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A Monthly Journal

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EDITED BY W. E. GOWER, C. E.

VOL. I.—No. 1. MONTREAL, JANUARY 31, 1893. $1.00 PER ANNUM. SINGLE COPIES, 10 CENTS.

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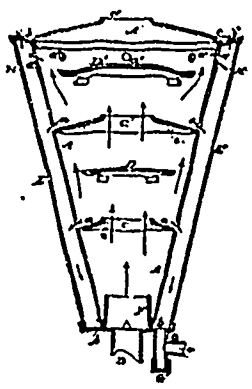

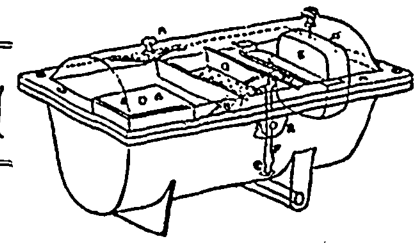

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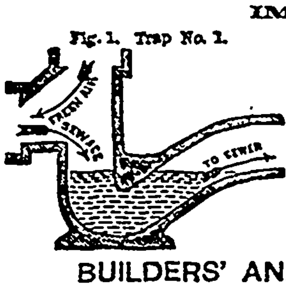

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CANADIAN ENGINEERING NEWS,
PUBLISHED AND EDITED BY W. E. GOWER, C. E.
204 ST. JAMES STREET,

Montreal, Feb. 1893.

Dear Sir,

We herewith send you a copy of the first number of the Canadian Engineering News. As this is the only publication in Canada representing the general engineering profession and trades, I trust you will see your way to become one of my regular subscribers and would ask yau to fill in the anexed form.

Yours truly,

W. E. GOWER,
PUBLISHER & EDITOR

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THE CANADIAN ENGINEERING NEWS.

Vol. I. MONTREAL, JANUARY 31, 1893. No. 1.

THE CANADIAN ENGINEERING NEWS.

In introducing to our readers the first number of this journal we will endeavour to lay before them as concisely as possible the aims of the editor, and trust that at the end of the first year's issue we may be able to congratulate ourselves on having carried out what we now conceive to be our lines and duties.

Up to the present there has not been published in Canada any Technical Engineering Journal embracing all the branches of the profession. The issuing of a Mining, Electrical and Architectural Journal has made the lack of a Civil, Mechanical, Hydraulic, and Sanitary Engineering medium all the more apparent, and to fill this void we hope we shall succeed to the advantage of the professions and trades interested.

We are aware the field is not exhaustless, but we feel sure we shall in a short time bring into our columns new and unexpected sources from which a variety of special and technical information for the benefit of most of our readers will be gathered.

It will be our endeavour to introduce and discuss all the most recent discoveries and appliances in science and mechanics, and an attempt will be made to avoid excessive technicalities where this can be done without detracting from the value and importance of the subjects discussed and written upon.

The more support we get the better matter we shall be able to give, and we rely on our *confreres* if they are satisfied with our first efforts making our journal known to their fellow-workers whom we may not have reached.

Our leading matter in this first issue will tend to show how large a field we cover, and it will always be our aim to make the subjects as universal as possible,—as engineering should be. The Canadian engineer does his work from Cape Breton to Vancouver Island, and we desire to give to the one on the western slope of our Domioion matter as interesting and instructive in his work as his fellow-laborer at the iron works and collieries of Nova Scotia.

Whilst we give way to no one in patriotism, we will utilize, as far as possible, gleanings and items of news from the engineering and scientific papers in the United States, England, France and Germany, and shall lay ourselves out to devote part of our journal to eclectic copy, doing our best to make wise and careful choice from the masses of information that we shall have at command.

The question of a deep water canal from the west to the seaboard appears to agitate our friends in the United States very considerably at this period; we have therefore given a short paper on our own inland navigation as applicable to our great northern river; it will appear that the distance from Liverpool to Chicago could be shortened some 800 miles, and this in these days means much.

Later we will discuss more fully this Ottawa River navigation, and also the question of the ship railway or canal via Lake Simcoe.

It appears desirable that our Government should come forward at this time and assist in the settlement of the Chignecto Ship Railway. Having prosecuted the scheme so far, and there being no physical or mechanical difficulties to encounter, it should not be left to hang fire and be looked upon as a hopeless failure by those who, on the strength of the Government fathering the whole scheme put in their money with the full hope of getting a moderate return.

There does not appear to have been any waste or jobbing. The work done appears to have been well done. The contractors and sub-contractors have been of the highest standing. We would advise some action being taken before any serious deterioration of plant or machinery takes place.

In each issue we will give at random workshop receipts and short paragraphs that will be useful, we feel sure, to all engineers, and as all these will be carefully indexed at the end of the year we would advise all our subscribers to keep and bind every volume. They will in this way have at hand an encyclopedia of useful mechanical, chemical, electrical and metallurgical knowledge that would cost a great deal if they had to be purchased from other sources.

We shall be glad to have any suggestions from our readers as to our future issues, and will at all times try to act on them.

A series of tests have been instituted by us on a new basis, and will be published from time to time. We shall give results of various lutes and cements as applicable to metals, tensile strains of various materials, and workshop receipts, &c., &c.

The New 100-H. P. Engine recently purchased by the Royal Electric Company is nearing completion and it is expected to start it on the 11th February. A full description of the Engine will be given in our next issue.

The Rolling Mills owned by Abbott & Co., which were burnt down last fall are now rebuilt and fully equipped with the latest improved machinery for rolling iron and steel and manufacturing all kinds of nails, spikes, bolts, horse-shoes, etc.

The principal buildings have iron trussed roofs of good design built by the Dominion Bridge Co.

The Canadian Pacific Railway have in hand, for exhibition at Chicago, a complete train, comprising: engine, sleeper, Dining car, first-class, second-class. This will be on view during the whole of the Exhibition and will no doubt attract many visitors and reflect a great deal of credit on the Company. From what we have seen we feel sure that nothing will be seen on this continent to equal the luxury of these cars.

January of this year has been a very favorable month for railway work no heavy snowfalls interfering with the moving of produce and freight. The snowfall and temperature have been very similar to 1888, when the average temperature in Montreal at 8 a.m. was 1.71.

We are indebted to the London "Engineering" and "Engineer," the New York "Engineering News," and "Engineering Record;" the "Stationery Engineer"—"Power" &c., for our eclectic matter. Any Engineering or Scientific Journals that will kindly exchange with us we shall be glad to hear from.

THE NEW EXPERIMENTAL ENGINE AT McGILL COLLEGE.

The quadruple expansion engine now being erected at McGill College will be one of the finest and largest experimental engines in the world. That it is so is due to the wise munificence of Mr. W. C. McDonald, who has treated the steam laboratory in the new engineering building with the same liberality as the others.

The purpose of such an engine in the laboratory of a school of engineering is mainly two-fold. The elementary students need to become acquainted with the actual construction and working of a steam engine, with its valves and the different kinds of valve-motions; they must learn how to take and read indicator diagrams, to make the usual calculations in connection therewith, and to carry out dynamometer tests and and other simple measurements. The more advanced students require to study the action of steam under different conditions, such as varying grades of expansion, different arrangement of cylinders, and varying clearances, steam jacketing, and varying amounts and temperature of circulating water; and to measure and note the temperature and the condensation in various parts of the engine. The second object of such an engine is the carrying on of experimental research in connection with various questions which are still matters of controversy. Thus, for instance, the great question of the loss due to cylinder condensation, in regard to the different factors, such as piston speed, ratio of diameter to stroke, cut off release, etc., which affect the matter still demands careful enquiry, notwithstanding the valuable contributions of Hirn, Cotterill, Dwelshauvers-Dèry and others. The problem of the proper ratio of the cylinder diameters, in quadruple, triple, and even double compound engines, has not yet been satisfactorily solved. Again the question of the most economical point of cut off has to be answered for certain sizes of engines, although much has been done by the valuable labours of Emery, and more recently Professor Peabody, with the triple engine at Massachusetts Institute of Technology and of others. On most of these points the new engine at McGill will, it is hoped, have something to say in the near future.

The engine is of the double-tandem or Woolf type, working on two cranks. The engines are designed to work either with quadruple, triple, double, or simple expansion, and all these either condensing or non-condensing. The steam pressure may be as high as 200 lbs. All the cylinders are jacketed on their top, bottom and sides with steam up to 200 lbs pressure. The two engines may be disconnected from each other on the plan suggested by Mr. Thornycroft and carried out on the Owens College engine in Manchester. This is equivalent to varying the ratio of cylinder volumes. Clearance pots, by means of which the clearance volumes can be varied, have been fitted on the L. P. cylinder. All four cylinders are fitted with expansion plates on the back of main valves; the H. P. engine on the Rider system; the L. P. on the Meyer plan. The engines are non-reversible, but both main and expansion eccentrics have a variable angle of advance, and the L.P. engine main valves have a variable travel. As the valves of the upper cylinders are driven by rocking levers from the stems of the lower valves, there is only one main and one expansion eccentric for each engine. The diameters of the cylinders are 6½" and 9" on the H. P.; 13" and 18" on the L. P. engine, and 15" stroke. There is a surface condenser fitted with a separate air-pump, worked by steam either from the main engine steam pipe or from a separate boiler.

Measurements will be made of the feed-water as it is pumped into the boiler; of the quality of the steam as it passes into the engine; of the action of the steam in the steam chests, cylinders and receivers, by means of from 8 to 14 indicators; of the amount of condensed steam rejected into the hot-well; of the amount of heat rejected in the circulating water and of the brake horse-power received by the dynamometers.

There are two brakes on the H.P. and one on the L. P. engine shaft. One is a rope brake on Mr. Halpin's plan, the other two are hydraulic or reversed turbine brakes, as invented by Froude and improved and applied by Osborne Reynolds to the engines in the Whitworth Laboratory at the Owens College, Manchester. The measurement of the jacket water will be performed by direct weighing in a closed vessel connected alternately to each jacket in succession.

The engines are of an extremely substantial design throughout, are of first-rate material and workmanship in every part, and reflect the greatest credit on Messrs. Schonheyder and Druitt Halpin, of London, the designers; and on Messrs. Yates & Thom, Blackburn, the manufacturers.

In our next issue we will give a full page illustration of this engine.

A POSSIBLE WATER FAMINE IN MONTREAL.

As far back as February 1888, or not much over two years after the twelve million gallon Worthington engine was put in at the low level pumping station of the Montreal Water Works. Mr. D. Kearney, the chief engineer at that station, wrote to the Superintendent, calling his attention to the fact that owing to deficiency of water power, the whole available steam power was pressed into service to keep up the supply and that in case of a serious accident to either of the steam engines, the situation would be alarming. He went on to say that, in any case, with the then existing increase in the rate of consumption, another steam pumping engine would be a necessity inside of four years and advised as a matter of precaution that it be procured at once, showing that the only extra expenditure involved in such immediate action would be four years interest on cost of engine, for which full value would be had, in a sense of security not otherwise attainable.

Some two years later Mr. McConnell, the then superintendent, reported to the Water Committee that more pumping power was required at the low level pumping works. Again, in January, 1892, he reported to the same effect, but with greater urgency, and in this instance the report was adopted and sent to Council and by Council referred to the Finance Committee, with whom it remains.

In September last, Mr. A. Davis, superintendent Montreal Water Works, reported to the Water Committee, on this question, as follows: "The need of another similar engine" (alluding to the twelve million Worthington) "is very urgent, as I find by refering to the two last winter's steam pumping, that all the steam capacity was brought into use at once, this for weeks at a time, hence an accident to one of these two engines, would have left the city on half supply, or possibly worse."

Finding that these three aforementioned civic officials, a special part of whose duty it was, to be watchful of, and keep themselves properly informed as to, the sufficiency and efficiency of the plant for the maintenance of an uninterrupted water supply, concur in the opinion that an increase of pumping power is required, it may be well to glance at the facts bearing on the question, to enable our readers to judge whether or not a water famine in Montreal is so within the limits of probability, as to call for measures of prevention.

Montreal as regards its water supply is divided into two districts known as the high and the low level, the pumps at the lower station delivering the water for both districts to the height of McTavish street reservoir, from which point another set of machinery forces the upper level supply to the Peel street reservoir and through the distributing pipes of the high level district.

The pumps at the lower station are 14 in number, 10 worked by water power and 4 by steam. The former are driven by one breast wheel and three turbines and their combined capacity runs from 0 to 12½ million gallons daily, varying with the climatic conditions. The steam pumping engines are, one of 12 million gallons and one of 8 millions and will be referred to hereafter as No. 1 and No. 3 respectively, the designations by which they are known at the Water Department.

The consideration of the question need not take in the upper level pumping plant, because there, the pumping by steam is a known quantity, unaffected by river fluctuations and subject only to a regular annual increase easily foreseen and provided for.

It should further be noted that the McTavish street reservoir cannot be looked upon as a source from which to draw in case of a partial water famine. Under such circumstances it would be very unwise to allow the reservoir (the capacity of which is equal to, not more than three days ordinary supply) to be drawn upon for domestic or manufacturing purposes. It should be strictly reserved for fire protection.

In Feb., 1888, the pumping by water-power for the whole month, averaged 2¾ million gallons per day, and there were at least two days in the same month when it was at zero, leaving in the first case 10½ million gallons to be pumped by steam and in the other 13.2 million gallons. The large engine (No. 1) alone could have pumped the 10½ million gallons, but the small engine (No. 3) alone would have left a shortage of 2½ millions. For the two days when all the wheels were idle, neither of the steam engines alone could have done the work. No. 1 would have left 1.2 millions short and No. 3, 5.2 millions.

In March of the same year 69 million gallons were pumped by water and 365 millions, equal to 11.8 millions per day, by steam. This is about all No. 1 engine could do alone and if disabled and No. 3 were working, there would remain a shortage per day of nearly 4 millions. In the winter of 1889, from 23rd February to 23rd March, the average pumping by water power was 444,000 gallons per day and by steam 11 millions. Here again an accident disabling No. 1 engine, No. 3 would have left a shortage of 3 millions.

Again, in February 1892, there were eight consecutive days during which the water power pumping averaged only 77,000 gallons, and on the eight following days, the remainder of the same month, the water power was *nil*. In the first case 12.4 million gallons daily was supplied by steam and in the latter case 11.8 millions. Here if No. 1 had been unable to work, No. 3 would have left a shortage of, first, 8.4 millions and secondly of 3.8 millions. And in the first case with No. 1 alone able to work, there would have been a shortage of 400,000 gallons per day.

The foregoing shows in part what the steam pumping engines have been called on to do and to which calls they have hitherto not failed to respond.

But without referring to the records at all, except to learn from them, that at times the whole of the city water supply has to be pumped by steam and that the consumption of water has, even in winter, exceeded 14 million gallons per day (and is, of course, on the increase with the growth of the city), we have the fact that our two steam pumping engines of 12 and 8 million gallons capacity may be called on to furnish 14 million gallons per day for a month at a time. This they can do so long as both are in working order. But an accident disabling either at once leaves a shortage, or, in other words, a partial water famine ensues.

Neither of the engines has ever had a serious breakdown at a critical time, though each has at times been obliged to stop for repairs, and it once happened that the plunger of No. 3 was broken, disabling the engine for five days. It may seem idle to speculate on the chances in such matters, yet everybody knows that steam engines, even those of exceptionally good construction, do break down and frequently at the most inopportune moment. In this connection we call to mind a report, of some years back, of the chief engineer of Toronto waterworks, where in advocating a reservoir for the city, he bases his argument on the liability of steam pumping engines to break down and cites the experience of Brooklyn, where with two pumping engines the city has on several occasions been unable to use either of them and at one time was for six days dependent on her reservoirs alone. There is nothing to guarantee Montreal against a similar experience, minus the dependence on her reservoir which as has been shown is not a factor in the calculation.

With the foregoing facts in view, we have no hesitation in saying, that the existing pumping power at the low level pumping station, is not sufficient to ensure the city against a water famine, that the risk the city runs, in depending, as practically it does depend, for nearly a month out of every year on the staying powers of two steam pumping engines neither of which is able to furnish the whole required quantity, and either or both of which, subject as they are to the uncertainty in emergencies common to all heavy machinery, may give out at any critical moment, we say, that the risk the city runs under these conditions is such as, no consideration of so-called economy, or any other consideration that we conceive of, can justify "the powers that be" in their long delay to make provision against it. If economy is the excuse they offer, let them consider for a moment whether this matter, or the widening of old and opening of new streets on which so many millions are lavished, is the more urgent. And they may also compare the cost of this improvement, absolutely essential as it is to the safety and well-being of the city at large, with that of the many enormous expenditures so lightly undertaken to enhance the value of properties belonging to the favoured few.

What a water famine might mean to the Montreal of to-day with its varied manufacturing industries as well as the large population to be considered in a domestic point of view, is difficult to picture, but citizens who remember the winters from 1860 to '67, when the water supply was intermittent, the lower parts of the city getting water by day and the upper parts by night, many being obliged to supplement their portions by melting snow gathered in the streets and backyards or by hauling water from the sewage-polluted harbour, will perhaps be able to form some, though an inadequate idea of the loss, inconveniences and misery, such a state of things would now produce, with Montreal'sl argely increased area and nearly tripled population.

Should this article chance to come under the notice of one of our City Fathers, we trust its perusal may incite him to a consideration of the grave responsibility resting on those who, having solemnly undertaken to care for the public interests, allow a matter of such paramount importance to be consigned to oblivion, and that he will forthwith stir up his *confreres* to immediate action, no longer waiting for the "possible," to become an actual, water famine.

CANADIAN CANAL NAVIGATION.

At a recent convention held at Washington to discuss the project of a deep waterway from the head of Lake Superior to the Atlantic Ocean at New York—entirely on American territory—a member remarked that: "It is time to show Canada that the great west is no longer dependent on her for her water route to the seaboard" and that: "once the American canal is built Canada will be forced to adopt a more neighborly spirit in her dealings with us."

The cost of the projected American water way is put down by experts at $500,000,000 to $600,000,000, and, if we except a few enthusiasts whose prtriotism has temporarily swamped their common sense, is looked on as visionary by every practical man who has considered the subject. But while we have nothing to fear from this source—the fact that the commercial interests of the great west have now reached such a stage of development as to warrant such keen business men as our American neighbors in calling a meeting to seriously discuss a $500,000,000 project to give them another outlet for their products should set our own people to thinking and cause them to realize their natural advantages, some of which they have so far done almost nothing to improve.

From the earliest days the Ottawa and Mattawa Rivers and Lake Nipissing have been the travelled route for the Indians from the locality of Montreal to Lake Huron, Michigan and Superior. It was traversed by Champlain and his followers more than three hundred years ago and long before the existence of the St. Lawrence route was known to whitemen. From a glance at the map it would appear as if nature had laid out this line as the natural highway to and from the North West and it was long ago proposed to utilize this highway by the construction of what is called the "Ottawa Ship Canal."

In the year 1858 Mr. W. Shanly, C. E., made a survey of this route and an elaborate report. He estimated the cost of a canal from the mouth of the French River to Montreal, (a distance of 430 miles) with locks 250 feet long and 45 feet wide with 10 feet of water on the mitre sills, at $24,000,000. His plan was to raise the level of Lake Nipissing—by dams—23 feet and make it the summit from which to draw his water supply—this would give a canal of only five miles in length between the Lake and the head waters of the River Mattawa—with a maximum cutting of 30 feet through granite rock. The country around the lake was at this time a wilderness inhabited only by scattered bands of Indians, but the soil was good and the building of the Canadian Pacific Railway through this region has brought in a large population, who are now settled along its shores, which renders the scheme of raising the water level impracticable. No doubt we have sufficient engineering skill in the country to devise some other plan, though it would, probably entail an increase in the cost of the work, but as our facilities for carrying on works of this kind are now far greater than they were thirty-five years ago the estimate then made would probably still be sufficient even in face of this difficulty. Since this report was made this project has been talked of from time to time and some additional reports made, and some construction work done, viz: The Lachine Canal has been enlarged to 14 feet draught and the Ottawa canals, between Ste. Anne and Ottawa, have been made nine feet deep. The Chats Canal, between Lakes Deschenes and Chats, has been partly completed and then abandoned, and small locks have been constructed at one or two points, but no systematic work has been done and the scheme has been apparently dropped. Mr. E. L. Corthell, C. E., of Chicago, the projector of the Hurontario Ship Railway, has recently looked into the Ottawa scheme in comparison with his own and puts the cost of a 20-foot navigation, with locks 600 feet long and 85 feet wide, at $83,000,000. The project of making Duluth and Chicago ocean ports by means of deep water canals is a very taking one, especially for the western people; but it is hardly a practicable scheme from a commercial point of view to move grain, etc., in large ocean steamers, in order to save the cost of one transhipment, when it can be handled more cheaply in barges and other lake craft, and it will probably be found that the limit has been reached when a 14-foot channel has been obtained with locks 250 feet long, by 50 feet wide, similar to the new ones on the St. Lawrence. This would cost say $30,000,000 and the result would be that the bulk of the produce of the North Western States, as well as that of Manitoba and our own North West, would come down through Canada to our own seaports instead of seeking an outlet at New York or Boston, and the western farmer would be about five days nearer the Liverpool market than at present.

The distance by this route from Chicago to Montreal would be 980 miles as against 1338 miles, by the present St. Lawrence route a saving of distance of 368 miles in favour of the former. The distance from Chibago to New York by the proposed American canal would be 1504 miles, making the saving between Chicago and the sea by the Ottawa route no less than 524 miles If to this we add the 240 miles saved between Montreal and Liverpool, as against the distance from New York to Liverpool, we have a total saving in distance between Chicago and Liverpool of 704 miles. Taking Duluth as a starting point the saving of distance would be approximately the same.

This is the commercial aspect of the scheme—from a military point of view the canal would be equally important. The prospects of war with the United States are so remote that such a question is hardly worth considering, but some of their papers are so fond of speculating on the possibility of British gunboats being sent up the St. Lawrence to devastate their lake cities that it may be well to show what might be done. In case of trouble it would be a small matter to hurry a few men across the frontier and a very few hours work would ruin the St. Lawrence canals and render them useless, but to obtain control of the Ottawa canal the country would have to be first overrun and then there would be no necessity for its destruction. The people on both sides of the line are, however, sufficiently wide awake to see that any advantage that might be gained by a war would be purchased at too dear a price to make it a good investment, and we will therefore probably continue to fight our battles through the newspapers at long range.

HEATING AND VENTILATION OF DWELLINGS.

It is not the purpose of this article to enter in detail into this subject upon which so many treatises have been written, but merely to repeat a few important points which it is well for the house owner and for the architect to keep in mind, and which appear nevertheless to be too frequently disregarded.

These points are with reference to ventilation, which necessitates a consideration of the method of heating adopted.

The healthiest kind of heat is by radiation entirely, as provided by the sun, but this is the costliest method of heating that can be adopted in a house. The open fireplace removes a great deal more air than it requires for combustion, and this air must be supplied to the room. No special arrangement is necessary to supply it however under ordinary circumstances, as even with the doors and windows all closed the open fire will suck in air through the solid walls. A good fire will cause a circulation of air into and out of a room at the rate of about 6 to 10,000 cubic feet per hour. In the winter time here heating by open fireplaces entirely, is out of the question owing to the great expense it would be, therefore some other method has to be adopted.

The chief methods in use are stoves, hot air furnaces, steam pipes, and hot water pipes. None of these methods secure any ventilation except the hot air plan, and it, as generally in use, is otherwise objectionable.

An ordinary cast-iron stove, though a comparatively cheap method of heating, is not a good one because the gases inside diffuse readily through the iron should it become red hot as is frequently the case in cold weather; and the air which comes in contact with the hot surface of a stove acquires a dry peculiar taste and smell. This may be caused by the roasting of small particles of dust or organic matter. A closed stove does not provide any ventilation drawing in as it does only as much air as it requires for combustion.

This same objection applies to the hot air furnaces in use. The roasted odor and the odor of sulphurous and other gases which have diffused through the hot shell of the furnace are a cause of general complaint.

The hot air furnace is a more costly method than the stove.

Hot water pipes, for heating purposes, are the best and on the whole, most economical method of heating. The pipes are never so hot as to roast the air, and the heat is more easily regulated than by any other method. Whether the air is to be heated in the room or driven in after it is heated hot water pipes are better than stoves.

The temperature is not so easily regulated when steam is used in the hot pipes instead of water, but otherwise the system is the same in principle.

The superiority of the hot water system for dwellings is well recognized in Canada, and is coming daily into still more general use even in the smaller houses.

We have then the system of heating in most general use, and the one most suitable for our climate, a system which provides us ventilation to the house, and with which it is not necessary to construct any flues (other than the furnace and kitchen chimney flues which could be used for ventilation).

But is ventilation absolutely necessary? The answer must be that in sitting rooms and sleeping rooms it is. It is not necessary to go into the various sources of contamination of the air in a dwelling, which necessitates its renewal. Were these causes of contamination all removed (and they can be reduced to very small limits) except that arising from the process of respiration. This latter is so injurious in its effects that if not counteracted, the health of the occupants of the house is seriously endangered. Of course a great deal can be done spasmodically by throwing open windows and thoroughly airing rooms, but this is an uncomfortable plan which cannot always be adopted, in our climate in the winter time, and it requires to be done far too often to be agreeable in the case of a room occupied by several persons for several hours of an evening.

A hurtful condition of the atmosphere will frequently be arrived at in half an hour or less where several persons are sitting in a perfectly unventilated room.

The general indifference to lack of ventilation which most people display is no doubt due to the fact that the effects from day to day are so slight that they are not perceived or taken any account of. Nevertheless all medical authorities assure us that the continued breathing of impure air in enclosed and unventilated areas is the fruitful source of lung diseases.

From personal experience we are convinced that the want of proper provision for the constant admission of fresh air into our dwellings in the winter time is as fruitful a cause of a high mortality rate as any that exists, not excepting bad sewerage systems, lack of subsoil drainage and other kindred evils of a sanitary, or rather insanitary nature, the importance of which is now pretty well recognized.

In this article space will not allow us to go into details as to what should be done to secure proper ventilation for dwellings, which is indeed a difficult thing to decide, depending principally as it does upon the pocket of the householder, but to insist that it is time this subject were raised to the same position of importance as has been tardily granted by the public to drainage and plumbing.

STREET CONDUITS FOR ELECTRIC SUPPLY MAINS.

Looking to the near future when the placing of all wires underground in Montreal, Toronto and other cities will become a necessity, we give the following particulars of the two systems adopted in the city of London and which appear to be the ones that will meet with general favour throughout Europe.

THE CALLENDER SOLID BITUMEN SYSTEM.

This consists of high insulation cables laid in suitable troughs placed in trenches under the streets, the whole of the vacant space in the trough round the cables being run in solid with refined bitumen.

The troughs should be of cast iron. For town work especially this is preferable, as it offers a permanent protection, and is not liable to injury from picks or the operations of workmen of other companies.

The thickness of metal is from 3-16 to 5-16 inch, varying with the size of the trough, and the liability of the soil to disturbance.

These iron troughs are made in lengths of 6 feet, and are cast with socket pieces at one end, so that, when fitted together, the "run" inside is free and uninterrupted. The lengths are held in place by a bolt and nut, countersunk. Circular-pieces and bends are made to carry the mains round corners and for changing levels at street crossings, but considerable deviation from the straight line is possible with those of the standard type.

As soon as the troughs are placed in position and connected into lengths, about ¼ inch refined bitumen, in a molten state, is run in, and before setting, spacing bridges of bitumenized wood are placed in it, at about 18 inches apart. Insulated cables are then payed into position, and held in place by these bridges, so that they are clear of the sides and bottom of the trough and of each other. More bitumen is carefully run in, so that all the space remaining around the cables and between them and the sides is filled solid by it to within half an inch of the top of the trough, and, on its setting, the main is finished off by a covering of Portland cement concrete, about 1 inch thick. Strong cast iron lids are sometimes substituted for this concrete, and for high pressure mains steel plates are used.

All the bitumen employed is genuine natural Trinidad bitumen, free from admixture of gas-tar or pitch.

In the Dominion, where wood is plentiful, troughs of sound timber may be substituted for the iron, care being taken to select material which will stand underground without rotting. The planks should not be less than ¾ inch, and the lid should be of 1 inch stuff. It is not advisable to creosote the wood, as the action of the products of coal tar distillation is injurious to nearly every form of di-electric.

Brick and cement trenches are occasionally used, but they are expensive and offer no advantage over cast iron.

Where connections with the net-work are necessary they are made at

- Feeding boxes, placed at the termination of the various feeders, at the points where these cables join the net-work.
- Joint boxes, placed where necessary to connect and disconnect the various sections of the net-work, and branch lines, or to divide long feeders into sections for the purpose of testing.
- Service boxes, placed at suitable points on the net-work, to supply branches and large consumers direct from the distributing mains.
- Supply boxes, placed also on the distributing mains, or on branch lines, to supply one or two smaller consumers.

The method of making connections in any one of these boxes is the same. The insulation being removed from the cables, lug pieces of a special form are sweated on to the conductors. These lugs are attached to a copper bar by set screws, and from this bar branch lines of services are run where required, their connection with the bar being also by lug pieces and set screws. Standard sizes of lugs, bars, and coupling pieces have been prepared, so that any cable in a box can be joined to any other in a few minutes, thus keeping the net-work under complete control.

The cables used as branch lines or services can either be of the type described for the mains, or lead-sheathed, in which case they are generally protected from mechanical injury when laid, by strong wooden casing.

Two types of boxes are employed, one being accessible at any moment from the footpath, the other being buried and covered by the paving.

Those of the accessible type are made in two parts, the "pavement plate" being distinct and independent from the "box." This latter is set in brickwork under the sidewalk at a level to suit the run of the mains. The brickwork is carried up so as to support the pavement plate flush with the footpath. The varying depths at which mains must be run can in this way be arranged for by one standard type of casting.

The box is of cast-iron ¼ to 5-16 inch in thickness, measuring inside 16 x 12 x 12 inches. Faucets are cast on the sides to receive the troughs carrying the cables, and where necessary, openings are left for lead-sheathed or other service lines. A strong lid is carefully fitted, with a rubber washer, and is held in position by a phosphor bronze set-screw. When made fast, the box is perfectly water-tight; it is easily opened for inspection or repairs, and as easily closed.

The cover plate consists of a frame and lid, the latter lifting out in preference to opening with a hinge. It is made of cast iron, either with grids and letter, or finished with cement to match the adjoining paving. The usual size of the frame, showing in the path, is 20 x 15 inches over all.

This type should be adopted when the mains are run under the footpath; and there is a probability of the box being frequently examined for any purpose whatever. It is specially useful at feeding points, and at all service or other boxes, in which "cut-outs" are placed.

The buried type of box is cast with outer and inner walls, the lid having a flange fitting into this space. When laid, and the cables connected, bitumen is run in between the walls and over the lid, sealing the box hermetically, and absolutely preventing the passage of moisture at the top, or where the cables enter. The bitumen can easily be removed by a heated tool, for the purpose of opening the lid.

This type of box is valuable where mains are run under roadways, or where immediate and constant access is not requisite. No cover plate is provided, the paving being lifted when it is necessary to examine the connections.

This solid system is specially suitable for every description of mains in large cities, for heavy distribution net-works, or for feeders at isolated installations.

Every precaution is taken to guard the conductors from mechanical injury, from outside. They are completely shielded by the bitumen bedding from the action of damp or water, or with the various gases met with underground, which are often most injurious to the life of a cable.

The combination of vulcanized bitumen as the di-electric with plain bitumen as its sheath in the trough is one that ensures an absolutely safe and reliable insulation, on which faults are most unlikely to occur. Repairs, when necessary, can be easily and rapidly made.

It is the most reliable and satisfactory method of laying cables known; and there is the certainty of its being the most permanent and lasting. Such work, once done, is thorough and complete.

It is customary to design the distributing net-work with sufficient section to supply any reasonable demand, and to meet increased consumption by laying new feeders to the net-work direct from the station.

[In our next issue we will give the Webber system.]

THE COMPOUND LOCOMOTIVE OF THE ADIRONDACKS AND ST. LAWRENCE RAILWAY.

We give our readers an illustration of the above which was the first compound locomotive that ever came into Canada and which, on its first run into Montreal a short time ago, excited a great deal of interest during the three or four days it remained at the Grand Trunk Railway shops at Point St. Charles.

This locomotive is one of a number built by the Schenectady Locomotive Works, N.Y., for the above railway now running daily trains from Montreal to New York.

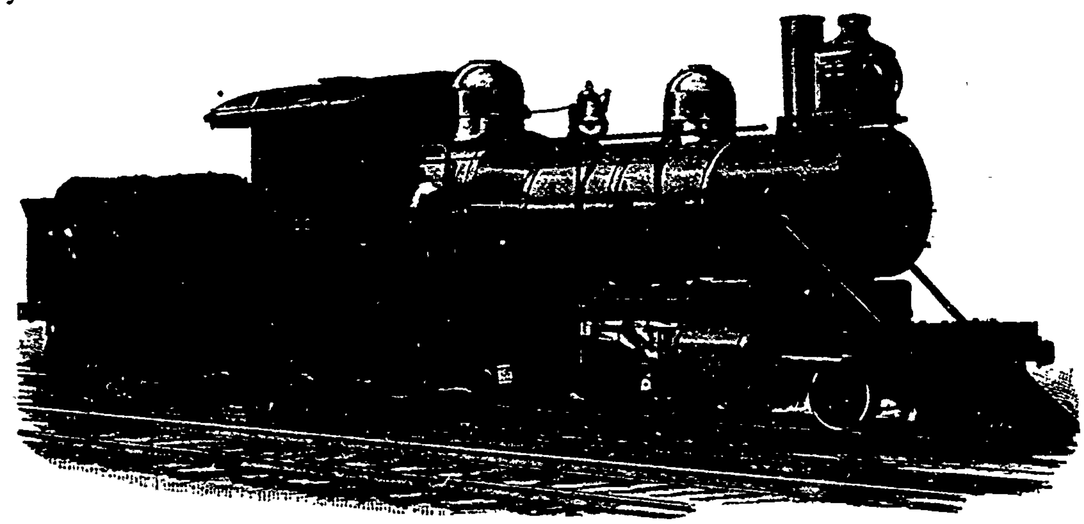
We give below a few particulars:

The total weight is 132,500 lbs. The boiler is wagon-top style, of steel, double rivetted, with quadruple rivetted horizontal seams with welt inside of 58 inches dia. and having 268 two-inch dia. charcoal iron tubes. The working pressure being 180 lbs. Tank capacity is 4,000 gallons. The dia. of the high pressure cylinder is 20", and that of the low pressure 30", with 26" stroke and 3½ in. dia. piston rod.

The driving wheels are 57in. dia. Total wheel base is 21ft. 11in., dia. of truck wheels is 30". Each locomotive is provided with an automatic intercepting valve which enables it to exert its full power in starting.

The heating surface of tubes is 1602'; the heating surface of firebox 146'.6", total of 1748'.6". Grate surface is 30ft. with rocking bars; smoke stack is 16½" inside dia. at top and 14in. at bottom.

The makers claim for this type of locomotive economy in fuel and water of from 15 to 30 per cent., and that these engines will pull in addition to engine and tender at 20 miles an hour 3,341 tons on a level.



DISCHARGE OF SEWERS.

Extract from Paper read before the Canadian Society of Civil Engineers,

By C. H. Rust, M. Can. Soc. C. E.

In connection with the proposed intercepting sewer along Front street, Toronto, for which plans have been prepared, it was considered advisable to guage all the main sewers for the purpose of ascertaining the amount of sewage to be intercepted and carried away by the main trunk sewer along the front of the city.

Dams were constructed in different sewers and a weir built by taking a one or two inch plank, and cutting a notch of the proper size varying from 1' 2" up to 4' 0" with a depth of water over them from 2" up to 6", care being taken to have the top of the weir, over which the water discharges, of a horizontal sharp corner in thin partition. The formula used is the one given by Mr. James B. Francis, compiled from the result of his observations at Lowell, Mass., and is as follows:—

$$D=333\left(1-\frac{nh}{10}\right)h^{3/2}$$

Where D = discharge in cubic feet per second 1 = width of weir in feet, n = number of end contraction (= 2 in these guaging) h = head (measured at some distance back from weir). This formula gives results from 10 to 15 per cent. less than quoted by Mr. Baldwin Latham in his Sanitary Engineering. The guaging was carefully done by Mr. W. T. Ashbridge, a member of the Society. Observations were recorded every hour from 5 o'clock, a.m. till midnight. It was found that the flow in the sewers between midnight and 5 o'clock a.m. varied so slightly that it was not considered of sufficient importance to take any record between these hours. The observations were carried on during the months of March, April and May, 1891; the dry weather flow only being recorded. From the results of the guagings it has been ascertained that the total daily dry weather flow of the sewage of Toronto amounts to 2,150,901 cubic feet in the twenty-four hours. The average quantity of water pumped during this period was 2,4000,000 cubic feet per day. The population from the last census returns being 181,220, this gives an average discharge of 11.87 cubic feet per head per day, the highest discharge being from the Bay Street sewer, which gives 42.14 cubic feet per head per day. This sewer drains a district almost composed entirely of wholesale houses, nearly all of which use lifts. The lowest discharge is from the Simcoe Street sewer, which gives 7.02 cubic feet per head per day. This can be accounted for from the reason that this sewer drains the district embracing the Queen's Park and University, the old Upper Canada and Government House grounds. The total area drained by the sewers is 7,277 acres, this gives an average of 25.9 persons to the acre,—the maximum population is 45.7 per acre for the district by Spadina Avenue sewer. This is almost an entirely residential district, nearly every house being connected with the street sewer, the area being 311 acres with a population of 14,213 persons. At the minimum 8.8 for the area draining into Fort Rouille Streets where this sewer drains the extreme west end of the City, and at present is very sparsely populated, the area drained being 360 acres with a population of only 3,168 persons. The population for the different districts drained by the various sewers was taken from the census returns, giving the population for each Ward. This, I think, will hardly be absolutely correct, for the business districts, which during the day have a much larger population, this would apply more particularly to Bay street and Yonge street. The total amount of sewage discharged per minute is 1,493.4 cubic feet, which gives an average of ·205 cubic feet of sewage per acre. The highest being 1.29 for Bay street and the lowest .09 for Fort Rouille. It was found that one-half of the sewage flows off in an average of 10.37 hours, Bay street gives 7 hours and Yonge street 9 hours as the time discharging one-half. As before mentioned, a large number of wholesale places drain into these sewers in which a number of lifts are in constant use during business hours. In some of the older sewers no doubt a certain amount of subsoil water finds its way, and being nearly constant in volume throughout the day tends to modify the hourly fluctuations.

In Yonge street the flow varied from 150 to 300 cubic feet per minute, and Bay street from 8 cubic feet up to 33 cubic feet per minute. During business hours, that is from 3.30 a.m. until 5 p.m., the flow ascends very rapidly, owing, as stated before, to the number of lifts constantly employed. Again, taking Spadina avenue and Simcoe street, which drain a district almost entirely residential; Spadina avenue; the flow of which only varies from 100 to 140 cubic feet per minute, Simcoe street from 80 to 112 cubic feet per minute. From the result of these observations it will be seen that the hourly flow of sewage varies to a large extent throughout the twenty-four hours. In designing sewers this variation in the hourly flow has to be carefully considered. Especially is this the case where the sewage has to be treated by chemical means.

BELT LACING.

A very important feature in the shop or factory is the lacing of belts.

As long as the ends of a belt are fastened together the operator or machine hand thinks that is all that is necessary.

When a belt is properly laced there is a saving of the belt, time and power, all of which means money. If it is not properly properly laced there is an unequal strain on the sides and centre of the belt produced, which either causes the ends of the laces to become loose or the lace in the middle of the joint to bag, thereby causing the belt to come apart and slip on the pulley; sometimes when the strain is very great to one side the lace or the belt breaks away, and if in the latter case your belt is a pretty tight one it necessitates a new piece to be spliced, riveted or laced to it.

The most important point to be observed in lacing a belt is to produce an equal strain on all parts of the joint and to present as much bearing surface as possible to the face of the pulley.

There are many methods in use, some of which we will present to the reader.

Rucker's method is to lace double over the joint and single on the outside of back. This method will suit double belts, and the claims made by Rucker are that a belt laced by his method will last for years.

Fischer's method is adapted for single belts, and consists in starting to lace from the centre instead of from one side.

The lace is passed through a centre hole in the belt, bringing it up through the joint, then through the centre hole on the opposite side; pass through the joint again, then through the hole from which you started, thus making a double stitch; after which each end is laced up in single stitches.

This style of lacing is the same on both sides of the belt.

RUCKER'S LACING.

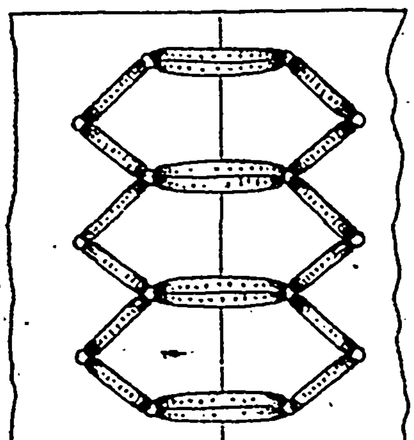


Fig. 1.

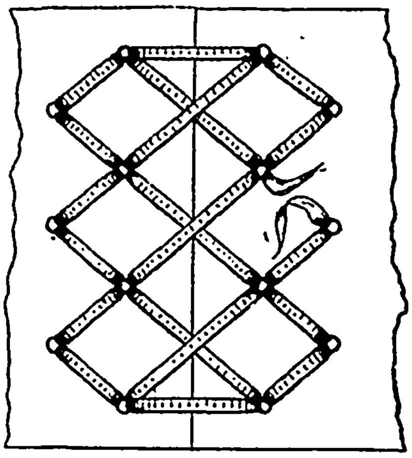
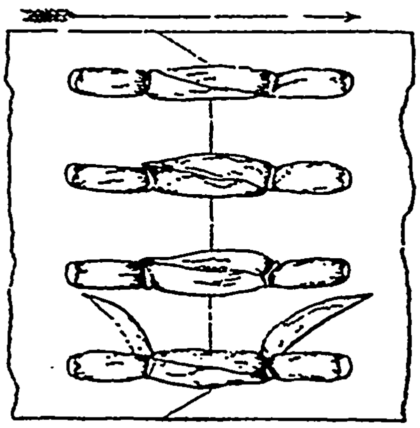


Fig. 2.

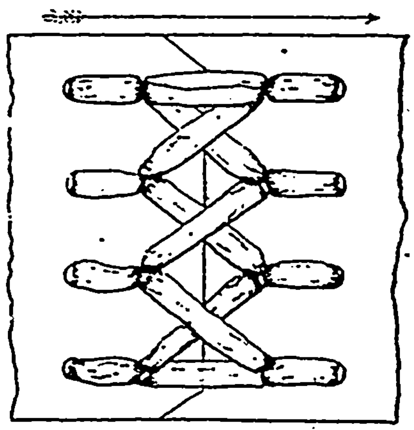
Ricker's method.—The belt is cut with a protector on each side of the lacing, which *prevents it from getting caught and tearing* the holes out where shifter forms are used.

The lace is put on in such a manner that it will never pull out, each stitch being fastened by passing the end under the small loop between the holes, as shown at the end of the lacing, and the lacings being crossed instead of lying flat upon each other in each stitch upon the pulley side.

The belt should be punched with as much space between the two rows of holes as there is between the lower row of holes and the end.



Pulley side.



Outside.

We will continue this subject with additional examples, and are arranging for a series of tests of tensile strains of the different styles, and if any of our readers will furnish new examples we will include them in our tests.

THE CHIGNECTO SHIP RAILWAY.

The financial difficulties which last year beset the Chignecto ship railway enterprise and compelled a cessation of work on it are apparently about to be removed The total capital and bonded indebtedness of the company amounts to $5,500,000, and the Canadian Parliament has agreed to pay it a subsidy of $170,000 a year for twenty years, on condition that the railway company gives satisfactory performance of its corporate services, including the raising, transporting and lowering of vessels of 1,000 tons burden with their cargoes. The date of completion has been extended to July, 1893, and a further extension will undoubtedly be granted.

The railway has a length of 17 miles and will possess docks at each end for the reception of vessels. A large amount has already been expended on the Amherst dock at the Bay of Fundy end of the railway, and a less amount on the Tidnish dock at the St. Lawrence end. A hydraulic ship lift will be provided in each of the two docks. This lift consists of a ship carriage or cradle resting on wheels and provided with keel blocks and guards placed on the rails which rest on a gridiron. The gridiron is actually a portion of the railway, and when a ship is to be lifted it is lowered through the water with the cradle upon it to the bottom of the dock. The vessel which is to be transported is floated accurately over the cradle. The gridiron is first raised to the level of the keel and the blocks placed in their proper position close to the vessel's side. A rack with pawls at the back of the blocks prevents any movement. The gridiron is then raised by means of hydraulic presses ranged on each side of it.

The length of the stroke of these hydraulic presses is 42 feet in each lift. A vessel with its cargo weighing 2,000 tons will be raised to the level of the railway in 10 minutes. When the lift is complete, the gridiron is securely locked in place with its rails in level and line with the railway track on terra firma. The cradle and ship together may then be hauled off the lift and transferred to the railway, along which they will be transported by two locomotives to each vessel and its cradle, at the rate of 10 miles per hour. When the vessel and cradle have reached the other end of the line, they are pulled on a hydraulic lift in precisely the same manner and by the same means as they were first hauled on the railway, and then lowered into the water. As the gridiron sinks to the bottom of the dock, the vessel floats herself off and resumes her water route.

It is estimated that the Amherst dock can be finished in eight or nine months, but it will probably require a year to complete that at Tidnish. The railway proper is practically completed. It is perfectly straight and level from end to end. Its construction required one heavy cutting of 450,000 yards rock and clay.

The cradles for the vessels will be supported on trucks with the weight evenly distributed so as not to exceed 10 tons per wheel.

The tracks are 18 feet from centre to centre, and are laid with 110-pound rails. It is thought that the work will eventually be taken over by the Dominion Government and completed. A revenue of $500,000 per annum was originally counted on, but it is doubtful whether that amount will be realized. Although the railway line will save about 500 miles of water travel, in passing from the Gulf of St. Lawrence into the Bay of Fundy, many shipowners fear their vessels may be strained, and they must pay tolls in order to make the experimental trip.

PLUMBAGO, AND SOME OF ITS USES.

Extract from paper read before Canadian Society of Civil Engineers.

By JOHN FRASER TORRANCE, M. Can. Soc. C. E.

Plumbago, graphite or black lead is well known to all of us in its various forms of application as stove polish, foundry facings, lubricating powder, pencil leads, graphite grease, graphite packing, graphite paint, etc., etc.

It sometimes occurs in nature in flat hexagonal crystals, but generally it occurs massive or more or less radiated, foliated, scaly or compact. It is of a grayish-black colour with an almost metallic lustre and a black shining streak. It is too soft to strike fire with a steel and it is a splendid conductor of electricity. Its specific gravity ranges from 1·8 to 2·24. It is composed chiefly of carbon; but usually it contains more or less alumina, silica, lime, iron, etc., apparently in mechanical mixture rather than in chemical combination. Next to the diamond it is the most combustible form of carbon. For this reason it is used in combination with fire-clay for the manufacture of crucibles to resist the highest temperatures.

As far as I can learn, all the known deposits of plumbago of any economic value occur in rocks of Laurentian age. The only mine working on a large scale in the United States is operated by the Jos. Dixon Crucible Co. at Ticonderaga, N.Y. In a report by Albert Williams, Jr., of the United States Geological Survey, on the Mineral Resources of the United States, it is stated that the deposit now being exploited is a bed of graphite schists fifteen feet thick, carrying from 8 to 15 per cent. of graphite. This is treated by a wet process, wherein the ordinary practice is reversed; the "heads" being the refuse and the "tails" being the valuable graphite The average output is placed at 500,000 lbs., valued at an average of 8 cents per lb. at the works. Apart from this company's output the North American trade is supplied almost entirely from the amorphous earthy deposit near Passau in Bavaria, and large veins of graphite in the Laurentian gneiss near Travancore in Ceylon. But the first pencil lead comes from the mines in Irkutsk, Siberia.

Some interesting notes on the geology of Ceylon were published as far back as 1818 by Dr. John Davy, who says: "Graphite is pretty commonly disseminated in minute scales through gneiss. It is worthy of remark that graphite is generally found in company with gems. I have had so often occasion to make the observation that now I never see the former without suspecting the presence of the latter.

The Ceylon graphite is extracted from large fissure veins in the gneiss, which are completely filled by the graphite. It requires to be merely cobbed and sized before going to market. It is known as "dust," "chip," and "lump." Dust sells at 2½ cents per lb. in New York, chip at 3½ cents, and lump at 5½ cents. It is used for all purposes except pencil making.

The American and Canadian graphite is used for all purposes of the trade and excels all others as a lubricant. Many tests have proved this conclusively.

As graphite or plumbago is found almost exclusively in rocks of Laurentian age, and there is a greater develpment of these rocks in Canada than anywhere else, we would naturally expect to find many deposits of graphite in this country. It is nearly half a century since two of Canada's most distinguished citizens called attention to the large deposits of graphite in the Laurentian formation both north and south of the Ottawa River, and pointed out the possibility of their profitable exploitation for shipment to the British market. Since the date of this first report by Sir Wm. Logan and Dr. Sterry Hunt, the marvellous growth of the American nation has developed a demand for this material on our own continent such as they hardly anticipated. And it is not creditable to the enterprise and skill of our Canadian capitalists and miners that this market is supplied from similar deposits in Bavaria and far-distant Ceylon, while our own lie idle and almost-unknown.

In Canada the graphite is usually found in close relation to some of the large bands of massive crystalline Laurentian limestone that can be traced through Burgess and Elmsley (near the Rideau), and reappear in Hull, Templeton, Buckingham, Lochaber and Grenville. This mineral generally occurs disseminated in scales in beds of limestone, sandstone or pyroxenite; or else in veins from a few inches to several feet thick. These beds are often interrupted, producing lenticular masses which are sometimes pure and sometimes mixed with carbonite of lime, pyroxene and other minerals. At times it is so finely disseminated through the limestone as to give it a blueish-grey colour, which serves to mark the stratification of the rock. In one locality at Grenville sphene, zircon, pyroxene and tabular spar have been found associated with it, reminding us of Dr. Davy's observations about the precious stones in Ceylon. No veins of graphite, however, have bee found yet in Canada of sufficient size and extent for profitable exploitation. All attempts at plumbago mining in Canada have been confined to the limestone beds of disseminated graphite in Buckingham, Lochaber and Grenville townships as well as some rich masses where a number of small veins are seen to intersect; and to a sandstone bed near Oliver's Ferry on the Rideau Lake, which is richly impregnated with graphite.

From the valuable report on the mineral resources of the United States, published in 1884, I quote the proportions of the output, etc., devoted to various uses, as follows:—

	per ct.
Making crucibles and refractory wares,	30
Stove polish,	30
Lubricating graphite	13
Foundry facings	10
Graphite greases	8
Pencil leads	3
Graphite packing	3
Polishing shot and powder	2
Paint, ½; electrotyping and miscellaneous, ⅓	1

But it is altogether likely that this comparative statement will be radically modified, as a result nf the general introduction of the new lubricating composition known as fire-graphite.

This fibre-graphite is simply an intimate mechanical mixture of finely divided plumbago and mechanical wood pulp, in varying proportions, according to the purposes of the special bearing. These materials are mixed in water, and pumped with a hand-pump into the moulds, which are made of brass, with grooves on the outside and small holes, possibly 1-16 inch in diameter, spaced about ⅝ inch apart. Each mould is inclosed in a heavy case made of a steel casting. The mass is compresse by hydraulic pressure to about ¾ its original bulk, while the water escapes through the holes and along the grooves. After sufficient pressure the piece is removed from the mould and dried. It is then immersed in a bath of hot linseed oil, and finally subjected to a slow baking in a gas oven.

This product can be cut and tooled with ease. But it takes and retains the form of the mould so perfectly that any tooling is unnecessary.

The remarkable qualities of this bearing material are strikingly exhibited in its application to the spinning frame, when the spindles are run at very high velocities. Spindles running with unusually tight belts constantly for ten hours a day for three weeks, at a speed of 8,400 revolutions per minute, did not heat or show any perceptible wear, either of the spindles or the graphite bearings.

SAFE WORKING PRESSURE OF BOILERS.—It is a common thing among the engineers to ask one another "What is the safe working pressure of your boiler?" and the reply will be 80, 100, or 150 pounds, as the case may be. Their calculations are usually based on such rules as these. Suppose, for example we take an 84-inch boiler of half-inch steel plate, with a tensile strength of 60,000 pounds. Now 60,000 multiplied by .5, the thickness of the plate, and divided by 42, the radius of the boiler in inches, gives 714.3 as the bursting pressure. This divided by 5 as the factor of safety, gives 143.5 pounds as the safe working pressure. This rule is very good if all other things are in proportion.

BREAKAGE OF CAST IRON COLUMNS.

Owing to the collapse of the Y. M. C. A. Building in Montreal some time ago, we wrote to the local papers calling attention to the danger of using circular cast iron columns and urged the architects to avoid them as much as possible, substituting either cast iron stancheons or wrot iron or steel made up columns. We pointed out the liability to unseen defects, especially blow holes and slipping of cores. We give below some particulars of tests made at Hamburg, and it will at once be seen what a great difference there was between the perfect column and the one with blow holes:

Test No. 1—Ornamental cast iron column, 6.56 feet long, but with flat or fixed ends; same area of section as No. 2. A load of 105,000 pounds was applied with a downward deflection of four-tenths of an inch. The column became red hot after 18 minutes. Water was then applied for 1½ minutes, with deflection increased to one-half inch. After 28 minutes water was again applied from below; streams of water were run upon the base, cap, and one on the central part of the column, but no cracks were visible after this treatment. The column was again heated, and broke at a pressure of 37,600 pounds per square inch, with a deflection of 1.57 inches.

Test No. 2.—Cast iron column 6.56 feet long; same cross-section area of 9.85 square inches. The column was made red hot underneath; then water was applied for one minute. The deflection then amounted to 1 1-10 inches under a total load of 65,000 pounds. The pressure was then increased until failure took place at 22,100 pounds per square inch. Blow holes were revealed at the section of fracture.

DISINFECTANTS.

A true disinfectant should be at once a deodoriser (destroyer of odours) and an antiseptic (destroyer of low forms of life). The presence of sewage gas in an apartment may be detected in the following way:—Saturate unglazed paper with a solution of 1 oz. of pure lead acetate in ½ pint rain water; let it partially dry, then expose in the room suspected of containing sewer gas. The presence of the latter in any considerable quantity soon blackens the test paper.

Eckstein states that bleaching power is the most effective disinfectant for privies, urinals, &c., inasmuch as it rapidly decomposes hydrogen compounds, such as amonia, sulphuretted hydrogen, &c. It is conveniently applied in a bag made of parchment paper, through which the disinfectant slowly passes by osmosis. Comparative experiments made in a house (where at least 100 persons use the closets daily) gave the following results:—(1) 2 lbs. sulphate of iron (green vitrol) dissolved in water prevented the production of smell for two or three hours, and had wholly lost its preservative action in twelve hours. (2) Sulphate of copper in solution produced the same result. (3) 2 lbs. solid sulphate of iron or sulphate of copper acted as a disinfectant for full two days. (4) A mixture of iron and copper sulphates and carbolate of lime (2 lbs. in all) only remained active for two days. (5) Solution of sulphurous acid lost its action quickly; it was perceptible to the respiratory organs for an hour. (6) 2 lbs. good commercirl bleaching powder in a parchment paper bag became active in two hours, and remained efficacious for full nine days, without in the least affecting respiration or smell.

Sulphate of iron (copperas or green vitrol) is not a hygenic disinfectant, since it does not destroy the lower forms of life, but as a chemical disinfectant for the suppression of offensive odours it is an excellent agent.

Valmagini, of Vienna, alleges that binoxide manganese is valuable and potent for destroying putrefactive gases. Lead chloride is declared to be an excellent disinfectant, absorbing and neutralising various organic vapours. It may be prepared by precipitating 65 oz. lead nitrate with 23 2-5 oz., sodium chloride, yielding 55 3-5 oz. dry lead chloride. It is very slightly soluble in cold water, 1 gallon not holding more than ¼ oz.; hot water dissolves more, but the salt crystallises out again on cooling. For closets ½ lb. of the salt may be suspended in 1 gallon of water, but it is better hot.

A disinfectant paint is composed of 5 to 10 parts carbolic acid, 15 manganese binoxide, 10 calcium chloride, 50 china clay, 20 infusory earth, 10 dextrine or gum-arabic.

THE TORONTO CONDUIT ACCIDENT.

The pumping station is situated on the main land, from which a 4-foot steel pipe, with flexible steel joints, crosses under the bay to a connecting crib at Hanlan's Point on a neighboring island. This part of the conduit was laid in a trench dredged for the purpose. From Hanlan's Point a 5-foot steel pipe is laid in a lagoon to the main portion of the island where another connecting crib is placed, and from this crib a 6-foot wooden pipe extends out into the lake. A screen is placed temporarily in the connecting crib on the island, at the junction of the 6-foot wooden and the 5-foot steel pipes, and a man is instructed to keep it clean. This he failed to do properly, according to the superintendent, and the engineer at the main pumping station allowed the water to be exhausted from the 4-foot and 5-foot steel pipes. Consequently, the pipe rose and after breaking to allow the escape of the air, subsequently filled with bay water and sank again, except at two places in each pipe.

The circumstances under which the accident occurred are peculiar. A new pumping engine had just been set up but one of the cylinder heads blew off, throwing it out of use. The screens at the pump house were located in the well of this new pump, so that it was necessary to use a temporary screen in one of the connecting cribs, as mentioned above. A man was regularly employed to keep this screen clear, but as the water in the pump well was unusually low, the inference is that the screen was clogged for some time on Christmas morning causing the accident.

None of the wrought steel flexible joints gave way or were in any way injured, although the pipes were torn apart. The flexible joints are the patent of Mr. W. H. Law, of Peterborough, who also made the larger portion of the main pipes.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

A Regular Meeting of the Canadian Society of Civil Engineers was held in thoir rooms, corner of Mansfield and St. Catherine street, Montreal, on Friday the 20th inst., John Kennedy, Esq., president, in the chair. A paper on Steam Boilers was read by Mr. Ogilvie, Stu. C.S.C.E., and a discussion followed.

It was agreed that a Committee, composed of Mr. P. A. Peterson, Mr. Herbert Wallis, and Mr. Kenneth Blackwell, be appointed to make arrangements for an excursion by the Visiting Members of Mining Engineers.

THE CANADIAN ASSOCIATION OF STATIONERY ENGINEERS.

The Association is now steadily growing and number 327 members spread over Brantford, Hamilton, Montreal, Toronto, London, Brandon. We have no doubt that Halifax, St. John, Quebec, Ottawa and other cities and towns will soon fall into line and form branches that will flourish.

The Regular Meeting of Montreal No. 1 was held in Mechanic's Hall on Thursday, the 19th inst.

The President Elect, Mr. J. G. Robertson, was installed by Past President Mr. G. Hunt.

Mr. York reported that Messrs. W. Laurie and Hersey both promised to lecture before the Association at an early date.

On a motion the President appointed a Committee to make arrangements for the annual dinner of the Association.

The Secretary was requested to obtain from the Manager of the Montreal Street Railway a report of the Delegation to the States as to the best engines and boilers for transmission of power for electric railways.

Mr. J. Yorke gave examples on the black board in hydraulics and heating.

A meeting of the Dinner Committee was held in Mechanic's Hall on Thursday, the 26th, composed as follows:

Mr. George Hunt—Chairman of Committee.

Mr. Thomas Ryan—Treasurer.

Mr. Bates Nuttall—Secretary.

Messrs. Jos. Robinson, Jas. Elliott, Wm. Weir, J. Yorke, T. Thompson—Committee.

It was decided to hold a dinner at the City Hotel on February 11th, and that 24 visitors' invitations be issued.

FINDS IT UP-HILL WORK.

Albert E. Edkins, president of the Executive Board of the Canadian Association of Stationary Engineers, in a recent letter says :—

I am working very hard to make this a red letter year in the history of the C. A. S. E., and it is very up-hill work, as many engineers seem very careless in the matter of education and organization. However I am determined to keep my hand to the plow. I can't see how engineers can remain blind to the advantages of education and C. A. S. E. membership when they see young men all around them who, a few years ago, were occupying inferior positions, but who have made a study of their profession and attend the meetings to gain knowledge and to-day are holding down the best positions. But there are engineers and engineers. Some are engineers of ten hours a day and no longer—and poor at that ; others, in addition to the ten hours, are engineers at home for two or three hours, four or five nights a week. You know what the result must be in either case.

RAPID INCREASE IN THE MILEAGE OF ELECTRIC RAILWAYS.

The rapidity with which the electric motor is displacing other methods of traction on street railways is not fully realized, even by engineers. Five years ago the electric railway was an experiment, and in the whole United States but 50 miles of street railway was operated by electricity. At the present time trolley cars are running on street railways aggregating about 6,000 miles in length, a greater mileage than that of the street railways operated with every other kind of motive power, including animal power. This progress has been made by an acceleration somewhat comparable to that of a falling body ; and of the total mileage in operation, nearly one-third was built during 1892.

Of course a large part of the electric railway mileage consists of lines formerly operated by other motive power ; but the impetus to the building of new lines for city passenger traffic, and perhaps still more for suburban lines, which has been due to electric traction, has been enormous. In July, 1890, the street railway mileage of the country was 8,650 miles. At present the total mileage is 11,655 miles, an increase of 3,000 miles in 2½ years. The increase during 1892, according to a table recently published, was 1,066 miles, a figure which represents an enormous gain in the transit facilities of American cities.

From these figures the evidence appears to be strong that the electric motor is destined to supplant animal power on a very large proportion of our railways which are still operated by horses or mules. Whether it be able to obtain sole possession of the field is less certain. On many lines of very thin traffic, cars run by animal traction or by some form of indipendent motor may prove on the whole cheaper than the trolley or conduit system, and some form of gas, steam or compressed air motor may yet be able to compete with the trolley on its own ground. On roads with undulating or very steep grades and few curves, as well as on roads of the heaviest traffic, the cable system still holds its own.

MINUTES OF THE PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS, WITH OTHER SELECTED AND ABSTRACTED PAPERS. Vols. CVII. to CX. Edited by James Forrest, Assoc. Inst. C. E., Secretary. London : Published by the Institution.

The amount of valuable matter in the four volumes of Proceedings issued by the Institution during the working year which was ended last June, is so great that it is impossible to do justice to it in the space at our disposal. The address of Mr. George Berkley, President, with which the first volume opens, constitutes an interesting review of the advance of engineering work in relation to social progress. This is followed by a series of papers on "Portland Cement," by Messrs. H. F. Bamber, F.I.C., A. E. Carey, M. Inst. C.E., and W. M. Smith, M. Inst. C.E. The first two papers deal rather with the manufacturing side of the subject, and it is interesting to note the importance attached to fine grinding. Mr. Carey, indeed, points out that the material left on a sieve of 32,257 meshes to the square inch has no cementitious value, but is merely inert material. The paper of Mr. Smith deals with the action of sea water on Portland cement concrete, as illustrsted by the failure of the south breakwarer at Aberdeen. The concrete in this instance appears to have been very porous, and the sea water flowing in and out of it at each tide, a substitution of the magnesia in the sea water for the lime in the cement took place, causing swelling of the concrete and ultimate failure of portions of the wall. This substitution of the magnesia for lime was proved to occur by forcing sea water through blocks of the concrete, and comparing the analysis of the concrete after this had been done with what it was previously. Mr. Smith claims thar the only certain way of preventing this action is by making the whole mass of the concrete impermeable, but it may happen that rubble masonry may then prove cheaper. In the discussion Mr. Henry Faija remarked that it was true that if sea water was passed through concrete lime would be dissolved from the cement and magnesia precipitated, but this did not necessarily involve the destruction of the cement if it was sound, because as the lime from the outside surface was dissolved, a crust of lime and magnesia was formed which rendered the mass impervious to further destructive action. He had passed sea water through blocks under a head of 21 feet, and found, as Mr. Smith had done, that after a time percolation ceased, because the pores of the concrete had become filled with the deposit of lime and magnesia. He accordingly attributed the failure at Aberdeen either to bad cement or bad manipulation.

The next paper in the volume is on the sale of water by meter in Berlin, its author being Mr. Henry Gill, M. Inst. C.E., in which the author objects that the ordinary English system of a water rate leads to waste of the water, which is avoided when the water is sold by meter, since every individual user is then interested in preventing waste. The system was first tried tentatively in Berlin in 1865, owing to the excessive waste which took place under the rating system. At the present time, when the whole of the water for both domestic and trade uses is supplied by meter, the quantity per head per diem for the city taken as a whole has been reduced to 15.2 gallons as against 40.3 gallons in 1865.

PERSONAL.

Hill Tout, City Engineer of Guelph, has resigned.

The indefatigable Dr. Smiles, who wrote the Lives of the Engineers, and who is just entering his eighty-first year, is preparing another contribution to industrial history and biography, the story of the life and work of Josiah Wedgwood, the father of modern English pottery.

TAMPING WITH PLASTER OF PARIS.—This substance is said to make a very efficient and safe tamping, its peculiar advantage being the abolition of the tamping bar, and the consequent danger of explosions resulting from its use. The plaster is used in the usual way, but with a little sand. It is found that in many cases the placing of an elastic cushion or some compressible substance just above the cartridge produces good effects. All danger of cutting the fuse in tamping is removed by the use of plaster.

VENTILATING SEWERS is a problem in some sections of Toronto, and is made more difficult by the action of the residents in placing over the open covers of the man-holes a sheet of brown paper, and throwing sand and dirt on it to keep it down. Just what good such a course will do it is difficult to see, especially when sewer ventilation is receiving a large part of the attention of the Assistant City Engineer, and such actions on the part of the householders hinder his investigations considerably.

TWO BIG GAS WELLS IN CANADA.—The Erie County Natural Gas Fuel Company, which supplies this city, is feeling jubilant over one of the biggest natural gas wells ever struck in its territory on the Canadian side of the river. The well was shot on Tuesday evening, and the expert estimates that the daily flow will be at least ten million feet daily. Another gas-gusher was struck yesterday by the same company near Bertie, Ont., which will make a flow of nearly two million feet daily. Arrangements for the shooting of other wells are being made.

THE C. P. R.

The Canadian Pacific Railway Co. proposes to establish an independent entrance into the State of New York, by building a line from Woodstock to Niagara Falls, and crossing the gorge on a bridge of its own. The new bridge will be constructed between the present cantilever and the suspension foot structures, and will consist of a single arched steel span, resting on buttresses on either bank about 1200 ft. apart.

SHRINKAGE OF CASTINGS.

In making allowance for shrinkage in casting, pattern makers understand that different shapes will shrink differently. The standard table of allowances for shrinkage in use is as follows, per foot:—For loam castings, 1-12 inch; for sand castings, 1-10 inch; for dry sand castings, 1-10 inch; for brass castings, 3-16 inch; for copper castings, 3-16 inch; for bismuth castings, 5-31 inch; for tin castings, ¼ inch; for zinc castings, 5-16 inch; for lead castings, 5-16 inch.

TO ESTIMATE THE WEIGHT OF A CASTING FROM THE WEIGHT OF THE PATTERN.

A Pattern Weighing 1 lb. and Made of	Will Weigh when Cast in				
	Cast Iron.	Zinc.	Copper.	Yellow Brass.	Gun-metal.
Mahogany........	8	8	10	9·8	10
White Pine......	14	14	18·7	17·5	18·7
Yellow Pine......	13	13	17·5	17·1	17·5

The dryness and quality of the wood being variable, the above is only approximate.

NICKEL STEEL.

It is reported to have a tensile strength of 90,000 pounds per square inch and an elongation of 20 per cent. Its superior value to carbon steel, should these claims prove to be well founded, is at once apparent. It is intended to keep the exterior diameters of the shafts the same as for ordinary steel; but their cores would be removed, thus reducing the weight very materially.

If this metal should prove to be well adapted for steel forgings and the heavy parts of marine machinery, a very considerable advantage would be secured for that class of construction, as the difficulty of reducing the weight of the latter for a required power, is one of the greatest which the marine engineer now has to deal with. Its use could also be extended to the construction of marine boilers which are usually built of about 58,000 to 60,000 pounds carbon steel. With the high steam pressures now in use, a greater percentage of saving in weight would probably be secured in this connection than in any other department of marine machinery.

WHO SHOULD OWN THE METER?

The merits of the meter system have been so decisively demonstrated in all sections of the country, that its advantages are no longer disputed. It is a settled fact that meters lend efficient aid to the economical management and maintenance of water works plants. The question now agitating the minds of manz water works people is, "Who should own the meter?"

The favorable results from the use of meters have been so significantly valuable and instructive, that meters are now considered almost as necessary as the pumping machinery, pipes, etc. Why, then, should they not be owned by the department, just the same as the articles specified?

On account of this advocacy by many engineers, and for the reasons already given, we recommend that all water works should own and control all meters in use on their plants. This plan is undoubtedly advantageous to both the consumer and the department.

BOILER NOTES.

A good fireman can get better results out of a poor equipment than an ignorant or careless one will get out of a well-designed plant. It is too often the case that an expensive and promising plant is given over to the management of a gang of ordinary laborers, who would do nicely to shovel coal on the dock, but who know absolutely nothing of burning it under a boiler, or of the management of the boiler itself. The value of the fireman as a factor is recognized by the mechanical engineer in charge of a large Western establishment, who has not only a recording pressure gauge, but requires periodical and frequent records of the coal fed to the furnaces and the water feed to the boilers, all of which is metered. In this way he is able to tell who gets the most work out of the coal which is furnished him, and to replace men who make notoriously poor records, and who will not improve with instruction, with more efficient materials.

Care of Boilers.—A boiler should never be blown out while hot. Portable tubular boilers should stand at least twelve hours after the fire is out before letting out the water. Stationary boilers should stand long enough to allow the brick walls to cool. Let boilers stand from 18 to 24 hours, and by so doing keep the dirt in solution and wash out without any trouble. In case there is any scale, use a boiler pick and a good scraper. When there is any lime in the water, the latter should pass through a good purifier before being pumped into a boiler. Water should never be pumped into a boiler cold, as it makes hard firing, and allows all the impurities in it to enter the boiler. In case the scale is hard, and can not be easily removed, saturate it with coal oil before filling the boiler with water. This will loosen the scale without harm to the boiler. A good skimmer, properly constructed and properly attended to, will do much toward keeping a boiler clean, but cannot be relied upon. All boilers should be opened and thouroughly cleaned at least once in two weeks, as they are often burned by relying on some automatic device for keeping them clean that fails to do its work.

ITEMS.

Compressed Air for Cleaning.—Compressed air for cleaning cars is used on the Union Pacific Railroad at its Portland shops. The air, under a pressure of 50 pounds per square inch is delivered from a flexible hose with a small nozzle, and is used as water would be.

Electricity's Effect on Water Pipes.—It has been discovered that the underground wires of the West End Street Railway, Boston, Mass., by electrolytic action, due to escaping currents, so affect the water pipes of Cambridge that they last only from one to three months. In attempting to remedy this the Water Board has used galvanized iron, rustless iron, brass, lead and drain pipes, but all have been corroded by the action of the electricity. To remedy this, the West End Company is running a large amount of overhead return wires, and it is hoped when the work is completed that the injurious effect of the current on water pipes will not be noticeable.

Brooklyn, N. Y, Pumping Facilities.—The Aldermen of Brooklyn, N.Y., on Jan. 9 took action on the long delayed question of providing adequate pumping facilities for the water supply system of that city. The sum of $685,000 was appropriated for the purchase of new engines and repairs of the old ones, and $70,000 was transferred from the account for laying new mains to be used in putting in an engine and stand-pipe at Mount Prospect. The necessity for this action has been frequently pointed out. Last May it was asked for, but nothing was done. One of the old engines broke down three weeks ago and the city was in danger of a shortened water supply. It was repaired last week and put at work on Sunday, so that the full quantity can now be pumped; but there is no reserve supply.

High Pressure Engines.—The correct definition of a high pressure engine is as follows:—When the steam engine was first invented the boiler was run at very little above atmospheric pressure, the condenser doing practically all the work. When higher boiler pressures came into use, and it became possible to get some power out of an engine by exhausting it directly into the atmosphere, the engine which was thus run non-condensing, came very naturally to be called a "high-pressure" engine while the term low pressure was applied to those engines which exhausted into a condenser. These terms have continued notwithstanding all engines are now run at what would have been at the time of their application abnormally high pressure.

NEW BRIDGE ON G. T. R.

The Grand Trunk Railway have just completed a steel swing bridge, 187 feet span, through truss crossing the sea at Portland, Me. This bridge, constructed under the authority of the Secretary of War of the U. S. Government, was rendered necessary by the utilization of a cove for commercial purposes. The total length of approaches which have been rebuilt to meet the requirements of the new bridge is about 1,350 feet. The centre pier is 32 feet square laid on piles, the piles being sawed off with sawing bench specially made for working under water at a depth of 32 feet below high-water mark. The superstructure was constructed by the Rochester Bridge and Iron Co., the balance of the work being done by the railway company.

SULPHATE OF IRON AS A DISINFECTANT FOR SEWER PIPES.—A reliable remedy for destroying the germs and sewer emanations is to make a solution of sulphate of iron. This solution will not only arrest decomposition, but will absorb the odor of sulphureted hydrogen, and absorb ammonia and oxidize organic matter with which it comes in contact. It is largely used in solution for disinfecting closets, fæcal matter from animals in slaughter-houses, ditches, sewers, and drains, and all places where noxious vapours are produced. The cheapness of sulphate of iron renders it suitable as a general disinfectant. One and one-half pound to a gallon of water is capable of making the surface of waste-pipes unfit for vegetable growth or life, and if applied once in twenty-four hours to all closets, wastes, and drains, will no doubt destroy the germs which are striving to exist in our homes. There is one disadvantage to its general use. If the solution comes in contact with marble basins or slabs it will stain them so that the colouring cannot easily be removed. It should be introduced into the water pipes through a funnel, which remedies the above objection.

PREVENTING RUST. -To prevent formation of rust the bright steel should be painted with wax varnish, made by dissolving one part of solid paraffin in fifteen parts of benzole. This is a much more cleanly application than such fatty compounds as blue ointment, and is eminently suitable for steel grates, fireirons, bicycles, etc., etc.

NO DECREASE OF GAS PRODUCTION.—Judging from the annual Parliamentary returns just issued relating to the gas undertakings of the United Kingdom, the companies have not yet been seriously affected by the adoption of the electric light. Indeed the gas companies still continue to be steadily progressive and fairly remunerative.

A GERMAN OFFICIAL REPORT states that no case has been recorded where a ship rigged with wire rigging has sustained any damage from lightning, except in a few instances where continuous connection had not been made with the hull.

A SERIES OF MISTAKES IN A BOILER ROOM.

It is a wonder that more serious accidents do not occur when boys and inexperienced persons are set to repairing steam boilers, or superintending their operation. The *Locomotive* tells the following story, and the editor vouches for its accuracy :

"A short time ago our attention was called to some most remarkable doings in a boiler-room, which we proceed to relate. The boiler was originally built to furnish power, and was good for about 75 pounds steam pressure ; but is now used only for heating purposes. Some of the steam and return valves to the large coils leaked about the stems, and the owner of the boiler, instead of sendidg for a steam-fitter to repack them, called in a plumber. The plumber, being busy, sent his boy helper. The boy began to work on some of the valves that were within sight of the boiler front, but, being troubled by some of the steam that escaped, he shut off the steam valves, leaving the return valves open. The coils were large, and when the steam in them had condensed, water began to back up from the boiler, for there was no check valve on the returns. As the boy worked away, he noticed that the water in the gauge glass was going down somewhat rapidly, and also that the steam pressure was rising. He did not know where the water was going to, nor did he know how to feed it more ; but he thought that if he opened the furnace door, and so checked the fires, the evaporation and the rise of pressure would proceed much more slowly. Jumping down into the pit in front of the boiler, he opened, what he thought in the darkness, were the fire doors, but it appeared subsequently that he did open the ash-pit doors, this making matters worse instead of better. The fire brightened up, and the pressure began to rise rapidly and the water level to go down, The boy was greatly troubled at this, and when the rubber diaphragm in the damper regulator burst from the increasing pressure, he "went all to pieces," as the saying is, and ran for his boss.

The boiler being originally intended for furnishing power, the safety valve could not be set to blow at less than about 20 pounds, while the damper regulator was designed to carry not more than 6 or 7 pounds, so that ts diaphragm burst, naturally enough, before the blowing-off point of the safety valve was reached. The plumber came in haste, and found the people in the building overhead badly frightened, and the boiler-room filled with steam, so that he could not make out precisely what had happened. He told the boy how to turn on the feed, however, and that well-meaning, but badly "rattled" individual, went to the back end of the setting, and, instead of opening the plug cock in the feed pipe, he opened the plug cock in the blow-off pipe, which only added to the noise and confusion. Meanwhile, the plumber hauled the fire out on to some pine boards that the regular attendant had laid in the damp-pit. The boards took fire, and smoke was soon added to the escaping steam, to the intense horror of the occupants of the building, who by this time were on the other side of the street. When the fire had been hauled and the danger averted, the plumber soon learned the cause of the disturbance, and quiet was speedily restored by shutting off the damper regulator and the blow-off, and throwing a few buckets of water on the burning boards.

It seems hardly possible that such a succession of mistakes could follow one after another in so orderly a manner, but we can testify, from personal observation, that they did. And we may add that not long afterwards, when the boiler was out of use, a coal dealer put 100 tons or so of coal into the same boilet-room, piling it up in such a manner that some of it ran down into the open man-hole, and the rest of it covered up the blow-off pipe and the rear door of the setting, which were both open, so that there was plenty of trouble digging them out before the boiler could be started again.

SILICON BRONZE.

This alloy, which is now used for the wires of many telephonic lines, and is gradually replacing the iron wires of telegraph lines, contains a very slight percentage of silicon and sodium. The addition of these two metals to fused bronze has the effect of reducing the oxide of copper, which, to a smaller or greater extent, is present in most commercial metal, and greatly impairs its electric conductivity. For some of the first telegraphic lines copper wire was used, but it was found to stretch gradually, and to be too weak against rupture, its resistance being only 28 kilos, per square millimetre. Iron wire became, therefore, general, although it is so much inferior as a conductor of electricity, and a much greater thickness (usually 4 millimetres) had, therefore, to be given to it. The new bronze is equal to copper in conductivity, and surpasses iron in resistance to rupture (49 kilos, per square millimetres, against 36 kilos, for iron wire). Silicon bronze wire of 2 millimetres can be used instead of galvanised iron wire of 5 millimetres thickness, the former weighing 26, the latter 155 kilos, per kilometre. In consequence of the smaller weight, the telegraph posts can be placed farther apart, and the laying of the wires is much less expensive.

A CONTRACT has been signed by the Phoenix Bridge Company for the erection of a tower at Chicago, to be finished before the opening of the Exhibition. The tower is to be 560 ft. high and 210 in diameter. A spiral railway, running round the exterior of the tower, will convey passengers to the top. This railway will be nearly a mile long. The foundation of the tower will consist of some 2000 piles. Some 3500 tons of iron and steel and 500,000 ft. of lumber will be used in the construction.

SWANSEA AND THE AMERICAN TRADE.

As already chronicled, Swansea, which modestly announces itself as "the ocean port of England," and believes that it is going to be "the Liverpool of the future," is trying to get a share of the Canadian and American traffic, and has gone so far as to send a deputation, including, or according to another story, consisting of Sir John Jones Jenkins, to interview Sir Charles Tupper, the Canadian High Commissioner, on the subject. Sir Charles, it is stated, was "much impressed" by the arguments brought forward by that titled gentleman—or perhaps we should say the titled deputation—with the alliterative name, nevertheless, being an astute man of business, he required an authoritative written statement showing what inducements the local authorities would be likely to offer to such a line of steamers as the Canadian Government proposed to establish.

And what will Sir John Jones Jenkins, or rather the Swansea Harbour Trust, offer, we wonder. What, indeed, can they offer? We have seen plenty of evidence lately of the exertions being made by various ports to secure this same sort of traffic. We have heard what Southampton is already doing, and we know what Bristol is going to do. Further, we are aware of the facilities already existing at Cardiff, and Milford, and Barry, for dealing with traffic of this kind. If Swansea has got a trump card up her sleeve, it is just as well she should play it at once, if only to show that she is not merely bluffing. It was not so very long ago since we heard a great deal of talk about dock extension at the port, but where is that scheme now? Possibly that scheme was as bad as the new scheme hatched out of the fertile brain of Sir John Jones Jenkins is good, but first of all it would be interesting to know if there is a scheme at all. "The ocean port of England" looks very well in print, but if nothing is done to deserve that reputation the name becomes somewhat of a mockery. —*Transport English Ex.*

THE DISTINCTION BETWEEN IRON AND STEEL.

According to the definition of steel generally adopted at the present time, the word must be applied to all those welded products which can be hardened, and to all varieties of malleable ingot metal, whether they can be hardened or not. The absence or presence of welds will, therefore, decide whether a product which cannot be hardened is steel or wrought iron, and the effect of etching a flattened and smoothed surface with nitric acid was found to give decisive evidence on this point. Steel of the second kind will always present a uniform dull-grey appearance, the acid attacking it equally over the whole surface. Wrought iron is acted on irregularly; a roughly-grooved surface is produced, on which longitudinal stripes, some formed of bright grains, others of the dull grain of etched steel, are developed. In iron blooms the stripes are broader and interrupted, the bright grains are more plentiful, and the cinder becomes visible in the form of black bands. In wrought iron which has been formed by the welding together and further diminishing of different layers of metal, the lines of contact become clearly visible, the different layers forming throughout separate bands. The following experiment proves that the bright grains are actually produced in the welding. A number of extra-soft steel bars were piled and welded in the same manner as is usual with wrought iron. Although the welding was not perfect at every point, no traces of imperfect places were visible after polishing. On treatment with acid, every weld became visible as a line of brilliant grains standing out from the generally dull-grey surface. These lines of bright grains are an infalliable proof that a material which cannot be hardened is wrought iron, while their entire absence characterizes it as steel. M. Walrand describes an easy method for distinguishing iron from steel when in small pieces. The test-piece, which may be some 25 or 30 cm. long, is slightly indented 4 or 5 cm. from each of its ends; one of the ends is then heated gradually to a dull-red heat, and is afterwards very slowly cooled in water, the metal being scratched repeatedly with a file until the clean surface takes a dull-yellow colour, or, better still, becomes blue. It is then plunged into the water, and the cooling is completed rapidly. Both ends of the piece are then broken off, and serve for comparison. Ordinary wrought iron appears fibrous or granular, but if treated as above its fracture is dull, and it has a short fibrous structure. Hard and moderately hard steel is finely granular, but after treating in the manner described above, the fracture is bright and partially or entirely smooth. Swedish iron shows only traces of a fibrous structure, and does not otherwise differ from soft steel, but when it has undergone the treatment described its fibres are more apparent, and the smooth appearance has disappeared, while in the case of soft steel it is all the more obvious.

FORCED DRAUGHT AND LEAKY TUBES IN MARINE BOILERS.

Being engaged in an investigation of the straining forces in boilers while heated, I venture to offer an explanation, possibly a remedy, for the much discussed plague of leaky tubes.

To put it in a few words; the highly-heated tub-ends are *crushed* by the holes in the tubeplates, which are contracted at their firebox ends, forming a cone into which the expanding tubes are firmly pressed when the tubes-ends are so far weakened by the hot gases and the very questionable cooling of a mixture of steam bubbles and water, if the temperature of the fire gases exceeds a certain limit.

That the holes must be deformed conically is quite clear, on account of the enormous difference of temperature on the two sides of the tubeplate. This is near 1,000 deg. cent. in locomotives, and possibly more than 1,200 deg. in the combustion chambers of marine boilers, where the enormous temperature is created by the combining of highly heated combustion gases and hot air.

That the tubes ends are literally crushed is a fact of which every one may convince himself by examination; the ends are quite loose in the holes, and may be moved by hand.

The high temperature is a consequence of forced draught, by which far more hot gases are produced than by natural draught. These, cooled by the same heating surface of the furnaces, enter the combustion chamber with higher temperature, and double the difference by the fact that the combustion in the chamber now proceeds with hotter gas and air.

You see now at a glance that the Admiralty ferrule acts as a stiffener, not permitting the crushing, and retaining the elasticity of of the tube to follow the expansion and contraction of the tubeplate.

To resume:

1. Furnaces should have greater heating surface.
2. The tubeplate should be
   - *a.* of a material the expansion coefficient of which is a minimum, to reduce the contraction pressure between plate and tubes.
   - *b.* of little thickness to the same effect.
   - *c.* the tube-holes as large as practically compatible with the desired heating surface.
   - *d.* capable of giving way a little to the expansion of the tubes.
   - *e.* cooled so far as possible by good circulation.
3. Ferrules are of good use.
4. Separate combustion chambers for reducing the temperature of the gases.
5. Stocking should be effected with as little air surplus as practically possible to reduce combustion in combustion chamber.

FIRE PROTECTION BY HAND GRENADES.

M. Hunkel gives the following solution as an efficient material for filling hand grenades and other portable fire-extinguishers. Six solutions should be prepared as follows:

1. Ammonium chloride	200 grammes
Water	20 litres
2. Calcined alum	350 grammes
Water	10 litres
3. Powdered ammonium sulphate	3 kilogrammes
Water	5 litres
4. Common salt	2 kilogrammes
Water	40 litres
5. Sodium carbonate	350 grammes
Water	5 litres
6. Soluble glass	4.5 kilogrammes

The whole of these should be mixed together in the order indicated, and 20 litres of water are then added to the result.

INLAND WATERWAYS OF FRANCE.

The British Consul at Rouen, in a recent report, says that France is greatly in advance of England in the movement for developing inland navigation. More than £60,000,000, or $300,000,000, has been expended by the French government for the enlargement and improvement of its inland waterways within the present century. The perfection of the vast network of canals and "riviéres canalsées" has been the work of the present republic, which has spent $200,000,000 on the work. France possesses a comparatively perfect system of inland waterways, the total length of which now reaches 7,456 miles. These waterways are as free to the use of all as the roads of the country, the last vestige of canal dues having been swept away in 1880.

AUTOMATIC WEIR GAUGE.

An automatic weir gauge which has been used for some years in Philadelphia, P.A., and also at Albany, N.Y., consis's essentially of a float rising and falling with the water to be measured, and connected with a pencil moving back and forth with the float in the direction of the axis of a revolving cylinder, and tracing on the paper rolled around the cylinder a line representing the varying depth of flow over the weir. In one case the rate of motion of the movable pencil is 1 inch to 5 inches. A second pencil traces a line representing the height of the crest of the weir. The depth of flow at any time is therefore found by multiplying by five the distance from the zero line to the flow line on the cylinder, which is revolved at the rate of 1 inch an hour.

DEEP ARTESIAN WELLS.—The deepest artesian well in the world is said to be one which penetrates to a depth of 4194 ft., near Berlin, most of the distance through a solid belt of salt. The next deepest well is 3843½ ft., at St. Louis, Missouri; and the third on the list is a well 3553 ft. in depth, at Titusville, Pennsylvania.

A HIGH-SPEED ELECTRIC RAILWAY.—Messrs. Ganx & Co., of Buda-Pesth, have submitted to the Hungarian Government plans for an electric railway from Vienna to Buda-Pesth. A journey between these two capitals is now accomplished by fast trains in about five hours, but it is stated that the run could be made by the proposed electric railway in an hour and a half.

THE WASHINGTON-BALTIMORE ELECTRIC RAILWAY, which will be built by the Baltimore & Washington Turnpike & Tramway Co., capital $150,000, will undoubtedly be, when completed, one of the greatest enterprises yet projected in electric roads. It will be constructed with double tracks, and substantially ballasted, so as to permit a train speed of sixty miles an hour. The total length of the road will be a little over 50 miles, and it is intended to make this distance in forty minutes.

HALIFAX, N.S.

WATER WORKS.

SEALED proposals will be received by the Board of Commissioners of City Works of the City of Halifax, Nova Scotia, until 12 o'clock, noon, on Monday, February 20th, 1893, for the manufacture and delivery of about 2400 tons of CAST IRON PIPE and necessary SPECIALS and VALVES.

Plans, quantities, specifications and other information can be obtained from the City Engineer.

The Board of Commissioners of City Works hereby reserve the right to reject any or all bids, or to accept separate tenders for pipe and specials, and for valves, or any that in their judgment will be for the best interest of the City.

No tender will be considered unless accompanied by cash draft, or a certified cheque for five hundred dollars ($500.00) for pipe and one hundred dollars ($100.00) for valves, payable to the City Treasurer of the City of Halifax, as a guarantee that in case the contract is awarded the successful bidder will execute said contract with satisfactory security within ten days after notification of award.

Each bidder will be required to state in his proposal the name and address of his sureties.

Each proposal must be made on the forms furnished by the City Engineer, and must be marked "*Tender for Water Pipe*" (or valves) and addressed to the Chairman of the Board of Works, City Hall, Halifax, Nova Scotia.

By order of the Board.

W. B. McNUTT,
Clerk of Works.

F. W. W. DOANE,
City Engineer.

City Hall, Halifax, N.S.

—TO—

CIVIL ENGINEERS.

THE ST. JOHN'S MUNICIPAL COUNCIL invite applications for the position of

Civil Engineer for the City of St. John's, Newfoundland.

Applicants must have a thorough experience of all the branches of Municipal Engineering, including water supply and sewerage.

Applications, stating age and salary expected, with copies of testimonials, will be received by the subscriber up until the first of April next.

By order.

P. W. KELLY,
Secretary.

THE MUNICIPAL OFFICES,
St. John's, Nfld., 29th December, 1892.