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For THE CANADIAN ENGINEER.

FIRES AND FIRE ENGINES IN THE OLDEN TIMES.

BY WILLIAM PERRY, HYDRAULIC ENGINEER, MONTREAL.

Long before the appearance of man on the earth, water was the great transporting medium which carried trees and stones down from the hills to the ocean, and it was also the first source of inanimate motive power controlled and directed by the ingenuity of mankind. Water alone might form the subject of many discourses. In the dawn of civilization, it was reverenced by philosophers as the life-giving principle of the universe, and even in the present day shoals of pilgrims are to be seen travelling to the Ganges, the sacred river of India, to worship the self-same substance. With these people, it is deemed a virtue to think of the river, while to bathe in its waters washes away all sin, and to expire on its brink, or be suffocated in its embrace, is the climax of human felicity.

The subject is a large and important one, and is destined to become of still greater importance. Its rapid progress in recent times is apt to lead one to suppose that the engines, pumps and machines actuated by water are of modern origin, but ancient writers tell us that Archytas, of Tarentum, invented hydraulic machinery about the year 400 B.C.; no description of his inventions has reached our times, but we have records extending nearly as far back. Hero, a celebrated mechanician, of Alexandria, who lived over 2,000 years ago, among other works, wrote a treatise on pneumatics, in which he described several curious devices handed down by former writers, whom he at that time called "ancient philosophers." Among these devices is one in which water is caused, by its weight, to effect the opening of a temple door.

I shall endeavor to describe it to you. We will suppose we have the interior of a temple, with a door on the right and an altar on the left. The altar contains an air-tight receptacle, in such a position that it will be subject to great heat as soon as a fire is lighted. This receptacle communicates by a pipe with a larger receiver partly filled with water, and placed in the basement, or any excavation below the temple floor. A syphon pipe leads from this receiver into a bucket hanging to a cord, which passes over a pulley, and is wound round a shaft firmly secured to the door above, and pivoted at the bottom. Attached to this shaft is another cord wound in the opposite direction, passing over another pulley and supporting a weight. The action of the apparatus is this: When a fire is kindled on the altar, the air-receiver under it is heated, the air expands, and passing down the pipe, presses on the water in the large receiver, forcing it through the syphon pipe into the bucket. As soon as sufficient water has entered the bucket to overcome the resistance of the suspended weight and the friction of the door, the bucket begins to lower, and, pulling on the cord wound round the upright shaft, opens the door and raises the weight. The apparatus is so proportioned that as the water pours into the bucket and the bucket lowers, the mouth of the syphon pipe keeps just below the level of the water, and the bucket reaches the ground before the pipe is quite withdrawn. When the temple services are concluded and the fire extinguished the air receiver cools down, the air in it contracts and causes a partial vacuum in the large receiver and the water flows back into it from the bucket. The weight has more power than the empty bucket, and now lowers, turning the shaft round and closing the door. Of course, this piece of mechanism below the floor, if ever used, formed part of the esoteric religion, and no vulgar eyes were allowed to see by what earthly means the gods signified their approval of the burning sacrifice by mysteriously opening to them the temple door.

The following anecdote, for which I am indebted to Thomas Ewbank's admirable book on raising water, will show you how and when this force-pump arrangement received its last and most important addition—that of an air vessel:—

About the year 200 B.C., during the reign of Ptolemy Philadelphus over Egypt, an Egyptian barber pursued his vocation in the city of Alexandria. Like all professors of that ancient mystery, he possessed, besides the inferior apparatus, the two most essential implements of all—a razor and a looking-glass or mirror, probably a metallic one. This mirror, we are informed, was suspended from the ceiling of his shop, and balanced by a weight, which moved in a concealed case in one corner of the room. Thus, when a customer had undergone the usual purifying operations, he drew down the mirror that he might witness the improvement the artist had wrought on his outer man, after which he returned it to its former position for the use of the next customer. It would seem that the case in which the weight moved was enclosed at the bottom, or pretty accurately made, for as the weight moved in it and

displaced the air, a certain sound was produced, either by its expulsion through some small orifice, or by its escape between the sides of the case and the weight. This sound had probably remained unnoticed, like the ordinary creak of a door, perhaps for many years, until one day, as the barber's son was amusing himself in his father's shop, his attention was arrested by it. This boy's subsequent reflections induced him to investigate its cause, and from this simple circumstance he was led eventually either to invent or greatly to improve the hydraulic organ, the force pump, the air gun fire engine, &c. Now this barber's son was Ctesibius, of Alexandria, one of the most eminent mathematicians and mechanicians of antiquity, and the teacher of Hero, of Alexandria, of whom I have previously spoken. No illustration of the pump of Ctesibius has survived, but from the descriptions handed down it is supposed to have been thus:—

A wheel having projections or float boards on its rim is placed in a stream; fixed upon the same shaft with the wheel, and therefore revolving with it, is a piece called a cam, which stands out more on one side of the shaft than the other. At each revolution this pushes down one end of a lever, to the other end of which is connected the pump rod, carrying a solid piston closely fitting the barrel of the pump. In the bottom of the pump is a suction valve and a pipe leading to the water, and in the side another pipe, terminated by a delivery valve at the bottom of an air vessel. Inserted in the air vessel is a delivery pipe, up which the water passes to its destination. The air vessel is in effect an elastic cushion, compressed during the stroke of the pump, and expanding during the return stroke, so that the water is forced up the delivery pipe in a continuous stream. In some cases there were two pumps worked by the same wheel and connected to the same air vessel to still further equalize the flow. No details are shown, but the mechanical arts must even at that time have arrived at some degree of perfection, for we are told that "the cylinders were made of brass, the pistons turned very smooth, and the valves hinged with very exact joints."

About the beginning of the Christian era, a Roman architect and engineer, named Vitruvius, wrote a treatise on those professions, and inserted a brief account of the hydraulic machines then in use.

It is an interesting circumstance in the history of this ancient engine that the air vessel should have been preserved through so many ages, when its use was not known. While its size was diminished, its form was retained. It is no wonder that the old copyists consider it an unsightly and unnecessary enlargement of the discharge pipe, and hence they removed it accordingly; certainly the fancy that could add the rectangular twist to the upper part, would not hesitate to remove the supposed deformity from the lower one. Some persons, deceived by the imperfect representation, have supposed that such engines were not used in the time of Heron, and that the figure and description were inserted in his work as mere hints for future mechanicians to improve on, but the description sufficiently indicates that similar machines were in actual use. The materials and workmanship of the pumps—metallic pistons and spindle valves—with guards to prevent the latter from opening too far, the mode of forming the goose neck by a kind of swivel joint, somewhat like the union or coupling screw, the application of an air vessel, two pumps forcing water through one pipe, and both worked by a double lever, are proofs that the machine described by Heron was neither an ideal one nor of recent origin or use. There are features in it that were very slowly developed by manufacturers in modern times. It is not at all improbable that ancient engines were equal in effect to the best of ours, but, whether they were or not, one thing is certain, that to the ancients belong the merit of discovering the principles employed in these machines, and of applying them to practice. It is remarkable, too, that fire engines made their first appearance in Egypt, thus adding another to the numerous obligations under which that wonderful country has placed civilized nations in all times to come.

FIRE APPLIANCES, LONDON, 1660.

Having noticed the use of pumps to extinguish fires, I may remark that they were also employed in the middle ages, if not before, to promote conflagrations, viz., to launch Greek fire. This mysterious substance is represented as a liquid. Beckman says it certainly was one, and so far from being quenched, its violence was augmented by contact with water. It was principally employed in naval combats, being enclosed in jars that were thrown into the hostile vessels. It was also blown through iron and copper tubes planted on the prows of galleys and fancifully shaped like the mouths of animals, which seemed to vomit streams of liquid fire. There is among the figures of war machines in the old German translation of Vegetius, one that (judging from the flames issuing from monstrous animals' mouths) seems to have been designed for projecting Greek fire, though it is difficult to see how it was done. Another mode of using this terrible material was by forcing it in jets "by means of large fire engines," and sometimes "the soldiers squirted it from hand engines." Its effects upon those on whom it was thrown seem to have been somewhat similar to those produced by the composition of alcohol and spirits of turpentine recently adopted as a substitute for oil in lamps, and which has occasioned so many fatal disasters, by the explosion of vessels containing it and its consequent dispersion over the persons of the sufferers. It was easy (says Beckman) to conceive the idea of discharging Greek fire by means of forcing pumps, because the application of them to extinguish fires was known long before its invention. It is supposed to have originated with Callinicus, a Syrian engineer of Balbec, in the 7th century. It may, however, have been known to the old Greeks and Romans, for they made use of similar devices for projecting fire. Montfaucon, in describing their marine combats, observes

"another mode of annoying enemies' ships was by throwing fire therein, which they did after different ways, some using for that purpose siphons, and fire buckets, others threw in pots filled with fire." From an expression of Dr. G. A. Agricola, a physician of Ratisbon, of the last century, in a work on gardening, it would appear as if something like the Greek fire was then in use. Enumerating several pernicious inventions, he notices "that infernal one of gunpowder. How many cities and fortresses has it ruined? How many thousands of men has it destroyed? And what is more deplorable is, that this art grows more and more complete every day, and is brought to that perfection that in Holland and some other parts they have fire pumps filled with burning compositions, wherewith they eject fiery torrents to a great distance, which may occasion dreadful and irreparable damages to mankind."

Fires and wars have ever been deemed the most awful of earthly calamities, and, unfortunately for our race, they have too often been united, for warriors have generally had recourse to the former to multiply the miseries of the latter, and in almost every age cities have, like Jericho and Ai, Hebron and Ziglag, Troy and Thebes, Carthage and Athens, Saguntum and Bagdat, been burnt with fire, and in some cases "all the souls therein destroyed."

SCENE AT A FIRE IN LONDON, 1670.

As Greek fire preceded gunpowder in Europe, so pumps or the "spouting engines" for projecting it may be considered the forerunners of guns; it is even possible that the first idea of the latter (supposing they were not introduced from the east) might have been derived from accidental explosion of the liquid in the pump cylinders, when the pistons would of course be driven out of them like balls out of cannon. Be this as it may, enough has been adduced to show that the forcing-pump and its modifications have exerted no small degree of influence in ancient wars, and consequently in the affairs of the old world.

Although the police and other arrangements for the actual suppression of fires in ancient Rome are not well ascertained, some interesting particulars are known. A body of firemen, named matricularii, was established, whose duty it was to extinguish flames. Similar companies were also organized in provincial cities. This appears from Trajan's reply to Pliny respecting the formation of one in Nicomedia, and from which we learn that these ancient firemen frequently created disturbances by their dissensions and tumults. Pliny (the younger) was governor of Bithynia; after giving the emperor an account of a fire in Nicomedia, a town in his province, he continues: "You will consider, sir, whether it may not be advisable to form a company of firemen, consisting only of one hundred and fifty members. I will take care none but those of that business shall be admitted into it, and that the privileges granted them shall not be extended to any other purpose. As this corporate body will be restricted to so small a number of members, it will be easy to keep them under proper regulations." In answer the emperor sent the following letter: "Trajan to Pliny: You are of opinion it would be proper to establish a company of firemen in Nicomedia, agreeably to what has been practiced in several other cities. But it is to be remembered that societies of this sort have greatly disturbed the peace of the province in general and of those cities in particular. Whatever name we give them, and for whatever purpose they may be instituted, they will not fail to form themselves into factious assemblies, however short their meetings may be. It will therefore be safer to provide such machines as are of service in extinguishing fires, enjoining the owners of houses to assist in preventing the mischief from spreading, and, if it should be necessary, to call in the aid of the populace."

The direction to procure "machines as are of service in extinguishing fires" was in consequence of Nicomedia being destitute of them—an unfortunate circumstance for the inhabitants, but one that is hardly now regretted by those who are in search of information respecting fire-engines among the ancients, since it led Pliny to mention them, and thereby afford us a proof of their employment by the Romans. "While I was making a progress (he writes to Trajan) in a different part of the province, a most destructive fire broke out in Nicomedia, which not only consumed several private houses, but also two public buildings, the town house and the temple of Isis, though they stood on contrary sides of the street. The occasion of its spreading thus wide was partly owing to the violence of the wind, and partly to the indolence of the people, who, it appears, stood fixed and idle spectators of this terrible calamity. The truth is, the city was not furnished with either engines, buckets, or any single instrument proper to extinguish fires, which I have now, however, given directions to be provided."

It has been generally imagined (observes Melmoth) that the ancients had not the art of raising water by engines, but this passage seems to favor the contrary opinion. The word in the original (for engine) is sypho, which Hesychius explains, "instrumentum ad jaculandus aquas adversus incendia"—an instrument to throw up water against fires. But there is a passage in Seneca which seems to put the matter beyond a conjecture, though none of the critics upon this place have taken notice of it. "Solemus," says he, "duabus manibus inter se junctus aquam concipere et compressa utrinque palma in modum siphonis exprimere"—Q. N. ii. 16, where we plainly see the use of this sypho was to throw up water.

In the French translation of De Sasy (Paris, 1809) the word is rendered pumps: "D'ailleurs, il n'y a dans la ville, ni pompes ni seaux publics, enfin nul autre des instrumens necessaires pour eteindre les embrasemens." And Professor Beckmon quotes both Hesychius and Isadore to prove that "a fire-engine, properly so called, was understood in the 4th and 7th centuries by the term sypho," and we may add that Agricola in the 16th century designated syringes for extinguishing fires by the same term. Heron's engine is also named a syphon.

From an expression in the letter of Pliny just quoted, we learn that men were regularly brought up

to the art of extinguishing fires, the same as to any other profession. Of the company that he proposed to establish, he remarks, "I will take care that none but those of that business shall be admitted into it." The buildings in ancient Rome were very high, the upper stories were mostly of wood, and the streets and lanes were extremely narrow, hence the suppression of conflagrations there must have been an arduous business, and one that required only extraordinary intrepidity and skill, qualifications that could be obtained by experience. Besides engines for throwing water, the firemen used sponges or mops fixed to the end of long poles, and they had grapples and other instruments by means of which they could go from one wall to another (Encyc. Antiq.). Of the great elevation of the houses several Roman writers speak. Seneca attributed the difficulty of extinguishing fires to this cause. Juvenal mentions

> Roofs that make one giddy to look down.

When the city was rebuilt after the great conflagration (supposed to have been induced by Nero), the height of the houses was fixed at about seventy feet. These were raised to a certain height without wood, being arched with stone, and party walls were not allowed. That fires were constantly occurring in old Rome is well known. Juvenal repeatedly mentions the fact. Thus in his third satire:

> Rome, where one hears the everlasting sound
> Of beams and rafters thundering to the ground,
> Amid alarms by day and fears by night.

And again:

> But, lo! the flames bring yonder mansion down!
> The dire disaster echoes through the town:
> Men look as if for solemn funeral clad,
> Now, now indeed these nightly fires are sad.

Their frequency induced Augustus to institute a body of watchmen to guard against them, and, from the following lines of Juvenal, it appears that wealthy patricians had servants to watch their houses during the night:

> With buckets ranged the ready servants stand,
> Alert at midnight by their lords' command.

As every calamity that befalls mankind is converted by some men to their own advantage, so the numerous fires in Rome led to the detestable practice of speculating on the distresses they occasioned. Thus Crassus, the consul, who, from his opulence, was surnamed the Rich, gleaned his immense wealth, according to Plutarch, "from war and from fires; he made it a part of his business to buy houses that were on fire, and others that joined upon them, which he commonly got at a low price on account of the fear and distress of the owners about the event." But the avarice of Crassus, as is the case with thousands of other men, led to his ruin. With the hope of enlarging his possessions, he selected the province of Syria for his government, or rather for his extortion, because it seemed to promise him an inexhaustible source of wealth; but by a retributive Providence his army was overthrown by the Parthians, whom he attempted to subdue, and who cut off his head, and in reference to his passion for gold fused a quantity of that metal and poured it down his throat.

Among other precautions for preventing fires from spreading that were adopted in Rome on rebuilding the city, was one requiring every citizen to keep in his house "a machine for extinguishing fire." What these machines were is not quite certain, whether buckets, mops, hooks, syringes or portable pumps. That they were the last is supposed to be proved by a passage in the writings of Ulpian, a celebrated lawyer and secretary to the Emperor Alexander Severus, wherein he enumerates the things that belonged to a house when it was sold, such as we name fixtures, and among them he mentions siphones employed in extinguishing fires. Beckman thinks the leaden pipes which conveyed water into the house for domestic purposes might be intended, but they would hardly have been designated as above merely because the water conveyed through them occasionally put out fires. This was not their chief use, but an incidental one. That they were pumps or real fire engines was the opinion of Alexander ab Alexandro, a learned lawyer of the 15th century, an opinion not only rendered probable by terms used and the necessity of such implement for the security of the upper stories, which neither public engines nor streams from the aqueducts could reach, but also from the apparent fact that syringes or portable pumps have always been kept (to a greater or less extent) in dwellings from Roman times. And a sufficient reason why they should generally be sold with the houses, might be found in their dimensions being regulated according to those of the buildings for which they were designed.

The population of Rome was so great that the area of the city could not furnish sites sufficient for the houses, and hence the height of the walls was increased in order to multiply the number of stories—"for want of room on the earth the buildings were extended towards the heavens." Portable fire engines were therefore particularly requisite, in order to promptly extinguish fires on their first appearance, whether in the upper or lower floors. In the latter case, when this was not done, the people in the higher stories would be cut off from relief and the means of escape. Were some of our six or seven story buildings in the narrow streets densely filled with human beings, and a raging fire suddenly to burst out on the ground floors, the probability is that many lives would be lost, notwithstanding the great number of our public engines and hose and ladder companies. Juvenal estimates the distressed situation of those dwelling above under such circumstances:

> Hark! where Ucalegon for water cries,
> Casts out his chattels, from the peril flies,
> Dense smoke is bursting from the floor below.

Fire engines were nearly or altogether forgotten in the middle ages; portable syringes seemed to have been the only contrivance, except buckets, for throwing water on fires, and from their inefficiency and other causes, their employment was very limited. The general ignorance which then pervaded Europe not only prevented the establishment of manufactories of better instruments; but the superstitions of the times actually discouraged their use. There is not a more singular fact (and it is an incontrovertible one) in the history of the human mind, than that the religious doctrines and opinions of a large portion of mankind should have in every age produced the most deplorable results with regard to conflagrations. The Parsees, Ghebres, etc., of Asia, and other religious sects, which have subsisted from the remotest ages, never willingly throw water upon fires—they consider it criminal to quench it, no matter how disastrous it may be; they had rather perish in it than thus extinguish the emblem of the Deity they worship. "They would sooner be persuaded to pour oil to increase, than water to assuage the flame." Among such people fire engines, of course, were never used. Another and larger part of the human race, though they entertain no such rever-

ence for fire, are so far influenced by the pernicious doctrine of Fatalism, as to make little or no efforts to suppress it. They look upon fires as the act of God, determined by Him, and therefore conclude it useless to contend with Him, in attempting to extinguish those which He has kindled.

(*Concluded in next issue.*)

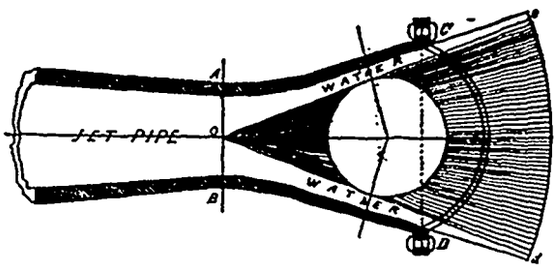
For THE CANADIAN ENGINEER.

SOLUTION OF THE "BALL-NOZZLE FIRE JET" PARADOX.

BY CHAS. BAILLAIRGE, C.E., QUEBEC.

The action of the "ball-nozzle fire jet" was considered contrary to the laws of nature, so the American scientific papers said. Not only was it thought so by scientists in general, and by hydraulic engineers, but by the inventor himself. To be sure, I merely announced the solution in general terms and without any explanatory diagram, as due to the formation of a vacuum behind the ball, and the scientific world may therefore be still sceptical on the subject or as to the true explanation having as yet been arrived at.

I am led to this conclusion from the fact that even the scientists and hydraulicians of our "Canadian Society of Civil Engineers" seemed at first sight to doubt the correctness of my enunciation of the solution, and directed the secretary to write me for a graphic and scientific explanation of how the mere pressure of the atmosphere could resist or counteract a pressure of may be 100 lbs. to the inch against the rear of the ball.



Now, as seen by the diagram, there is no pressure against the ball, or only that of friction at the circle of contact between the ball and water. The pressure is in the moving water, and is expended, not in pushing the ball, but in expelling the water through the annular space, *ab*, around the ball, and between the ball and conical or divergent nozzle, *ABCD*, the ball so adjusting itself, of course, that the sectional area of the funnel-like jet of water at *ab*, or area of the annulus, becomes equal to the sectional area of the solid jet at *AB;* and the thickness of the jet or breadth of annulus at *ab* goes on decreasing, of course, as the diameter of the cone increases at *cd*, where, supposing the velocity still the same as at *AB*, less the diminution caused by the resistance and pressure of the air, the area at the annulus at *cd* is still the same or so much greater as the velocity at *cd* is less.

Of course, the water, when first let on, forcibly projects the ball against the confining wires at *CpD*. In the meantime, the friction of the water around the inner periphery of the apex of the cone *AOB* quickly sucks away the water from the concave-conical space behind the ball, thus creating a vacuum towards which, or away from the confining wires, the atmospheric pressure pushes back the ball until, as already said, the area of the annular space for the water around it becomes adjusted to an equality with that of the solid water at *AB*.

Of course, in company with all other technologists or engineers, I can only see with the eyes of faith what I here describe, as the solid brazen funnel *ABCD* cannot be seen through, and even if it could, or if the nozzle were of glass, still would the glass and water and vacuum be all of a color, and the vacuum unseen; but that there is a vacuum there, that there must be one, must be just as obvious to the scientist as if it could be proved to exist; nor even can the engineer doubt it, when he knows how in sewers the current of water carries a current of air along with it, or as a current of water will, and does, draw away with it a film of the quiescent water it is in contact with, and those of your readers who have in your April issue studied "Taylor's System of Air Compression," cannot believe in it any more than in the explanation of the "fire nozzle paradox" unless they admit, as Taylor explains, that the water sucks down the air with it, though in this case the proof is evident from the fact of the existence of the compressed air as evidenced by its power motor action.

For THE CANADIAN ENGINEER.

THE PREVENTION OF STEAM BOILER EXPLOSIONS.

BY CHAS. BAILLAIRGE, C.E., QUEBEC.

Notwithstanding all the precautions, suggestions and scientific disquisitions by mechanical engineers, scientists and would-be connoisseurs during the last fifty years, steam boiler explosions continue to be as persistent as ever, and so they will be until some such preventive as suggested by the writer, now fully thirty years ago, shall have been insisted on by legal enactment.

I have been a close observer of these periodically recurring accidents, many of which I have seen and made a special study of, as set forth in papers read by me before the Royal Society of Canada, in May, 1891. See page 8, items 5, 6, 7, 8, of "Bibliography of the Members of the R. S. of Canada," as published by the society in the volume of transactions for 1894.

The explosion is due in many cases, of course, to the overloading of the safety valve, or to this becoming so firmly stuck and rusted *in situ* that it cannot be forced open even by such a pressure as that capable of bursting the boiler; but in many and most cases the safety valve has been found open after the explosion, an evident indication that had it been large enough to allow of blowing off the steam as fast as formed, the rupturing of the vessel would not have occurred.

There are no doubt cases where, the water becoming low and the surfaces red hot, a new supply over the unduly heated areas forms steam with such rapidity and in such quantities that the ordinary safety valve full open cannot give vent to it, the pressure increasing till the boiler bursts.

When a boy of 17, and with a friend of the same turn of mind, I built some fifty years ago a double engined steam carriage for ordinary roads, and many a trip we made with it in and about the ancient capital, till stopped by the police for frightening horses. We had returned from one of these outings, and, intending to go out again, did not draw the fire, but laid up during dinner time at my father's then residence, No. 17 Genevieve street, Cape, when hearing an uproar in the yard, I got my head out just in time to see the valve returning almost vertically downwards from the height to which it had been blown by the increasing force of the vapor from within. This vapor continued to escape from the valve in a solid cylindrical form of some ten feet at least in height, before it was sufficiently cooled down and disintegrated by the resistance of the atmo-

sphere to become visible as condensed steam, showing the super-heating it had attained to under confinement, and in fact the whole contents of the boiler, water and all, were in some 20 seconds thoroughly cleaned out.

Now, sir, any ordinary sized boiler of say 4 to 6 or more feet in diameter would certainly have burst under the circumstances, and so would this but for the fact that it being but 2 feet in diameter or less and 2½ to 3 feet long, and built of ¼-inch boiler plate, it was of course many times stronger than a larger boiler with same thickness of metal.

I have said that when steam forms so quickly—and this it will every now and then do, owing to the sleepiness or forgetfulness of our human nature—yes, when it forms so quick, and even if it overcome the pressure on the so-called safety valve and blow it open, it may, nevertheless, burst the boiler when forming faster than it can flow away by the comparatively tiny opening of the blow-off.

Hence the suggestion I made years ago, and which I now reiterate, of such an enlargement of the valve as shall remove the steam as fast it can possibly be formed under the most favorable conditions for such formation.

I am not a mechanical engineer, or at least do not practice at it as a specialty; but would merely suggest that our "Canadian Society of Mechanical Engineers," or any other, do study up the question as to whether one very much larger escape valve should not be henceforth insisted on. May be, in long boilers of the Cornish type, two such valves or more than two would put a stop to these generally fatal accidents.

CEMENT TESTING.*

BY CECIL B. SMITH, MA. E., A. M. CAN. SOC. C.E.

This subject has so often been written on, and is being so continually and persistently investigated, that it forms, as it were, an inexhaustible mine.

But this very feature shows how very important and yet how little understood it is, for, when investigators continue to disagree, the presumption is that there is either a lack of agreement as to the basis on which the investigations are made, or else a failure, up to the present, to solve all the intricate mazes of the problem, or indeed a combination of the two.

The variations in the standard tests in use in various countries are too great to be reconciled, and it is evidently difficult to compare results and a hopeless task to bring them to a uniform standard. What it behooves us, as Canadian engineers, to do is to take such sensible and immediate action on the subject as will commend itself to the good graces of all of us, if possible, or, if not, of a great majority of those who test the manufactured article.

However, before proposing a mode of conducting such tests as will be of practical utility to practical men, the following table is presented as embodying results which have been obtained during the last two sessions (McGill College) in making ordinary commercial, private and student tests (chiefly commercial and private).

Many results have been discarded as being inaccurate, and only those are recorded here which are believed to be very close to the truth, much closer than is ordinarily obtained.

These results have been classified according to country of manufacture, and somewhat on a scale of increasing tensile strength.

*Condensed from a paper read before the Canadian Society of Civil Engineers.

CONDENSED TABLE OF CEMENT TESTS. 1893-1894.

Designation of Origin.	No. in Table.	Obtained from.	Specific Gravity.	% water for standard consistency	Residue % on Sieves. No. 20	No. 50	No. 80	No. 120	Blowing test result.	Time of setting in air. Incipient	Time of setting in air. Full.	Average Tensile Strength in lbs. per sq. in. Neat Cement. 3 dys.	1 wk.	2 wks.	3 wks.	4 wks.	2 mos	3 mos	4 mos	6 mos	1 year	Average Tensile Strength in lbs. per sq. in. 1 to 1. 1 wk.	2 wks.	4 wks.	2 mos	3 mos	4 mos	6 mos	1½ to 1. 1 month.	2 to 1. 1 wk.	4 wks.	2 mos	3 mos	4 mos	6 mos	3 to 1. 1 wk.	2 wks.	4 wks.	2 mos	3 mos	4 mos	6 mos
Canadian	N 1	Dealer	3·01	33	0	7·2	12·6	18·3	very good	4'00"	7'45"	78	71	....	....	124	226	....	....	....	633	68	....	102	125	162	163	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Canadian	N 2	Maker	2·96	33½	0	2·9	11·1	21·4	good	0'45"	2'45"	99	160	....	....	268	377	448	478	492	648	76	....	115	158	....	....	....	....	132	....	....	....	....	....	....	....	....	....	....	....
Canadian	P 3	Maker	3·12	26½	0	1·1	4·2	31·2	good	5'00"	20'00"	125	210	....	....	355	....	....	....	....	606	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Canadian	P 4	Maker	3·12	26	0	0·8	2·7	6·7	good	0'37"	3'10"	235	388	....	....	626	....	....	....	....	693	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Canadian	P 5	Maker	3·09	25	0	0·6	5·6	13·2	good	1'00"	5'00"	218	399	....	....	459	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Canadian	P 6	Maker	3·12	24	0	0·9	6·4	13·2	good	4'30"	6'00"	438	588	....	....	671	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Canadian	6a Dealer	....	3·01	24	0	3·0	13·6	20·7	very good	2'00"	6'30"	312	531	....	....	611	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Canadian	6b Dealer	....	2·96	24	0	2·3	9·7	40·7	fair	.....	.....	300	307	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Canadian	6c Dealer	....	3·12	23	0	31·4	52·2	61·2	bad	.....	.....	263	264	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	P 7	Dealer	3·09	33	0	10·6	21·6	....	good	....	....	230	....	....	....	331	....	....	....	....	....	134	210	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	P 8	Dealer	3·09	25	0	14·0	28·4	39·6	good	3'20"	6'30"	160	414	....	....	628	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	P 9	Dealer	3·05	26	0	1·4	12·8	22·9	good	13'	2'00"	390	420	....	....	463	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	P 10	Dealer	3·10	23½	0	6·7	19·2	26·6	good	25'	60'	250	306	372	....	652	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	P 11	Dealer	3·08	23	0	4·0	14·2	23·1	good	30'	1'00"	236	477	396	....	604	660	637	627	644	....	232	345	316	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	P 12	Dealer	3·11	24	0	4·2	19·6	28·6	good	25'	3'00"	244	362	....	....	641	....	....	....	....	....	192	....	204	245	253	257	631	....	151	198	189	196	189	271	....	....	....	....	....	....
English	P 13	Dealer	3·13	24½	0	4·6	17·3	26·3	bad	20'	4'00"	335	844	....	....	422	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	P 14	Dealer	3·13	24	0	0·25	5·0	12·9	very good	20'	2'30"	....	387	444	....	496	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	14a Dealer	....	3·12	23	0	6·6	20·9	30·6	bad	27'	3'05"	....	343	350	....	463	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
English	14b Dealer	....	3·05	23	0	6·3	19·7	30·1	some had	20'	2'30"	304	309	....	....	440	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Belgian	N 15	Dealer	2·97	30	0	7·1	16·4	19·4	very good	1'00"	2'30"	154	210	....	....	285	....	....	....	....	....	134	....	195	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Belgian	P 16	Dealer	3·03	26½	0	2·2	12·4	20·6	good	6'00"	12'00"	232	332	....	....	Fld	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Belgian	P 17	Dealer	3·03	26	0	3·1	12·9	20·1	bad	1'10"	6'00"	328	394	....	....	487	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Belgian	P 18	Dealer	3·09	27	0	0·3	2·8	9·4	good	1'20"	4'50"	265	360	....	....	492	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Belgian	P 19	Agent	3·08	25	0	0·9	6·2	16·8	good	2'40"	7'40"	452	636	....	....	625	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	20	....	....	25	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	21	....	....	25	0	4·0	10·8	....	....	....	....	....	....	....	463	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	22	....	....	....	....	....	....	....	....	....	....	....	....	162	....	485	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
	23	....	....	....	....	....	....	....	....	....	....	....	....	345	480	645	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

Let us consider the various qualities given in their tabular order.

(*a*) *Specific Gravity.*

The average of Canadian Portlands = 3·11.

The average of English Portlands = 3·10.

The average of Belgian Portlands = 3·055.

The average of all Portlands (16) = 3·09.

It would seem advisable, therefore, to specify a minimum for Portlands of 3·10.

The samples were not dried or prepared in any way; if they were dried for 15 minutes, according to English practice, it is probable they would go somewhat higher.

It will be noticed that the only two Portlands (?) whose specific gravity was low (Belgians Nos. 16 and 17) were both poor cements; one, No. 16, sets slowly, and the briquettes made for 4 week tests, and immersed in water after 24 hours, were found sloughed down in the tanks, and had evidently run and set over again! They would not give any test to speak of. Evidently the hydraulic property, in 24 hours, was not enough to hold them together, while the other one (No. 17) failed in the blowing test. Altogether, it is doubtful whether these cements are Portland or naturals, although sold as the former, owing to their color being gray.

It will be noticed, with satisfaction, that Canadian Portlands stand at the top in specific gravity, judging by the samples tested, which were, however, all received from manufacturers.

The specific gravity of natural cements might be placed at 2·95, although it is not so likely to be underrun, owing to the ease with which this can be obtained.

(*b*) *Water required for standard consistency.*

This is considered, by many, to be very important; but many tests have demonstrated to the writer that what is especially needed is that there shall be sufficient to make good briquettes; to err, say, 1 per cent. in adding water is fatal, if too little, while if too much, it does not seem to affect the strength of briquettes at one week, certainly not at four weeks. This is contrary to statements often made regarding the increased strength given by a minimum amount of water; but probably what is referred to is an excess of water sufficient to make a thin batter or soup. Undoubtedly such an amount not only makes the briquettes shrink and crack in drying, but will seriously affect the early strength.

A very peculiar effect was met with in two Canadian and one English Portlands. They were evidently fresh, and when mixed with a normal amount of water would work into a good plastic mass, but in about one to two minutes after the water was added, they would suddenly set, so hard that it was useless to attempt to put them in the moulds.

By increasing the per cent. of water to about 30, a thin batter was made, which could be got into the moulds before this action took place; of course this amount of water made the set very slow, and deadened the indurating action in one week tests.

When tests were made, several weeks later, on these cements, this effect had disappeared; perhaps some one connected with this industry can explain the cause of this action.

(*c*) *Residues or Fineness.*

The variation is enormous, as the following statement shows:—

	Residue on No. 50 Sieve. Per cent.	Residue on No. 80 Sieve. Per cent.	Residue on No. 120 Sieve. Per cent.
Coarsest	31·4	52·2	61·2
Finest	0·25	2·7	6·7

The English Portlands are generally very coarse, as will be seen, and the selected Canadian ones fine.

It is not putting it too severely to say that specifying a certain residue on No. 50 Sieve is a direct premium on coarse grinding, and so, in fact, are neat tensile tests.

For instance, English brands, No. 10, No. 11, No. 12, No. 13 and Nos. 14 A, 14 B, are all evidently ground to pass a specification of 5 per cent. residue on No. 50 Sieve, and are all very coarse when sifted on finer ones, thus plainly showing the failure of the specification to obtain as good a product as possible.

The author would urge the severest requirements for fineness.

Various papers read and the statements of manufacturers themselves go to show that the increased cost is very slight, not more than 10c. per bbl. between ordinary and fine grinding.

10 per cent. residue on No. 80 Sieve
20 per cent. residue on No. 120 Sieve } as maximums are not too high for present facilities for fine grinding; this would let in 3 out of 4 Canadian Portlands tested, 1 out of 10 English Portlands tested, 2 out of 4 Belgian Portlands tested, or in all 6 out of 18 brands. There are signs, however, that the English manufacturers are waking up to finer grinding, and will soon fall into line; there is no reason why educating influences should not bring grinding down much finer still for ordinary brands, but for the present, too much severity would defeat the object in view.

(*d*) The time of incipient and final set, as found by Gilmore's needles, does not seem to affect the strength, except for very short tests. When the slow settings are generally stronger, good cements may be either the one or the other; but ordinarily, unless for tidal work, a slow setting one has the desirable feature of allowing masons to mix and use good sized batches of mortar, without constant tempering, which is the practice with quick setting ones, much to their own hurt.

(*e*) The blowing test advised by Faija, has detected a "blowey" tendency in several instances; but much late evidence seem to throw some discredit on blowing tests, whether made with hot or boiling water, on the ground that manufacturers can, by the addition of sulphate of lime, cause the cement to be so slow setting and set so strongly as to resist the blowing tendency of so much as 3 per cent. of free lime added after the cement had been burnt. If this is a fact, chemical analysis will need to be resorted to more frequently, to detect this dangerous adulteration which is fatal in seawater, and bad in any case, as the great strength which it gives to cements at early dates is apt to decrease at longer periods. Belgian No. 19 cement tested gave higher results at 1 week than at 4 weeks; this looks a little suspicious.

Cements have been tested usually neat; the Germans have reached the stage of 3 to 1 mixtures as the deciding test, and this would seem to be the only rational way of testing a cement, *i. e.*, in the same condition as it is used.

The difficulty, however—and it is a very serious one—has been to get anything like uniform results in sand tests. The variation in putting the mortar in the moulds has been so much more than the variation in the cementing value of the cement that the tests were valueless, so that the most testers have clung to neat tests as being simple and a fair index of cementing qualities. That this view is in fault, and misleading,

CONDENSED SUMMARY OF PRESSURE SAND TESTS.

Put in Moulds with 20 % water, 20 lbs. per sq. in.

Brand	Mixture.	1 week tests, 1 air, 6 water.							4 week tests, 1 air, 27 dye. water.							REMARKS.
		lbs. per sq. in.			Weight when tested.	Weight after 2 days evapn.	% of evaporation.	Product, col. 3 x col. 6.	lbs. per sq. in.			Weight when tested.	Weight after 2 days evapn.	% of evaporation.	Product col. 3 x col. 6.	
		Highest.	Lowest.	Average.					Highest.	Lowest.	Average.					
No. 1	1 to 1	75	46	58	5·25	4·55	13·33	773·1	102	80	93	5·32	4·70	11·73	1090·9	Temp. of air, 60° F.
No. 2	1 to 1	157	90	114	5·67	5·13	9·63	1097·8	297	212	264	5·62	5·28	6·12	1616·6	" " 60° F.
No. 15	1 to 1	146	114	135½	5·63	5·17	8·20	1111·1	.....	.....	.....	....	....	.....	.....	" " 61° F.
No. 15	3 to 1	17	8	12½	4·85	4·28	11·75	146·9	28	19	24	4·89	4·36	10·80	259·2	" " 60° F. (1) 69° F. (2)
No. 3	3 to 1	19	8	13	4·74	4·17	12·06	156·8	52	37	47	4·48	3·89	13·20	620·0	" " 63° F.
No. 9	3 to 1	29	25	26½	4·80	4·19	12·78	338·7	143	109	127	4·69	4·26	9·17	1164·5	" " 65° F. (1) 68° F. (2)
No. 10	3 to 1	42	31	35	4·82	4·24	11·96	424·5	84	56	71	4·97	4·42	11·03	783·2	" " 68° F. (1) 59° F. (2)
No. 8	3 to 1	34	26	30½	....	....	.....	.....	85	76	80	4·99	4·41	11·55	924·0	" " 54° F.
No. 5	3 to 1	16	12	14	4·78	4·12	13·70	191·8	58	43	50	5·13	4·36	15·01	750·0	" " 74° F.
No. 4	3 to 1	52	30	39½	4·94	4·37	11·58	457·4	118	83	103	5·02	4·49	10·56	1087·7	" " 61° F.
No. 19	3 to 1	77	58	69½	4·79	4·09	14·61	1015·3	143	101	129	4·88	....	.....	.....	" " 65° F.
No. 6	3 to 1	83	74	78	4·77	3·97	16·84	1313·5	.....	.....	.....	....	....	.....	.....	64° F.
No. 11	3 to 1	25	16	19	4·56	4·13	9·51	180·7	46	37	41½	4·85	4·18	13·90	576·8	" " 48° F.
No. 14	3 to 1	16	8	10½	4·69	....	.....	.....	36	24	30	4·88	4·16	14·76	442·8	" " 53° F.

every tester will admit, and it is only partly avoiding the difficulty to specify a certain fineness, strength and specific gravity in combination, and even then the results are not definite, as each cement is different in value. However, for those who have facilities for testing cement, neat only—and these will probably be in the majority for some time to come—it would seem that 350 lbs. at 1 week neat and 450 lbs. at 4 weeks neat are easily obtained, and quite enough to specify; 11 brands tested would give this much strength and stand the blowing test, and of these there are 6 brands fine enough for 10 per cent. residue on 80 sieve and 20 per cent. residue on 120 sieve, with a specific gravity varying from 308 to 313, while the six brands which are not strong enough are also too coarse.

The tests on natural cements are not extensive enough to form a good basis, but it would seem easy to get 100 lbs. neat at one week and 200 lbs. neat at four weeks, and a fineness the same as for Portlands. The tests on No. 2 natural and No. 1 Portland were carried on for 6 months, and show the natural to be gaining on the Portland, although each has evidently nearly reached a maximum. This would seem to bear out the idea which many people yet have, that in time a natural cement, not being so brittle, will catch up to a Portland. Long time tests are very much needed on this subject. Natural cements being underburnt (usually), have very much less combining power with sand; the 1 to 1 natural is not as strong as 2 to 1 Portland, according to tests made last year, in which the mixtures were made with 15 per cent. of water for 1 to 1, and 12 per cent. of water for 3 to 1 mixtures, the mortars being lightly tamped into the mould with an iron rammer; the tests made this year, however, by means of a uniform pressure, give much higher results for 1 to 1 naturals, when 20 per cent. of water is used, which would seem to be nearer to the amount used in practice, making a soft plastic mortar. (See pressure tests.) Natural cement has many uses. It is being passed aside in many quarters. Why? Because if immersed in water for one week or four weeks, it will give low tensile tests. That terror of the present day, the testing machine, condemns it.

Now there are many occasions where it would not be wise to use anything but the best Portlands—such as laying mortar in extreme frost, or where great immediate strength is required, or for sub-aqueous work generally, but, on the other hand, no one doubts the *durability* of good natural cement. Works in Europe hundreds of years old, and all the work done in the United States and Canada previous to 30 years ago, are built with such mortars, and stand as witnesses of their lasting qualities.

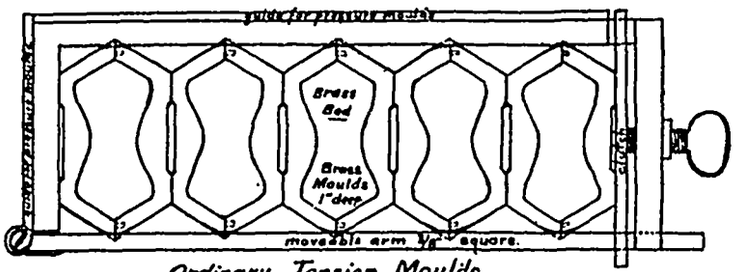
Moreover, tests made on No. 1 natural cement (see frost tests) show that while it cannot be immediately exposed to extreme cold, yet when it is exposed, after it has set, it will resist frost thoroughly, and become stronger than if immersed in water at an ordinary temperature. There are thousands of situations where natural cement mortar, 1 cement 2 sand, will be found amply strong for the purposes required, in which case it will be found cheaper than Portland mortar, 1 cement 3 sand. Referring ahead to the frost tests, it will be seen that if mortars are tested in open air, the Portlands are weaker and naturals stronger than if the briquettes had been under water. This is a point of much importance, because if work is to be done which will not usually be submerged, as in damp foundations, abutments on land, culverts, etc., then tests made in open air will give results more favorable to naturals. In so many words our standard tests say: "Let us test all hydraulic cements under water; whether the mortar as used will be so or not, we will be on the safe side." This, as a generality, is doubtless best; but if we consider what a large proportion of cement is used in situations usually not submerged, it would seem more rational to test cements under conditions similar to those under which they are to be used, in each case, be it in water *or air*.

As before mentioned, all the sand tests given in the table were made by tamping the mortar lightly into the molds with an iron rammer weighing about ½ lb. and ½ inch square—section.

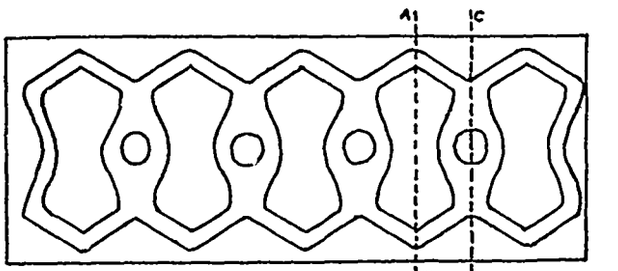
This has been done in as nearly a uniform manner as possible; about three layers were tamped, and then a fourth layer smoothed off with a spatula; every effort was directed toward uniformity in method, and, doubtless, some degree of accuracy was obtained; but it was felt that the best possible would only enable compari-

sons to be made in this laboratory, it would not enable any to be made with results obtained elsewhere.

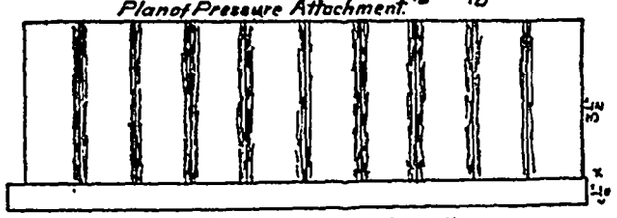
The cement committee of the society (of which the writer was made a member by invitation) advised that tests should be made under pressure of 10 lbs. per sq. inch. It was not defined at the time whether this applied to sand tests only or to neat tests also; but the necessity for pressure is not so great in neat tests, because anyone with ordinary skill and practice can make a good neat briquette, and a light pressure will not affect the result much, as will be shown further on.



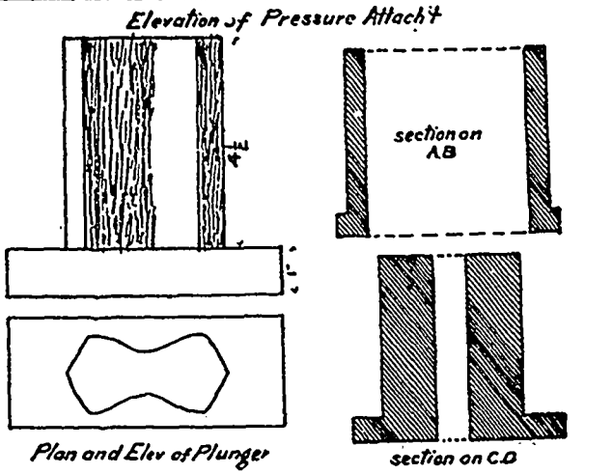
Ordinary Tension Moulds



Plan of Pressure Attachment



Elevation of Pressure Attach't



Plan and Elev of Plunger

In November last the molds above illustrated for applying pressure, which were from a design of the writer, modified by Mr. Withycombe, were completed, and since then several hundred briquettes have been made with them. It would seem a simple matter to mix up mortar, put it under a plunger, and by putting on 10 lbs. per sq. inch, make briquettes; but theory and practice must be fellow-laborers. Now, 12 p. c. of water is considered the correct thing in 3 to 1 mixtures, but with this amount the mortar would not pack at all in a closed mold under so light a dead pressure, and it is light dead pressure that is wanted; even 20 lbs. per sq. inch was of no greater effect; then 15 p.c. of water was tried, with very little better results.

It was finally concluded to try several series with different percentages of water, and thereby determine the best per cent. for making a good briquette.

As a result of these tests, the author thinks that 20 per cent. of water is just sufficient to make a plastic mortar, so that a good briquette can be formed, while more water tends to drown the cement and make it weaker at both the 1 week and 4 week tests, although longer tests would probably show a recovery in this respect.

This 20 per cent. applies to 1 to 1 and 3 to 1 mixtures, and will probably be about right for 2 to 1 also, if it is desired to make such tests. It is conclusive that if any standard test under light pressure is to be adopted for sand tests, 20 per cent. of water must be prescribed as a definite part of the test, and in this way perfect uniformity obtained. It is understood that the sand used is standard sand, dry and sharp; a finer or rounder sand would allow less water to be used. This amount of water, while greater than that usually given by authorities whose method of making sand briquettes is by some severe hammering process (*e.g.* German), is still close to the amount used in practice.

What we want, it seems, is, first of all, a uniform method capable of application in any part of the Dominion; after that we want it to approach as nearly as possible to actual usage, and fortunately the two conditions are in harmony with each other. The pressure adopted was 20 lbs. per sq. inch.

(*Concluded in next issue.*)

SCREW STEAMER AND STEEL TOW-BARGE EFFICIENCY.

BY JOSEPH R. OLDHAM, N.A. AND M.E., CLEVELAND, O.

Speaking of the invention or application of the screw to the propulsion of ships, Mr. John F. Pankhurst says "that the great lakes can boast of floating the first screw steamer ever built for business purposes." This has reference to the "Vandalia," built at Oswego, on Lake Ontario, in 1841.

It would be agreeable writing to give an unqualified support to this statement, but, unhappily for me, I cannot endorse this, as my friend, the Sunderland poet, Mr. William Allan, marine engineer, claims the same honor for his native lakes, for he states that the "Archimedes," built in 1840, was the first screw steamer, and, parenthetically, let me add that the application of twin screws was patented as early as 1832 by Bennett Woodcroft in conjunction with his patent for expanding pitch. But long before this date, viz., in 1804, Col. John Stevens, of Hoboken, built a boat and fitted her with four-blade screw propeller. Moreover, the same great inventor introduced twin screws in 1805. Several other engineers proposed, and some of them tried, screw propulsion, but it was not brought into general use until John Ericson, a Swedish engineer residing in England, and E. P. Smith, an English farmer, perfected and pushed its introduction in Great Britain, and in America in 1836-7. However, as we are dealing with men whose inventions, improvements and labors in the arena of marine engineering have tended to such rapid advancement of marine transportation and commercial intercourse, it would be futile to attempt to apportion the exact degree of origin validly due to their inventions; therefore, let me again quote and say of the construction of these early screw steamers: "A mighty

leap was this, no transient stride—a great conception of still greater brain."

One feature of this controversy is clear, and that is that about the year A.D. 1840 was the great epoch in marine engineering.

A suitable screw for a large steamer would not be well adapted for a steamer engaged in the North Atlantic trade. An efficient propeller for smooth water is seldom efficient with a head wind and rough sea, at which time, in many cases, the water appears to be screwed through the propeller instead of the hull being propelled through the water. In the early days of screw propulsion it frequently happened that a side wheeler of inferior speed in smooth water would pass ahead of the same screw steamer when a heavy head sea was encountered, but when a screw steamer has a suitable propeller her towing power, as well as her speed, is greatly in excess of a similar side wheeler. As an illustration: The screw steamer "Rattler" and the side wheeler "Alecto" were of the same proportions, displacement and power. These steamers were secured stern to stern, and the "Alecto" obtaining the start, acquired a speed of two knots with the "Rattler" in tow, but in five minutes the "Rattler's" stem way was arrested, after which she towed the "Alecto" stern foremost against the whole force of her engines at the rate of 2.8 knots per hour.

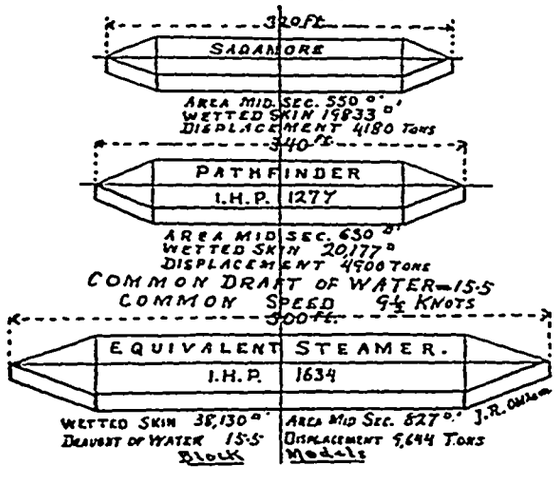
This test of ship propellers hardly coincides with Sir Nathaniel Barnaby's statement, that the side wheel as a propelling instrument is not inferior to the screw, but it must be pointed out that the side wheel steamer's engines soon ceased to indicate much more than half their normal power, whilst the screw engines, as may frequently be observed, when steaming directly head-on to a gale of wind, continued to exert almost their maximum power.

TOW-BARGE EFFICIENCY.

Of course, towing large wooden schooner consorts is by no means new on these lakes, but towing regular steel tow-barges is certainly comparatively new and may merit careful investigation even by those connected with salt water transportation.

The steel whaleback screw steamer "Pathfinder" is 340 feet long, 42 broad, and 25 feet deep; she is fitted with triple expansion engines; the dimensions of cylinders are 23 feet + 37 feet + 37 feet + 62 feet, and length of stroke 3½ feet. Steam is supplied by three Scotch boilers, each 11½ feet diameter and 13 feet long, with two furnaces of 44 inches diameter in each boiler, working pressure 160 pounds. The indicated horse-power, when steaming on an average slightly over 10 miles per hour, through tortuous rivers and other shallow waters, with her consort the "Sagamore" in tow, is 1,277, while the consumption of fuel per voyage of 1,696 miles is 257 net tons. If this consumption of fuel does not appear low, I may say that the coal was used to propel the hulls and not merely to show surprising results in comparison with the I.H.P. She has a crew of twenty-one, all told, and the total cost of working is a little over $250 per day.

Her consort, the steel barge "Sagamore," is 320 feet × 38 × 24; she has a crew of eight men, all told, and is connected to the "Pathfinder" by a 12-inch manilla tow-rope 170 fathoms in length; the combined cargo of these two vessels at 15½ feet mean draft is 6,000 gross tons. These connected hulls are now through their second season's work, and I may say that they have worked at least quite as efficiently and as safely as the average lake steamer without a tow to take care of. If it were required to transport an equal freight on the same draft of water and at the same rate of speed in a single hull, such a steamer would require to be 500 feet long, 56 feet broad, and, say, 29 feet deep. She would require engines capable of exerting, in ordinary working, 1,634 I.H.P. to attain an average speed, as above, of 10 miles per hour; her consumption of fuel would be about 340 tons for the voyage of 1,700 miles, and this would add $30 per day as the extra expense for coal; to this add $40 for extra oil, storage, insurance, etc., and it makes the cost of working the big steamer about 28 per cent. more than the other two. There is the cost of two ropes (she uses two every season), and perhaps a little extra harbor towage in connection with the tow barge to be debited to the two vessels, which may slightly lessen the economic gain of 28 per cent., but, after allowing this, I think there is a sufficient margin of profit left to the advantage of towing to make it still more popular in the future. I will endeavor to demonstrate this by figures. It appears that freight may be transported by a steamer and tow barge combined with 28 per cent. less horse-power than is required to carry the same dead-weight, say, 6,000 tons, in one large, light-draft steamer, at the same average speed. The displacement, however, of the large steamer capable of carrying the same dead-weight of cargo would be about 6 per cent. more than the "Pathfinder" and "Sagamore" combined, whilst her wetted skin would be about 5 per cent. less.



To make this clear, we must ascertain the I.H.P. necessary to drive such a ship at a speed of 9½ knots, which is the minimum required for an average of 10 miles per hour over shallow and deep waters. To drive this steamer 10 knots, 5 I.H.P. per 100 feet of wetted skin, measured by a block model as devised by Mr. Kirke, is required. By this system of mensuration the steamer 500 × 56 × 15½ draft has a wetted surface of 38,130 square feet. In such vessels, for slight variations of speed, it will be accurate to assume that the horse-power will vary as the cube of the speed.

The rate per 100 feet of wetted skin $= \frac{9\frac{1}{2}^3}{10^3} \times 5 = 4.287$.

Then I.H.P. required $= 4.287 \times 38130 = 1635$.

Compare this with the old formula based on the augmented surface, thus:

$$\text{I.H.P.} \quad \frac{38{,}130 \cdot 9\frac{1}{2}^3}{20{,}000} = 1634.$$

$$\text{or Speed} = \frac{1634 \times 20{,}000}{38{,}130} = 857.$$

Then the cube root of 857 = 9½, which is the speed required.

The divisor in this rule (20,000) expresses the number of square feet of augmented surface which can be driven at one knot per indicated horse-power; it may be called the co-efficient of propulsion.

The "Pathfinder" steams with her consort, the tow barge "Sagamore," at the rate of 9½ knots with 1,277 I. H. P. As the "Pathfinder" requires, at least, 864 horse-power to keep her 4,900 tons of displacement moving with an average speed of 9½ knots, it leaves only 413 horse-power to be applied to the "Sagamore's" tow-rope to pull her 4,180 tons displacement, at the rate of 9½ knots per hour.

This is not more than 53 per cent. of the I.H.P. required to propel a *screw* steamer of the same size at the same rate of speed.

The "Pathfinder" attains a speed of 12½ miles per hour when fully loaded, but *without* a "*tow*," so that the economy resulting from the connection of these two hulls is represented by a cargo of three thousand tons dead-weight transported at the rate of ten miles per hour, involving a reduction in speed, for the "Pathfinder," of not more than 2½ miles per hour.

Such extraordinary efficiency, as shown by this investigation, I cannot satisfactorily account for. The explanation that occurs to my mind is, that the horse-power necessary to propel a screw steamer at a reduced velocity when she is retarded by a tow rope pull instead of by her own inertia and skin friction, lessens in a greater ratio than the cube of the speed. If this be so, less power than is shown above would be absorbed by the "Pathfinder," and, as a consequence, more than 413 horse-power would remain to be utilized by the tow barge.

The originator of these peculiar vessels might say this is perfectly clear and just as it ought to be, and I, for one, am ready to admit that the whalebacks are the most perfect type of large tow-barges ever designed, as the cutting away of the fore-foot reduces skin friction and permits of easy turning in our shallow waters; in addition, they have the minimum of top hamper with the maximum of hold space. This all tends towards the production of an ideal freight tow-barge; but, nevertheless, such a result is surprising.

As regards the steamer, however, her functions are very different, and it appears to me that her general efficiency would be increased by modifying the ideal type of tow-barge bow and resorting to the common fore-foot, as it does not appear how a light or a lightly loaded steamer can keep her head up to a gale of wind with no dead wood forward, and having such a remote hold upon the water forward. The conditions surrounding the operations of the common freight carrier and the regular fine lined, high speed passenger steamer, are more diverse than some constructors appear to realize.

If the fore-foot and lower part of the fore-body, which does not displace its own weight of water, were removed from some of our sharp passenger steamers (which are loaded to a comparatively deep and almost invariable draft of water, and which consequently have a redundance of lateral resistance), and be added to the cargo steamers that have no dead-wood forward, I think that both types of marine architecture would be thereby improved.

As the time may not be far distant when the fresh water seas and salt water oceans will, in a commercial sense, seem but to join the great cities they divide, and that largely by means of tow barges, it appeared to me that the subject merited consideration, hence my reason for going somewhat fully into this subject.

In this comparison between the thrust of the screw propeller, as indicated by the horse-power and the tension on a tow-rope, I cannot, without the assistance of a dynamometer, quote figures showing accurately how much the thrust of the "Pathfinder's" propeller was, nor can I say, except by deduction, what the pull on the tow rope amounted to, but you may rely upon it that in ordinary working there is but 1,277 I.H.P., which propels these connected hulls of 9,000 tons displacement at the rate of 9½ knots per hour in deep water.

Now, it will not be difficult to ascertain the proportion of the above horse-power which the "Pathfinder" will confiscate to her own service.

$$\text{By wetted skin formula I. H. P.} = \frac{20177 \times 4.287}{100} = 865$$

By the co-efficient of propulsion theory

$$\text{I.H.P.} = \frac{857 \times 20{,}177}{20{,}000} = 864$$

By displacement formula

$$\text{I.H.P.} = \frac{D^{\frac{2}{3}} \times S^3}{C} \text{ or } \frac{289 \times 857}{286} = 886$$

This appears to be convincing that, provided there is nothing phenomenal about the "Pathfinder's" hull, she will require not less than 864 indicated horse-power to drive her 9½ knots per hour, then 1,277 − 864 = 413, as the number of I.H.P. available to pull the "Sagamore" 9½ knots.

Let us now see briefly by the above formula the minimum h.p. required by a steamer of the same model and displacement as the "Sagamore" to attain a like speed.

$$\text{1st Rule, I.H.P.} = \frac{19{,}833}{100} \times 4.287 = 850.24$$

$$\text{2nd Rule, I.H.P.} = \frac{857 \times 19{,}833}{20{,}000} = 849.84$$

$$\text{3rd Rule, I.H.P.} = \frac{*260 \times 857}{†286} = 779\ 09$$

$$\text{then } \frac{413}{850.24} = 47.4 \text{ per cent.}$$

$$\text{and } \frac{413}{849.84} = 48.6 \quad \text{“}$$

$$\text{and } \frac{413}{779.09} = 53.0 \quad \text{“}$$

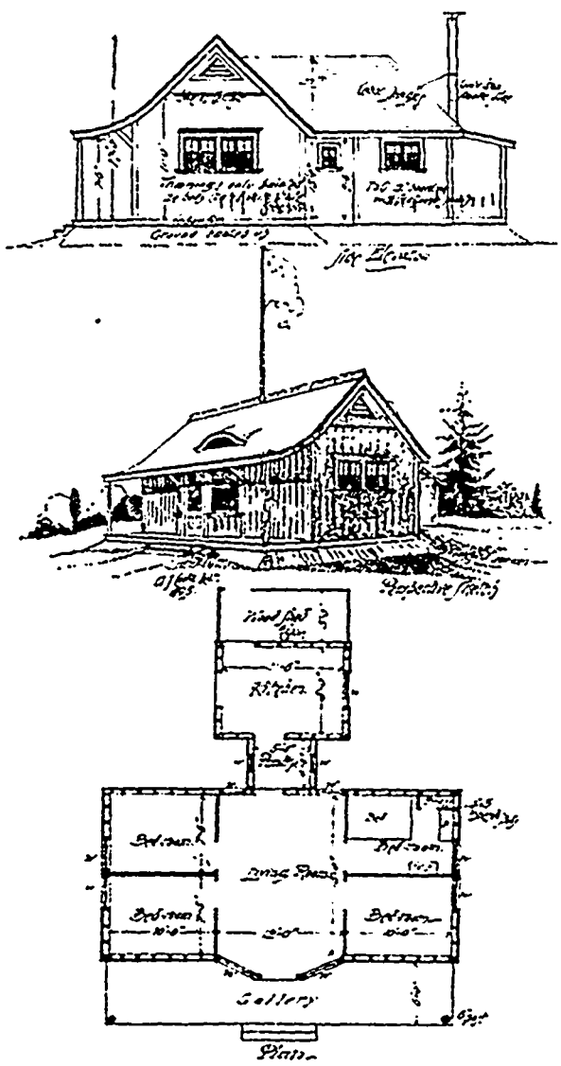
From this it is clear that the barge "Sagamore" attains an equal speed by means of the tow rope pull, without absorbing more than 53 per cent. of the I.H.P. which would be required were she an efficient screw steamer. Further, it would seem that, assuming the "Pathfinder" and "Sagamore" to be but ordinary vessels as regards efficiency for speed, there must be a general economic gain, by virtue of the tow rope, of not less than 28 per centum.

*$D^{\frac{2}{3}} = 260$. †$C = 286$, a constant.

We learn from the Quebec *Mercury* that a movement is on foot to increase the salary of Charles Baillairgé, city engineer. We sincerely hope this will be done. Mr. Baillairgé, whom our readers will know as the writer of several able articles in this paper, is not only an exceptionally able engineer, but a man of great energy and versatile talent, as well as an officer of strict integrity. If the city government of Quebec increase his salary, they will do honor to themselves as well as to the most efficient officer in their service.

A CHEAP SUMMER COTTAGE.

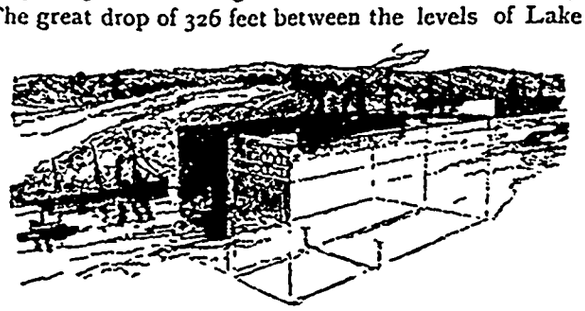
With the advent of spring the problem of selecting a suitable rural retreat for the hot summer months again presses attention on the heads of families, the best medical authorities having laid it down as an axiom that a thorough change in the system of living from the city to the country is the best restorative and recuperative agency we possess.



Considering the many convenient health-giving resorts, it is an easy matter to choose a desirable location; the next consideration should be a radical change in the style of habitation. The cares and anxieties incidental to ruling a city house or flat, with its stereotyped conditions, can find no better antidote than a few months free and easy life in a one-storey cottage or bungalow, with its attendant rustic and restful characteristics. Unfortunately there are very few cottages possessing these advantages to let at a moderate rental, the charges asked for a season, $100 or more, being far too exorbitant for the average pocket. The design illustrated is intended as a suggestion to our readers of a very cheap, convenient and semi-portable cottage, the arrangement of plan for those purposes being all that is practicable for the small sum of money it would cost, viz., between three and four hundred dollars. The site should be on rising ground, naturally drained to prevent heaving by frost. Large flat boulders or field stones are then placed at salient bearing points to carry a flatted cedar or tamarac sill; 11 x 3-spruce 16 ft. plank lengths at 2 ft. centres, diagonally braced, form floor joists, the floor being laid with 1 in. tongue and grooved flooring, gallery floor 1¼ tongue and grooved on flatted cedars. A balloon frame of 4 in. x 3 in. dressed studding is then erected on sill, well spiked to same and strengthened with braces, intermediate and top sills. Over this, on the outside, ⅞ tongue and grooved sheating is laid horizontally, and 7 oz. tarred paper next the weathering, covering of wide tongue and grooved boards placed vertically, with a 2 in. x ½ in. strip over joints, thus forming a weather-tight siding, with the advantage of the dressed studding giving a pleasing appearance in the house. The roof is formed of rafters of 5½ in. x 3 in. (dressed) 1¼ in. roofing boards, tarred paper and cedar or pine shingles, with wavy ridge piece, and projects over gallery supported by brackets and two 6 in. posts. The partitions between bedrooms and living room are of 1¼ tongue and grooved pine, with strip over joints. Doors, 1¾ in. four panel; windows, 1½ in. casements. Ceiling joists at collar of roof floored with 1 in. tongue and grooved pine, with trap hatch for access, forms a receptacle for storage of furniture between seasons. Other explanatory notes and sizes are given on the drawings, which have been prepared by Arthur J. Cook, architect, of Fraser Building, Montreal, and are offered as ideas to those desirous of building cheaply under the usual conditions met with in country districts.

PROPOSED CANAL FROM THE ST. LAWRENCE TO THE HUDSON.

Reference has been made to the proposed canal connecting the waters of the St. Lawrence with the Hudson River. A company with a proposed capital of $150,000,000 seek incorporation to build a ship canal from Lake St. Francis, *via* Lake Champlain, to a point on the Hudson near Albany, and it involves the deepening of the St. Lawrence canal system with the construction of a new Welland canal. The scheme would give New York direct access to Lake Superior and the heart of the continent, and would make sea ports of such cities as Toronto, Cleveland, Chicago and all the other cities on the Canadian-American lakes. The great importance, not only to the internal trade of the continent, but to the trade of the world, of giving direct access to the great lakes for ocean vessels, has been realized for a long time; but the enormous cost of deepening the existing canals has stood in the way. The great drop of 326 feet between the levels of Lake



Erie and Lake Ontario is of itself an enormous obsatcle to any economical solution of the problem. But according to reports from New York, it has remained for Chauncey N. Dutton, an American engineer, to solve the problem by the invention of a new pneumatic balance lock, operated by compressed air and built of steel. "It will be possible to build these locks at least four times as high as the greatest lock now in existence. The latter is the single lock on the Manchester ship canal, forty-five feet high. Two locks, each 160 feet high, will replace the twenty-four locks now required along the Welland canal. Instead of the thirty-five or forty

locks now required between Lake Erie and the sea, this new canal system looks forward to but five." The promoters claim that with the new lock, an outline sketch of which is here given, they can get over difficulties that would require an outlay of $175,000,000 on the present system of locking. The inventor, describing his lock, says:

The peculiar utility of compressed air, as applied to lift ships in dry docks and locks, consists in that it gives an elastic support directly beneath the load, and consequently the structure is very simple and cheap, it makes the pressure independent of the height through which the lift operates, so that the pressures and strains are no greater in a lift of one hundred and sixty feet than in one of sixteen feet, and it flows with twenty-eight times the velocity of water, and thus makes it possible to operate high lifts in about the same time as low lifts.

The pneumatic lift has been developed until it is pronounced by the most eminent and experienced expert engineers to be scientifically and mechanically perfect. It is primarily a steel caisson, of tank structure, working up and down in a water well or pit formed in the lower level of the canal. Compressed air is the motive agent. In all the proposed works the pits will be sunk in rock. The tanks, or caissons, will be balanced in pairs, each caisson having an upper gated lock chamber adapted to retain the vessel to be locked and water to the stated depth (say twenty-seven feet), and a lower open bottom air chamber, containing compressed air, which is retained by a water seal formed by the immersion of the lower walls of the air chamber in the water of the pit, as in gas holders.

The compressed air is at such a pressure that its lifting effort is very much greater than the downward effort of the loaded lock, and therefore, when a lock is down, there is always an elastic cushion beneath its floor; and when it is elevated to its highest position the compressed air tends to expand and raise the lock still higher; and should any accident occur the lock cannot possibly fall, but will on the contrary rise and remain supported, with perfect safety to itself and contents, until the damage is repaired.

To stop and hold the locks at the proper height, to keep them level and to operate them with certainty, facility and security, they are equipped with a hydraulic auxiliary apparatus which levels, actuates and controls them during manipulation, and absorbs the unequal forces due to wind and wave action.

The air chamber in one lock is connected with its fellow by an air conduit controlled by a valve. In these locks the air conduits will be 21 feet in diameter; and the valve is so designed that it has no friction or wearing parts, and it can be opened or closed in one minute without shock.

The air charge is kept at a uniform working pressure above the atmosphere by a small weighted equalizing tank, which automatically takes care of the changes in the volume due to changes in the temperature and density of the adjacent atmosphere. The working pressure in a lock 26 to 28 feet draught is 14¼ pounds to the square inch.

The type of gate proposed to be used is a modification of the familiar pontoon gate used in dry docks. It is built of steel, very simple in construction, and is operated by a pinion and wheel, as draw-bridges are operated. All the gates are duplicates, and while so simple and strong as to be practically safe from damage, an injured gate can be removed and replaced in a very few minutes.

The principle on which the locks operate is the familiar one of weighing in a scale, the locks representing the scale pans and the compressed air replacing the scale beam. The motion is due to a small difference in the total weights of the water in the two locks, just as the motion of a scale is caused by a smaller difference between the weight and the object weighed. The locks move oppositely and synchronously, like scale pans, one ascending while the other is descending. The depressed lock contains the normal depth (26 feet) of water, and floats like a pontoon, its air connection being closed and its hydraulic system by-passed, to that end.

The elevated lock is firmly thrust and held up against its stops by the compressed air, and is connected with the equalizing tank to keep the air pressure constant. It contains a surcharge of water—that is to say, the water in it is 27½ feet deep, 1½ feet deeper than in the depressed lock, and it is correspondingly heavier. If, now, the lock gates be closed to retain the water in the locks during the transit, and if the operating valves be manipulated, the heavier, elevated lock will descend, and in descending will force the compressed air into the air chamber of the depressed lock and elevate it, reversing their relative positions.

Commenting on the effects of this canal on Canadian trade, C. R. Chisholm, of Montreal, writes THE CANADIAN ENGINEER as follows: "The building of this canal would enable the farmer in Manitoba to secure from 3 to 4 cents more per bushel for his wheat, which means on the working of 160-acres sown in wheat, with a yield of 30 bushels to the acre, a gain to each farmer of $144 per year. Take one commodity as return cargo, Manitoba will probably use 160,000 tons of coal per year.

They pay say $9 per ton, or per year		$1,440,000 00
Coal cost to mine, per ton.....	$1 25	
Freight by water, including commissions....	3 75	
	$5 00	
One hundred and sixty thousand tons at $5		800,000 00
		$640,000 00
Add the saving on wheat crop		450,000 00
		$1,090,000 00

"This benefit would apply to Ontario, Quebec, Nova Scotia and New Brunswick, as they would all benefit by cheap freight rates by water.

"The freight movement in 1889 on all the lakes was estimated by the U. S. census report at 53,424,432 tons. The tonnage put afloat since then has increased this movement to 63,240,514 tons. Estimates only can be given, because at one point only on the lakes, Sault Ste. Marie, is there an official record made of tonnage movement. The movement through the Detroit River alone, in 1889, was estimated at 36,203,586 tons. The total entries and clearances, foreign and coastwise, for the port of London, England, that year (1889), were 19,245,417 tons; of Liverpool, 14,175,000 tons. The estimate of tonnage movement through the Detroit River, in 1889, was 3,000,000 tons above the combined foreign and coastwise tonnage of the ports of London and Liverpool.

"The rapid growth, too, of steam transportation, and the competition of lake lines with the railways, have caused continued reductions in the cost of transportation. The cost per ton per mile of carrying freight, an average distance of eight hundred miles, was one and one half mill in 1889. The value of all the cargoes—27,500,000 tons—carried on the lakes during that year was over $315,000,000.

"Had this been carried at railway rates, the cost to the public would have been over $143,000,000; by the lake rates it was about $23,000,000 only; so that transportation on the lakes saved to the public about $120,000,000 in one year. But as to a large portion of this tonnage, any possible cost on wheels would not have permitted it to move at all. In such a case, its production at the point of origin would, of course, have been impossible.

"The U. S. Census Bureau estimates the ton mileage for the season 1889 by the lakes to be 15,518,360,000 tons miles. The aggregate ton mileage of railways for the year ending June 30, 1889, was 68,727,223,146, which shows the ton mileage of the lakes is nearly one-fourth of the total ton mileage of the railways in the United States. In no other way could the relative importance of lake commerce be more effectively shown."

With reference to this question, we hope to give at an early date some facts and estimates concerning a distinctively Canadian route for a deep canal connecting the upper lakes with the seaboard.

BRITISH METAL TRADE WITH CANADA.

The following are the values in sterling money of the shipments of leading lines of metal from Great Britain to Canada for March and the first quarter of this and last year :—

	Month of Mar.,		Three mos. end'g Mar.,	
	1894	1895.	1894	1895.
Pig iron	£274	£1,034	£2,366	£1,243
Bar, etc	1,276	537	4,333	2,828
Railroad	1,520	900	8,537	900
Hoops, sheets, etc	636	1,659	4,986	4,524
Galvanized sheets	1,797	2,977	6,007	5,849
Tin plates	8,454	7,245	38,781	23,191
Cast, wrought, etc., iron	4,254	3,458	12,741	6,936
Old (for re-manufacture)	282	.....	1,380	.....
Steel	3,886	3,200	17,204	8,850
Lead	255	1,738	588	2,609
Tin, unwrought	1,628	1,708	4,495	5,468
Cement	1,684	630	2,922	660

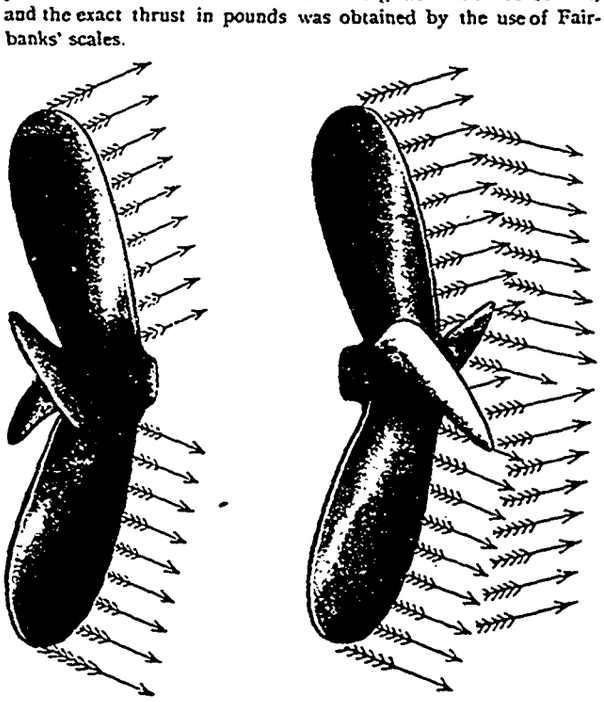
Our "Literary Notes," notices of new catalogues and other matter are unavoidably crowded out of this issue.

We learn that the Taylor Hydraulic Air Compressing Co., Ltd., of Montreal, whose system was fully described in our April number, have secured a contract for the installation of a large compressor from the Dominion Cotton Mills Co., of Montreal. This plant will be put in at Magog, to furnish compressed air to take the place of steam now used in the printing mills. As this plant will be the first of its kind on a commercial scale, its successful operation will be looked forward to with interest, not only by the whole scientific world, but by all those who have water powers, at present useless from low heads and in inaccessible places.

W. C. McDonald, the well-known tobacco manufacturer, of Montreal, whose donation of over $800,000 to equip the engineering department of McGill College, is on record as the greatest benefaction to a public institution ever given in Canada, suffered a severe loss last month in the partial destruction of his tobacco factory. When it was first known that the upper windows, instead of being provided with iron fire escapes, were all closed with wire guards, it was thought that Mr. McDonald had neglected to make proper provisions for the lives of his employees, but it transpired that while fire escapes are compulsory under the Quebec Factory Act, the closing of windows by wire nettings is also a provision of the Dominion Government for bonded warehouses, the upper part of this factory being so used. A score of employees were more or less injured in this fire, which caused a loss of about $400,000, and four employees have since died from their injuries. The accident and loss of life appear to have been almost wholly the result of panic among the employees, for a specially protected staircase was built by Mr. McDonald as an exit in case of fire, and this with the elevators and staircase in the rear, was sufficient to have allowed the escape of all the employees. As Mr. McDonald carried his own insurance, his personal interests, no less than his well-known philanthropic disposition, is a guarantee that there was no conscious neglect on his part. Nevertheless this calamity shows the advantage of having fire drills in all large factories. Several cases have occurred in Canada within the last six months, where well drilled fire brigades, belonging to the factories, have saved buildings through being taught just what to do when the fire breaks out, and through having appliances at hand. Yet it is one thing to have fire extinguishing appliance in the factory, and another to be practically experienced in using them. Mr. McDonald, who had just added another benefaction to McGill in donating land worth $50,000 for the new observatory for the college, will have the sympathy not only of his employees, but of a great many beyond the range of his personal acquaintance. In the re building of his factory as many of his own unemployed hands will be taken on as possible.

THE CASE PROPELLER.

The brains and genius which have in modern times been devoted to problems of steam navigation seem to have been devoted to the theories and practice relating to engines and hull construction. Comparatively little has been done to ascertain whether or not perfection has been reached in the design of the propelling instrument itself. We give herewith illustrations of a new screw designed by A. Wells Case, of Highland Park, Conn., who is about to introduce his propeller into Canadian waters. Mr. Case has made some original experiments, which appear to be carried out in a way best adapted to obtain in a simple way the highest results obtainable in testing the power of a propeller; and he tells us how he did it. A water tank of suitable size was constructed with shaft running through it. Two wheels of ten inches diameter, four blades each, had been made for the purpose, one right and one left hand, the blades being flat and the same on both sides, one with blades inclining a little forward, and the other the same rearward. Both wheels were placed on the shaft at a proper distance from each other. The tank was then filled, the wheels standing fully sixteen inches under water. The shaft was arranged so that it could move back and forth endwise. Mr. Case had expected when the power was applied to see the wheel with the blades inclining to the rear draw the other back, but to his surprise this wheel was drawn back and evidently was not doing good work. While the result was a disappointment, it was also interesting, and the inventor determined to weigh the difference between theory and practice. The method used in ascertaining the result was correct, and the exact thrust in pounds was obtained by the use of Fairbanks' scales.



OUTWARD THRUST. COMPOUND THRUST.

The scales were arranged at the end of the shafe, to weigh the difference in the work each wheel was doing. When running to four hundred revolutions, the difference in thrust, as weighed off on scales, was a little over nine and one-half pounds in favor of the outward thrust wheel. He decided to pursue this line of experiment a little further, by making two other wheels of eleven inches diameter and four blades each, with a total blade surface of 48¾ square inches. One wheel was made with flat blades straight out from the hub, the other with flat blades of same shape pitch and proportion as the first, except that the blades incline forward from the hub to end of the blade, in order to produce an outward thrust. This wheel was tested in the tank previously referred to, with the following result: At a speed of 440

revolutions the actual thrust produced by this wheel was 67½ pounds, as weighed off on Fairbanks' scales. When this wheel was reversed on the shaft so as to produce an inward or conical thrust, the conditions being exactly the same as before, the result in thrust was 56½ pounds, a loss of eleven pounds, or a gain of the outward thrust of over 19 per cent. The wheel with blades straight out from the hub was then put on to the shaft and tested under the same conditions as at the previous trials, with the following result: Thrust, 59½ pounds, or a gain of three pounds over the inward thrust principle, and a loss of eight pounds as compared with the outward thrust.

It would appear from these tests that inclining the blades rearwardly is bad practice in comparison with a blade straight out from the shaft, but especially in comparison with a blade inclined forward.

In proof of his theories, Mr. Case has replaced propellers in some of the fast American steam yachts with screws of his design, and invariably increased their speed, to the surprise and satisfaction of their owners. The statements of these yacht owners and engineers are given in an illustrated pamphlet just issued by Mr. Case, whose address is given above.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The society held its usual meeting in Montreal, on the 11th April, President Thomas Monro in the chair. Minutes of last meeting were read and adopted. An application was read by the secretary from a new member, Arthur Crompton, from Hamilton, Ont.

Professor Bovey entered into an explanation, illustrated by blackboard sketches, regarding the Canadian Douglas Fir, the subject of a previous paper by himself. Calculations went to prove that the true theory for calculating skin stress is unknown, the present method being only approximate. The professor explained his action in neglecting to calculate the percentage of moisture in timber. The whole timber would have to be kiln dried to obtain an absolutely correct statement. This process would be too expensive in view of their means. Even were this process carried out, the result would be a correct showing of the percentage of moisture at a certain portion only, as it varies throughout the whole beam It is doubtful if any means can be devised by which a correct statement may be obtained.

One of the members wished to know whether the absorbing propensities of timber were increased after the timber had been once wet and dried.

The society were informed that experiments were being carried on for the solution of this point.

Here the important matter of funds came up, and received a somewhat lengthy discussion. It was remarked that much of the success of experiments in the past was due to the support of Mr. Peterson, of the C.P.R., which support is still being given. Some mention was made as to a grant for testing Canadian structural mineral being requested by the society from the Government.

Prof. Bovey spoke of the large American institutions, and the great advantages which they possessed from having so much more money at their disposal. He wants a man to record tests and make calculations at a salary of about $75 a month, for about 8 months in the year.

Considerable discussion ensued regarding the material subject of finances, and it was suggested that the society, through different members of Parliament, should bring the matter up before the Government. No definite plan of action, however, was taken.

On motion of Prof. Bovey, it was decided that the names of three engineers should be added to the Cement Committee.

Mr. Smith sought an explanation regarding the position, etc., of the neutral axis.

Prof. Bovey considers this an unknown quantity, as yet, which cannot be explained. In glass beams there have been found two neutral axes.

The chairman trusted that Mr. Smith would, before long, be in a position to place the solution of the matter before the society.

An ordinary meeting of the Canadian Society of Civil Engineers was held on April 25th, Past-President John Kennedy in the chair.

The minutes of the previous meeting were read and adopted. An application for admission to the society was received from Alex. C. McCallum, Peterborough, Ont.

Notice of donation made by Reginald Boulton to the society was read. This was a work on "Motive Power."

A paper by Willis Chipman, M. Can. Soc. C.E., on "The Barrie Flood of 1890," was read. A vote of thanks was moved by the secretary, to be tendered Mr. Chipman.

Some little discussion arose on Mr. Thompson's paper, "A Micrometer Attachment." Mr. Irwin ignored the possibility of reading to one-seventh of an inch at 3,000 ft. with a 6-inch transit, as spoken of in paper. Prof. McLeod was of the opinion that Mr. Thompson had been led by theoretical calculations to forego practical results. The professor contended that no result should be given of which one is not absolutely certain. For instance, in reading a compass, it is better to read a fraction of a degree than in seconds. The experience of engineers seemed to point visibly to the adoption of an average or fairly accurate result, and eschewing the misleading process of "hair splitting" in calculations, the latter method very frequently leading to gross errors.

A vote of thanks was carried, to be tendered Mr. Baillairgé for his note and explanation on the "Ball Jet Fire Nozzle" question.

A letter was read from Alan McDougall, secretary of Canadian Institute, of Toronto, giving the report of committee appointed by Canadian Institute in connection with the geodetic survey.

The meeting then adjourned.

ROSARIO DROUIN, the energetic president of the Société Mutuelle d' Ingenieurs Mécaniques de la Province de Quebec, was born in Quebec in 1863, and followed a commercial course of studies until fifteen years of age. In 1878 he was employed by John Brown, ropemaker, of Quebec, in his repair shops. From 1882 to 1887 he served as assistant engineer and fireman in the Gulf, on the following steamers: "Conqueror," "Miramichi," and "Otter." In 1888 was employed in John McDougall's, of Montreal, boiler maker and machinist. On the 11th of October, 1889, Mr. Drouin obtained a situation as engineer in the Montreal fire brigade, which position he still occupies. To his popularity is chiefly due whatever success the Mutual Society of Mechanical Engineers of Montreal has attained to at the present time.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ANNUAL DINNER OF HAMILTON BRANCH.

Our annual dinner was held on Good Friday Eve, April 11th, in Commercial Hotel, and was in every respect a success. About seventy, engineers and friends, were present, and everybody appeared to enjoy themselves very much. Mr. Moxey, proprietor of the Commercial Hotel, did credit to himself in the good spread he made and the marked attention he paid to those present.

After all had done justice to the inner man, President Joseph Langdon called all to order, and in his usual good-natured style welcomed those present to the eighth annual dinner of Hamilton No. 2, C.A.S.E., after which he commenced the toast list by asking all to drink the health of the Queen, which was done in right good spirit.

Professor Cline sang a song, "Twelve months ago to-night."

The next toast was to the Governor-General, then the Dominion and Local Legislatures, responded to by Alex. McKay, M.P., of Hamilton.

Song—By Ernest Martin.

Toast—"Our Army and Navy."

Song—"Rule Britannia," by Prof. Cline.

Trio—Messrs. Moxey, Cline and Melard.

Toast—"The Mayor and Corporation," responded to by Ald. McKenne.

Song—By Mr. Thomas.

Toast—"The Executive Head," responded to by Bros. A. E. Edkins, A. M. Wickens and W. G. Blackgrove, all of Toronto No. 1.

Duet—By Prof. Cline and La Roy Melard.

The toast list was then handed over to the vice-chairman, Bro. Wm. Norris, and the following toasts were responded to:

Toast—"Our Manufacturers," responded to by Mr. Watson, of Kingston, for the oil companies; Bro. Clappirson, of Hamilton Engine Packing Co.; Bro. Brice, of Brice Electric Works, Hamilton; and Mr. Holden, of Hamilton.

Songs—By E. Martin and M. Thomas.

Toast—"Our Sister Associations," responded to by Bro. Phillips and Bro. Huggett, of Toronto.

Song—"Larboard Watch," Prof Cline and La Roy Melard, after which Bro. A. E. Edkins sang "The Maple Leaf."

Toast—"The Press."

Responded to by Mr. Martin, of Toronto *Globe*, and Mr. R. J. Robb, of Hamilton *Spectator*.

Song—Mr. E. Martin.

Toast—"Learned Professions."

Responded to by Bro. Pettigrew, of Hamilton Board of Education.

Bro. A. E. Edkins, of Toronto, then proposed a toast to Hamilton No. 1, which was responded to by Bro. Joseph Langdon, president, and Bro. William Norris, corresponding secretary.

Toast—"The Ladies."

Responded to by Bro. D. Robertson and Bro. Peter Stott, of Hamilton No. 2.

Toast—"Our Host and Hostess."

Responded to by H. Moxey.

During the evening the following letters of regret were read: Bro. Devlin, of Kingston branch; from Montreal branch; A. D. Stewart, mayor; from Ottawa branch; S. S. Ryckman, M.P. for Hamilton, J. T. Middleton, M.P.P. for Hamilton; J. M. Gibson, M.P. for Hamilton.

Our meetings of late have been very interesting; some important discussions have taken place. The members of this branch are very much disappointed at the results of the bill when it went into committee. It seems strange that when such an important matter is brought forward, that it should be dealt with in such a light manner. We are in hopes that the leaders of the movement will take time to consider the most effectual manner to bring the bill before the Government. The great trouble, in my mind, is that the Stationary Engineers are not heard enough of outside of their lodge rooms. It is time that more attention was paid to outside matters, and to the professional part of our meetings, and the meeting once each week instead of once in two weeks. I hope to be able to say more upon this subject in the future.

WM. NORRIS, Cor. Sec.

THE ENGINEERS' LICENSING BILL.

Editor CANADIAN ENGINEER.

SIR,—From the wide-spread interest taken by engineers, steam-users and employers in the bill recently before the Ontario Legislature for the licensing of engineers and the inspection of boilers, there is no doubt that many would like to know the results, and the present situation. A carefully prepared bill, one in which every precaution was taken to have it work equitably and smoothly, was entered by the member for West Toronto, Mr. Crawford. At the second reading of the bill a short discussion was had on the merits of it, with the result that the principle of the bill was agreed to and a special committee was appointed for the purpose of further considering the bill. This committee consisted of twenty-one members, and seemed to be loaded up the wrong way, as, after quite a stormy meeting, the committee, on resolution, accepted the principle of the bill, but objected to the details and machinery of it. There were only thirteen members of the committee present. Many of the absentees were avowed friends of the measure, and it is very probable that the result would have been very different had they been present. It is the old story of where a few who were opposed to the measure watched it closely, and were on hand at the right moment to defeat it, while friends, who were not enthusiastic, suffered other engagements to keep them from the meeting, and so lost the cause. It is to be hoped that the Government will take the matter up in the near future, as the necessity of such a measure is becoming more apparent each year, and is being adopted in different forms by many of the States and some of the European countries.

ENGINEER.

Toronto, May 3rd, 1895.

THE MONTH IN MONTREAL.

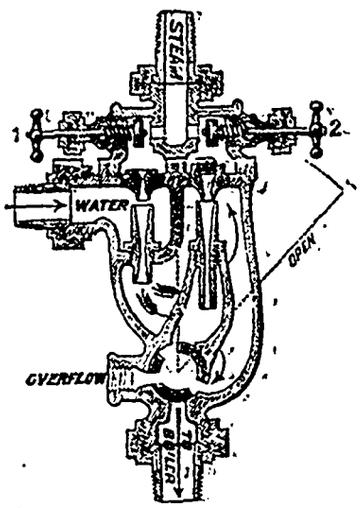
Montreal No. 1 has had a very satisfactory month. There have been several initiations. A paper on "Evaporation" was read by Bro. Granberg. There has been the usual number of knotty questions asked and answered. We had on exhibition in our hall a curiosity that I think no other branch of the association can boast of, that is an engine made almost entirely by a jack-knife and an old file. Most of the metal is made from tea chest lining; it works with steam. The maker, J. Wilson, is a fireman with two years' experience.

A. W. BROWN, Cor. Sec.

THE "NIAGARA" INJECTOR.

The boiler feeder which is very rapidly becoming popular among steam users and boiler makers throughout Canada is the "Niagara" Injector, manufactured by W. H. Stirling, of St. John, N.B. The claims for superiority are as follows:—

The machine is complete in itself, *requiring no valves*, as will be seen in cut.



It can be throttled by means of valve No. 1 on suction side, so as to supply from full capacity down to required quantity, thus reducing the quantity of steam used, and delivering the water 90° hotter. This feature will save the price of the injector many times over in fuel alone. The foregoing fact has been demonstrated beyond doubt by the "Niagara" Injector being connected where other machines have been taken off.

The machine is meeting with great success for the short time it has been on the market.

Mr. Stirling has shipped these injectors to nearly every western city in Canada as far west as British Columbia.

The "Niagara" Injector is sold in Montreal by W. H. Nolan, Canadian Machinery Agency, 321 St. James st., and Samuel Fisher, 57 Sulpice st.

SAFETY VALVES.*

BY W. G. BLACKGROVE, TORONTO.

The safety valve is a device constructed to relieve the boiler of all surplus steam generated therein above a given pressure. It is a factor that cannot be ignored, and the usual practice of opening the valve or causing it to blow-off at least once a day does not really seem sufficient to be a guarantee that it will perform the duty required of it just at the time it should work to best advantage.

A safety valve may readily stick, especially those that are constructed to prevent the steam blowing into the engine-room whenever the valve performs its duty. A valve of this kind is usually fitted with a cap surrounding the stem through which it is intended to move, without friction, and also without permitting an escape of steam around the sides of the stem; and for this reason there is great danger of its sticking, and that without any indications which will call attention.

Valves of this kind, whenever inspected, will be found to have the stem thickly covered with mineral matter, which has been carried off with the steam, and finally adheres to the stem with such tenacity that it can only be removed by filing or sand-papering. Such accumulations enlarge the stem, and a similar deposit in the cap often produces such a condition of affairs that to start the valve from its seat, even when the lever is removed, requires considerable effort. Under such conditions the valve is not corroded to its seat, as usually expressed, but the stem and cap are caused to adhere on account of the accumulation deposited from the flow of steam, which carries with it more or less water from the boiler, which in turn deposits the sedimentary matter carried over.

* A paper read before the Toronto Branch, Canadian Association of Stationary Engineers.

Safety valves that stick will stick even though tried every day, if they are simply lifted and dropped to the old place on the seat again. If a boiler should be found with an excessively high pressure, it would be one of the worst things to do to start the valve from its seat unless extra weight was added, for should the valve once start it would so suddenly relieve the boiler of such a volume of steam as would cause a rush of water to the opening, and by a blow just the same as in water hammer would rupture the boiler.

Such a condition is very possible to occur of itself when the valve sticks. The valve holds the pressure, that gets higher and higher until so high that the valve gives way, and allows so much steam to escape that the sudden changing of conditions sets the water in motion, and an explosion is liable to be the result. James Brownlee, one of the committee of the Institution of Engineers and Shipbuilders in Scotland, in his experiments on safety valves opening, found that with a square-edged entrance the flow of steam was reduced from 12 to 14 per cent. The safety valve, as generally made, cannot be considered as presenting a much better entrance to the steam than a square-edged orifice. In making this 14 per cent. allowance, the weight in pounds of steam discharged per minute per square inch of opening with square-edged entrance corresponds with very nearly three-fourths of the absolute pressure in the boiler, as long as that pressure is not less than 25·37 pounds. Examples of this are shown in the following table:

Absolute pressure in lbs. per square inch.	Weight discharged per square inch of orifice with rounded entrance, per minute.	Weight discharged per minute with square-edged orifice.	Three-fourths of absolute pressure.
P_1.	W_r.	W_s.	$\frac{3}{4} P_1$.
25 37	22·81	19·6	19
30	25·84	23	22·5
40	35·48	30·5	30
45	39·78	34·2	33·8
50	44·06	37·9	37·5
60	52·59	45·2	45
70	61·07	52·5	52·5
75	65·30	56·1	56·2
90	77·94	67	67·5
100	86·34	74·3	75

The area of opening requisite to the discharge of any given constant weight of steam, it will be observed, is very nearly in the inverse ratio of the pressure. Thus, while 3 square inches of opening with square-edged entrance will discharge $3 \times 23 = 69$ pounds weight of 30 lbs. pressure per minute, 1 square inch of opening will discharge 67 lbs. per minute of 90 lbs. pressure of steam.

The quantity of heat, however, requisite to generate (from water at 100°) 67 lbs. weight of steam at 90 lbs. pressure, is only 1 per cent. less than is required to evaporate 69 lbs. at 30 lbs. pressure. The boiler which will generate 69 lbs. of steam per minute at 30 lbs. cannot therefore possibly generate more than 67·7 lbs. at a pressure of 90 lbs., but many experiments on record seem to indicate that the deficiency at the higher pressure is more than 10 per cent.

In ordinary marine practice there is not often more than 20 pounds of coal consumed per hour per square foot of fire grate. Under these conditions, the area of the opening requisite to discharge all the steam a boiler can generate corresponds to four times the square feet of fire grate divided by the absolute pressure $(p+15)$

$$\text{or } A = \frac{4G}{P+15}$$

Rule 1st.—Multiply the square feet of the fire grate by the number 4.

Rule 2nd.—To the steam pressure add the number 15.

Rule 3rd.—Divide the first by the second, and the quotient will be the area in square inches.

The English Board of Trade allowance is half of one square inch of valve area for each square foot of grate surface. Hence, the lift of valve is proportional to the diameter and inversely as the pressure. For a discharge of 3 lbs. per minute, per square foot of grate surface, the requisite lift in inches is twice the diameter of a (flat-faced) valve divided by the absolute pressure. This, however, does not apply to pressures less than 25 lbs. (10 pounds per gauge plus 15).

Take, for example, a safety valve 5 inches diameter = 19.6 sq. inches in area, which corresponds to $2 \times 19.6 = 39.2$ sq. feet of grate surface, which would evaporate $39.2 \times 3 = 117.6$ pounds of water per minute. Then, since the area A in square inches requisite to discharge any weight W in lbs. of steam, per minute at the pressure $P+15$ is

$$A = \frac{4W}{3(P+15)}$$

We would have by taking the pressure $P=45$ and the weight W 117.6, the area

$$A \frac{4 \times 117.6}{3(45+15)} = 261 \text{ sq. ins.},$$

which corresponds to the opening of a flat-faced valve 5 inches in diameter when lifting

$$Lift\ h. \frac{2 \times 5}{60} 0.1667.$$

The circumference of a 5 inch valve being 15.7 inches, and $15.07 \times 0.1667 = 2.61$ square inches of opening as stated.

When the angle of seat of valve is 45°, the lift required in inches is

$$Lift\ h. = \frac{2.8 \times Diam.\ of\ valve}{P+15} = 2.33$$

When a boiler is regularly fired and all the steam generated discharges through an ordinary safety valve under a succession of different pressures, the lift of valve multiplied by those absolute pressures should be a constant quantity, provided the same quantity of heat is constantly entering the boiler, and provided also that the absolute pressure in the boiler or pipe below the valve is not less than 1.726 times the absolute pressure of the steam in the chamber above the valve.

In actual experiment, a deficiency is generally manifested at the higher pressures. Hence the suspicion of some considerable loss of heat at the higher temperatures. It has been suggested that this might be accounted for by the low-pressure steam carrying water along with it, retarding its motion, and thereby requiring a larger opening; but this would only aggravate the case, since the same opening will permit of a much larger quantity of heat being discharged from the boiler with wet than with dry steam. This phenomenon may be suggested as one worthy of further investigation.

To calculate load on lever safety valve:

Let A = Area of valve in sq. ins.
F = Fulcrum distance in ins.
L = Length of lever.
W = Weight of ball in lbs.
P = Blowing off pressure in lbs. per sq. in.

$$P = \frac{X \times L}{A \times F} \quad L = \frac{A \times F \times P}{W} \quad W = \frac{A \times F \times P}{L}$$

Examples:—

Suppose we take a valve 5" dia., length of lever 24", distance from fulcrum to pivot 3", weight of ball 60 lbs, and we want to find at what pressure that valve will blow at:

Formula $P = \frac{W \times L}{A \times F}$

60 lbs., weight of ball
24 " length of lever

21.2058)1440000(67 9 or 68 lbs.
1272348
1676520
1484406
1921140
1908522
12618

Area of 3" valve 7.0686
Dist. of ful. to pivot 3"
21.2058

Now we take the next formula to find length of lever required:

$$L = \frac{A \times F \times P}{W}$$

Area of 3" valve 7.0686
Fulcrum to pivot 3"
21.2058
Pressure 68
1696464
1272348

Weight of ball 60 lbs.)1441.9944(24".0332 length of lever
120
241
240
199
180
194
180
144
120
24

I have used 68 lbs. as the pressure because the quotient in the first formula is so near to it, thereby saving an unnecessary amount of figuring.

Now we proceed to the next formula to find out the weight required :

$$W = \frac{A \times F \times P}{L}$$

Area of 3" valve 7.0686
3
21.2058
68
24)1441.9944(60.0831
144
000199
192
74
72
24
24

I have worked out these formulas just to show you how it is done. If I had gone further into the decimals the answers would in all probability be absolutely correct Another formula I might mention which may be of service to some, and is as follows, for finding weight of ball required for any given pressure :

$$\frac{A \times P - D\ W \times F = W}{L}$$

Now, this looks somewhat formidable to those who are not familiar with calculations in any form, but a few words and a little study will make it clear to most persons. We will take a valve of the same size and all pertaining to it as in the previous questions. Valve 3" drain ; pressure, 68 lbs. per sq. in.; length of lever, 24" ; distance from fulcrum to pivot, 3" ; weight of lever and valve, 12 lbs.

The area of valve is multiplied by the pressure, minus half the weight of lever, which we will call 8 lbs. ÷ 2 = 4 lbs., and the whole weight of valve, which is 4 lbs.; the combined weights of the two will equal 8 lbs , the product to be multiplied by the distance from fulcrum to pivot ; divide this last product by the whole length of lever. The quotient will be the required weight to put on lever to balance a given pressure.

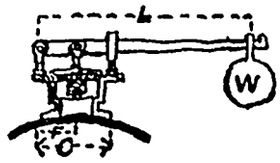
Area of valve 3" decim. 3
3
9
.7854
7.0686
68 pressure per sq. in
565488
424116
480.6648
Half weight of lever and whole weight of valve in lbs. 8
4726648
3 dis. from ful. to pivot.
Length of lever, 24")1417.9944(59.0831 { or nearly 60 lbs. weight of ball.
120
217
216
199
192
74
72
24
24

You will notice that the two different rules produced precisely the same results.

If the lever is not balanced, its effect, and the effect of valve and spindle, requires to be added to the pressure and to be taken in account in calculating L and W. For instance, if w = weight of lever, and v = weight of valve and spindle in lbs.; c = distance of centre of gravity of lever from fulcrum, then if p = pressure per sq. in on valve due to weight of lever and valve alone,

$$P = \frac{W \times C}{A \times F} + \frac{V}{A}$$

In most cases the effect of valve and spindle may be neglected ; but in the case of long, heavy levers, p will require adding to P to ascertain the blowing-off pressure. Safety valve levers should always be made of wrought iron. Malleable cast iron is sometimes adopted for the purpose, but its use is exceedingly objectionable. It is easily fractured and is liable to cause a serious case of scalding.



Sometimes the lever is extended backwards beyond the fulcrum, and fitted with a small weight at the end so as to cause the lever to balance exactly about the fulcrum pin. When such is the case the weight of the lever may be entirely neglected in estimating the pressure on the valve. When lever valves are adopted, they should be so designed that the working pressure requires the weight to be placed at the end of the lever, and thus prevent accidental overloading. While the foregoing concerning levers may be good advice, I am sorry to say it is sadly despised. In my visits to some boiler rooms, I have seen the valves weighted down with such articles as railroad iron, car couplings, sash weights, etc., and in one instance I saw the lever braced from the ceiling, indicating either laziness or carelessness on the part of the man in charge of the same It may possibly be that more pressure is required, but in the majority of cases it is done merely to stop a little fizzing noise, whereas one or two hours of grinding will seat and make the valve perfect, and I am sure would dispense with those unsightly appendages and add to the appearance of the boiler considerably.

ENGINEERING DEPARTMENT OF McGILL.

The results of the recent examinations in the Faculty of Applied Science at McGill University in the final year, are as follows :

Civil Engineering—William Frederick Carter and Gilbert S. Dobson, B.A., equal; James K. Scammell, Wilfrid Dougall.

Electrical Engineering—Robert Owen King, Ralph B McDunnough, Arthur R. Holden, B A.; Frederick M. Becket.

Mechanical Engineering—William Currie, George D. McDougall, Sampson P. Robins; Hugh C. Baker and John Primrose, equal; Alexander R. Greig, William Forrest Angus, Peter McNaughton, Michael E Griffin, Walter M. Scott, Kenneth Moodie; Thomas F. Niven and Geo. N. Boright, equal; John A. Turner.

Mining Engineering — Orobis C. Hare, John C. Gwillim, Charles E. Van Bamefield, Francis A. Wilson, Robert Askwith.

These students received the degree of Bachelor of Applied Science at the annual convocation. Robt. Bickerdike and George S. Spencer also received the degree of Master of Applied Science.

The honor list for the year in the Faculty is as follows:—

Honors in Thermodynamics—Frederick M. Beckett.

British Association Prize for Original Research Work, presented by P. A. Peterson, C.E.—William Frederick Carter.

W. F. CARTER, VALEDICTORIAN.

British Association Prize ; Honors in Dynamics of Machinery, Hydraulics, Machine Design and Thermodynamics—Wm. Currie.

Prize for Original Research Work, presented by P. A. Peterson ; Honors in Theory of Structures—Gilbert Sherwood Dobson.

Prize for Original Research Work—Wilfrid Dougall.

Prize for Summer Essay ($25); Honors in Designing; first rank honors in Natural Science—John Cole Gwillum.

Governor-General's Medal; Honors in Hydraulics, Metallurgy and Designing; first rank honors in Natural Science—Orobio Chandler Hart.

British Association Gold Medal; Honors in Dynamics of Machinery, Electrical Engineering, Machine Design, Thermodynamics, Designing and Physics—Robert Owen King.

R. O. KING, GOLD MEDALIST.

Honors in Hydraulics—George Dewar McDougall.

Honors in Dynamics of Machinery—Ralph Bayles McDunnough.

Honors in Hydraulics—John Primrose.

Prize for Original Research Work, presented by P. A. Peterson—John Kimball Scammell.

The names of Frank D. Rogers and Arthur Langley Mudge were added to the graduating class.

CECIL B. SMITH, Ma. E., A.M., Can. S.C.E., was born at Winona, near Hamilton, March, 1865, and received his education at the Hamilton Collegiate Institute, and afterwards in civil engineering at McGill University, graduating in 1884 with first honors and the Governor-General's medal. Since that time he has been engaged chiefly on railroads, although working for a short time under Mr. Thomas Monro on the Welland Canal, and under Mr. John Kennedy on the Montreal Harbor Commission. He has had charge of many heavy pieces of construction; on the Northern and Pacific Junction Railway under Mr. J. C. Bailey, on the St. Catharines and Niagara Central Railway under Mr. B. N. Molesworth, on the C.P.R., at London, Ontario, under Mr. W. T. Jennings; surveyed for the Toronto, Hamilton and Buffalo Railway during the summer of 1889, under Mr. A. L. Hogg. He was then appointed successively: Resident engineer, chief draftsman and division engineer on the C.C. and C.R.R. in Tennessee and S.C., under Mr. A. N. Molesworth, constructing 70 miles in all. He was then appointed division engineer on the Roanoke and Southern Railway, under Mr. Andrew Onderdonk, in charge of 65 miles of heavy work, including track-laying and maintenance. On this being completed, after short reconnoissances for the Concord Southern Railway, he was appointed resident engineer on the Baltimore and Ohio Railway, under Mr. W. T. Manning, in charge of 14 miles of very heavy work. On completion, he was appointed Lecturer in Civil Engineering and Descriptive Geometry at McGill University, the duties of the former being to lecture in railway engineering and on testing of materials of construction. In 1888 he was made associate M.C.S.C.E., and in 1894 obtained the degree of Master of Engineering from McGill University. The first instalment of Mr. Smith's able paper on cement testing appears in this issue.

THE hydrographic work of the Marine Department will this year be confined to operations on Lake Erie, and this section will be completed before proceeding with the survey of Lake Huron. The work will be in charge of W. J. Stewart, under the direction of Lieut.-Col. Anderson, chief engineer of the Marine Department.

THE TWO-PHASE SYSTEM.

To the Editor of ELECTRICITY.

DEAR SIR,—In an editorial in your issue of April 10th you say in reference to the new Westinghouse shops: "Aside from all this, these new works undoubtedly constitute the most complete electrical shops in the world of any kind, and the only ones using the two-phase currents for all operations." As to the first part of this statement it is a matter of individual judgment, and we have no comment to make; but we are certainly astonished at the latter part, as a reference to your own files would prove its inaccuracy. Our shops have long been operated by two-phase currents, and entirely so. There is not even a temporary use of direct current for elevators and cranes. The whole work is done by two-phase currents. Neither is our apparatus of such peculiar design that it can be operated only at an abnormally low frequency. All the apparatus in our shop is supplied from the central station of the town by a generator using the standard frequency of 16,000 alternations. It is not necessary for us to limit ourselves, therefore, saying that our apparatus could also be used at Niagara. It can be used in connection with any central station, and is being used in connection with many. We are surprised above all that you should undertake to decide the legal question as to the right to use two or three-phase currents for transmission purposes. Surely an anti-monopoly journal need not start in to create a monopoly in advance of the decision of the courts. Had these statements appeared in a journal known to be biased, or to be affected editorially by its advertising columns, we should have passed them over in silence as of no importance. In the millitant advocate of fair trade, however, they carry weight. We trust that, your attention having been called to their erroneous nature, in your usual spirit of fairness you will rectify them.

JOHN F. KELLY.

Stanley Electric Manufacturing Co., Pittsfield, Mass.

The above appeared in *Electricity*, and the editor makes the following comment: We thank Mr. Kelly for correcting us in making too sweeping a statement, as the Westinghouse shops are not "the only ones using the two-phase currents for all operations." More than a year ago *Electricity* published a comprehensive write-up showing the application of the S. K. C. two-phase system in the Stanley works at Pittsfield, which, we believe, was the first extensive installation, and which has worked with perfect success. We regret the overstatement, which was purely inadvertent. In regard to our remarks as to the legal questions involved, we made no attempt to anticipate the decisions of the courts, discussing merely the Westinghouse and Monocyclic systems, as a careful reading will show. We stated, what we knew to be a fact, that the General Electric people had *acknowledged* their Monocyclic system to be an infringement of the Tesla patents.

THE PROPOSED MARITIME CANAL.

Editor CANADIAN ENGINEER:

SIR,—The Montreal *Price Current* is taking me to task for saying that the outpour at Niagara will, on completion of the canal, be diminished by the quantity of water made to flow from Lake Erie towards the Hudson. This was the first idea of the great canal company, or of its predecessors in the field; but the company being now imbued with the importance of taking in the traffic not only of the upper lakes, but of the eastern portion of Ontario, the western portion of the Province of Quebec, and the northern portion of the State of New York, including Toronto, Ottawa, Kingston, Montreal, etc., the amended scheme is now to start the canal at Lake St. Francis on the St. Lawrence above Montreal, and thus secure the good will of the latter city and of all those above it in the line of traffic, as it must of course be indifferent to Montreal whether it gets its ocean steamers *via* the St. Lawrence or by way of New York, the Hudson, Lake Champlain, and the proposed canal between the latter and Lake St. Francis.

Still, is it true to say that while Lake Ontario will not suffer, nor the aforesaid cities and sections of the Dominion, there will yet be such falling off in the St. Lawrence below Montreal as due not only to the off-take by the Chicago drainage canal from Michigan towards the Gulf of Mexico, but also by so much water as may be taken from Lake St. Francis to feed the maritime canal?

Of course it would be useless, in view of the immense interests at stake, to offer any objections to a scheme so deeply affecting such a vast and important section of the Dominion, and all that Quebec can look to, and the riparians between Montreal and the Gulf, is a suitable compensation by the Government or by the company for our thereafter diminished traffic facilities, due to less draught of water between Montreal and the ocean.

CHAS. BAILLAIRGE,
Engineer, Quebec City.

Quebec, April 16, 1885.

NEW ENGINEERING FIRM.

The firm of Beker & Farewell has been formed in Montreal, with offices in the Temple Building, to carry on business as mechanical engineers and specialists. R. G. Beker, of this firm, was educated in the technical school of Vienna, Austria. He served an apprenticeship in the Silesian Iron Works, where he was afterwards employed in the drawing office in the construction of heavy machine tools, and superintendent of a large bolt, screw and rivet plant. He then made extensive tours, taking short terms of employment among German, Belgian and English steel, machine and iron works for studying purposes. Came to Canada about a year ago, commencing the present business with Mr Farewell. A N. Farewell served his apprenticeship with G. R. Stothert & Co., marine engineers, Bristol, England. Served several voyages as marine engineer, afterwards came to the Pacific coast, where he was for several years employed in various steamship yards in California and Washington, also for a time in the erection of quartz milling machinery in British Columbia. He came to Montreal about a year ago The new firm propose to make drawings, and perfect the designs for people who have patent ideas in embryo, in which especial line, we believe, they are alone in Montreal.

REVIEW OF THE METAL TRADES.

MONTREAL, May 6th, 1895.

Business is reviving in the metal trades, and prices are stiffening both in the Old Country and the United States. Advices from England state that the tin plate mills are working on heavy orders that will keep them running till June. Pig iron and bar iron do not show much change in price, but tin and copper are firm. The following are current quotations:—Summerlee pig iron, $20 to $20.50; Eglinton, $18.50; America, $18 to $18.50; Carnbro, $18.50; Ferrona, $16.50 to $17; Siemens, No. 1, $16.50 to $17; wrought scrap, No. 1, $14 to $15; bar iron, $1.55 to $1.60. Tin plates, cokes, $2.55 to $2.75; I. C. charcoal, $3 to $3.25; Canada plates, $1.95 to $2.10; terne plates, $5.75 to $6.25; galvanized iron, 4¼c. to 5¼c. as to brand. Orford copper, 9¾c to 10½c; ingot tin, 16c. to 17c.; lead at $2.90 to $3; and spelter at $4.50 to $4.75; cut nails, $2.10. A good trade is doing in cement. About 2,000 bbls., mostly Belgian, have been sold for the West, at $1 85, and English is selling at $1.95 in Montreal. Fire brick is quoted at $16 to $22 per thousand.

Industrial Notes.

A NEW and large planing mill is in operation at Sudbury.

THERE is some talk of a $50,000 flouring mill for Prescott, Ont.

THE buildings of the Wallaceburg, Ont., glass works are completed.

THE latest industry in Camlachie, Ont, is an axe handle factory.

THE Weston Woolen Company has assigned, with liabilities of $245,000.

IT is said that the Port Dalhousie Rubber Works will be moved to Hamilton.

THE Londonderry Iron Company's furnace at Londonderry, N.S., is now in blast.

THE Victoria Iron Works, Victoria, B.C., have closed down on account of slackness of work.

A NEW and improved wind mill, made entirely of steel, is about to be manufactured in Peterborough.

ON April 7th the saw and grist mills of Andrew Thompson, Strathroy, Ont., were burnt. Loss, $5,000.

THE town of Gananoque has been given permission by the private bills committee to bonus the carriage works there to the extent of $10,000.

THE directors of the St. Thomas Gas Company have decided to make improvements to their works, which will cost from $10,000 to $12,000.

THE city of Winnipeg and the Manitoba Government propose spending $200,000 in making the Red River navigable from Lake Winnipeg to the city.

IT is understood the Government have decided to rebuild the bridge over the old canal at Allanburgh, Ont., which was condemned a year or two ago.

JAMES HAMILTON is about to re-build his large saw mill at Strait Shore, N.B.

HIRAM WALKER & SONS are about to erect a large tobacco factory at Walkerville, Ont.

JOSEPH BEAUDIEN'S chicory mills at Outremont, Que., have been destroyed by fire. Loss, $8,000.

THE Toronto Mineral Wool Manufacturing Co. are applying for incorporation. Capital stock, $25,000.

A NEW saw-mill, to cost $20,000, is to be erected at Savanne, near Fort William, Ont., during the summer.

THE Sault Ste. Marie, Ont., Pulp and Paper Co. are applying for incorporation. Capital stock, $2,000,000.

A NEW bridge is to be built in Perth, Ont. D. Kippen is preparing plans, and has the whole matter in hand.

L. MCGLASHAN and E. Clark, of the Ontario Silver Works, Stonebridge, are removing their factory to Indiana.

JAMES FERRES has sold his interest in the Hamilton Hardware Co. (Ltd.) to Wm. Hersee, a retired contractor of Princeton.

ARCHITECT BURKE is preparing plans for Robt. Simpson's new palatial store in Toronto, to replace the one recently burned down.

THE Golden, B. C., *Era* reports that tenders have been accepted for lumber for the new bridges at Fort Stelle and St. Mary's.

AT the annual meeting of the B.C. Iron Works, Vancouver, the old board of directors was re-elected, and a dividend of 7 per cent. was declared.

AT a recent meeting of the Chatham town council, it was decided to build a fire hall at a cost of $1,200, also a water tank to cost $400.

MR. ODLUM, Government engineer, took soundings in the deep cut on the Welland Canal, and dredging will be done in the bank on the west side.

THIS year several new canneries are to be built on Rivers Inlet, B.C. The canning industry is yearly increasing in importance in British Columbia.

THE Laughlin-Hough Manufacturing Co., recently incorporated, have decided to locate in Guelph, and will fit up the McCrae woolen mills as a factory,

THE product of the Canadian pig iron industry last year, according to statistics recently given, was 53,014 tons, of which 40,000 were produced in Nova Scotia

G. V. HASTINGS and Matheson are prospecting for sites for a number of new elevators which the Lake of the Woods Milling Co. will build in Manitoba this year.

A NEW distillery is to be started in Windsor, Ont., by Patrick Beneteau. The works will be running very shortly, when a large number of hands will be given employment.

MR. PATTERSON is now negotiating for machinery for the new rolling mills in Guelph, Ont., and it is hoped that everything will be in readiness to commence operations this spring.

DANIEL SCOTTEN is about to erect a four-story block in Windsor, Ont., to cost $40,000, and John Curry will erect a $50,000 building in the same city. Work on both will commence shortly.

THE Montreal Brassworkers' Association have elected the following officers: President, W. D. Burns; vice-president, Jas. Daly; treasurer, J. Dansken; recording secretary, T. Nelson; and financial secretary, Geo. Henry.

THE Collins Manufacturing Co., Toronto, capital stock $40,000, are applying for incorporation. They will, as heretofore, manufacture metal roofing and ceilings, corrugated sheet iron, wire fencing, stamped goods, etc.

THE Prescott, Ont., Elevator Co. (Ltd) has been incorporated with a capital stock of $175,000. They will carry on a general business in grain dealing and elevating, and will acquire barges and other vessels as required.

SIMON GAGNIER, an employé in the Pain Court sawmill, Chatham, Ont., was last month struck in the forehead with a piece of the circular saw which he was operating. The steel penetrated his brain and he died in half an hour.

THE Hamilton Bridge Works will soon be in operation again. The *Times* says the company has been awarded the contract for all the Grand Trunk Railway Company's bridge work this year. There was talk of the removal of the company's works to some other city, but the city council having agreed to put their assessment down to $30,000 a year for eight years, and exempt them from other taxes, except school rates, the company decided to remain.

St John, N.B., will have an exhibition opening on the 24th of September next.

The Queen's Avenue Methodist Church, London, Ont., will be rebuilt at a cost of $65,000.

The Snowball Wagon Co., of St. George, Ont., contemplate removing their factory to Dundas.

Jos. Masse has sold his foundry and machine shop at Granby, Que., to Euclide Massé and Geo. Wilkinson.

The Wilson lead smelting factory in Hamilton was offered by auction on the 23rd April, but there were no bids.

A wire foot bridge has been built across the Bonnechere River at Renfrew, Ont. It is 300 feet long, and cost only $125.

T. Dancr is organizing in Peterborough a company for the purpose of establishing a factory for the manufacture of artistic woodware.

The tenders sent in for the proposed new town and fire hall at Carleton Place proved all too high, and new tenders will probably be invited.

Robin, Sadler & Howarth, belting manufacturers, have put in a 36-inch 3-ply belt 100 feet long, for the Temple Electric Co., Montreal.

The Welland Vale Manufacturing Co., St. Catharines, Ont., manufacturers of steel goods, have branched out into the manufacture of bicycles.

Sylvester Bros' agricultural works at Lindsay, Ont., have been destroyed by fire, probably the work of an incendiary. Loss, $8,000; insured.

Harding & Leathorne have been awarded the contract for cast iron pipes for London, Ont., water supply system, and Hunt Bros. the contract for coal.

Archibald & Co., Montreal, will establish a factory in Hull, Que., to employ 250 or 300 hands. They are asking for exemption from taxation for twenty years.

The machinery stock of the Crescent Chemical Works, Montreal, owned by Harry P. Hyams, under arrest on a charge of murder, have been sold by the sheriff.

Ontario architects are asking for a by-law enacting that all buildings over 70 feet high shall be fire proof and provided with elevator walls encased with terra-cotta.

Isaac Usher & Son are preparing to make extensive additions to their cement mill at St. David's. A new kiln is to be built, and the prospects for the season are very good.

The Ontario and Western Lumber Co. are about to put in at their mills at Keewatin, Norman and Rat Portage machinery for the manufacture of boxes and packing cases.

The Standard Drain Pipe Company, St. John's, Que., have elected the following officers: President, W. C. Trotter; vice-president, Capt. Chas. Coursol. Directors, G. H. Balfour, T. H. Dunn, F. C. Henshaw, T. T. Turnbull, and J. T. Ross.

D. L. Shannon, of Prince Albert, Sask., has purchased for his saw mill a 50-horse power engine and boiler and an extensive outfit of machinery. The capacity of the mill is now 20,000 feet of lumber, 20,000 shingles and 30,000 lath per day. About twenty men will be employed.

Architect Jarvis has prepared plans for a new magnificent $500,000 hotel in Toronto, for a company with which S. F. McKinnon, the wholesale millinery merchant, is connected. It is to have a frontage of 180 ft. on Wellington street, and 140 ft. on York street, and will be seven storeys.

McLeod Stewart, of Ottawa, is organizing a company for the purpose of utilizing the waste fish and offal from the canneries on the Fraser River in British Columbia. It is stated that 400 tons of guano and 145 tons of fish oil can be derived from 1,000 tons of residual matter and waste fish. The company will ask the Dominion Government for a grant of land on Lulu Island, at the mouth of the Fraser River, as a site for their factory.

Tenders for putting in the Digby, N. S, water works have been accepted. In all nineteen bids had been received, some from the United States. The contract for the construction was awarded to Messrs. Wood, Digby and Vye, of Bridgeville, N.S, for $14,499. Tenders from the Londonderry Iron Works for the pipes, Toronto Engine Works for hydrants, Truro Foundry for special castings, and the Burrill-Johnston Iron Works, of Yarmouth, for valve boxes, were accepted. The cost for the whole work comes well within $340,000, the estimate made by the engineer, J. A. Pickett. Work commenced on the first of May. The water will be brought a distance of five miles.

McLachlin Bros. have had their four saw-mills at Arnprior, Ont., thoroughly overhauled and refitted. All of them will be operated this season.

The mill of S. T. King & Sons, at Kingsville, N.S., will be put in operation again in July. The plate for the new boilers has been ordered from England.

The Anaconda company, of Nelson, B.C., is negotiating for a hoisting engine that will be capable of raising the regulation weight from a depth of 5,000 feet.

One of the shell boilers in S. T. King & Sons' saw mill, at Kingsville, N S., exploded recently, resulting in the death of Lee A. W. Smith, one of the hands, and injuring a number of others.

George White & Sons, of London, Ont., have fitted out the saw-mills of Gow & McLean, Fergus, and George A. Patrick, Delaware, with new internally-fired boilers and "Clipper" engines.

Edward Bradford was killed in his saw-mill at Mount Maple, Que., owing to becoming entangled in the shafts. His clothing was almost stripped off his body, and he died within a few moments.

The plant and stock in trade of the leather belting factory of Cassidy, Bonner & Co., Montreal, who assigned last month, has been sold to Robin, Sadler & Howarth. The estate will pay but a small dividend.

The Canadian Pacific has decided to build a large storehouse, capable of holding 5,000 barrels of flour, in Windsor, Ont. The flour will be brought down on the "Alabama" from the Soo and shipped to points east.

The survey for the new dyke at Delta, B C., has been completed. The cost of building the dyke is being estimated at between $40,000 and $50,000, and tenders will be called for in the course of a few weeks.

A company has offered the corporation of Levis to establish waterworks and sewerage for the town, also to illuminate the streets by electricity. After twenty-five years, the town council will have the right to purchase the property.

A disastrous flood took place April 9th, in Gorrie, Ont., on the River Maitland. The flood washed away William Dane's miller's dam, and totally wrecked Hammond Bros.' steam saw mill and office. Total loss, about $4,500.

An Order-in-Council has been passed disallowing the ordinance adopted by the North-West Assembly last session in reference to irrigation, on the ground that certain clauses infringe on the prerogative of the Federal Parliament.

The Lake Superior Water and Light Company, Sault Ste. Marie, Ont., have awarded a contract for building a tail-race, &c., to M. Dumont of the American Sault. The new power house, headgates, guards and bulkheads are already completed.

Work on the marsh on the Otonabee side of the river, near South Monaghan, Ont., is going on rapidly, and the roadway across it is almost completed, including culverts. Work on the new bridge across the river at South Monaghan will probably begin shortly.

The well-known grist mill at Upper Corner, near Sussex N.B., known as Hayward's mill, later as the Haggarty mills, was burned last month. The mill, which was 75 years old, had recently passed into the possession of Alex. Wilson, of St. John. The fire was probably incendiary.

The gift of $100,000 made by A. T. Gault will enable the church authorities to proceed with the contemplated Diocesan Theological College in Montreal. The Holland property on University street has already been secured, and the new building, which will be one of the finest in Canada, will soon be commenced.

The Longueuil, Que., authorities have decided to alter the machinery at the wheel-house and to extend the suction water main from its present terminus 1,000 feet further; also to erect a large filter, and to build on the shore a tunnel running parallel with the river. The improvements will cost about $75,000. The work must be completed during the summer.

James Fleming, proprietor of the Phœnix Foundry and Locomotive Works in St. John, has just sent out from his shops a new handsome and powerful locomotive for Canada Eastern Railway Although this is the dull season in the foundry and machine line, Mr. Fleming is employing upwards of fifty men, and his establishment is a busy place. Among other work in hand they are building a large boiler and engine for the Fredericton Boom Company, an engine for L. M. Jewett's tugboat "Fanchone," and a compound engine for the steamer "Hero," owned by D. D. Glagier & Co.—*Progress.*

THE Nelson Saw Mill Co. will shortly put in a mill at Rossland, B.C.

R B. ANDERSON, machinist, Comox, B.C., has added a power plant and machinery.

THE flood last month at Gorrie, Ont., carried away Hammond Bros.' saw mill.

JAMES LOCHRIE, cordage manufacturer, of Toronto, has gone into the manufacture of bicycles.

THE village council of Sweetsburg, Que., are discussing the establishment of water-works.

IT is proposed to start an oatmeal mill at Rapid City, Man., if its promoters can secure a bonus of $3,000.

THE Sisters of Providence are to erect an extension to their convent in L'Assomption, Que., to cost $10,000.

THE Jenckes Machine Co. have an order for 11 sets of pulp grinders from one of the largest pulp mills on the continent.

A MOVEMENT is on foot to establish a large cold storage warehouse in Winnipeg. J. J. Philp, of that city, has the project in hand.

ALEX. MACDONALD, of the St. Johns, Que., Stone and Chinaware Co., is in Paris endeavoring to organize a French company to work the potteries.

THE Record Foundry and Machine Company, of Moncton and Montreal, are enlarging their works, to meet the increasing demand for their goods.

THE by-law to grant $2,000 in aid of the bridge over the Otonabee at Rose's has been passed by the council of South Monaghan township.

AT the meeting of the Renfrew, Ont., council last month, it was decided to submit the question of the proposed water works to a vote of the ratepayers.

AT Carievale, Assa., a new steam elevator is to be built for the Carnduff Elevator and Milling Company, and the Ogilvie Milling Company may build one at Virden, Man.

THE Board of Works of Ottawa have awarded the contract for paving Sparks and Bank streets with rock asphalt to MacLean, Roger & Co., the tender being $56,063.

SURVEYS have been made for a bridge on the Bangor & Woodstock Railway across the St John River near Keegan's crossing, to connect that line with the Temiscouata when the B. & A. road reaches Van Buren.

THE White Cloud Novelty Works, of White Cloud, Mich., have been trying a number of councils of Ontario towns for a bonus to a factory they propose to establish to make a patent hame fastener. Any council gullible enough to accede to their demands would pay more than the entire business is worth.

E. S. STEPHENSON & Co., St. John, manufacturers of the Woodburn Pulverizer, are making a pressing machine for pressing black lead for a Nova Scotia firm, and also make machinery for cutting lead pencils. The pulverizers made by this firm have been shipped as far away as South Africa and Australia.

THERE came nearly being a serious accident in the Pender Nail Works, St. John, on the 18th April. The engineer, Mr Daly, had just started the engine, and the fly wheel, which is about fifteen feet in diameter, made a few revolutions, when it burst. Fortunately it was revolving slowly, and the broken pieces fell harmlessly on the floor, otherwise the result might have been very disastrous. The wheel was put in four years ago, and it is thought there must have been a flaw in it.—*Sun*.

THE Hamilton *Herald* says: Negotiations are in progress for the purchase by the Canadian directors of the Hamilton Iron and Steel Company of the controlling interest in the smelting works. They have secured an option from the American capitalists now controlling the company, and it is probable the deal will go through. Its consummation will not affect the position of J. J. Morehouse, the present manager.

THE Customs' Department have made the following decisions respecting the duty to be paid on articles which are not mentioned in the tariff, and regarding which there have been differences of opinion Babcock milk testsrs, 25 per cent., brass instrips, less than 4 inches wide, 30 per cent, cyclometers, 20 per cent.; fittings for cast iron pipe, cast iron, $10 per ton, but not less than 35 per cent.; fittings for wrought iron pipe, malleable iron, 35 per cent.; galvanized wrought iron tubing, over two inches in diameter, 15 per cent.; grenades, hand, 35 per cent.; Grimell sprinklers, 35 per cent.; tool handles, entirely of wood, 25 per cent; tool handles, filled with any metal, 35 per cent; type-writers, 27½ per cent.

A CHANGE is announced in the firm of Naud & Gauthier, fire engine supplies, Montreal The business will hereafter be carried on by J. E. Naud alone. Mr. Naud will deal in fire engine supplies, belting, packing, etc., and has been appointed agent for the Cancos Mfg. Co. of Philadelphia, manufacturers of the Rising Sun steam and hydraulic packings. The new address is 2,257 Notre Dame street.

THE Weddell Bridge and Engine Co., of Trenton, Ont., have received the contract for super-structure and sub-structure of the proposed new bridge at O'Brien's, Ont. The bridge will be of four spans. The two outer spans will be each 100 ft. long, and of the steel high truss pattern, and the centre spans will be 69 and 79 ft. in length and of the steel low truss pattern. The bridge is to be completed by October 1st.

THE *Post* reports that a settlement has been arrived at between the town and the Canada Life Association Co. regarding the water-works law suit. The Canada Life people pay the town $1,350 for the old system in lieu of the value of the stock claimed, make over the two pumps belonging to the old system, grant free water for the use of the town schools and for five street fountains, when set up by the council, and in addition, that in the event of the town purchasing the system by arbitration the value of the old system taken from the town shall remain at $1,350, the price now set upon it.

THE committee on works of Toronto city council have agreed to the estimate of $226,000 for special works required to give better fire protection to the city. The cost is divided as follows: 36-inch main to reservoir, from College street *via* Bathurst, $135,000, 24-inch main in Front street, $40,000; branch pipes, $22,400; 12-inch main in Avenue road, $5,500; larger mains in Parkdale, $20,000, etc. In addition to this, there is an estimate of $75,000 for 6-ft. steel pipe to replace the wooden one to the main pumping station.

KINGSTON, Ont., is jubilant over being chosen as the seat of the blast furnace proposed by the American capitalists referred to in last issue, to be erected at a cost of $600,000. The promoters will assume the title of the Ontario Iron and Steel Company (Ltd.), and have obtained a bonus of $250,000, giving in exchange for the same first mortgage bonds of their own in a like sum, bearing interest at five per cent. The company also asked for free water for ten years or the sum of $50,000 instead. The report of the joint committee appointed to negotiate with the Ontario Iron and Steel Company recommends the payment to the company of $3,000 a year for ten years instead of free water. The committee flatter themselves on their keen judgment in settling the water clause. The reason for this belief is that if the pumping plant should break down, under the original clause the city would have become liable for heavy damages. The city has the right of choosing a site, the company stipulating only that they shall have free access thereto by water or rail. The joint committee is strongly impressed with the genuineness of the offers made by the company, and with the good faith and intentions of the members to go ahead with the industry and to work it to its fullest capacity. Walter Kennedy, engineer, of Pittsburg, Pa., is engineer for the new company.

Railway and Marine News.

THE G.T.R. has put in a new steel bridge near Nipissing Junction.

THERE is some talk of reviving the Kingston and Smith's Falls Railway.

THE Windsor, Detroit and Soo line of steamers purchased the "Carmona."

THE new Soo canal is now open; vessels of 14 feet draft can pass through.

THE G. T. R. Co. has decided to erect a new passenger station at Glencoe.

A SPECIAL station is to be given the Fonthill nursery by the T., H. and B. railway.

THE "Alberta," one of the C.P.R.'s boats, will run between Windsor and Port Arthur.

THERE is some talk in Ottawa of a railway connecting San Francisco with Hudson Bay.

THE T., H. & B. Railway will build a new station at Brantford, and will ask the city for a bonus of $70,000.

THE White Line will have three steamers on the Sault route this season, the "Atlantic," "Majestic" and "Pacific."

THE Hudson Bay Railway has been graded and ... for 40 miles from Winnipeg northward.

CONTRACTS have been let for new stations at Tupperville, N S., Plymouth, N.S., and Hantsport, N.S.

THE Lower Laurentian Railway has been sold to the Quebec and Lake St. John Railway Company.

THE contract for the construction of the Kaslo & Slocan Railway has been let, and the road is to be in operation by the 1st of September.

THE steamer "Velos," of New Westminster, was lost off Trial Island recently. Of the crew of six men only the captain and mate were saved.

THE Montreal and Cornwall Navigation Co. have chartered the steamer "Paul Smith" to run between Valleyfield and Montreal.

To replace the wooden bridges on the Port Stanley R. R. with iron, the city council of London will ask the Legislature for power to issue debentures.

THE promoters of the Sault Ste. Marie & Hudson Bay Railway Co. are negotiating with Minneapolis capitalists with a view to disposing of the charter.

THE Grand Trunk shops at London are being closed and removed to other divisional centres. Nearly two hundred men have been employed there.

THE Canada Southern Railway Company has given notice that it will apply for power to acquire the Toronto, Hamilton and Buffalo Railway Company.

THE cross-sectioning of the Nova Scotia Coast Railway has been completed to East Pubnico. Plans for culverts, etc., are being prepared as rapidly as possible.

A DEPUTATION from the Kingston Board of Trade have interviewed the Ontario Government about the extension of the Bay of Quinte Railway from Tweed north.

A SERIOUS washout recently took place on the Dominion Atlantic Railway, between Yarmouth and Halifax, portions of the track and a bridge being carried away.

THE Government steamer "Bayfield,' of the survey service, is expected to engage in the survey of Lake Erie this summer, and make her headquarters at Port Colborne.

IT is estimated that between 25,000 and 30,000 Canadians annually engage themselves on board American vessels for the season, returning to Canada with their savings in the fall.

THE railway suspension bridge, at Niagara Falls, which is one of the oldest suspension bridges in the country, will soon be taken down, and will be replaced by a cantilever bridge.

IN spite of the depression and slack times by which other railway companies suffered in 1893, the Quebec Central receipts showed a decided increase over those of any previous year.

A SURVEYING party is working in the vicinity of Sydney, N.S., making a map of Dominion Coal Company's coal area. The railway is to be extended into the town during the early summer.

IT is said that only thirty miles of the remaining middle portion of the Ottawa, Arnprior & Parry Sound Railway will be built this summer, and that the whole line will not be completed till next summer.

THE city of London is about to erect new bridges across Kettle and Mill Creeks, near St. Thomas. These two bridges will cost between $25,000 and $30,000 each, and must be completed within six months.

THE *Miner*, of Nelson, B.C., states that a company has been formed under the Tramway Act to build and operate a tramway from the Idaho and Alamo basins to the concentrator. Work will be commenced as soon as the weather permits.

THE British Columbia Board of Trade are asking the Dominion Government to construct a stone beacon on Fiddle Reef, with electric light; an iron buoy on the west side of West Rock, off Sidney Spit, and a lighthouse on Portluck Point, Prevost Island.

IT is said that Newfoundland will demand, as the price of her entering confederation, that Canada build a tunnel under the Straits of Belle Isle, or complete the island railway to Belle Isle, and a ferry on the straits to make connection with a railway to Quebec.

A DEPUTATION from Pembroke visited Toronto recently to solicit aid for the construction of the Pembroke Southern Railway. A close observation of maps revealed the fact that should a railway be built from Pembroke to Haliburton (*via* Golden Lake) the distance from Pembroke to Toronto would be reduced 120 miles, making the trip one of 200 miles only.

J. H. GRAY, engineer, of Victoria, will superintend the building of the Kaslo-Slocan Railway.

THE Tay, Ont., canal cost $476,128. Its gross revenue last year was $128 and the cost of operating $2,485.

A C. P. R. ENGINEER named Parra was arrested recently in Winnipeg, charged with setting fire to a block near the railway works.

THE North Shore Navigation Company's new steamer, "The City of Toronto," was successfully launched on the 20th of April at Owen Sound.

A DELEGATION from Iberville, Que., has interviewed the Minister of Public Works, asking for improvements to the navigation of the Richelieu at that point.

J. & R. WEIR, Montreal, ... building a combined passenger and tow boat to ply on the St. Maurice River. The hull is steel, 67 feet over all, with a 12-foot beam.

THE Beaver Line is being run by the bondholders this year. There is no change in the company's Montreal offices, but the agents in Liverpool are D. & C. MacIver.

CAPT. R. C. PECK, of Hopewell Cape, N.B., is building a small steamer there. She will be used for towing purposes at the cape, and for carrying passengers between there and Moncton. The machinery for the new craft is made by Waring, White & Co. of St. John.

A. D. PROVAND, M.P., one of the directors of the Chignecto Marine Transport Company, has cabled that he would leave England on the 4th of May for Ottawa, to negotiate with the Government for extension of time on the contract for the completion of the railway.

OF eleven tenders received for the construction of the Peterboro' and Lakefield division of the Trent Valley Canal, that of Brown, Lorne and Aylmer, of Toronto, was the lowest. The length of this section is six miles, and the tendered price is about $350,000.

THE Colonial Iron, Coal and Railway Company met recently in St. John, and organized under the charter obtained at the last session of the Provincial Legislature. It is understood that work will shortly be commenced on the survey of the railway from Grand Lake to Fredericton.

THE annual meeting of the Yarmouth, N.S., Steamship Co. was held last month, and the usual reports were read and deemed satisfactory. A dividend of 5 per cent. was declared. L. E. Baker, Robt. Caine and D. McPherson were elected directors, and L. E. Baker, president and managing director.

A STEEL hulled steamer has been built for the Ottawa River Navigation Company, in Tate's dry dock, Montreal. The boat is 168 feet long by 41 feet beam. Among the steamboats ready for the ensuing season are the "Princess," "Richelieu," "Filgate," "Ile Heron," and "Chateauguay."

AT the annual meeting of the Quebec Steamship Company the directors elected for the current year were: John C. Thomson, D. C. Thomson, George T. Davie, Arthur F. Hunt, Honorables E. J. Price and P Garneau, and Mr. W. Simons, of Quebec, E. H. Botterell and W. J. Withall, of Montreal.

IMPROVEMENTS to the amount of $16,000 have been made on the propellers "St. Magnus," "Lake Michigan," and "Acadia." The last named will now accommodate 100 passengers. The "St. Magnus" and "Acadia" will run between Cleveland and Montreal, but the "Lake Michigan" will be run as a freight boat.

THE following are the officers of the steamer "Macassa" this season:—Captain, W. Crawford; mate, P. Welch; purser, Colin Arthur; chief engineer, W. Newman; assistant engineer, J Bain. After being put in dry dock at St. Catharines, the "Macassa" will be put into service about May 24th, with the "Modjeska," from Hamilton to Toronto.

SOMETHING new to cattle shippers will be introduced this season in the Montreal harbor. It is a huge barge for transporting live stock direct from the stock yards to the different ships. The scheme was carried out by J. C. Murray, ship liner, and Mr. Telfer, of the G.T.R stock yards. The barge has capacity of 400 cattle, and was made at Sorel.

THE S.S. "Campana," now on the upper lakes, is to take the place of the S.S. "Miramichi" on the route between Pictou and Montreal this year. She is a twin screw steamer of 1,300 tons, and is lighted by electricity and accommodates 100 passengers. She is being cut in two to be brought down the canals, as was done when she was taken up the St. Lawrence three or four years ago. This work is being done at Kingston.

THE American and Canadian Navigation Company, who propose to run steamers between Old Orchard Harbor and Canadian ports, have asked what help Toronto would give if that city is made a terminal port

A CHARTER is sought for the Lindsay, Haliburton and Mattawa Railroad Co The proposal is to construct a line from a point on the Midland Division of the Grand Trunk, north of Lindsay, to a point on the Ottawa River near Mattawa.

DAVIS & SONS, ship builders, Kingston, have sold one of their own single-acting 4 h.p. compound marine engines and boiler to C. W. Taylor, of Brockville, for a 30 ft. yacht. They also shipped one of the same pattern of engines to the Blackstock Bros., of Harrowsmith, Ont They are busy building several other engines on stock They have given up the agency of the sale of the Sintz Gas Engine, as they have not proved satisfactory. They say they have not had as good results from any kind of marine motor as with steam.

THE new steel dredge now being built by Connolly Bros. at Kingston, is to be finished in June. She is to be 112 x 36, with a depth of hold of 9 feet, and will have a capacity for excavating 3,000 yards a day, where the material to be worked is not difficult. She will be fitted with surface condensing compound engines. The dippers will range in capacity from 5 yards to 3½ yards, and will dredge to a depth of 45 feet. A Howe truss will be fitted up to run from end to end. This will be the first all-steel dredge built in Canada, and will cost nearly $80,000.

AT the late meeting of the local cabinet the St. John Street Railway Company asked for authority to cross the Suspension Bridge, so as to extend the present service to Fairville and Bay Shore. It is understood the members of the executive are disposed to assist the inhabitants of Fairville to secure the desired facilities, but it will be necessary for the Government engineer to inspect the bridge and make a report on the feasibility of allowing the cars to be run across the structure before a decision can be given in the matter.—*Weekly Telegraph.*

THE 23rd April was a *fete* day in Collingwood. On that day the new steamer "Majestic," referred to before in this department, was successfully launched. The steamer, one of the handsomest built on the upper Canadian lakes, is 227 ft. in length by 35 ft. 10 in beam, with a draft of 13 ft. 4 in. Her tonnage is 1,650, and estimated horse power 1,200. The compound engine is of improved type, designed by Logan & Rankin, of Toronto and Cleveland, designers of the "Chippewa's" engines. She has two square steel boilers with domes 10 x 13 ft. 9 in., built for a pressure of 136 lbs. She is lighted by electricity, and has a handsome saloon 200 ft. long. There are 120 state rooms with sleeping accommodation for 200 passengers. The dining saloon seats 120 people. She is heated by radiators, and is provided with steel-clad baths, also with smoking room, barber shop and other equipments of a first-class steamer. Her speed is nearly 18 miles per hour, and her estimated cost $115,000. Her keel was laid on Nov. 8th last and she will be finished this month. The following are the officers of the "Majestic": P. M. Campbell, captain, Wm. Bemrose, first mate; Isaac Woolner, second mate, Samuel Hewitt, purser; C. Tynon steward; W. Lewis, first engineer; F. Cleland, second engineer.

Mining Matters.

THE East Wellington, B.C., colliery has been purchased by R. Dunsmuir & Son.

THE effects of the Westminster, B.C., Slate Company, Ltd., have been advertised for sale.

DURING one week over 800 tons of ore was carried from the Three Forks and concentrator siding to Nakusp

NEW DENVER, B C., has an ore sack factory. The sacks are made from jute which is imported from India.

DEPOSITS of chrome or chromic iron have been recently discovered at Coleraine and Black Lake, in the Eastern townships.

A BIG strike of gold has been made on the Great Western, Trail Creek, B C A company is being stocked for $100,000 to work the property.

E. A. WATSON, M.E., Ottawa, has succeeded in forming a company to be known as the Watson Hydraulic Mining Co., to operate in the Big Bend country.

ANOTHER well of natural gas has been opened on the property of the Ontario Natural Gas Co., on the lake shore near Leamington, Ontario, and is said to be a very good one.

A NEW gas well, with a good flow, has been struck at Caledonia, Ont.

THE Provincial Gas Company is prospecting at St. Clair flats for gas and oil.

THE development of the gold mine near Bad Throat, Lake Winnipeg, is shortly to begin.

IMMENSE fields of petroleum have been discovered seventy miles north of Fort Saskatchewan.

THE proprietors of the Cliff mine, at Trail Creek, B.C., refused last week the sum of $80,000 for their interests.

DRILLING is going on for a new mineral spring at Preston, Ont., where a $10,000 bath house will be erected.

R. BRADSHAW, of Lindsay, Ont, has located a number of rich deposits of mica in Haliburton and Galway townships.

BRITISH COLUMBIA mining districts are being troubled with "claim jumpers," several valuable claims having of late been "jumped."

THE Ingersoll Rock Drill Company of Montreal are putting in an air compressor for the New Glasgow Gold Mining Company at Goldenville, N.S.

INSPECTOR of mines Dick has reported a five and a half foot seam of coal in the new shaft at Union near Nanaimo, B.C., at a depth of 270 feet.

THE Cariboo Gold Fields, Ltd. (foreign) has been registered, with a capital of £100,000. The head office is situated in England. —*B.C. Commercial Journal.*

DRILLERS at Sherkston, Ont, are over 3,000 feet down, and have found no gas. They expect to strike the granite at any time, which will stop the drilling.

AN explosion of gas occurred on the 16th April at No. 1 colliery of the Dominion Coal Company. Of forty men in the pit, all but two were rescued.

HUGH LEONARD shipped 400 tons of chromic iron from his mines at Little St. Francis, Que., to Liverpool, England, recently The ore yielded 50 per cent. pure iron.

AT the I. X. L., adjoining the O. K. Trail Creek, B.C., Mr. I. N. Knight collected some of the rock and pounded out in a mortar $312 in half a day. He is now shipping ore.

THE town of Alexandria, Ont., is having an artesian well bored for the purpose of obtaining a water supply from that source. Wallace Bell, of Montreal, is doing the boring.

THE shipments of ore from Trail Creek mines for 1894 aggregated 2,341½ tons, while the output for January and February this year was 1,011½ tons.—*B.C. Commercial Journal.*

THE dividends paid by B.C. mining companies in Spokane during the month of February were over $48,000. The Cariboo $8,000, Le Roi $8,000 and the War Eagle over $32,000.

THE Redando iron mines, Redando island, B.C., and the Glen iron mines near Kamloops, have been bonded by an American firm, who are negotiating to establish iron works near Seattle.

THE Gertrude Gold Mining Company was recently organized in Spokane, Wash. The capital is $500,000. Its purpose is to own and operate mining properties in the United States and British Columbia.

AT the No. 1 mine, in Ainsworth district, the concentrator is turning out four tons of concentrates a day, the supply of water being insufficient. The shipments of carbonate ore will average about five tons a day.

THE Londonderry, N.S., Iron Company's plant has been overhauled and put in good condition. The blast furnace has been rebuilt on improved lines, and is now 75 ft. high and 18 ft. wide. It was lighted up early last month.

CAPITALISTS are enthusiastic over the Rainy Lake gold fields, and after three weeks prospecting two capitalists and a mining expert returned with six trunks full of gold bearing rocks, and deeds to $250,000 worth of property, bought in the region.

FROM the Reco mine, in Slocan district, B.C., were shipped 305 tons of ore since last fall, one 20-ton lot of which netted $8,969.23 after deducting freight, duty and smelting charges. The 305 tons will net about $45,000, which will leave nearly $27,000 after paying all expenses of the mine.

A LARGE party of capitalists from Paris, France, is on its way out to Cariboo, B.C., by the C.P.R. It is understood to be composed of some forty or fifty Frenchmen, and arrangements on a most luxurious scale are said to have been made for their camps after leaving the railway.

THE Standard Oil and Gas Co. (Ltd.), of Essex, have appointe the following officers: President, Cameron Currie, vice-preside and general manager, E. E. Harris; secretary, A. H. Clarke treasurer, J. B Moore. General offices, Windsor, Ont.

THE Finch Mining and Dredging Co., of British Columbia who are claimed to be really the first to demonstrate the practicability of dredger mining, from March 21st to 29th cleaned up 50½ ounces of gold, valued at $909. Deducting government tax and expenses, the net profit was $732 for seven days.

THE Ontario Natural Gas Co. have decided to at once lay a second pipe from the wells to Windsor, and arrangements have been made with the Detroit Gas Light Co. to lay a third pipe over the river. They will also resume pipe laying in the direction of Sandwich.—*Amherstburg Leader.*

THE Montreal Hydraulic Gold Mining Co., of Cariboo, Ltd., has been registered, with a capital stock of $250,000; trustees are P. A. Peterson and John Kennedy, of Montreal, and F. C. Innis, J. M. Browning and S. O. Richards, of Vancouver. The head offices are at Vancouver.—*B.C. Commercial Journal.*

BOTH the War Eagle and the Le Roi (near Rossland, B.C.) are looking to be veritable bonanzas, the bottom of the shaft in the Le Roi being all solid ore. On the face of the west drift at the War Eagle three parties of drillers are at work. The new tunnel on the 112 foot level is in 30 feet.—*Nelson Miner.*

THE summer school of science for high and public school teachers in connection with Queen's University, Kingston, will open on the 10th July. Chemistry, mineralogy, geology, botany, etc, will be embraced, and the mining department will be open for courses of lectures.

THE Fossil Flour Co., of Portland, hope soon to have the plant in operation near Great Village, N.S. It will take ten years to use up the deposits at Castlereigh Lake. The silica will be refined at the lake and taken by railroad to Bass River landing, and there shipped to Portland. David Collins is manager.

THE Natural Gas and Oil Company of Ontario has been incorporated, with a capital stock of $500,000. The stockholders are: Sidney Arthur King, of Kingsville; Gordon Joseph Leggatt, of Windsor, and Thomas Reid, Chandler Walker and Hiram Walker, all of Walkerville. The objects of the company are to sink gas and oil wells, and to manufacture and use natural gas and oil.

DREDGING for gold in the Fraser has been demonstrated as practicable by the Finch Dredging Company. In seven days with one pump they cleaned up $909. This is good news for the province, for there are half a dozen well equipped dredging companies getting ready to dig for gold in the bottom of the rivers of B.C., and if they are successful their number will increase tenfold in another year.—*B.C. Commercial Journal.*

A. P. Low, of the Geological Survey, reporting his recent explorations in Labrador, says there are immense beds of iron ore found spread over large regions. The ores are chiefly specular and red hematite, with beds of siderite or carbonate of iron. Thick beds of fine ore, associated with jasper, were met with in many places, both on the Ungava and Hamilton Rivers, and the amount seen runs up into millions of tons. Owing to their distance from the seaboard these ores are at present of little value.

THE Broad Cove, N.S., Coal Company, in the person of the managing owner, Wm. Penn Hussey, of Boston, is petitioning the Nova Scotia Government to allow the first 300,000 tons of merchantable coal mined at Broad Cove to be sold free of royalty, or, if preferable, a cash subsidy of $30,000 instead. The company are also asking the Dominion Government for a money subsidy of $50,000 and the services of Government dredges to open up the channel and prepare for foundations at McIsaac's Lake, Broad Cove, which is contemplated to make a harbor of refuge and shipping port.

AT the annual meeting of the Ontario Mining Institute last month in Toronto, the following officers were elected: President, James Conmee, M.P.P., Port Arthur. Vice-presidents, James McArthur, Canadian Copper Co., Sudbury; Ian Cameron, Dominion Mineral Co., Sudbury; Peter McKellar, F.G.S.A., Fort William, and J. J. Kingsmill, Q.C, Toronto. Council—A. Blue, director of mines, Toronto; Dr. Coleman, school of practical science, Toronto; Dr. Goodwin, school of mining, Kingston; Prof. Nicol, school of mining, Kingston; R. W. Leonard, C.E., Kingston; W. Hamilton Merritt, A.R.S.M., Toronto; J. F. Latimer, Toronto; T. Shortiss, Toronto; T. D. Ledyard, Toronto. Treasurer—T. W. Gibson, bureau of mines. Secretary—B. T. A. Bell, Ottawa. The report showed an increase in membership of 49.

THE Fort William *Journal* says:—The first big deal in the Rainy Lake gold region has been concluded. It covers the sale of some eight sections near the Hillyer and Wiegand properties between Bad Vermillion and Shoal Lakes. The amount paid is said to be $250,000. Kelly-Mosher and Barclay are the sellers and J. J. McIntyre, of Niagara Falls, a paper manufacturer, and D. W. Pelton and Geo. L Potts, of Appleton, Wis, are the purchasers. The purchase was made on the strength of the reports of an old California expert. Dr. Thibodo, the company's expert, says the indications exceed anything he ever saw.

A CORRESPONDENT of the Montreal *Herald* writes from Sudbury: Few people believe in the divining rod as a means for locating mineral veins. In fact, it is generally regarded as a fake. But last fall two parties came here from Toronto to prospect in this way They had not only a divining rod, but also a new theory as to the mode of occurrence of the gold leads in this district. They maintained that the numerous small gold bearing veins on the surface were mere croppings of large mother lodes that had been covered over with lava flows and drift. They located several of such lodes, and in the most unlikely places. The old prospectors and miners laughed or shook their heads, and especially when the parties claimed to be able to tell the percentage of mineral in the ore and the exact depth of each lode below the ground. But in two cases, one near Markstay and the other in the township of Creighton, the diamond drill has proved, strange as it may seem, that they were not so far astray after all. In the one case they found gold and platinum at 160 feet from the surface, and in the other case free gold at a depth of 180 feet. These are undeniable facts. They say there is another large gold and silver lode on lot 4, cave 1, Denison, a few miles from the once famous Vermillion Mine.

Electric Flashes.

BELLEVILLE, Ont., has a new telephone service in prospect.

THE affairs of the Vankleek Hill Electric Light Co. have been wound up.

IT is expected that electric cars will be running in Berlin by May 30th.

A NEW and larger generator is to be put in at the Kingston, Ont., power house.

AN underground system of electric lighting is shortly to be introduced in Gananoque, Ont.

THE Council of Magog is in negotiation with the Dominion Cotton Co. to supply the town with electric light.

PREPARATIONS are being made to build the London, Ont street railway company's extension to Springbank.

THE Quebec Street Railway Company is seeking the privilege from the city to introduce on their lines the storage battery system.

THE London, Ont., Street Railway Company will probably rebuild their car house and repair shop in another part of the city.

THE contract for extending the N. B. Telephone from Moncton to Albert has been sublet by J. G. Forbes to I. N. Wilbur and S. Legere.

A COMPANY has been formed to construct and put in operation a telephone line connecting Florence, Croton, Dawn Mills and Thamesville, Ont.

THE first dynamo of 5,000 horse power was recently placed in position in the power-house of the Niagara Falls Power Co., and underwent a very satisfactory test.

THE bill concerning the Oshawa Electric Railway passed through the Ontario Legislature, and fifteen car-loads of rails are to be used in the construction of the road.

THE Owen Sound *Sun* declares that a railway between Owen Sound and Meaford is a necessity, and the only question is whether it should be electricity, gas, compressed air or steam.

THE Nanaimo, B.C., Electric Light, Power and Heating Co., Ltd., has been incorporated with a capital stock of $100,000. T. J. Jones, A. Lindsay and Joseph Hunter are trustees.

THE Hamilton Radial Electric Railway Co. has given notice that it will apply for an amendment to its charter to allow it to operate the Guelph and Berlin branches by either steam or electricity.

AS the result of conferences with the North Grimsby council it is probable the Hamilton, Grimsby & Beamsville Electric Railway Co. will extend its line to Grimsby Park on the lake shore this summer.

THE St. Thomas, Ont., Radial Electric Co. was incorporated last month.

AN electric railway, connecting Cow Bay with Dartmouth, N.S., is talked of.

THE Milton, Ont., Electric and Power Co has been incorporated with a capital of $15,000.

THE Three Rivers, Que., corporation wish to dispose of their electric light plant and offer it for sale.

THE Ontario Legislature has granted $4,500 in aid of the Midland & Penetanguishene Electric Railway project

THE Victoria School, Montreal, has been fitted with the Warner system of electric time, by Burt & Rousseau electricians, 36 Peel street, Montreal.

WALKERVILLE, Ont., is to cease to be lighted by electricity, and will rely upon natural gas for its illumination. The work of piping is now being carried on.

THE inhabitants of St. Rose and St. Martin, Que., have offered the Montreal Park & Island Railway special privileges to extend their electric railway to those towns.

THE Dunnville, Ont., Electric Light Company, Ltd., are about to build a 200 h.p. power-house, and to instal an alternating incandescent light plant of 1,000 sixteen-candle power.

THERE is a report that the C.P.R. will build an electric tramway from the Three Forks, B.C., to Sandon and Cody Creeks, B.C. It is said this would have a most beneficial effect on rates.

W. H. NOLAN, agent for the Robb Engineering Co. in Montreal, has received an order for another 80-horse power Robb-Armstrong engine to be added to the electric plant of the Board of Trade building.

AT a meeting of the British Columbia Board of Trade, held on April 11th, the desirability of securing telegraphic communication with the American lines was discussed, and favorable results are looked for.

THE extension of the Galt and Preston Electric Railway to Hespeler will be proceeded with this month. A freight car is to be added to the rolling stock. The contract went to the Canadian General Electric Co.

A CURIOUS incident occurred in Brantford, Ont., recently. A spider got inside a converter and established a short circuit, breaking the connection, and thereby cutting off a large portion of Brantford from its share of the electric light.

TENDERS are called for by the Listowel town council for lighting the town with electric light. Fourteen arc lights of from 1,500 to 2,000 candle power will be asked for. The tenders were to be in by 1st May, and the plant ready for operating by 1st July next.

IT has been found necessary to plate electric wires with tin in order to avoid the injurious effect which the sulphur in vulcanized rubber has upon the copper. It is then insulated with unvulcanized rubber and the whole covered with vulcanized rubber.

THE Hamilton Electric Light and Power Co have offered to continue the street lighting of the city at $91.25 per lamp per year, and the *Herald* thinks it probable that "the hypnotized council will conclude another bargain with the company," instead of establishing a civic lighting plant.

AT a recent meeting of the waterworks committee of Hamilton it was decided to recommend the city engineer's plan for increasing the water pressure, that is, the building of a new reservoir. The plan provides for the reservoir to be put on a higher level than the present one in Barton township, and a new set of pumps would be erected at the Beach.

THE Westminster and Vancouver Tramway Company's property was sold at auction recently, and was bought in by Frank Barnard, M.P., for $280,000. It is understood that he represented the Consolidated Electric and Light Company of Vancouver. The sale took place to satisfy a writ of the Supreme Court of B.C. in the suit of the Bank of British Columbia against the company.

WORK has been commenced at Lewiston, N.Y., on the new electric railway between that place and Niagara Falls. It is expected to be finished about July this year, and will be a formidable competitor to the Niagara Falls Park and River Railway on this side, for the reason that tourists will use both roads on making the round trip, which will reduce the fare one-half to each line.

THE chief engineer and the harbor master of the Montreal harbors works have made a joint report against allowing the Belt Line Railway to run along the wharves. It would take away much valuable ground, with the costly work upon it; would injure all the wharves by reducing their breadth, and would practically destroy the usefulness of some of them.

AT a meeting of the creditors of the Kay Electric Works, of Hamilton, held on the 1st ult., a statement was presented as follows: Assets, $5,367.66; preferred liabilities, $1,331.57; unsecured liabilities, $6,472.70. F. M. Wilson, the assignee, was instructed to sell the estate, which was accordingly done to John S. Job for $3,000. Mr. Job is continuing the business under the old style.

PLANS have been prepared in Montreal for utilizing the water power of Lachine rapids. It is proposed to construct a dam of 3,500 feet, parallel with the shore at an average distance of 500 feet from the city shore. A cross section will be built connecting the shore with the dam, and a power house constructed on this containing seventy-two turbine wheels and twelve dynamos of 750 horse power each.

THE Toronto Street Railway Company are fitting all their cars with improved electric dash lamps, and intend putting in a signal system for the purpose of distinguishing the different routes at night. These improvements are being supplied by Noah L. Piper & Son, Toronto. The illumination of the cars will be very much improved when the company put in ten electric lamps in each car, as they purpose doing.

JOHN STARR, SON & Co., manufacturers of electrical supplies, Halifax, N.S., are meeting with excellent success with their "Unique" telephones. They are giving satisfaction wherever used and a large number have been put up both in Canada and the United States. As an evidence of their efficiency we may mention that the Imperial War Department at Halifax have adopted them after careful competitive tests, and are now equipping their forts with these fine instruments.

THE failure of J. Ross & Co., manufacturers of insulated wire, Montreal, is recorded. The following were the creditors:—Dominion Wire Manufacturing Co., Montreal, $2,589; Alex. G. F. Ross, Montreal, $356; Frothingham & Workman, Montreal, $254; Alex. Walker, Montreal, $250; Wallace & Sons, Ansonia, Conn., $2,000; La Banque Nationale, Montreal, $3,600; G. H. Kendell & Co., Montreal, $716; Dame M. Ross, Montreal, $514; Dominion Cotton Mills Co., Montreal, $516; J. P. Cooke, Montreal, $221; Washburn & Moen Manufacturing Co., Worcester, $650; B. J. Pettenet (rent), Montreal, $200.

A GANANOQUE correspondent writes: The gentlemen who have had the formation of an electric company under consideration for some time, have decided to go ahead. The new company will be a strong one, backed up by New York capital. The plans have not just yet been decided upon, except that the power will be supplied by a 400-horse power compound triple expansion marine engine. The reason for getting the upright engine is to avoid the use of belts. The wiring of the town will be under ground. The company have now orders for over 500 lights, which they expect to be able to supply by fall, with doubtless many more, as they will in all probability get a large patronage, their prices being only about half that at present paid by users of the electric light in town. The company intend in time, should everything prove satisfactory, to extend their line from the town east, taking in the villages of Lansdowne, Mallorytown and Lyn to Brockville.

Personal.

WM. CROSS, engineer of North Toronto, has withdrawn his resignation.

WM. MURDOCK, C.E., of St John, N.B., has been appointed city engineer of that city.

A. J. KAMMERER, of the Royal Electric Co., Toronto, was in Montreal for a few days this month.

H. S. POOLE, of Stellarton, N.S., has returned home from Egypt, where he has been for a year.

J. R. WHITE has been appointed secretary-treasurer of the Montmorency, Que., Electric Light and Power Co.

THOS. GRAHAM, the new chief of the Toronto fire brigade, paid a visit of enquiry to the Montreal fire department.

JOHN E. HARDMAN, of Halifax, a well-known mining engineer, was married last month, at Ottawa, to Miss Lizzie McCarthy.

W. G. KINNEAR, late assistant engineer of the M.C.R., is now chief engineer of the Toronto, Hamilton and Buffalo Railway.

JAMES CLARKE, who for several years past has held a position with John Bertram & Sons, Dundas, Ont., has been appointed manager for the Ontario Peat Fuel Co., Toronto, in the works at Welland.

D. D. Wilson, of Toronto, inventor of the Kingston chemical fire engine, has retired from the position of manager of the company.

Architect J Alcide Chausse, 153 Shaw street, Montreal, has opened a branch office at No. 2140 St. James street, St. Henry, Que.

John F Paterson, late engineer at the cotton factory of Wm. Parks & Son, Ltd., St. John, died last month of heart disease, aged 67.

A. F. Wise, superintendent of the Rideau Canal, died last month. The vacancy will probably be filled by M. K. Dickinson, of Kingston.

J. A. Marion, Montreal, was the only one out of seven candidates who passed the recent examination as provincial land surveyor in Quebec.

Charles Mainwaring, of Stratford, Ont., the G.T.R. engineer who received such terrible injuries in the wreck at Weston, Ont., died on April 18th.

F. H. Badger, jun., manager of the Montmorency, Que., Electric Power Co., has returned from an extensive business trip to the United States.

Capt. Baquet, of the well-known old Gulf steamer "Miramichi," will this year command the "Campana," which is to be put on the St. Lawrence and Gulf route.

M. S. Davys, C.E., of Nanaimo, B.C., has been appointed manager of the "Silver King" mine, near Nelson, Mr. Jordan, the former manager, having returned to England.

Edward C. French, who till within the past three months represented the Babcock & Wilcock's boiler company in Canada, died somewhat suddenly at Deseronto on the 19th April.

S. E. Peters, of the office staff of the Record Foundry and Machine Company, Moncton, was married in Boston last month, to Miss Emma, only daughter of H. W. Peters of that city.

Francis Northray, engineer at the high-level reservoir pumps, Hamilton, dropped dead on the 5th April, while at work. He was 77 years of age and had been in the employ of the city for fourteen years.

The Toronto Trades and Labor Council have strongly recommended Miss Jessie Hepburn for the position of female inspector of factories in Ontario. Her literary ability and facuity for organization are highly spoken of.

The death is announced of Mr. John Sutcliffe, C.E., at his residence, 391 Victoria avenue, Westmount (Cote St. Antoine), Que. The deceased was a native of Liverpool, Eng., and was inspector of the Lachine Canal enlargement works.

Simon Peters, vice-president of the Quebec and Lake St. John railroad, and a prominent contractor, head of the firm of Peters, Moore & Wright, who built the Princess Louise embankment, died on the 26th April, aged 80, after only a few days' illness.

John Johnson, who for ten years previous to the union of St. John and Portland, N.B., was chief engineer of the Portland Fire Department, dropped dead in a tobacco store on the 23rd April, while in the act of blowing his nose. The deceased was 63 years of age.

The death is announced at Lachine of Captain Charles Leger at the age of eighty. The deceased was intimately acquainted with the navigation of the St. Lawrence. He took a deep interest in the improvements suggested for the harbor of Montreal, and especially for the prevention of floods. He had a scheme which consisted in breaking up the ice of Lake St. Louis by erecting piers for preventing it from coming down with a rush and filling the harbor.

W. H. Jeffery, the well-known mine owner, died at his residence, Newhurst Grange, Richmond, Que., on the 14th April, at the age of eighty-five. The deceased gentleman was born in England and came to this country sixty years ago. His life was a most active one, and was marked with some bright successes and some reverses. He was one of the first to recognize the importance of the mineral asbestos, and for some years worked the mine near Danville. Mr. Jeffery leaves a large family.

J. L. Whatley, secretary of the Standard Drain Pipe Co., of St. John's, Que., has been missing since about the 5th April, and his disappearance is still a profound mystery. He has many friends, who are entirely at a loss to account for his absence, but it is thought he may have gone to the Old Country. He was a cultivated man of quiet habits, and there was nothing in connection with the business to cause him to leave. He was about 50 years of age, tall, well built and wore a long iron-grey beard.

Owing to the general advance in the price of hides, the manufacturers of leather belting in the United States raised the price of belting last month 20 per cent. Owing to the same causes prevailing in Canada there has been an advance in Canadian belting of 20 to 25 per cent. this month. The rise in the price of hides in Canada amounts in some cases to 50 per cent., so that, considering the depressed state of the belting trade for the past year or two in this country, such an advance has been an absolute necessity.

The Patent Review.

46,711 C. Kelley, Toronto, combined air trap and valve for water closets.
46,712 H. A. F. Peterson, Milwaukee, Wis., underground conduit system for electric railways.
46,713 Bell Telephone Company of Canada, multiple telephone.
46,721 A. W. Schwarz, Leipzic, Saxony, rock blasting.
46,723 W. P. Carstarphen, Denver, Col., electrical tool.
46,725 H. D. Symmes, St. Catharines, Ont., automatic electric speed regulator for dynamos.
46,729 J. H. Smith, Plymouth, O., rock drill.
46,732 C. R. Fletcher, Boston, Mass., production of alloys by electro-decomposition.
46,735 O. Frolich, electric meter.
4 Alex. Philipsborn, Berlin, Germany, electro locomotive.
46,737 A. Philipsborn, Berlin, Germany, electro motor car.
46,740 R. Callender, Brantford, Ont., electro motive device.
46,741 Jean F. and Joseph Chazotte, Montreal, incinerator.
46,742 R. J. Flynn, Boston, Mass., steam trap.
46,743 A. Davis, Montreal, incinerator.
46,747 A. Worner, Budapest, Austria-Hungary, electric railway trolley.
46,749 W. Biddle and P. Kennedy, Brooklyn, car lighting apparatus.
46,751 Thos. Craney, Bay City, Mich., electrolytic apparatus.
46,752 J. H. Eickershoff, Cincinnati, O., steam engine.
46,753 F. Hoch, Wauwatosa, Wis., cable street railway.
46,754 J. C. Brown, Santa Barbara, Cal., nut lock.
46,756 C. S. English, Lovell, Mich., electrical governor for water-wheel.
46,760 Fowden Printing Telegraph Co., Trenton, N.J., printing telegraph.
46,764 and 46,765 H. H. Eames, method of and apparatus for treating ores.
46,768 M. T. Pupen, New York, method of and apparatus for electrical transmission.
46,770 W. D. Scott, Moncrieff, Westminster, London, Eng., treatment of and apparatus for treating sewage.
46,773 Geo. A. Hoffman and Max Friedlaender, Berlin, Germany, railway rail joint.
46,837 F. H. Sleeper, Coaticook, Que., alternating current generator.
46,838 D. Seibert, sr., Petoskey, Mich., eccentric spring motor.
46,839 B. A. Seaton, Rochester, N. Y., electric railroad signal.
46,840 H. S. Pell, Toronto, pulley.
46,841 P. Black, Kilburn, London, Eng., apparatus for moving and locking railway points and safety bars
46,842 J. H. Bozlett, Poughkeepsie, New York, detector bar for switches.
46,843 Electric Selector and Signal Co., New York, electric block system.
46,844 W. Meisner, Konigsberg, system of electrical distribution.
46,845 C. A. Hussey and C. C Edey, rheostat.
46,847 Ries & Henderson, Baltimore, Md., method of propelling vehicles by electricity.
46,850 L. Lavergne, Montreal, street gully.
46,851-52, New York Car Switch Co., New York, railroad switch.
46,854 S. W. Summers, St. Louis, Miss., combined car and air brake coupler.
46,855 L. Ballback, Detroit, Mich., thill coupling.
46,856 T. Craney, Bay City, Mich., furnace grate.
46,860 N. B. K. Hooffman, New York, air brake.
46,865 C. A. Christin, Ottawa, car brakes.
46,870 Patent Telephone Indicator Company, indicator.
46,872 O. Flohr and F. C. Loh, Buffalo, N.Y., car coupler.
46,878 A. McKay, Vancouver, B.C., saw mill.
46,883 J. M. Boudrie and T. McManus, both of Rulo, Neb., steam shovel.
46,888 Thos. Cooper, Great Ryburgh, England, steam engine.
46,895 Chas. F. Churchill, Melrose, Mass., metallic piston rod packing.

AMERICAN PATENTS.

The following is a list of patents recently granted in the United States to Canadians This list is specially furnished to THE CANADIAN ENGINEER by H B. Willson & Co., Washington, D.C.—

Jared H Beamer, assignor of one-half to W. P Ryan, Brampton, Ont., machine for cleaning and polishing fruit.

Edward E Horton, Toronto, tire.

Charles J. Stuart, Montreal, projectile.

Henry M. Childs, Montreal, egg case.

Thomas Harold, assignor of one-half to J. McColl, Vancouver, B C., adjustable panel mitre-box.

Charles L. Higgins, Montreal, footwear.

Samuel Hughes, Lindsay, Ont., heating and ventilating railway carriages.

James T McCabe, Toronto, assignor to McCabe Manufacturing Co., support for travelling hangers for step-ladders.

James T. McCabe, Toronto, assignor to McCabe Manufacturing Co., door hanger.

Walter Rowlands, Montreal, railway switch stand

Joseph A. G. Trudeau, Ottawa, electric current transformer.

Oliver W. Ketcham, Toronto, hydraulic press.

Nelson Lampman, Woodstock, brake for railway cars

Michael J. Moran, St. John, N.B., chimney cowl or ventilator

Thomas Parker, assignor of three-fourths to J. D. Wright and A. M. Colquhoun, Toronto, brick press.

Robert D. Robbins, Port Perry, Ont., assignor, lawn mower.

Robert S Anderson, Toronto, pneumatic tire for bicycles.

Alexander Barhite, Toronto, assignor, road-grading machines.

Edmond H Casgrain, Quebec, apparatus for casting metals.

Edmond H. Casgrain, Quebec, vulcanizer.

Thomas C Edwards, Chatham, sad-iron.

George W. Green, Kingsville, assignor, bed-brace

Wm. B. Hamilton, Toronto, printing form.

Newman H. Holland, Montreal, automatic telephone-switch

Stephen S. Kimball, Montreal, street-car fender.

Samuel Knighton, assignor of one-half to C. E. Kavanagh, Winnipeg, band-tie

William Kyle, Brockville, Ont , torsion-spring gear for vehicles

John R. Meadowcroft, Montreal, valve.

John Velie, Winnipeg, cooking utensil

Alexander Barhite, Toronto, excavator.

John W. Hallman, Toronto, assignor, composition for melting snow.

William H. Emerson, assignor of one-half to M. Campbell, Chatham, elevator-cup attachment.

John D. Howe, St. John, N.B., chair.

Reuben T. Morehouse, Sandy Cove, N.S., assignor of one-half, instrument for obtaining altitudes at sea.

RECENT GERMAN PATENTS.

Compiled at the Patent and Technical Office of Brockhues & Co., Cologne Information on all questions referring to this list is given gratis to subscribers of THE CANADIAN ENGINEER.

Otto Hentschel, Gümma, in S., machine for washing, steeping and germinating grain.

Dr. Friedr. Hoffmann, Berlin, artificial fuel.

Heinrich Hüttenrauch, Linden, Hanover, switch with automatic motion for an alternating direction of cars for tramways.

Rud. Lamarche, Hamburg, apparatus for automatic disinfection of the mouthpiece of telephones.

F. G. Berg, Düsseldorf, gas stove with storage of heat.

C. Weiss, Hanover, pliable wooden wall.

Gust. Martens, Geestemünde, seine, with arrangements for allowing the smaller fish to escape.

F. Schotte, Berlin, process for making iron alloys.

Friedr. Siemens, Dresden, safety cock for gas-heating stoves.

Noe Berlin, jr , Cologne, cylinder caps, influenced by the gas cock, for incandescent gas lamps.