1867. I do not think that this plan can be found in any other building in Canada; it has done good duty during the last cold winter; it is a little more expensive than our improved plans in the main building. Some 43 years ago I was appointed to take charge of this plant; it was working very badly, but since then it has done well. About 20 years ago I saw great improvement could be made. I laid my plans before the Government, which after serious consideration granted the necessary funds to carry them out; about twelve years ago I took out eight of the furnaces and put in two boilers in their places, which have done well. The four furnaces now in the cottages we intend to move and replace with one boiler for each, soon.

DAM BUILDING.

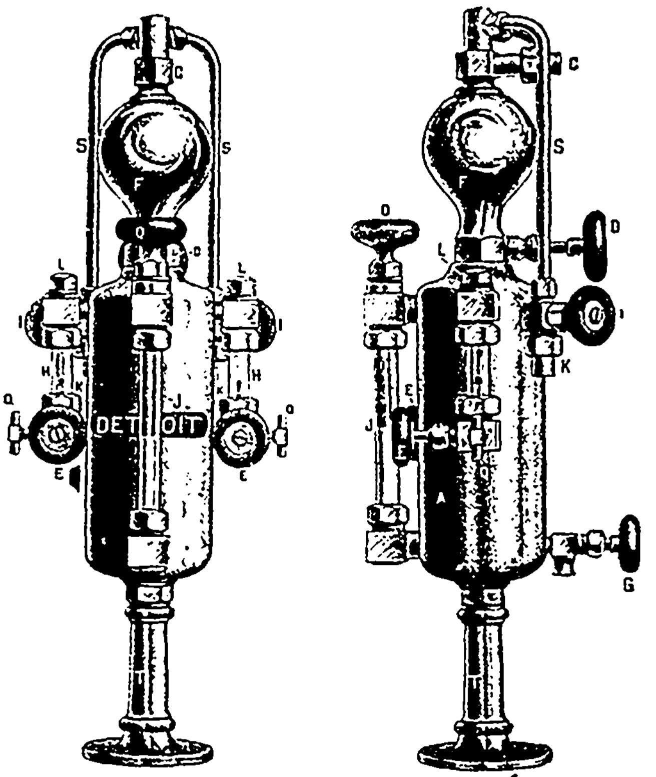
Editor CANADIAN ENGINEER :

Referring to Mr. Fielding's views re construction of dams, as courteously expressed at page 349 of your April issue, this gentleman is no doubt right, that in computing for factors to cross section of dam wall, some consideration should be due to length of structure; as a short dam would evidently derive some resistance to its giving, by friction at its abutting ends. Looking around in my mind's eye for some abetting theory or proof of the correctness of Mr. Fielding's holding in the premises, it occurs to me that he might predicate his assertion as to length of dam, on the fact that the cutting up of the length into two shorter stretches evidently adds to the efficiency as exemplified in the lock gates of a canal, where with the same thickness, the half dam or wall across the lock makes it sufficiently strong to stand the pressure, which it certainly would not do if a wall of the same size or thickness ran straight across from side to side, with almost double the length of structure. But this very mode of construction of a lock gate is also an argument in favor of the arched structure as compared with the rectilineal; and notwithstanding that this up stream arching or its efficiency is disputed, and was so in the discussion by engineers relating to the proposed "Quaker Dam" at New York; still would it seem that there must be something suggestive in the fact of a lock-gate-dam being thus arched up stream as it is, or thrown into a truss to stand the pressure, which it could not do if built straight across, and in a single flap or section from wall to wall, unless made considerably thicker. This is another fitting matter of enquiry, never as yet theoretically or practically discussed, for our friend Bovey, and the McGill faculty to exercise their ingenuity on, with request that he will air them. CHAS. BAILLAIRGE.

Quebec, April 12th, 1899.

LUBRICATOR FOR COMPOUND ENGINES.

The accompanying cuts show front and side views of the double sight feed lubricator made by the Detroit Lubricator Co., Detroit, Mich., for use on compound engines. Each sight feed is "equalized," that is, it is furnished with an equalizing pipe S, which supplies a current of steam to carry the drop of oil, as soon as it rises through the glass to the steam chest. They are also equipped with features which prevent siphoning or unsteady feeding, and a regular feed is maintained, it is claimed, under all circumstances, to both the high pressure and



the low pressure cylinders. The long experience of the makers in the manufacture of locomotive cylinder lubricators, in which, of course, both cylinders are supplied with oil from the one lubricator, has enabled them to meet and overcome all contingencies liable to arise with this class of engines. They also make triple sight feed, and quadruple sight feed lubricators for use on triple expansion and quadruple expansion engines. Any further data that may be desired will be furnished by the manufacturers on application.

IMPROVEMENT IN CAST-IRON FLY-WHEEL DESIGN.

There are a great many fly-wheels built by the makers of medium and low speed engines that are made in halves with the joints placed midway between the adjacent arms, and these wheels are often run at a higher rim speed than are the larger built-up wheels, which as now generally made have the joints in the rims at the ends of the arms, says F. W. Salmon, in a recent issue of The Street Railway Review. The radial centrifugal force acting uniformly round the rim like a fluid pressure tends to separate the rim, and the joints, no matter where placed, must resist this stress. The centrifugal force of the portion between the arms acts to load that portion as a beam and thus additional stresses are introduced. The point in this portion at which the joint is placed greatly affects the stress placed on the joint. Considering the solid segment in Fig. 1, we have a beam fixed at both ends and uniformly loaded. The maximum bending moment under such conditions is $WL \div 12$, where W is the total uniformly distributed load and L the distance between supports. This maximum bending moment occurs at the two supports; midway between the supports the moment is $WL \div 24$. There are two points, about one-fifth way from each support, where the moment is zero, these being the points of contrary flexure.

If we place midway between the arms a joint of the type shown (with inward projecting lugs to receive bolts) in the cut, we practically have two beams fixed at one end. The maximum bending moment in each of these beams, fixed at one end and

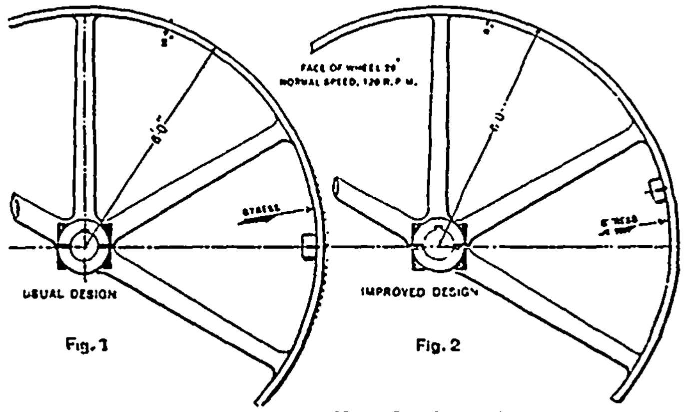


Fig. 1 Fig. 2

uniformly loaded, would be $WL \div 8$, where W is the total load on both beams and L is the total length of both beams. This, it is seen, is 50 per cent. greater than in the solid segment.

If the joint be placed, as shown in Fig. 2, about one-fifth from the end of the segment at the point of contrary flexure, the bending moment, Mr. Salmon shows, at that joint has to resist only the stress tending to separate the rim in halves. Changing the position as here suggested does not add in any way to the cost of manufacture, nor does it make the joint as strong as the solid rim, nor does it eliminate the stress the rim bolts are generally computed to stand, that of holding the two halves together; but as the joint lugs are usually made, placing them nearer the arms lessens the stress in the section of rim where the joint occurs, conduces largely to cause the wheel to revolve at a high velocity as a true circle (instead of as an ellipse, with the joint on the major axis), and reduces the stress in the bolts from the joint "giving" or "opening" slightly, as is so often the case.

IRON PRODUCTION.*

BY GEO. E. DRUMMOND.

Canada, like the rest of the world, has produced unusual quantities of pig iron in 1898. Following the usual course and reviewing briefly the iron markets of the world, we have first the United States, showing a most remarkable record for 1898 as far as production is concerned, and a wonderful rate of consumption that already, in February, 1899, indicates almost a famine in iron and products of iron. Figures for 1898 show that the United States produced 11,773,934 tons of pig iron, and this enormous production goes on at an increasing ratio. The great revival of trade in the United States, brought about by two successive years of splendid crops and consequent increase in railway earnings, which enabled the railroad companies to undertake vast expenditures for new rolling stock, is the cause, no doubt, of a great deal of the revival, but everywhere most satisfactory expansion is marked in all lines of manufacture of which iron is the basis. The lessons of the war with Spain will probably result in a great expenditure being made by the American Government in perfecting their coast defences, and all this is in the direction of an increased utilization of iron. The export trade in the United States in 1898, in all kinds of metals, reached the enormous sum of $120,000,000. In the item of pig iron they exported 250,000 tons. With the scarcity of iron for home requirements at the present moment, it is not likely that they will press the export trade unduly in 1899, and the iron producers of other countries (and not least of all Canada) will have a chance to gain strength to meet future competition from the United States.

*From a paper read before the Canadian Mining Institute.

Great Britain.—The British ironmasters hold second place as the iron producers of the world to-day. The total records of iron produced in Great Britain in 1898 are not yet to hand, but it is pretty safe to estimate an output aggregating 9,500,000 tons, as against a production in 1897 (revised figures) of 8,796,465 tons. The use of British iron has almost ceased in Canada, and while that does not mean that Britain is not holding her own in other markets, still the situation is a somewhat grave one for British iron producers, inasmuch as their ore supply is growing more precarious every day. The life of the Spanish iron mines, upon which Britain draws heavily for supplies, is already well understood to be but short. The product of the home mines grows steadily less, and it will be well for Great Britain to look to her colonies, such as Canada and Newfoundland, for her future source of ore supply. The indications are that this course alone will enable her to hold the position that she has held for so many years. The British home trade in iron has been very prosperous in 1898, exceeding that of any previous year. In shipyard and railway work, and in all branches of the iron trade, manufacturers have been exceedingly busy, and, with more or less freedom from strike difficulties, Great Britain emerges at the close of the year with a splendid record, but Canadians regret to note how very much "out of touch" they are to-day with the British ironmasters, who formerly supplied this country, and who have been replaced to a very great extent during the past few years by the iron producers of the United States.

Germany and Luxemburg—Enormous strides have been made by the Germans during the last three or four years in their iron industry, and the figures of production for 1898 (Germany and Luxemburg), 7,402,717 metric tons, come so close to the records of the British ironmasters that there is grave cause to fear that unless most vigorous measures, political and economic, be taken by Great Britain, her rank as an iron producing nation may be displaced by Germany, as it has been by the United States.

Canada.—The output of the Canadian furnaces for 1898 exceeds that of 1897. Advices received from Hamilton, Ont., New Glasgow, N.S., and Radnor Forges, Que., report a combined gross tonnage produced of 75,920 net tons of pig iron, 23,541 tons of steel, and 2,276 tons of forgings. The combined tonnage of pig iron in 1897 was 57,904 net tons. The works at Londonderry, N.S., were closed down throughout the year, the company being in liquidation, but this not because the market could not absorb their full output had the works been running. Everywhere the product of these Canadian furnaces has given entire satisfaction, so far as the quality of metal produced is concerned. The work of developing the Canadian mines has been carried on quietly, but steadily, and the new year opens with splendid prospects for a very much larger production of Canadian metal in 1899. The new charcoal furnace constructed at Deseronto, during 1898, has just been put into blast, with an average output of 30 tons of charcoal metal per day, practically doubling the daily production of charcoal iron in Canada. A new charcoal furnace is projected for Midland, Ont., by the Canada Iron Furnace Co., Limited, of Montreal, and Radnor Forges, this being a branch of their business at the latter point, but the intention being to manufacture at Midland an iron similar in quality to Lake Superior charcoal, and which is required for mixture with the special charcoal metal now made at Radnor from the bog and lake iron ores of the district of Three Rivers. The new Midland furnace will have a daily capacity of from 60 to 80 tons of charcoal iron. A four-furnace coke iron plant, of large capacity, is projected by American and Canadian capitalists at Sydney, C.B., where the ores of Newfoundland will be smelted with Canadian coal.

Other furnaces are talked of, but those already mentioned will turn out sufficient iron to meet all the immediate wants of Canadian ironfounders, and doubtless a considerable quantity of the metal produced will be exported to Europe, especially, perhaps, from the proposed Cape Breton plant. The time is rapidly approaching when the product of the Canadian furnaces will have to be carried (on a larger scale than the present) to the finished stage of iron and steel of all descriptions, there being an ample and increasing home market for such products. The following are the records of the furnaces at Hamilton, Ont., New Glasgow, N.S., and Radnor Forges, Que., for 1898:

THE HAMILTON BLAST FURNACE CO., LTD., HAMILTON, ONT.

Ore smelted (tons of 2,000 lbs.)	77,023
Scrap and mill cinder (tons of 2,000 lbs.)	8,614
Limestone (tons of 2,000 lbs.)	13,799
Coke (tons of 2,000 lbs.)	50,407
Pig iron product (tons of 2,000 lbs.)	48,253
Average number of workmen	130
Wages paid for labor	$61,476
Value of pig iron at furnace	530,789

The coke used at this furnace is all of American make and the same applies to a considerable proportion of the iron ore smelted.

THE NOVA SCOTIA STEEL COMPANY, LTD., NEW GLASGOW, N.S.

Production for 1898:

Pig iron (net tons)	21,627
Steel made (net tons)	23,541
Forgings made (net tons)	2,276

The materials used being as follows:

Coal (net tons)	107,000
Canadian ore (net tons)	19,000
Newfoundland ore (net tons)	15,000
Spanish or Cuban ore (net tons)	6,000
Coke (net tons)	32,000
Limestone (net tons)	18,000
Average number of men employed	750
Wages paid—about	$280,000

These figures do not take into account the men employed in mining coal, nor do they include the various parties employed professionally and otherwise and not paid directly by the company.

In addition to the operations carried on by this company, they have, during the year, been working their Newfoundland iron ore property more extensively than ever before, having shipped to Germany and Scotland about 75,000 gross tons, besides bringing over 30,000 tons to their own works at Ferrona.

The Canada Iron Furnace Co., Ltd., Montreal and Radnor Forges.—Owing to the plants being overhauled and improved during the year, only about eight months' is to be considered. The production during that time was:

Special charcoal pig iron	6,040—420-2,000 tons
Charcoal made	580,100 bush.
Ore made	14,400 net tons
Limestone flux made	1,432 net tons
Average number of men employed	600

This company used Canadian material entirely. As usual, the labor in connection with this furnace was principally drawn from the farming class, and the field work is, therefore, of a more or less intermittent character, being performed at seasons of the year when the farmer is not engaged in his usual agricultural pursuits. A very large number of horses are also employed in teaming the ore and wood necessary for the supply of the furnace.

The product at Radnor Forges continues to attract most favorable consideration from engineers abroad, as well as at home. During the year, shipments of "C.I.F." special charcoal metal were made from the furnace to leading establishments in Great Britain, France, Germany, and the United States, and the demand for this special iron is an increasing one. The furnaces in blast show a healthy, strong, business growth, and the projected furnaces (all in strong hands) now coming into the field is good evidence of the fact that we are on the eve of a very considerable expansion of the native iron industry. A great factor in bringing this about is the settled condition with regard to the Governmental policy of encouragement. If that policy is steadily maintained for a few years to come, Canada will have an industry that she may well be proud of, one that will strengthen and build up every other kindred industry in the Dominion, and an industry, too, that will be useful in an Imperial sense, making for the independence of the Empire in so important a commodity as iron.

THE SECOND ANNUAL CONVENTION OF THE MARITIME ELECTRICAL ASSOCIATION.

The second annual convention of the Maritime Electrical Association was held, pursuant to announcement, at the New Victoria Hotel, Halifax, on Tuesday, April 18th. The Executive Committee met at 9 a.m. to transact business relative to the admittance of new members to the association and its financial condition. The opening session of the convention was held at 10 a.m., with the president, F. A. Bowman, in the chair. There were present the following members: J. H. Winfield, F. A. Hunter, G. M. MacDonald, J. W. Crosby, W. A. Winfield, H. P. Archibald, I. H. Smith, G. C. Seibert, R. T. MacKeen, F. A. Hamilton, W. L. MacDonald, W. Luke, P. A. Freeman, S. G. Chambers, P. R. Colpitt, Jas. Graham, C. E. Harris, J. D. Briggs, A. Miller, A. E. Souliss, J. A. Anderson, W. N. Pickles, J. L. MacDonald.

After a few opening remarks, the president called upon the secretary to read the minutes of the last meeting, held in Halifax, September 27th, 1898. Upon motion the minutes were adopted.

The president then delivered his annual address as follows: "We have now passed through the first year of our existence, and have found out what are our powers and what our limitations. We held a convention during Exhibition week, last September, which was a fairly successful one, and would have been much more so had not the weather interfered with it, as it did with pretty much all arrangements of that week. In spite of this, one of the objects of the association was distinctly advanced by the meeting. Several of the out of town members made the acquaintance of each other and the town members. One feature of this meeting was most valuable, and will, I hope, be repeated this time. Several matters were brought up and discussed that were of direct interest to the members present, and personal experiences on these were freely exchanged. With a view to encourage this, we issued a circular to the members asking if there was any question that they would like to bring forward. The response to this request was not as full as I would like to have seen, but we must not expect too much at first. We have a few questions that will be introduced for discussion as opportunity arises, and hope that some of those who did not answer the circulars have brought questions with them, and will bring them up for discussion. It is the discussion of the smaller and more local issues that I wish to encourage in this association. As I think I have said before, we can depend on the larger associations and the technical journals to furnish us with valuable papers on the main principles of the industry. We should, therefore, devote our attention more to smaller details. Steady progress has been made in the electrical industries in these provinces during the past year. While we cannot expect to see the very large transmission scheme undertaken among us just at present, some smaller ones have been well worked out on modern lines, and some steps have been taken in connection with larger projects. All this going to show that our people have grasped the great possibilities of electrical power. Among the many steps in advance that the industry has made during the past year, one that should be most seriously studied by the smaller stations, is the question of forced draft in the furnaces. While this matter has been coming steadily to the front for some years, it has lately been pushing itself into notice most markedly. Some remarks on this subject were made at our meeting last September that showed that our members were studying the subject and stand ready to adopt new ideas when it becomes apparent that they will pay. I hope that further information may be brought out at this meeting from those who have had practical experience in this matter or who have given it study."

Mr. Hamilton expressed his pleasure in listening to so able an address. In the course of his remarks he also stated that the suggestions made by the president were good. After some fitting remarks upon the zeal and untiring efforts displayed by the president during his term of office, Mr. Hamilton moved that a vote of thanks be tendered Mr. Bowman. This was seconded by Mr. Colpitt and heartily approved of by the members.

The president, replying, expressed his thanks to the meeting. He felt that he had done what he could, being hampered to a large extent in his duties on account of living at such a distance from the majority of the members. In the course of his remarks he again referred to the advisability of electing the members resident in Halifax to the offices of president, vice-president and secretary, also suggesting that a sufficient number of Halifax members be elected to the Executive Committee, in order that a quorum could be formed at short notice, if necessary, without difficulty.

The secretary, J. H. Winfield, then read his report, as follows: At the meeting of organization held last April in Halifax, we had the names of fifty-six persons who were interested in the formation of this association, and had expressed their wish to become members. That meeting was a success, and the prospects seemed good for the formation of a very useful society. Since that time every effort has been put forth by the officers to further increase the membership list, though apparently with not any great degree of success. Circulars of information have been sent to all persons in the province whose names we could obtain, that were eligible for membership. Only three new members have been added during the year, but we trust that our efforts have at any rate broken the ground, and that the fruits of our labors will appear later. Two meetings of the Executive Committee were held during the year, and various plans were discussed for rendering the association of as much value as possible to its members. The following statement will show the financial condition of the association at the close of the year, March 31st, 1899:

RECEIPTS.	
46 membership fees at $2	$92 00
EXPENDITURE.	
Rent of room for meeting, April, 1898	$ 5 00
Books, etc., for secretary	4 35
Membership certificates	6 20
Printing	34 50
Rent of room for meeting, September, 1898	5 00
75 copies of report of meeting, September, 1898	3 75
Expressage and telephone	1 50
Postage	10 00
Cash in hand	21 70
	$92 00

The total membership list at the close of the year was 59. There were four new members elected at the executive meeting this morning, bringing the number up to 63. There are thirteen fees for last year still remaining unpaid.

Mr. Anderson moved, seconded by Mr. Chambers, that the report be adopted, which was carried. A short time was then devoted to a general discussion as to the standing and financial condition of the association, the general opinion being that, although the record of the association during the past year had not been particularly bright, yet the present year promised better success. The election of officers for the ensuing year was then proceeded with. For the office of president Mr. Chambers nominated P. R. Colpitt, of Halifax, the retiring vice-president. Mr. Colpitt, however, feeling that it would be impossible for him to accept the nomination, nominated F. A. Huntress, of Halifax, for the office. This was seconded by Mr. Anderson, and met with the universal approval of the members. For the office of vice-president, R. T. Mackeen moved, seconded by Mr. Chambers, that Mr. Colpitt retain his office as vice-president. This motion also met with the approval of the members. Mr. Chambers nominated Irving Smith, of Halifax, as secretary-treasurer. Mr. Smith declining the nomination, Mr. Chambers nominated Mr. R. T. Mackeen, who was elected to the office.

The following members were then elected to the Executive Committee: H. Brown, St. John, N.B.; J. Eddington, Moncton, N.B.; J. A. Weddel, Charlottetown, P.E.I.; S. G. Chambers, Truro, N.S.; W. Pickles, Irving Smith and J. A. Anderson, Halifax.

Mr. Miller moved that a vote of thanks be tendered to J. H. Winfield, the retiring secretary-treasurer. This was seconded and carried unanimously. Mr. Winfield expressed his gratitude to the members for their token of regard. In the course of his remarks he referred to the suggestion made by Mr. Bowman in regard to the difficulty experienced by the officers in fulfilling their respective duties, owing to their living at such a distance from the majority of the members. He thought that for the first few years the principal officers, at least, should be so located that they would be in touch with most of the members, thus increasing their opportunities for developing the association. It was then moved and carried that the selecting of place and date of next meeting be left to the newly-elected Executive Committee.

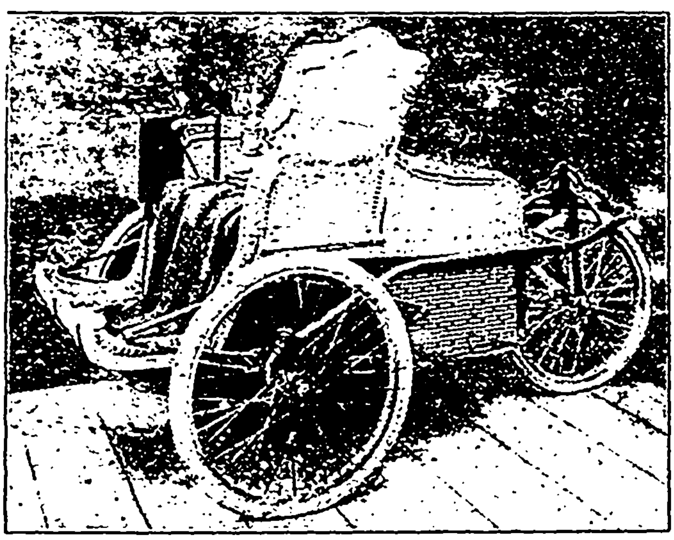
During the convention the following papers were read and discussed: Iron-armoured Conduit Installation at New Drill

Shed, J. R. Griffin; Fire Alarm Telegraph Systems, P. R. Colpitt, city electrician, Halifax; Reminiscences, F. A. Hamilton; Church Wiring with Iron-armoured Conduit, J. A. Anderson; Steam Engineering, P. Freeman, chief engineer Halifax Tramway; Electric meters, R. T. MacKeen; Telephones, J. H. Winfield, of New Glasgow; History of Electric Lighting in Halifax, W. Pickles.

AUTOMOBILE PROGRESS

One striking feature of the developments of the past few months is the conviction that has permeated all classes that the horseless vehicle is a success. Even the "compressed air" exploitation, which is looked on with suspicion by most sober-minded people, and is a stock speculation in which Richard Croker and the Tammany leaders are to make large profits--even this scheme has been passed upon as feasible mechanically, and as likely to be a financial success if only done upon a sufficiently large scale. Everywhere, indeed, the same note is being sounded—the horseless vehicle has come.

A large factor in this sound public opinion is the business-like developments of the past few months in the matter of the manufacture of horseless vehicles. It would be impossible to trace all the lines of effort that are being made in all parts of the world in this direction. France is forging ahead, and holding the long lead obtained at the start. The English are following next. The people of the United States are waking up, but the New Jersey law which allows a company to be formed with $0.01 in the treasury and $9,999,999.99 to be "floated" on a gullible public, is bound to do great damage to the business, as similar "flotations" did in England three years ago. As a matter of fact, there is not to-day on the United States market a thoroughly workable, mechanically dependable motor, although there are 65 manufacturers at work. The electrics are all tremendously heavy and at the same time comparatively inefficient, while the gasoline is still in the experimental stage to a large extent. One of the astounding things to a reader of the autocar journals is that so far no American company has made arrangements to push the French automobiles, which have proven so successful in actual running, although unsightly and heavy. Of course the Americans explain this by saying



that the French autocars are too ugly, and not in accordance with the United States desire for neat and natty vehicles of all kinds, for which they have a reputation which is sacred to them as a nation. The American rubber and battery trusts are planning large things and putting down a heavy foot on all competitors.

Since our last issue the Canadian Motor Syndicate, pioneers of the movement in Canada, has established works in the factory premises, 710-724 Yonge street, Toronto, and are already crowded with orders for electric motets, delivery vans and carriages. The Motet appears to be popular already. Since our former mention of it, several improvements have been introduced in its construction, notably in the frame and wheels, so as to make it much stronger, and provision has been made for the same frame to carry either a 30-mile or 50-mile equipment—the boxes of cells being instantly removable from the side, as shown in the illustration presented herewith. With this construction it will be possible, by use of duplicate battery, to keep a motet out constantly, making a total of 100 miles per day—thus doing the work of five horses on light loads such as butchers and grocers carry.

The Fischer Equipment Company, of Chicago, are represented in Canada by the Motor Carriage Company, of Ontario, in which large shareholders of the Canadian General Electric Co., are interested, H. P. Dwight being president, and Fred. Nichols, manager. The company propose to manufacture under the Woods' patent in Peterboro, at the works of the Canadian General Electric Co., and their charter covers all lines of autocar development. A line of electric hansoms was promised for May Day. Mr. Nichols, Mr. Dwight, and some other Canadians are organizing an American company for $3,000,000 in New Jersey, and will have factories in Chicago and in the east for exploiting the Woods' electric patents.

The autocar journals are enjoying the boom. The Horseless Age of New York has changed from monthly to weekly issue; in England the Autocar has enlarged its weekly issues; the Automotor is regularly published in enlarged form; and a new Motor Car Journal, weekly, has been established in London, England.

THE PRACTICAL MAN.

Boring Holes in Bricks.—Holes may be very quickly drilled in brick or stone walls by making the cutting end of the drill in the form of a cross with four cutting edges, says The Building World. The drill is held in one hand and rotated while being struck with a hammer. When the holes are required to be deep, a projection may be made on the outer end, by which it can be knocked out of the hole quickly. The cutting end should be larger than the shank, so as to allow for clearance, and the shank should be sufficiently long to allow a hammer to be used for knocking it out of a deep hole. An old twist bit also makes a good boring tool for the purpose required, also a piece of steel tube, such as bicycles are made with, will, if jagged at the end, answer very well. These tools are only suitable where the bricks are fairly soft.

Table of decimal equivalents of 8ths, 16ths, 32nds, and 64ths of an inch:

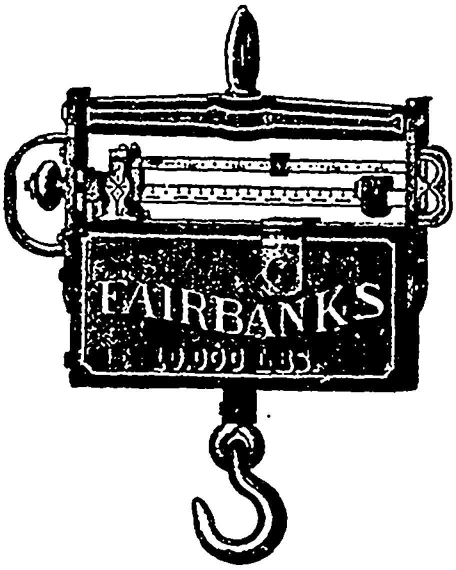
8ths.	5-32 = .15625	17-64 = .265625
	7-32 = .21875	19-64 = .296875
1-8 = .125	9-32 = .28125	21-64 = .328125
1-4 = .250	11-32 = .34375	23-64 = .359375
3-8 = .375	13-32 = .40625	25-64 = .390625
1-2 = .500	15-32 = .46875	27-64 = .421875
5-8 = .625	17-32 = .53125	29-64 = .453125
3-4 = .750	19-32 = .59375	31-64 = .484375
7-8 = .875	21-32 = .65625	33-64 = .515625
	23-32 = .71875	35-64 = .546875
16ths.	25-32 = .78125	37-64 = .578125
	27-32 = .84375	39-64 = .609375
1-16 = .0625	29-32 = .90625	41-64 = .640625
3-16 = .1875	31-32 = .96875	43-64 = .671875
5-16 = .3125		45-64 = .703125
7-16 = .4375	64ths.	47-64 = .734375
9-16 = .5625		49-64 = .765625
11-16 = .6875	1-64 = .015625	51-64 = .796875
13-16 = .8125	3-64 = .046875	53-64 = .828125
15-16 = .9375	5-64 = .078125	55-64 = .859375
	7-64 = .109375	57-64 = .890625
32nds.	9-64 = .140625	59-64 = .921875
	11-64 = .171875	61-64 = .953125
1-32 = .03125	13-64 = .203125	63-64 = .984375
3-32 = .09375	15-64 = .234375	

To find the number of gallons delivered per minute by a double-acting pump at 100 feet per minute piston speed, square the diameter of the water piston or plunger and multiply the result by 4. This gives a result less than 1 per cent. greater than the full displacement. It might generally be well to use a multiplier a little smaller, say, 3.5 or 3.8, which would give some allowance for slip, leakage, etc.

In Germany, machine shops are frequently paved with wood blocks set in tar and sand upon concrete as in the best practice in street paving. This is found to be more lasting than a plank floor, and one or more blocks can be replaced at any time without disturbing any but the very small area of the floor under repair.

SUSPENSION SCALES.

Every machine shop handling castings or machinery should have a Compound Suspension Scale. These scales are very compact, and simply act as a part of the chain connecting the crane hook with the article to be weighed. John Bertram &



Sons, of Dundas, Ont., have just put in a thirty thousand pound machine in their works; Boivin, Wilson & Co., of Berthier one of twenty thousand pounds, and I. Matheson & Co., of New Glasgow, N.S., one of ten thousand. All of these were made by the Fairbanks Company, who carry sizes from 400 to 10 000 lbs in stock in their warehouse, 749 Craig street, Montreal.

Industrial Notes.

The Granby, Que., foundry has been leased to M. McDonald.

A new station for the C.P.R. at Woodstock, Ont., is under way.

J. Bousfield & Co. will install a creamery plant at Portage la Prairie, Man.

Longueuil, Que., is negotiating with a company which proposes to build a large abattoir.

The McClary Mnfg. Co., London, Ont., is putting up a large addition to its stove works.

Plans have been passed for a new Anglican church in Sherbrooke, Que., to cost $30,000.

The University of New Brunswick, Fredericton, N.B., will build an engineering building to cost $17,000.

The General Hospital, St. John, N.B., requires a new heating and ventilating plant. Estimated cost $5,000.

E. Leonard & Sons, London, are installing a 500 h.p. engine in the power house of the London Electric Co., Ltd.

London, Ont., will shortly let contracts for engines and dynamos for the Victoria Hospital now in course of erection.

C. Kloepfer, M.P., has bought the Guelph, Ont., rolling mills property. It is possible Mr. Kloepfer may start the mill again.

The M.C.R. is placing a third truss in the cantilever bridge across the Niagara River. This will greatly strengthen the bridge.

The Gas and Gasoline Engine Co., Toronto Junction, is being formed to make gas and gasoline engines. The company purposes turning out engines from ¾ h.p. to 50 h.p. R. Hunter, Jos. Murchey, Dr. Perfect, A. H. Royce and B. B. Henderson are the incorporators.

J. Campbell is building a new sawmill at Springhill, N.S.

A 250 h.p. self-oiling engine, built by E. Leonard & Sons, London, Ont., has just been put in for the Bennet Furnishing Co., London, Ont.

The Massey-Harris Company is building a 4-story stone and brick paint shop, 55 x 178, situated west of their bicycle factory, Toronto, to cost $12,000.

The farmers in some townships bordering on Lake Simcoe are urging on the Government a project to lower the lake level and reclaim a large amount of land.

S. R. Gaudet, of Memramcook, N.B., is adding to his present power plant a 100 h.p. Robb-Armstrong engine with boiler, supplied by the Robb Engineering Co.

Truro, N.S., has decided to purchase a 100 h.p. Mumford improved boiler from the Robb Engineering Co., to replace the boilers at present in use in the pumping station.

W. Partlow & Son, Ingersoll, Ont., flour millers, have bought the King flour mill, which has been idle for some years, and will equip it with an entire new plant, including steam power.

Work has been commenced on the enlargement of the buildings of the Simcoe Canning Co., at Simcoe, Ont. This company recently had a mammoth storehouse erected near Simcoe.

A new power plant is to be installed in the premises now occupied by Garneau, Eckert & Co., spice merchants, London, Ont., and the building will be used by the London Printing & Lithographing Co., Ltd.

The contract for rebuilding the Union Bank building, Wellington street, Toronto, has been let to J. E. Webb, including hot water heating, and electric lighting. Bond & Smith, Temple Building, Toronto, were the architects.

W. F. Grant & Co., Toronto, have the contract for the abutments for the Eastern avenue bridge, Toronto, at $4,070.96. City Engineer Rust's estimate was $8,800. The other tenderers asked respectively $7,649, $8,895, $8,189 and $7,558.

Geo. Clayton, who has been employed by the Standard Drain Pipe Co., St. Johns, Que., for 15 years, together with his sons, has moved from St. Johns to St. Henry, where they are going into manufacturing as the Montreal Fire Brick & Terra Cotta Works.

Winnipeg has accepted the following tenders for waterworks supplies: The National Meter Co., for Empire meters at contract price, for straight reading dials, at $36,855; John McDougall, Montreal, for Worthington pumping engine, at $89,080; Jas. Robertson Co., for supply of pig lead, at $80.80 per ton.

The capacity of the works of the Detroit Lubricator Co., of Detroit, Mich., has been overtaxed during the past few months by the quantity of orders received from foreign and domestic firms. They are now installing a large number of new lathes and other machinery, so as to be able to ensure prompt deliveries on future orders.

La Compagnie Savoie Guay has been incorporated with a total capital stock of $50,000, headquarters at Plessisville, Que., for the fabrication of acetylene gas apparatus, thermic motors, etc. The incorporators are: F. T. Savoie, J. Z. Triganne, M.D., C. Ed. Gosselin; G. Savoie, J. B. Gosselin, Plessisville; G. R. Smith, artisan, Thetford Mines, and G. E. Tanguay, Quebec.

The project of connecting the mainland with the Island of Orleans by a bridge is now being seriously agitated. The proposition is to erect a cantilever bridge from the Island to the Beauport shore, and to utilize it, not only for vehicles and foot passengers, but for electric cars. The shoals run out so far both from the island and from the Cote de Beaupre, that the distance to be bridged would not be very great.

Montreal received permission to spend $30,000 on repairing its water supply system, from last session of the Québec legislature. The city council now proposes to employ only part of this sum at present—the intention being, no doubt, to let the remainder leak into channels where it will "do the most good." In the meantime the city is threatened every moment with the failure of the reservoirs (which are in an indescribable condition), and a fearful loss of life and property.

Belleville, Ont., is buying a steam road roller.

The Sturgeon Falls, Ont., Pulp Co., Ltd., is going to build a large mill at once.

A large school building is to be erected in Chatham, Ont., at once. J. Dunn is the architect.

Rossland, B. C., has two new machine shops—Ablett & Cunliffe, and that of the British American Co., Ltd.

Much damage has been done to bridges, dams, flumes, etc., at Elora, Galt, Hespeler, Brantford, Ont., by recent floods.

C. A. Matheson, Perth, Ont., is going to manufacture peat fuel on his farm in Drummond township, Lanark County.

The farmers in the neighborhood of Sault Ste. Marie, Ont., are arranging with F. H. Clergue to build a flour mill at that point.

The iron moulders in Montreal are demanding a minimum rate of $2.50 per day, and that those now making more shall not be reduced.

An iron bridge over the Grand River at Paris, Ont., was undermined by the high water, and fell April 24th. The damage to the bridge will be at least $5,000.

Bond & Smith, architects, Temple Building, Toronto, have recently let the contracts for four dwelling houses on St. Clarens avenue, Toronto, for T. W. Murray.

The Farmers' Elevator and Shipping Co., of Kincardine, Ltd., has been formed to provide an elevator at Kincardine, Ont., and do a general produce business; capital, $5,000.

It is stated that capitalists, of whom J C. Robertson and T. McAvity & Sons, St. John, N.B., are mentioned, are considering the establishment of a rolling mill at Courtenay Bay

The Reeves Pulley Manufacturing Company, Ltd., has been incorporated with $10 000 capital; head office, Toronto, and provisional directors, D. T. McNiel, A. W. Johnston, and Maggie M. Johnston.

The Montreal Pipe Foundry Company, Ltd., will manufacture the pipes required for the water-service that the town of Liverpool, N.S., is about to inaugurate. About five hundred tons of pipe will be required.

H. Corby, M.P., proposes to build at Belleville, Ont., an elevator with a capacity of from 500,000 to 1,000,000 bushels, provided connection can be established for northwestern grain to be transhipped via that point.

St. Louis, Que., has decided to accept Mr. Bernier's offer to establish a foundry in St. Louis, employing at least fifteen workmen during nine months in the year, and to exempt the establishment from taxes for ten years.

The action of David Menzies against the Bertram Engine Works Co., Toronto, for damages for injuries received while in the employ of the firm, was settled recently by the plaintiff accepting an award of $1,042 and costs.

Waterloo, Ont., carried a by-law, April 7th, to devote $40,000 to waterworks purposes. The company will receive $23,000 for the present plant, and the balance will make necessary improvements and build a stand pipe

The Standard Mica Company of Toronto, Ltd., has been incorporated; capital, $90,000. The charter members are C. M. Clark, Cape Vincent, N.Y.; H. A. Clark, E. Mackenzie, E. W. Klotz, Toronto, and E. I. Sifton, of London.

R. Hadden and J. C. North, J. H. Allan, W. E. Vanvlack, W. Smeaton, R. H. McKenna, C. H. Widdifield, Picton, Ont., and J. E. Clapp, Hallowell, have been incorporated as the Prince Edward Peat Fuel Company, Ltd., capital, $20,000.

In view of the condition of the Toronto waterworks pumping plant it has been decided to have an expert investigation into the cost of pumping. The investigation of the Green's Economizer reports, prepared by Engineer Pink, is still proceeding before Judge Macdougall.

The wooden bridge over the Mississippi river at Appleton, Ont., gave way recently, having been weakened by an ice shove, and threw three men, a carriage and pair of horses into the river. One man was drowned and another badly injured. The bridge had been unsafe for some time. A new bridge will probably be built at once

Belleville, Ont., is offering $177,351 to the waterworks company for the plant supplying the town.

The Aylmer, Ont., Iron Works has recently had a large amount of new machinery placed in position.

The town of Uxbridge, Ont., has bought a large rotary pump from Young Bros., Almonte, Ont., the Mississippi Iron Works.

E. Simpson & Co., Moose Jaw, N.W.T., have made an agreement with the farmers in the neighborhood to build a flour mill there.

The town of Windsor, N.S., has decided to purchase a steam fire engine at a cost of $4,000. It will also erect a town hall to cost $7,000, including the site.

The Burrill-Johnston Iron Co., Yarmouth, N.S., ceased work and dismissed all its hands April 25th. Among the hands dismissed were some who had been working constantly there for 42 years. It seems the company has not made money for its shareholders for some years, though there was a time when 16 per cent. dividends were paid.

Toronto has given the contract for the abutments of the Queen street bridge at $13,900, to W. S. Gibson. There were six tenders for this work, ranging from $13,900 to $17,027. For Humber river bridge abutments, the city engineer's tender was the lowest, at $4,500, and he was directed to do the work. Rathbun & Co. got the contract for Portland cement.

C. W. Adams, W. W. Ramsey, president Expanded Metal Fireproofing Company, Chicago; C. J. Root, J. H. Barnard, Chicago; E. F. B. Johnston, C. S. Spencer, Toronto, are applying for incorporation as the Expanded Metal Company of Canada, Ltd., to make expanded metal fireproofing, and to do a general fireproof construction business; chief place of business, Toronto; capital, $100,000.

W. G. Smart, for the past two years chief engineer of the Jenckes Machine Co., Sherbrooke, Que., has resigned, and has gone into the machine business in Hamilton, Ont.; the Smart-Eby Machine Co., having been formed. It has taken over the plant, machinery and patterns belonging to the Osborne estate, which were recently used by A. J. Nie, many of which patterns are for machinery used by local manufacturers. The new company is overhauling the plant, and is to extend the business very largely.

The company which has been formed for the purpose of manufacturing bar iron and other products of iron, at Belleville, and removing the Abbott & Co.'s Iron Works of Montreal, is known as the Abbott-Mitchell Iron and Steel Co., Ontario, Ltd. The executive officers are F. A. Mitchell, Thames Iron Works, Norris, Conn., president and managing director; William Abbott, Montreal, vice-president and secretary; Henry Pringle, Belleville, treasurer. The company will proceed at once to erect buildings and install its plant.

The Sun Oil Refining Company has applied to the city for land and the privileges of establishing a distributing depot in St. John. It proposes going extensively into the business through the Maritime Provinces in opposition to the Standard Oil monopoly. The city has promised it the same privileges it has given the Standard. The Cornplanters' Refining Company, of Warren, Penn., is backing the operation. Warehouses and tanks will be erected and all necessary plant provided to carry on the barrelling business. The oil will be brought here in tanks and by means of a pipe line from the ballast wharf it will be pumped to the tanks and then barrelled. The site granted is just south of the exhibition grounds.

The General Calcium Carbide Company is applying for a Dominion charter for the purpose of utilizing and converting waste wood, chips, shavings, sawdust and other wood products into calcium carbide; and also for recovering all other by-products therefrom; and for separating, distilling and refining the same; for the production of wood-tar, acid and gases; and also for acquiring, owning and operating iron mines, and for mining, digging and quarrying iron ore, and for the smelting and reduction of iron ore, and for the manufacture of steel for manufacturing and producing gases; and for manufacturing, conveying and disposing of gas for lighting and heating purposes; and for the reducing, treating and production of phosphates, etc.

A grist mill is to be built at Agnes, Lake Megantic, Que.

Stayner, Ont., is issuing debentures amounting to $24,000 to provide a system of waterworks.

Bathie & McLarty, machinists, Hartney, Man., have bought the business of Watson & Whimster, Portage la Prairie, and will move there.

R. M. Beal, tanner, Toronto, is to be granted a ten years' exemption from taxes if he erects a tannery this year in Lindsay, and employs 20 adults.

L. McGlashan offers to move the Ontario silver works from Stonebridge to Thorold, Ont., for a bonus of $10,000 and ten years' exemption from taxes.

Corbeil & Leveille, sash and door manufacturers, Montreal, have filed consent to assign. In 1897 they compromised liabilities of $25,500 at 30 cents on the dollar.

The Alpha Chemical Co., Berlin, Ont., will build a new factory if Berlin grants a bonus, and if not will move to some town offering greater inducements.

A company has secured an option on a large tract of land on the New York and Ottawa Railway, near Newington, where there are valuable peat bogs. They will turn the product into peat, and place it on the market.

Lachine town council considered a bonus of $15,000 for a boot and shoe factory, and $20,000 for a furniture factory. The bonus industry continues to be one of the most profitable in Canada for the manufacturers.

The extensive water power on the Bonnechere river at Renfrew, belonging to the estate of the late M. L. Russell, has been sold to Thos. R. Lowe, and will, it is said, be developed at once for industrial purposes.

The William Rutherford & Sons Company, limited, have been incorporated; capital, $150,000, at St. Cunegonde of Montreal; to manufacture and deal in lumber and woodwork of every description, to take building contracts.

Recent strikes among the moulders in London, Brantford, Hamilton and Toronto, have been settled it is said by the foundrymen, in addition to granting an advance of 10 per cent. agreeing to recognize shop committees. The moulders entered into an agreement for a year.

A New Brunswick charter has been granted to George F. Baird, J. Manchester, J. Allison, T. H. Bullock, D. J. Purdy, J. F. Robertson and R. C. Elkin, St. John, N.B., to purchase the property formerly owned by the Portland Rolling Mills Company, Ltd., and to carry it on under that name, with a capital of $90,000.

A delegation of Buffalo aldermen recently examined the gas plant in Toronto, and were so much interested by the sight that they went home and stated that it was a municipal plant. As Toronto has more than the usually vigorous monopoly which is owned by a few of the wealthiest citizens a great deal of speculation has been indulged in as to what the visitors really saw.

The constantly increasing demands for its goods has made it necessary for the Garlock Packing Co., Hamilton, Ont., to open a branch in Montreal at 103 Common street, as well as to move into larger premises in Hamilton at 22 John street north. The past four months' business has been much the most prosperous in the history of this enterprising and progressive company.

Among the acts passed by the Nova Scotia legislature at its last session were Acts to supply the town of Sydney with water; to incorporate the Windsor Calcium Carbide Company, Ltd.; to amend Chapter 157 of the Acts of 1893, entitled "An Act to incorporate the People's Heat and Light Company, Ltd." and the Acts in amendment thereof, to incorporate the Dominion Fire Brick and Tile Company, Ltd.; to incorporate the Consolidated Graphite Company, Ltd.

The activity in manufacturing in Canada is evidenced by the amount and variety of orders which our belting manufacturers have on hand. The firm of Sadler & Howarth is particularly busy, and at their Toronto office alone have a large number of orders yet unfilled for double and single leather belting of all widths to forty inches wide, from sawmill owners, cotton, woolen and flour mill owners, foundries and other factories.

R. J. Matheson has erected a flour mill at Dartmouth, N.S.

Brockville, Ont., is enforcing a wide tire by-law in its streets this season.

A project to erect a creamery at Melbourne, Que., is said to be assured of success.

It is expected that the G.T.R. office building in Montreal will be begun early this month.

P. E. Doolittle, Toronto, is promoting a project for establishing a gas plant in Rossland, B.C.

Corbeil & Leveille, manufacturers of doors, sashes, etc., Montreal, have assigned with liabilities of $44,752.

C. Douglas & Son, foundrymen, Berwick, N.S., have dissolved partnership, Howard Douglas continuing under the old style.

The British Timber and Manufacturing Company, of London, England, is said to be looking into the question of erecting a pulp mill in Canada.

Some square timbers of Douglas fir have been shipped over the C.P.R. from British Columbia to Montreal which measured 36 x 36 inches and 60 feet long.

The Canadian Rand Drill Co. is now building new workshops in Sherbrooke, Que. The building will be of brick, 90 x 200 feet, and will be floored with concrete.

The compressed air method of painting, which was described in The Canadian Engineer a couple of years ago, has just been put into use in the C.P.R. car shops at Perth, Ont.

Inness, Hemeon & Co., Liverpool, N.S., are building a large rotary saw mill. The engine boiler and other machinery have been ordered from the Robb Engineering Co.

Baxter & Galloway, Burlington, Ont., it is said, ordered from the Goldie, McCulloch Co., Galt, Ont., the equipment for a hundred-barrel flour mill, which will be erected shortly.

The Stearns Bicycle Co. will, it is said, establish a large factory at an early date, a large part of whose output will be tools, as is the case in the company's works in the United States.

The Ottawa Building Company, Ltd., of which Edward Wallace, T. Ahearn and W. Y. Soper are leading members, has been incorporated to buy land and buildings; capital, $200,000.

The Algoma Brick Co. has been organized at Rat Portage, Ont., with Jacob Hose, T. R. Deason, J. W. Humble, R. Dewsett, J. Brenchley and J. Dauphin as provisional directors. It is the intention to supply the Manitoba market with pressed brick.

The Montreal city attorneys have now definitely reported that the proposed tax of one per cent. per annum on machinery, etc., would only apply to machinery that is practically and permanently affixed to buildings.

The building of the new waterworks system at Prescott, Ont., is now going on. W. M. Watson, whose articles on Sanitation in The Canadian Engineer have attracted so much attention, is superintendent of construction.

M. H. Bissell, R. A. McLelland, J. Bissell, Brockville, Ont., and C. H. Bissell, J. B. Bissell, Augusta, Ont., have been incorporated as the Algonquin Milling Co., Ltd.; capital, $10,000; chief place of business, Algonquin, Ont.

Peck, Benny & Co. gave a large luncheon to their employees and friends on the opening of their new building lately. The feast was a recognition of the good work done in saving the buildings in the disastrous fire of some months ago.

The firm of Connell Bros., Woodstock, N.B., iron founders, etc., is to become a joint stock company with the following directors: H. A. Connell, R. B. Ketchum, John Graham, D. Munro, R. M. Gabel, Woodstock, N.B.; capital, $60,000.

The actions for smoke nuisance, taken recently in Montreal by the city boiler inspector against the Canadian Pacific Railway Company for its power house, Robert White, factory; W. Macdonald, tobacco factory; the Montreal Steam Laundry, and the Laval University, have been settled. All pleaded guilty before the Recorder of neglecting to install smoke consumers when so ordered by the boiler inspector, and were allowed time by the Court to introduce them.

Wilson & George will erect a flour mill at Indian Head, N.W.T. The contract for the milling machinery has been given to the North American Milling Company, of Stratford, Ont. In addition to the milling machinery an electric light plant will be added. The whole will cost in the neighborhood of $8,000.

Tenders will be called for an eight-day clock for the Toronto city hall tower, having one large hour striking bell, to weigh 12,000 pounds; two secondary ¼, ½ and ¾-hour striking bells, to weigh 3,000 and 2,000 pounds respectively. There will also be required nearly one hundred small clocks for various offices.

Frederic W. Whelpley, Greenwich, N.B.; William T. Fanjoy, St. John, N.B.; Daniel R. Whelpley, Alberta E. Whelpley and Edgar D. Whelpley, Greenwich, N.B., have been incorporated as the J. A. Whelpley Company, Ltd., iron founders and skate manufacturers; capital, $20,000; chief place of business Greenwich, N.B.

Geo. F. Baird, James Manchester, Joseph Allison, Thos. H. Bullock, D. J. Purdy, Jas. F. Robertson, R. C. Elkin and A. H. Hanington, St. John, N.B., are seeking incorporation, as the Portland Rolling Mills Co., Ltd., to operate the rolling mills formerly controlled by the James Harris Co., Ltd. The capital is to be $90,000, in $100 shares.

The B. Greening Wire Co., Hamilton, Ont., has closed a contract for building a new wire-cleaning house, which will enable them to greatly increase the output of their wire-drawing mill. During the building of this addition they will add thirty feet to their smokestack, it being their intention to increase the power by the addition of 100 horse-power.

The terms of amalgamation of the Hamilton Blast Furnace Company and the Ontario Rolling Mills Company have been agreed on, and amalgamation will be proceeded with as soon as possible. The new company will have, it is said, a capital of $2,000,000. It is the intention to establish a steel plant for the manufacture of all kinds of billets, bars, etc. Among those who have stock in the new company are: A. T. Wood, M.P., Senator Sanford, C. S. Wilcox, C. Doolittle, A. Wilcox, Lieut.-Col. McLaren, R. A. Lucas, John Milne, W. Southam, A. E. Carpenter, Hon. J. M. Gibson, Alexander Turner, W. A. Wood, John Moodie and S. F. McKinnon and G. B. Smith of Toronto.

Marine News.

The R. & O. steamer "Algerian" will run with the steamer "Hamilton" from Montreal to Hamilton, Ont., this season.

J. & T. Colson, Thorold, Ont., have appointed to their steamer "Erin," master, Capt. P. Sullivan; engineer, P. J. Kerr.

Myles' Sons, Thomas, Hamilton, Ont., have appointed to the steamer "Myles," Capt. John S. Moore; engineer, James Smeaton.

J. B. Fairgrave, Hamilton, Ont., has appointed to his steamer "Arabian," master, Oliver Patenaude; engineer, Wm. Harwood.

The Lake Ontario Navigation Co., Ltd., A. W. Hepburn, manager, Picton, Ont., has appointed to the steamer "Argyle," Capt. G. O'Brien; engineer, John Hayelette.

The steamer "Bohemian" of the R. & O. fleet will meet the new steamer "Toronto" at Prescott, and take the passengers down the St. Lawrence rapids this season.

The Detroit, Windsor & Soo Navigation Company has decided to place the sidewheelers "Majestic" and "City of Collingwood" on its line from Windsor to Georgian Bay ports and the Soo.

The railway swing bridge pier, which has been an obstruction to traffic in the Sault Ste. Marie canal since its construction, is now being removed, and a new bridge, 48 feet long is building. The whole work will cost in the neighborhood of $70,000.

Northwest Transportation Co., Sarnia, Ont., has appointed to the steamers "United Empire," Capt. Jno. McNab; engineer, S. Brisbin; "Monarch," Capt. E. Robertson; engineer, E. W. McKean.

The boats and interests of the Lake Temiscamingue Navigation Co. have been purchased by Alexander Lumsden, M.L.A., Ottawa.

The Lake Labelle Navigation Co., Ltd., has been incorporated with a capital of $10,000 to do business in the township of Labelle, Que.

The gold deposits in the River Gilbert in Beauce county, Que., are attracting attention at present. One man in St. Francis recently brought $1,800.

Application has been made to the New Brunswick Legislature for the incorporation of the Imperial Dry Dock Company, with a capital of $1,000,000. Geo. Robertson, St. John, is the prime mover in the enterprise.

D. D. Glasier & Son have bought from the Grand Manan Steamboat Company the steamer "Flushing," which has for some years run between Grand Manan and St. John, St. Stephen and St. Andrews.

The steamer "Swift," Capt. D. Noonan, is being enlarged for the season's run on the Rideau. The Davis Dry Dock Co., Kingston, is building a sister boat to the "Swift," which will later on make the Ottawa-Kingston service, via the Rideau, a daily one.

E. C. Walker, Walkerville; F. H. Walker, J. H. Walker, Detroit, U.S.; S. A King, M.D., Kingsville, Ont., and W. Woollatt, Walkerville, will be incorporated as the Lake Erie Navigation Co.; capital, $40,000; chief place of business, Walkerville, Ont.

The annual meeting of the Westcott Wrecking Company was held at Sarnia, Ont., recently. The election of officers resulted as follows: President and manager, J. W. Westcott, Detroit; directors, F. F. Pardee, M.P.P., Sarnia; Isaac Watt, Windsor, and J. W. Westcott.

Playfair Barge & Tug Line, Midland, Ont., has made these appointments—Steamer, "St. Andrew," Capt. W. H. Featherstonaugh; engineer, Jno. McRae. Tugs, "Magnolia," Capt. R. H. Gilbertson, Engineer A. E. House; "Metamora," Capt. Jas. Tindall, Engineer Geo. Smith; "Minitaga," Capt. Ed. Burke, Engineer J. McGregor.

The electric light plant on board the steamship "Mulgrave," of the I.C.R. ferry service of the Strait of Canso, was supplied and installed by John Starr, Son & Co., Ltd., Halifax, N.S. It consists of a 110 volt direct current compound wound dynamo, adjusting its own voltage on an increased load, and directly connected with a Robb engine.

It is understood that Jno. Ross and Jno. McRae have undertaken to complete the Great Northern Railway, from the end of the present track at Shawinegan to the town of Hawkesbury, exclusive of a 20-mile section already built, or a distance of about 88 miles. J. M. McCarthy and J. M. Shanley have been appointed joint engineers of construction.

The two well-known steamship companies on the Georgian Bay, familiarly known as the Black and the White lines, have been amalgamated. The new company will be known as the Northern Navigation Company, of Ontario, Ltd., and will have a capital of a million dollars. The provisional officers are: President, James Scott, Toronto; vice-president, J. J. Long, Collingwood; directors, H. E. Smith, Owen Sound; W. J. Sheppard, Waubaushene; M. Burton and F. A. Lett, Barrie.

The Canada Atlantic Railway has leased from the Kingston and Montreal Forwarding Co. its line of barges to run between Coteau and Montreal with the C.A.R. Transit Company's business. This will give a grain route direct from Chicago and Duluth to Montreal. Last year the C.A.R. paid the Forwarding Company so much per bushel for transportation; now they have the barges, some 12 or 15 in number, leased for three years.

Montreal is to have another line of coal-carrying steamships. Mackenzie, Mann, Peter Ryan and others have purchased the extensive coal fields of Inverness County, Nova Scotia, located at Port Hood, Broad Cove and Chimney Corner, and embrace what is called the largest single coal-bearing area in Canada. The plan is to have a fleet of steamers which will carry coal to Montreal, Boston and Prince Edward Island. In this manner it is said that the new company will become a formidable rival of the Dominion Coal Company. This syndicate recently acquired the Inverness and Richmond Railway.

Capt. J. E. Carnwell has bought the passenger steamer "Ontario" from the N.W. Transportation Co., Sarnia, Ont., and has taken it to Sombra, where he will remove the cabins and convert it into a lumber carrier.

W. Ross, E. W. Brydges, Rat Portage; C. G. Neilsen, Sandusky, Ohio; G. H. Bertram, Toronto, Ont., and A. R. Bartlet, Windsor, Ont., have applied for a charter as the Rainy River Navigation Company, Ltd.; capital, $99,000; chief place of business, Rat Portage, Ont.

A. Mackenzie, who was last year with the Pioneer Steamboat company, has bought the steamer "Sir W. C. Van Horne," and fleet of barges, from Boucher, Langstaff & Holmes, and will run an independent passenger and freight line on the Rat Portage-Fort Frances route this season.

The Toronto Ferry Company, Ltd., W. Galt, manager, has appointed the following captains—"Mayflower," Capt. G. Moulton; "Primrose," Capt. R. Williams; "Shamrock," Capt. T. Jennings; "Thistle," Capt. A. Martin; "Kathleen," Capt. J. Fertile; "Island Queen," Capt. M. Corcoran; "Luella," Capt. C. Tufford.

Canadian Transit Co. has made these appointments—Steamer "Briton," master, James B. Watts; engineer, W. R. Donaldson; "German," master, D. Carrier; engineer, H. J. Gilbo; "Grecian," master, William Baxter; engineer, Thomas Kelly; "Saxon," master, Alex. Birnie; engineer, George E. Averill; "Roman," master, A. J. Greenlay; engineer, S. A. Wells.

The New York State advisory board, appointed by Governor Roosevelt, — Bond, state engineer and surveyor, and J. N. Partridge, state superintendent of public works, will inaugurate the investigation of the canal problem on May 10. It is their purpose to commence their work by an inspection of the canals of the Dominion of Canada. They will investigate the construction, improvement and commerce of those waterways.

Montreal Transportation Co., Kingston, Ont., has made these appointments—Steamers, "Active," Capt. Edward Bennett; "Bronson," Capt. Joseph Murray, Engineer Robt. Hepburn; "Glide," Capt. Thos Murphy, Engineer Jas. Conley; "Glengarry," Capt. Gordon Kean, Engineer Geo. Tuttle; "Jessie Hall," Capt. Chas. Martin, Engineer Geo. Tuttle; "Jas. A. Walker," Capt. John Boyd, Engineer Geo. Boyd; "D. C. Thomson," Capt. Jas. Murray, Engineer Geo. Henderson; "Bannockburn," Capt. John Irving, Engineer R. Taylor; "Rosemount," Capt. J. W. Mawdesley, Engineer John Evans.

Mining Matters.

Ore shipments from the "Payne" silver mine for the week ending April 4 were 300 tons. For the month of March the total ore shipments were 1,100 tons.

The McGowan gold mine at Parry Sound, comprising 159 acres, has been sold, according to the Parry Sound Star, for $110,000. The purchasers have also bought the Smith, Virgo and Lafex locations.

The discovery of what promises to develop into a valuable coal property is reported at Sandy Cove, B.C., on the mainland, facing Queen Charlotte Sound, and just above the northern extremity of Vancouver Island.

The discovery of the presence of platinum and gold in the black sand found at the confluence of the Hootalinqua and Lewis rivers is very important and valuable, since it opens up a new mining industry. Black sand is found pretty much in all these and has been hitherto considered of no value. The sand has been assayed and found to consist of about 75 per cent. of iron and 25 per cent. of copper, tin, silver, gold and platinum.

The manganese deposits which are located about five miles from New Ross, Lunenburg county, N.S., have been worked to a limited extent last season, but more work will probably be done this. The ore occurs in the limestone formation and requires to be sorted, washed, dried and dressed by hand, after which it is hauled to Chester Basin, thence to Halifax by schooner and by steamer to New York. The ore contains about 60 per cent. metallic manganese.

The Payne Mine is to be Canadianized, it is said. A Canadian charter is being asked for, and the American company will be taken over. The provisional directors of the reorganized mine are to be James Ross, Hon. L. J. Forget, Edwin Hanson and C. J. McCuaig. It is understood that the capital of the Payne will not be increased, but the shares will be reduced to one dollar.

With regard to Ontario's mineral production for 1898 nickel is still her most extensively developed industry. The copper and nickel mines of the Sudbury country gave employment to an average of 610 men during 1898, and the wages paid to them amounted to $315,500; as against $253,256 in 1897, and $240,151 in 1896. All the ore produced was smelted, reduced to matte, and then exported to the United States to be refined; 8,373,560 pounds of refined copper were produced, valued at $268,080, and the produce of fine nickel was 5,567,690 pounds, valued at $514,220. These valuations are based on the selling price of the matte, which is figured to be one-third of the market price of the refined metal. The total value of both metals produced in 1898 was $782,300, and in 1897 was but $559,710. In 1896 it stood at $247,151. The gold bullion produced during 1898 was 16,075 ounces, valued at $271,906, but this does not include the product of one mine on the Seine River. In 1897 the bullion product was 11,412 ounces; in 1896, 7,154 ounces; and in 1895 it was but 3,038 ounces. It is expected that the present year will show a much heavier increase, both relatively and positively than the past four years. The iron product during 1898 was as follows: Pig iron, 48,253 short tons, valued by the selling price at $530,789. The industry employed 130 men, and the total wages paid was $61,476. During the present year the product will be increased by the recent establishment of the Deseronto smelter, no returns from which are included in the above figures.

Railway Matters.

The C.P.R. at its annual meeting approved two extensions in Manitoba; one the Stonewall branch, northward to Foxton, and the other the Pipestone branch, westward.

The spur line from the main line of the O.A. & P.S. Ry. to Parry Sound is to be built by Mackenzie & Mann. It will be nominally a part of the James' Bay Railway, whose charter would expire if no work was done this year.

A bill was recently put through the Nova Scotia legislature incorporating the Halifax and Colchester Railway Co., a company that proposes to build a railway through the Stewiacke valley from Brookfield ending at Eastville.

The C.P.R. is about to inaugurate the "Empire limited" train from coast to coast. This train, it is said, is to average 45 miles an hour in its transcontinental passage, and will make no stops, save to change engines and take on water. The fast train will carry mails, express and baggage.

The C.P.R. will make the following expenditures on improvements this year: Permanent way, $1,150,979; for additional station, yard, and terminal facilities at Montreal, Vancouver and other points, $788,187; for the completion of air brake and automatic coupler equipment, $305,010; for branch lines to mines in connection with Crow's Nest Pass line, $300,000, and rolling stock, $1,000,000, as the traffic of the company may require.

Mackenzie & Mann have received the franchise for the construction of a railway over a hundred miles in length from Broad Cove, Cape Breton, to the Straits of Canso, and the work on the building of the line will commence as soon as weather permits. The price which Mackenzie & Mann paid for the franchise is stated to be in the neighborhood of $110,000, of which $50,000 has been paid to gentlemen connected with former projects, while Thomas McMillan, who owns the Gladwyn Coal Mining property and franchises, received $50,000.

A great deal of reconstruction has taken place along the Grand Trunk system during the past year, under F. H. McGuigan, general superintendent; 255 miles of steel rails of the standard 80 lbs. were laid. The 80-lb. rails just referred to replaced others from 65 to 70 lbs., and 240 miles of the latter were relaid on lines carrying lighter traffic. There were also a fraction over 66 miles of new side-track, 54 of these being at stations, etc., and 12 for the use of manufacturing establishments in different parts of the country. No less than 85 light iron, steel and wooden bridges were replaced by new steel bridges of the best modern description, their total length being 21,236 feet, or 116 feet over four miles. The number of running feet includes the 25 spans, equal to 6,592 feet of the new Victoria, but it does not include the Niagara bridge, which was completed in 1897. The record for the year also shows that 35 wooden pile bridges and trestles, possessing a total length of 2,361 feet, as well as 10 wooden overhead wagon bridges, the whole being 1,108 feet long, were completely rebuilt, most of these being on the branch lines. The Grand Trunk laid during 1898 no less than 1,759,833 cross-ties, being an increase of half a million over 1897.

Electric Flashes.

The Royal Electric Co. is installing in the premises of the Hudson's Bay Co. at Winnipeg, a complete electric lighting plant.

The Canadian General Electric Co. has sold D. Manchester, woolen manufacturer of Ottawa, Ont., one of its latest type 15 h.p. motors.

The Hamilton Brass Mnfg. Co., of Hamilton, is installing in its factory a 30 h.p. "S.K.C." induction motor to drive its shafting. The premises are also being lit throughout by electricity.

The Cataract Power Co., of Hamilton, is installing in the premises of the Norton Mnfg. Co. three 15 h.p. and one 20 h.p. "S.K.C." induction motors to operate the entire factory by electricity.

The Royal Electric Co. is installing in the works of the Hamilton Bridge Co. a 40 h.p. two-phase induction motor for operating the cranes and machinery. The works are also being lit throughout by electricity.

The Ottawa Journal recently published fac-similies of letters from the president of the Metropolitan Electric Co., Ottawa, offering it for sale at $40,000 to the Ottawa Electric Co. The Metropolitan charter was granted on condition that no such sale should take place.

The solid masonry of the dam across the Jacques Cartier River at St. Catherines, Que., has been completed, and four fifty-four inch water wheels of the most modern type are to be used to develop power. It is proposed to deliver in Quebec for electrical purposes 5,000 h.p. The work will probably be completed by about July, at a cost of $275,000.

Barrie, Ont. has just gone into the electric lighting business, and the first schedule of rates which it has issued fixes the rates at a very low point. Store lights are $5 per single light and $2 per light for twenty and over; residences, $4 for one light, and $1.50 each for twenty or over. Churches are given lights at $1.50 each per year. Meter rates for ten lights and over have been fixed at 10 cents per thousand volts. There are at present three thousand lights installed, and applications for more are coming in rapidly.

Winnipeg, Man., has carried a by-law in favor of municipal ownership of electrical lighting plant, and April 18th tenders were received for a 300 h.p. cross compound engine, with pumps, condensers and fittings for electric lighting purposes, as follows: Polson Iron Works Co., Toronto, $8,550; Goldie & McCulloch, Galt, $9,350; Robb Engineering Company, Amherstburg, N.S., $7,400. For electrical plant and supplies—Western Electrical Company, Chicago; Canadian General Electric Company, Toronto; Royal Electric Company, Montreal; United Electric Company, Toronfo.

The T. Eaton Co., of Toronto, is installing in their new factory two Canadian General Electric Co. motors.

The Chambers Electric Co., of Truro, N.S., has purchased a 10 h.p. motor from the Canadian General Electric Co.

The Montreal Street Railway Co. has placed another order with the Canadian General Electric Co. for twenty "C.G.E." 1,000 railway motors.

The E. T. Wright Co., of Hamilton, manufacturers of tin and stamped ware, are having their steam engine replaced by a 30 h.p. "S.K.C." two-phase motor, receiving its current from the lines of the Cataract Power Co.

The Dowsell Mnfg. Co., Hamilton, Ont., is having installed in its works, one 30 h.p. two-phase motor of the Royal Electric Company's make. The current for this installation is to be taken from the Cataract Power Company's service.

It is said that the prospects are encouraging for the completion of the Windsor, N.S., Calcium Carbide Co.'s works in the near future. The engineers have been engaged and a survey will be made at once. It is proposed to have the plant completed within ten months. The power will be obtained from the West Branch of the Avon river.

The B. Greening Wire Co., Hamilton, Ont., had installed in its works, about three months ago, a 40 h.p. "S.K.C." two-phase motor, by the Royal Electric Co. It receives its current from the Cataract Power Co. This has worked so satisfactorily that it has placed an additional order for one 50 h.p., one 30 h.p. and one 20 h.p. motor of the same type, to operate its entire works by electricity.

The Gurney Tilden Company, of Hamilton, is having installed in its works by the Royal Electric Company, one 30 h.p., three 15 h.p., and one 7 h.p. "S.K.C." two-phase motors, which are to drive the machinery and elevators in their entire works, entirely replacing steam. At this rate, Hamilton will soon be a smokeless city, as the engines of the Hamilton Electric Light & Power Co. were closed down on March 5th, and have not been in operation since, everything being driven by the large "S.K.C." motors, with power from DeCew Falls.

Judge Carman, Cornwall, gave a verdict for $100 in Miller vs town of Cornwall and the Cornwall Electric Street Railway Co This was an action for $200 for injuries sustained by the plaintiff falling off his wagon and striking his head on a rail. It was held that the accident was due to the rails of the street railway track being higher than the roadway. His Honor in giving the verdict for $100 held both defendants liable. The suit was brought against the town, which had the Street Railway Company added as defendants. The case is said to be the first of the kind in Ontario and the third in Canada.

The International Traction Company took over the Canadian property at Niagara Falls, Ont., April 19th. A meeting was held in Toronto and officers and directors for the Niagara Falls Park & River Railway were elected as follows: W. C. Ely, president; Daniel S. Lamont, vice-president; Richard Rankine, secretary and treasurer, and B. Van Horne, general manager. The property acquired is the trolley line from Chippewa, Ont., to Queenston, a distance of twelve and a half miles. This completes the acquisition of the properties embraced in the title of the International Traction Company. They comprise six electric railway lines, including the Buffalo city and suburban system, and two bridges spanning the Niagara river.

The water commissioners of Fort William have bought from the Royal Electric Co., an additional "S.K.C." two-phase generator, having a capacity of 200 k.w. Their lighting has increased so rapidly that the 75 k.w. plant, which was put in a year ago, was not sufficiently large to supply the demand. They are also revamping a portion of the city and extending their lights. About 500 lights capacity of "S.K.C." transformers are being put in The changes will be made, and the additional plant in operation about the middle of June, after which it is proposed to supply the C.P.R. station, the elevators, freight sheds, round houses and the Kaministiquia Hotel. The growth of the lighting has been phenomenal, and has been taken care of by T. E. Oakley, secretary of the commissioners. The waterworks and electric light plant are in charge of W. H. Smith, formerly of Goderich, Ont.

The John McPherson Co., Ltd., manufacturers of boots and shoes, Hamilton, Ont., has placed its order for a 40 h.p. "S.K.C." two-phase induction motor, which is to be used to cperate the entire plant, replacing its present steam equipment. The company is also having its factory lit throughout by electricity.

The Canadian Pacific Railway Co. has found it necessary to increase the power plant at the Trail Smelter works, Trail, B.C., owing to the large contracts it has undertaken, and has placed an order with the Canadian General Electric Co. for another 75 h.p. induction motor and a 75 h.p. three-phase synchronous motor.

The B. Greening Wire Co., of Hamilton, has placed an order for another 30 h.p. "S.K.C." two-phase motor, which is to be installed about the middle of May, and will complete the conversion of their manufactory from a steam driven to electrically driven plant, and adds another smokeless chimney to Hamilton factories.

During the past thirty days the Canadian General Electric Company has received many orders for its standard three-phase induction motors; among which are: Three 150 h.p. to the British America Corporation, Rossland, B.C.; one 50 h.p. to the Trail Smelter, Rossland, B.C.; one 200 h.p., one 100 h.p. and one 20 h.p. to the Montreal Cotton Co., Valleyfield, Que.; one 100 h.p., four 5 h.p., two 3 h.p. and two 2 h.p. to the Lachine Rapids Co., of Montreal; one 50 h.p. to the West Kootenay Power & Light Co., and one 5 h.p. to the Miller Bros. & Jones, Montreal.

The West Kootenay Power & Light Co., Rossland, B.C., has met with such success in its power transmission undertaking that it has found it necessary to increase its plant to double the present capacity. About a year ago this company commenced supplying current to its customers at Rossland and Trail, a distance of nearly 40 miles from the power house, which is located at Bonnington Falls on the Kootenay River, and to-day has more orders for power than it can supply. The present generating plant consists of two 1,000 h.p., three-phase revolving field dynamos of the Canadian General Electric Co.'s make, and the company has just placed an order for a 2,000 h.p. generator of the same type with the company. The Canadian General Electric Co. is also supplying a complete equipment of marble panel switchboards, and 3,000 k.w. capacity in high potential step-up and step-down transformers. When this additional installation is completed the West Kootenay Co. will have one of the largest power plants in Canada, and the distance of transmission is the greatest in operation in Canada.

Personal.

C. H. Topp, city engineer, Chatham, Ont., has accepted the position of city engineer, Victoria, B.C.

The Canadian representative of Holland's Mnfg. Co., vises, machinists' and plumbers' tools, Erie, Pa., A. Younghans, called at the Toronto office of The Canadian Engineer recently.

N. J. Ker, C.E., assistant city engineer, Ottawa, Ont., has had a considerable addition made to his salary in Ottawa to induce him to decline the position of city engineer of Victoria, B.C.

W. A. Dube, formerly employed as train despatcher by the Grand Trunk Railway in its Montreal office, has been appointed superintendent of the Intercolonial Railway for the Ste. Flavie and Montreal districts. The new superintendent has been in the Grand Trunk service for twenty-five years, rising from the position of telegrapher to that of train despatcher, and at as early an age as 18 years having charge of the running of trains between Montreal and Island Pond, being made chief train despatcher at the age of 23, which position he held for fifteen years.

Jno. Inglis, senior member of the firm of J. Inglis & Sons, engine and boiler-makers, died suddenly last month at his home in Toronto. He was a Scotchman, and came from that country 47 years ago. He was a millwright by trade, and worked for a time at Chippawa. From there he moved to Simcoe, and shortly afterwards to Dundas. He only remained a short time in the latter place, going from there to Guelph, where he went into the manufacturing business on a comparatively small scale with Mair and Evatt, the firm name being Mair, Evatt and Inglis. After a time it became Evatt and Inglis, and finally Inglis and Hunter. The business developed into pretty much the same line as that at present carried on in Toronto, though not of the same proportions. About 18 years ago, when manufacturers of all kinds began to gravitate towards Toronto, the firm made their headquarters in this city. Some eight yea s ago Mr. Hunter went out of the business, and Mr. Inglis' sons were admitted to partnership.

Brief, but Interesting.

The fireproof curtain of the Paris Opera House is made of aluminum plates, each about 13 feet long, 39⅜ inches wide and 3-32 inch thick. The exposed area of the curtain is 3,229 square feet, and the curtain weighs 1.8 tons.

The latest use of electricity is the seasoning of wood. A current drives out all the sap from a piece of timber in about six hours. The second process is the injection of a septic solution into the pores by an electro-capillary method, and the timber is seasoned. Such inventions lessen the necessity for anticipating future needs.

In the factory of the Grant Ball Company, Cleveland, large quantities of oil and emery are used for grinding, and the oil finally becomes so thickened with particles of emery and steel as to make it of the consistency of mud. In the city where this material accumulated no other way of disposing of it could be found except to pay for its removal outside of the city limits, for it was of such a character as to make it practically impossible to dispose of it in any other way. Finally the managers hit upon the plan of running it through a centrifugal cream separator, which completely separates the particles of emery and steel and runs the oil out at a separate spout, so that it can be used over again, while the mixed emery and steel can be disposed of much more readily than when, as formerly, mixed with oil.—American Machinist.

A Parliamentary return has recently been issued giving particulars of the water, gas, tramway, electric lighting and other reproductive undertakings carried on by municipal boroughs in England. The total capital invested in such undertakings amounted at the end of March, 1898, to £88,152,600, of which £83,379,300 had been borrowed. Of this borrowed money, however, about £11,250,000 had been paid off at the date of the return, leaving £71,883,200 outstanding, against which there had been accumulated sinking and loan funds to the amount of £3,203,600. The Economist summarizes this document. It appears that the average annual income from all the undertakings in the five years ending March 31, 1898, was £8,898,400 or 10.09 per cent., the average annual net profit for the same period £3,613,700 or 4.04 per cent., and the average annual amount paid in respect of principal and interest on capital borrowed £3,171,300. Water and gas works are the two chief undertakings in which the municipal boroughs have embarked, the capital invested by them in the former amounting to £48,434,900, and in the latter to £20,175,800. Tramways figure in the investments to the amount of £3,213,700, electric lighting undertakings for £3,416,700, markets for £4,770,300, and piers, quays, etc. for £4,797,500.

The London (Eng.) Times recently publishes the report of the Departmental Committee appointed to enquire into the manufacture and use of water gas and other gases containing a large proportion of carbonic oxide which has just been issued as a Blue Book. It shows that we can both learn from and teach the British gas consumer. The committee was appointed by the Home Secretary on February 9, 1898, and it consisted of Lord Belper (chairman), H. H. S. Cunynghame, assistant Under Secretary for the Home Department; J. S. Haldane, M.D., F.R.S.; H. F. Parsons, M.D., assistant medical officer of the Local Government Board, and William Ramsay, Ph.D., F.R.S., professor of chemistry, University College, London, with John Pedder, of the Home Office, as secretary. The committee was to enquire into and report (1) on the extent to which water gas and other gases containing a large proportion of carbonic oxide are manufactured and used for heating, lighting, and other purposes; (2) the danger attending such manufacture and use; (3) the means by which such dangers may be removed or diminished, either by the discontinuance of the use of such gas or gases or otherwise, and what regulations for the prevention of danger should be established. The summary and the recommendations of the committee are as follows: To sum up, we have come to the conclusion that, if the accidents attributable to water gas are not yet very numerous in Great Britain, the reason is that the proportion in which this gas has been used has not hitherto, except in a few instances, been high. A large increase in the use of the gas is, however, to be expected in several localities, and in some places the use of pure carburetted water gas is contemplated, in the absence of legislative restriction. We therefore think the present time opportune for dealing with the matter before the manufacture of water gas is established on a large scale, and we beg to submit the following recommendations, to which, if approved, effect should, in our opinion, be given by a public bill: 1. That it should be illegal for any person to make and distribute for heating and lighting purposes any poisonous gas which does not possess a distinct and pungent smell. 2. That all persons applying for statutory powers to make and distribute gas should be required to state in their application the kind of gas which they propose to sell, viz., whether ordinary coal gas, carburetted water gas, plain water gas, or other variety of gas, separately or mixed 3 That before any kind of water gas is distributed in any place due public notice of the proposal should be required to be given; and that, so long as there is any water gas in a gas supply, that fact should be stated on every demand note. 4. That where water gas is distributed, records should be kept by the producer, showing the respective amounts of the gases issued day by day, distinguishing the gas supplied to each area (if more than one and separately served), and the day and night supply; that these records should at all times be open to inspection by any gas consumer or ratepayer of the district, and should be published quarterly in a local newspaper, and that a new column should be added to the annual returns made to the Board of Trade giving the total amount of water gas issued, as compared with coal gas. 5 That power should be conferred upon a central department to make regulations, enforceable by adequate penalties, limiting the proportion of carbonic oxide in the public gas supply at night to 12 per cent, or such greater amount as the department may consider desirable. These regulations might be applicable either generally over the United Kingdom or to any particular locality, and might contain such conditions, if any, as appeared necessary. 6. That powers should also be given for the regulation of the distribution and use of gas by means of by-laws, made subject to the approval of a central department and administered under local control. The matters to be so dealt with might include the following: The hours during which, or the arrangements by which, the limit imposed upon carbonic oxide should be enforced, the use in emergencies of more than the authorized proportion of carbonic oxide, the character of the gas burners, fittings and apparatus to be used, having regard to the circumstances of their employment, the testing of the gas, and other similar questions. 7. That the provisions of Sections 28 to 34 of the Gasworks Clauses Act, 1871, should be made applicable to the testing of gas for carbonic oxide, and that in all cases where a limit has been placed upon the carbonic oxide in the gas supply of a locality there should be some person empowered and required to test for carbonic oxide and publish the results periodically.

The incorporators of the Union Match Company, organized at Trenton, N J, with an authorized capital of $10,000,000, are: Erskine Henry Bronson and Levi Crannell of the Bronson & Weston Lumber Company, Ottawa, Ont.; William M. Ivins of New York, Camillus G. Kidder of Orange, N.J.; W. E. Cook of the Adirondack Match Company, Ogdensburg, and G. H. Williams of New York.

LITERARY NOTES.

William T. Lancefield, Hamilton, has published "A Century of Achievement," by James H. Coyne, B.A. Mr. Coyne is president of the Ontario Historical Society. While necessarily condensed, the reader is given a most interesting account of the achievements of this century.

Williams' Official British Columbia Directory, 1899, is a particularly timely and valuable addition to the business man's library, as it includes not only the Omenica, Cassiar and Atlin mining districts in British Columbia, but also the Yukon district of the Northwest Territory, which is now the centre of so much interest and commercial activity.

The publishers of The American Artisan, Chicago, have issued a very valuable Manual of Receipts, compiled by Sydney P Johnston, largely from material that has appeared in the columns of The Artisan, and the new volume makes a book of over 241 pages, and contains over 1,600 receipts and processes relating to metal working and allied subjects. From a hasty glance at the volume, we should say that this is the most complete budget of receipts and formulae ever put together in one book.

FIRES OF THE MONTH.

April 7th. The Cariboo Lumber Company's sawmill at 110 Mile House, B.C., was partially destroyed by fire.——April 7th. The Langmuir Mnfg. Co.'s trunk factory, Toronto; loss, $60,000; partially insured.——April 7th. The Dominion Metal Works, Montreal, owned by C. Garth & Co., was totally destroyed by fire; loss about $60,000.——April 14th. Reid Bros., Toronto, makers of billiard tables; loss about $4,000.——April 18th. C.P.R. round-house, Fort William, Ont., seven locomotives destroyed.——April 20th. McComb & Stanley's oatmeal mill, Lucan, Ont.; loss about $10,000.——April 30th. Beaudry buildings, Montreal, containing Vinette & Co.'s shoe factory, New York steam laundry, Kieffer Bros., shoe machinery, Benard & Magor, carriage makers; the Universal Patent Development Co., and Lymburner & Matthews, brass moulders; loss about $100,000.

NEW SYSTEM OF FIREPROOFING.

Ever since the first fire took place in a building fitted with Luxfer Prisms, it has been recognized that, glazed as it is in four inch squares by electrolytically-applied copper, the prism panels form an efficient fire screen. Experimentally it is said to have proved that this was due to the small size of the lights, and the extraordinary strength of the metallic glazing, with the additional fact that continuous and intercommunicated support was afforded to the glass panel, throughout its area, by the electrically-toughened copper. In short, small squares of plate glass, glazed by the new copper process, were found to be similarly efficacious. Plate glass panels so made were fitted in an iron box 6 feet high, and 4 feet square. Open iron bars admitted air freely at the bottom, and a vent at the top permitted the requisite draught. The box was then fired with pine sticks soaked in kerosene, and an intense heat was maintained; cold water meantime being applied externally. Although shivered in every direction the glass panels withstood all persuasion to escape from the network of copper I bars binding them together. The result of this and other similar tests is that the Chicago and New York underwriters have highly commended the new Luxfer fire-proofing, and the Rookery, and several other of the largest buildings in those cities have adopted the system. Two great advantages are that windows furnished with Luxfer fire-proofing admit light at all times, while every chance of disaster from neglect to close the ordinary fire-proof shutter is precluded.