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The Canadian Engineer

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CONTENTS OF THIS NUMBER:

HYDRO-GEOLOGY AND HYGIENE.*

BY C. E. DE RANCE, OF H.M. GEOLOGICAL SURVEY.

The term hydro-geology, to express the study of the passage of water when, as rainfall, dew, or snow, it reaches the surface of the ground, or percolates beneath it, appears to the writer to deserve more general acceptance than has been accorded to it. It appears to have first been used by a French Jesuit priest about half a century ago, and was adopted by Mr. Lucas in his studies on the chalk-water supply of the south of England 20 years since.

A Lancashire squire, one of the Townleys of Townley, near Burnley, appears to have been the first to systematically observe the amount of rain falling more than 200 years ago; a century later, in 1766, a rain gauge was placed on the top of the square tower of Westminster Abbey by Dr. Heberden, F.R.S. Early in 1861, G. J. Symons, F.R.S., began his magnificent organization; his modest pamphlet of four pages of that year, with 168 observers, has now blossomed into a volume of 254 pages, with a staff of 3,043 observers. Looking to the bearing of the inquiry on manufacturing, engineering, agricultural pursuits, and the health of the inhabitants, it is remarkable that such an investigation should be left by the nation to the self-abnegation and industry of this remarkable voluntary effort. Mr. Symons' annual volume is a record of the nation's "Water Revenue," on which depends the amount available to be consumed by men and animals, to be absorbed by agricultural crops and forests, or utilized in manufacturing processes, purposes of inland navigation, the production of steam and electric energy, and the preservation of fisheries. From the amount recorded, large amounts have to be written off from several causes, which probably vary from year to year: (1) Evaporation, which is governed by the comparative dryness or wetness of the air at the moment of the rainfall; (2) the amount percolating, which varies also according to the comparative dryness or wetness of the soil, in dry periods vegetation taking up a very large proportion, and, indeed, after long periods of drought the whole of the volume percolating is so arrested, and none sinks to replenish the underground storage; and (3) lastly, there is loss from transit of percolation water into areas where the supply cannot be obtained by pumping. This is the case when the sectional area of a porous rock, where it dips and disappears beneath overlying impermeable material, is sufficient to discharge the water into outside areas—*i.e.*, tidal rivers on the sea. Of the rainfall that is absorbed by the area of outcrop of the porous rock, nothing goes into the streams until rainfall additional to the amount that runs to waste causes the saturation level in the porous rocks to rise above the level of the V-shaped valleys which intersect it, and in the case of dry valleys, a "bourne," or temporary stream appears.

Before dealing with the loss to be "written off" the annual "water revenue" falling as rain on impermeable rocks, it is desirable to state some facts as to the comparative area occupied by various classes of rocks and their varied degree of porosity. If a geological map of England and Wales and a hydrographical map showing the rainfall be compared, it will be at once seen that the hardness of the Lower Palæozoic rocks has caused them to form the three highest areas, viz., Dartmoor, the Welsh and Cambrian mountains. These receive the highest rainfall, and as they almost wholly consist of impermeable material, they throw off the rainfall in floods, and are drained by rivers in which the flood discharge and the dry-weather flow is utterly disproportionate. Were it not for the arresting influence of peat mosses these streams would in dry periods be still more insignificant. The discharge is often 500 cubic feet per second per 1,000 acres drained in flood, and only ¼ cubic foot off the same area in dry periods. Probably one-third of the annual rainfall runs off in floods, and unless it is caught in storage reservoirs, such as Manchester and Liverpool have made, and Birmingham is making, the whole of the water for potable purposes is lost, as it becomes polluted as it passes to the sea; and to a large extent it is lost for all purposes, as the flood is sudden, the flow great, and the gradients of the river bed steep, and all that is not caught must be written-off for "depreciation caused by floods." It is fortunate for the centres of large population in this country that, from the conditions of life directly produced by the geological character of the elevated areas referred to, they are areas of the least population in England and Wales, and, except to a slight and unimportant extent, due to mining, no pollution of these upland waters takes place. Further, the very important ad-

*Paper read before the British Association of Water Works Engineers at Nottingham, July 21, 22 and 23, 1896.

vantage accrues that the land is of little value, from the absence of manufacturing population and the pastoral character of the agriculture, causing the legal difficulties to be comparatively small, which in the case of large reservoirs near and in populated areas are such as to practically commercially preclude their construction.

Of an intermediate class are Millstone Grit moorlands forming the Pennine chain and much of Northumberland and Durham; there is generally a series of porous grits and sandstone alternating with beds of very impermeable shale, and the water that percolates into the former is supported by the latter and thrown out as springs, which when delivered in the same drainage area, permit a catchment reservoir to collect not only the flood water, but the percolated water, and make available in the case of the Manchester (Longdendale) and Liverpool (Rivington) works no less than 33 in. out of a total average dry year fall of 45¾ in. In these cases the temporary absorption, storage and delivery of the underground water form practically storage reservoirs, delivering a dry weather flow of pure spring water. In these cases, on the Millstone Grit moorlands, unlike the Silurian unpopulated areas, a teeming manufacturing population has insisted on Parliament compelling those who constructed waterworks to form large compensation reservoirs, often to the extent of the whole of the flood water passing down, and there is no doubt that mill owners have largely benefited by the regular supply afforded them instead of the capricious volume governed by elemental conditions; and in many cases the conditions exacted are far too onerous, and point to the necessity of the formation of a water board in each important catchment area, selected by members of the county councils and county boroughs forming such areas, so as to give power of control from the source of each stream to its outfall. Parliamentary relief should be given from the penalty clauses of "compensation in bulk" when it is the opinion of the water board (hereafter suggested) that a corporation has done all that could be reasonably expected, and corporations should be no longer compelled, after their compensation reservoirs are exhausted, to supply millowners with pure spring water, whilst human beings have to be put on short supply.

The amount of "average flow" of a stream will be found to be far below the volume that would be yielded by a third of the annual rainfall, and the disparity is still greater when the "dry-weather flow" of the stream is compared with a daily average of one-third of the annual rainfall, pointing to the necessity of regulating the floods, which inflict a threefold loss—first, by destruction of property in the lowlands; second, by depreciation of the value of agricultural produce and by the stoppage of manufacturing processes; third, by the loss of vital energy and the premature death of those whose business and occupations compel them to live in areas subject to floods.

When the far-reaching influence of uncontrolled water is studied, the constant drain that is made by floods on the health, life, and wealth of the kingdom will be realized, and the necessity of sweeping away the conflicting authorities that have control over our river basins admitted; these at present are multifarious in number, antagonistic in character, and often injurious in effect. The river Witham and its chief tributaries, for instance, is under the jurisdiction of 17 separate authorities, without including the various drainage commissioners of the Fenlands, that would bring up the number to 40; while the river Nene, according to the late Sir John Coode, on only 30 miles of its course, between Peterborough and the sea, is over-ridden by no less than 14 authorities.

Mill and navigation works affect rivers chiefly through weirs, obstructions fixed across a stream, with a view to prevent water passing on until it has attained a certain head; that height attained, its surplus water passes over the weir, in times of ordinary flow, with a more or less considerable fall. Landowners require a uniform top-level, neither too high to flood the meadows nor too low to deprive them of moisture. Navigation requires the water to be penned back to make the upper reaches navigable, whether the land below suffers or not; whilst fishing owners maintain their right at their own convenience to raise the top water to its highest limits, and then suddenly to depress it to its lowest limits, so that the fish may be caught in receptacles placed on the weir. Water users pound up the water to obtain increased fall and volume, and draw it off by a mill-race, discharging it at the mill-tail; the water is often allowed to pound up the mill-head until it backs up the mill-tail of the works above, no thought being taken of the requirements of the works above and below, "flashes" of water being passed on without any consideration whether the works below can use it or not. The burden of all Royal Commissions on this subject, and the consensus of opinion of all our eminent water engineers, is that without central control these varied interests cannot be reconciled. Weirs, properly constructed, would offer no obstruction to land drainage, but to carry this out the body exercising power over the river requires to be armed with the authority of drainage commissioners, so that in all cases districts receiving waters from above should have the corresponding rights of discharge into the districts below.

Applying these facts to that portion of the British Isles that have come under the jurisdiction of the Local Government Act of 1888, calling into existence the county councils of England and Wales, it appears to be necessary that there should be one authority for each river basin, with absolute control over its waters from their source to their tidal outfall, that such authority should be selected from or nominated by the county council of the county or counties forming the river basin, the number of representatives on the board being regulated partly by the rateable value of the portion of the river basin in the county in question, and not solely by its area.

Looking to the fact that the water used in this country for manufacturing and other trade purposes is so largely in excess of that required for drinking purposes, and that the value of a large area of land is in direct proportion to its facility of giving the water required by industry, it is inexpedient that there should be any interference with the riparian rights of ownership, now exercised by lords of the manor, so long as such rights do not interfere with the public good. The control of these rights might be safely left in the hands of a body acquainted with local requirements, appointed by the county councils, as suggested. Such a representative board would be able to benefit landowners far more than they could benefit themselves; having control of the whole of the river gradient from its source to its outfall, they would be able to maintain our rivers at sufficient average minimum height to insure a free arterial drainage, and the regulation of floods at a sufficient maximum height to originate hydraulic energy when required, and for the purposes of navigation. They could also insure sufficient purity to satisfy the requirements of water supply, manufacturing processes, and the preservation of fish.

Should a Water Board be appointed for each river basin, nominated by the county councils within that basin, before they commence their active operations, it will be necessary that the surveyor or engineer obtain for them reliable information as to the height of floods, and that the levels should be recorded on the 6-in. county maps of the ordnance survey. Such information would be greatly enhanced in value, if a record was taken daily of the height of streams on all the county bridges; such observations could be readily obtained if gauges were painted on them in white and black, giving the height in feet above the ordnance datum, of the mean sea level, to facilitate comparison, and the height of the water upon them was daily noted by the county constabulary on their ordinary rounds. At important points self-recording apparatus to ascertain the daily quantity of water carried down might be placed under the direct supervision of the board's official, who should organize a system of flood warnings by telegraph.

In the meanwhile much valuable information may be rescued from oblivion by observers, who will note the height marked by floods at important points, and the height in reference to the ordnance datum given, date and local circumstances recorded. If such a work were undertaken by the leading provincial societies, a valuable mass of facts would soon accrue. The author ventures to think it is also the duty of scientific societies to urge upon the Government the necessity of parliamentary power being given to the county councils, to sanction the small charge that would have to be made to obtain accurate water information, to fix gauges on the county bridges, to inaugurate a system of flood signalling, and to make such contributions, regulated by the area included, as would give funds for the inspection of rain gauges, and the tabulation of the averages of the rainfall of the district over which the board has control. Were such a mass of facts in existence, the Water Board, when appointed, would have a tangible foundation on which to improve their district, increase its wealth, and preserve the health of its inhabitants.

In the past parliamentary inquiries, though carried out with infinite patience and care by committees of both Houses, have been, and must ever be, liable to serious error, schemes being sanctioned that were impracticable, from old mines beneath reservoirs, causing fearful augmentation of local rates; of embankments that were in most unsuitable situations; of volumes of compensation waters ordered to be given out of all proportion to the supply to be obtained Even in enquiries of the Local Government Board on the spot important interests are often sacrificed by the facts, through the ignorance or apathy of the local authority affected by the proposals dealt with, not being disclosed—as in one case known to the writer, a sewage farm having been sanctioned on the site of springs dried up by the pumping of a public well of another local authority. Again, local authorities can often sink wells, on land they have bought, without a public enquiry of any sort, and in an instance in the writer's experience, they sank a well for an additional supply at a point where it was bound to draw on their own sewage farm, and eventually did so. In all these cases were Parliament to make it imperative that a preliminary local inquiry be held by the water board of the district, and they be requested to report their opinion on the merits of the case for the decision or inquiry of the Local Government, the dangerous results could not accrue.

The following table gives an approximate estimate of the square miles of each geological formation or group of such in England and Wales:—

Table giving an Approximate Estimate of Square Miles of each Geological Formation.

	Square Miles.	Hardness of Water. Deg.	
Tertiary	4,120	22.0	Bagshots permeable, Thanets partially.
Chalk	8,750	23.6	Permeable.
Greensand and gault	1,747	20.2	Gault impermeable.
Weald clay	664	27.3	Impermeable except banks.
Hastings sands	865	20.2	Permeable.
Oo'ites	6,671	24.4	Permeable and supra-pervious.
Lias	2,837	30.1	Marlstone partially permeable.
Trias	7,431	18.8	Marls impermeable.
Magnesian limestone	356	59.7	Permeable.
Permian marls and sandstones	858	..	Marls impermeable.
Carboniferous rocks	10,080	13.1	Alternating.
Carboniferous limestone	1,812	19.8	Permeable.
Old red Devonian, Silurian, Cambrian metamorphic rocks	11,062	2.5 to 12.0	Nearly wholly impermeable.
Granites	393	3	Occasionally permeable.

In the writer's work, "The Water Supply of England," London, 1882, he gives a hydro-geological map facing page 30, in which England and Wales are divided into four areas of geological formation, which for waterworks purposes may be given as follows:

1. *Pervious.*—Suitable for ordinary wells; pollution possible.

2. *Suprapervious.*—Suitable for artesian wells; pollution not possible.

3. *Partially Pervious.*—Suitable for artesian wells; pollution not possible; or for reservoirs, giving good dry-weather results.

4. *Impermeable.*—Suitable for reservoirs catching flood waters only; above limits of possible pollution.

The degree of porosity of a rock varies in direct ratio of the spaces between the grains of sediment of which it is constituted, the water being stored in the interspaces only, just as water may be stored in a tank filled with shingle, the quantity held varying from 0.185 of a gallon (a pint and a half) in a cubic foot content of granite to 1½ gallons in Bath oolite, and 2 gallons in chalk. Chalk and other limestones receive water with great rapidity, but part with it with exceeding slowness, there being a constant struggle between gravity and capillarity. It is important to distinguish between the amount of storage capacity and the actual volume annually absorbed from rainfall, the one appertaining to "water capital," the other to "water revenue."

When bands of permeable and impermeable rocks alternate, each porous band contains a separate sheet of water, which flows down the "dip planes" of the strata confined by the impermeable layers above and below. Such water flows with the "head," due to the difference of vertical level of the "area of outcrop" to that of the "area of discharge," less the frictional resistance of the fragments of the rock through which it passes. When the facilities for the discharge of a volume are less than the quantity capable of being received, the porous rock will be full up to the permeable layer above, which is invariably the case when all outlet is stopped by faults throwing in impermeable strata. Such porous rocks may be regarded as underground conduits, the depth of which is the thickness of the bed, the width of which is the extent of the outcrop or horizontal strata of its bed, and the inclination of which is the dip of the strata. When the outlet is blocked the saturation level remains unchanged, and unless water is artificially removed, so as to provide space for a fresh supply, no additional water can be added to the existing store. In wells and borings of the artesian class, in which the porous rocks absorb their supply in a distant area, the water rises to the height of the intake less loss from friction, and forms the artesian rest-level. The inclination of the water between several wells of this class gives the artesian gradient; heavy pumping may produce an "artesian pumping level," but not a true "cone of depression."

Pervious or permeable formations, by gradually absorbing waters which fall on the surface, and slowly percolate through them, act at once as filter-beds and as reservoirs, the capacity of which is limited by the area of absorption and the thickness of the pervious bed. When rain falls upon a pervious rock overlying impermeable deposits, the water-line is generally near the surface, and forms the "plane of saturation" which is found to be slightly above that of the deepest valley intersecting the water-bearing rock, rising toward the centre of the hill, varying within certain limits, being governed by the amount of previous rainfall. When wells are sunk into it, and excessive pumping takes place, the plane of saturation is artifically and locally lowered, and is known as the pumping level. After a few hours' cessation of pumping, the water rises to its original level, or nearly so; the point so reached is the "rest level." The difference between the "rest level" and the pumping level in some wells is as much as 100 feet. The area of exhaustion resembles an inverted cone, the apex of which rests on the point at which the pumps abstract the water, and the base of which is a circle at the surface around the well. If over-pumping takes place, the "cone of exhaustion" has to be enlarged; its vertical height increased by lowering the pumps to a lower level, and is followed by a larger concentric circle being added to the central one at the surface. At each successive lowering of the pumps a larger concentric circle of contribution is added to the original area of abstraction. Wells of this class are not artesian, and the water in them does not rise at pressure. In porous rocks of great thickness, the plane of saturation is often at a considerable depth from the surface, the annual rainfall absorbed being balanced by the springs running off at the lowest level, but little being collected from the floods, the water passing over the outcrop of the porous strata too quickly to sink into the strata. In these cases it would be possible to raise the height of the saturation level, increase the storage powers of the rock and the yield of the springs, by sinking "dumb-wells" into the porous strata, and draining storm water channels into them; in this manner the "floods" of wet periods might be collected and gradually distributed as "springs" during periods of drought, and the "dry-weather flow" of the streams increased.

(To be continued.)

For THE CANADIAN ENGINEER.

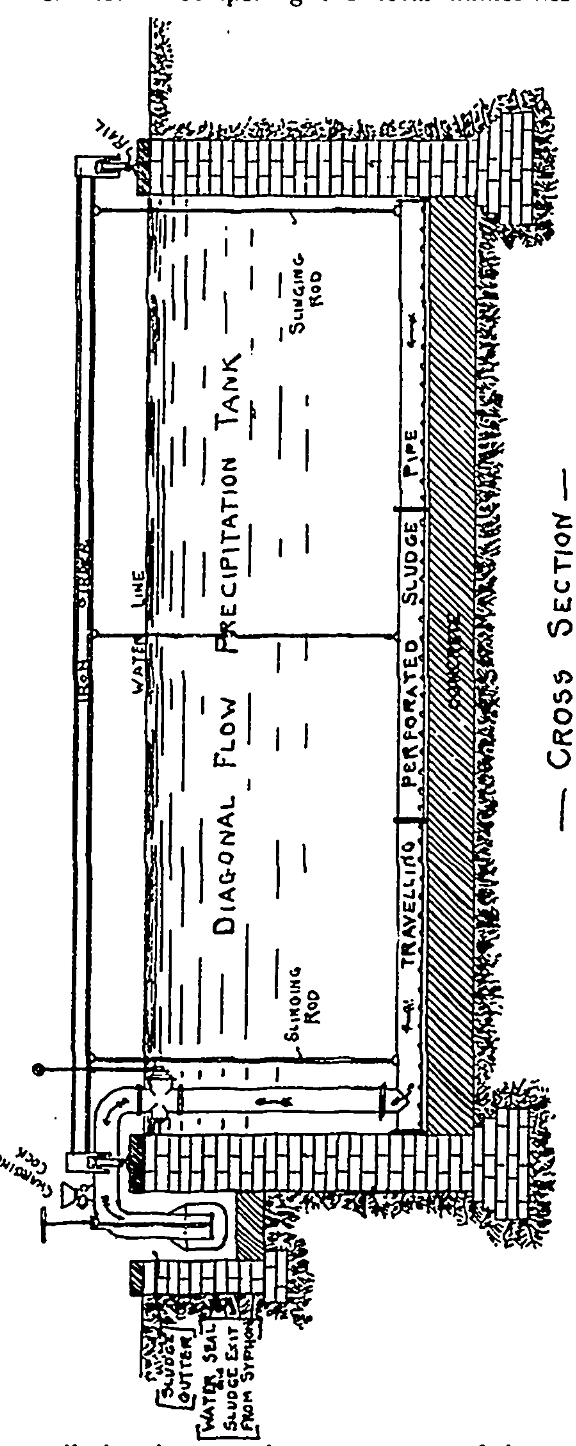
ENGLISH SEWAGE AND WATER WORKS.

BY W. M. WATSON, TORONTO.

THE FEROZONE AND POLARITE SYSTEM.

While in Yorkshire, England, this summer, I inspected several of the recently-built public works.

At the present time the cleaning of sewage is of the first importance, because the Government is in earnest in compelling the local authorities to stop



— Cross Section — of — Candy's Patent — Self Cleansing Rectangular Tank —

polluting the natural water-courses and rivers. During the past twenty years many large and expensive sewage-disposal works have been erected that have proved almost failures, nearly all being too slow in their action and too expensive to work. The authorities are beginning to see that simple and inexpensive methods give the best results.

The manufacturing town of Bradford built, nearly twenty years ago, about the largest sewage works in England. I fully explained their system in Toronto newspapers for January 25th, 1887.

They are now preparing to erect new works on the "continuous-flow" system, because the old works have never been able to handle all the sewage, though the cost of maintenance has been $18,500 per year, and $16,750 for interest and sinking fund.

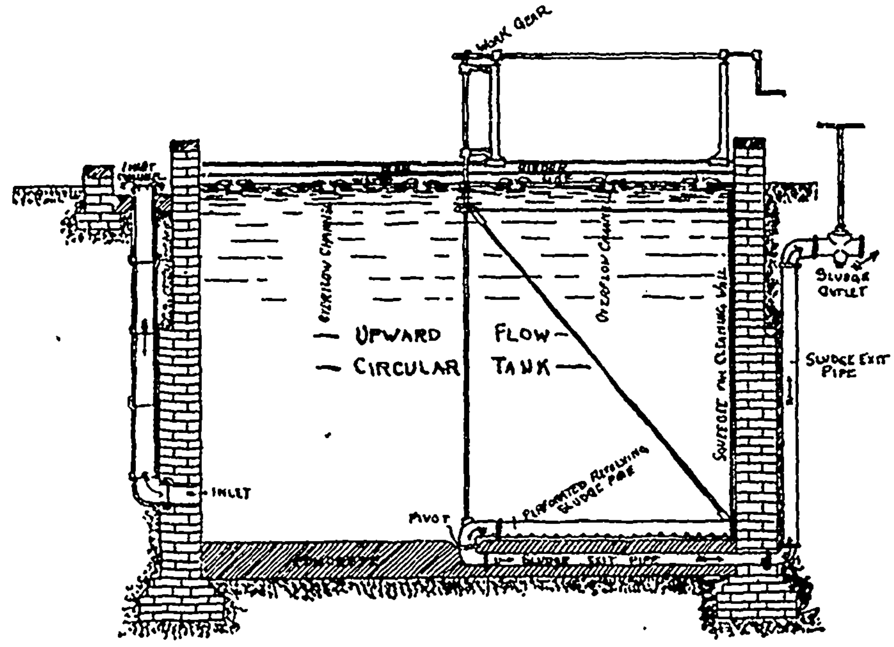
The town of Huddersfield has lately adopted the Ferozone and Polarite system. In this system, the sewage runs through a strainer to a settling tank, and during its passage from strainer to tank a substance called Ferozone is mixed with it, which causes the dirt to separate from the water much more quickly than by mixing it with lime. When the sewage arrives at the outflow end of the tank it has let go the heaviest dirt, and it is then passed upward through a filter containing Polarite, which the inventor claims will never foul or lose its efficiency. There is an arrangement attached to settling tank and filter, which cleans out the sludge without interfering with their working. (See sketch).

By the advice of several town engineers, I visited the Baildon Combined Destruction and Sewage Works. These appear specially suitable for large places, as it destroys the garbage and night-soil, and the products of the destructor furnace are used to clean the sewage, large clinkers being placed at the bottom of the filters, over them a thick layer of large cinders, then another layer of smaller cinders, all covered with about 8 inches of fine stuff that has been passed through a quarter inch sieve.

that one set can be cleaned while the others are in use. They need very little attention and only require cleaning about twice a month, and the sewage is continually on the run. Between the settling tanks and filter beds the water is made to pass over a wheel, which shakes up the water and supplies power for screening the ashes. One man on day and one on night duty are all that are needed to attend to the works.

This appears to me to be the best system of destroying garbage and cleaning sewage water, and it certainly is the cheapest. I believe there is no patent on the apparatus, it being (with the exception of the destructor furnace) a home-made concern.

I inspected several refuse and garbage destroyers. The best I saw was at Hamerton street, Bradford. The ashes and night soil of the neighborhood, also all the fish and vegetable refuse of the wholesale market, are here burnt up and made into a profitable product. The clinkers are prepared and sold to make concrete; some are mixed with one-fourth lime and made into building mortar. The old shoes and boots are sold for export to Germany. Old cans, after passing through the fire, are sold to chemical manufacturers. The bad fish is passed through a separate retort heated by steam and ground to a fine powder, which brings a high price as manure. The heat from the destructor fires are used to heat two large boilers, supplying steam to the engine which turns the grinding rollers, clinker and lime crushers, hoists, electric light dynamos, etc., besides steam to supply the fish retort, furnace blowers and heating pipes. The sale of the products nearly covers the expenses. The furnaces are well and solidly built, and every appliance is put in to keep the place clean and easily managed. They are built in the midst of a dense

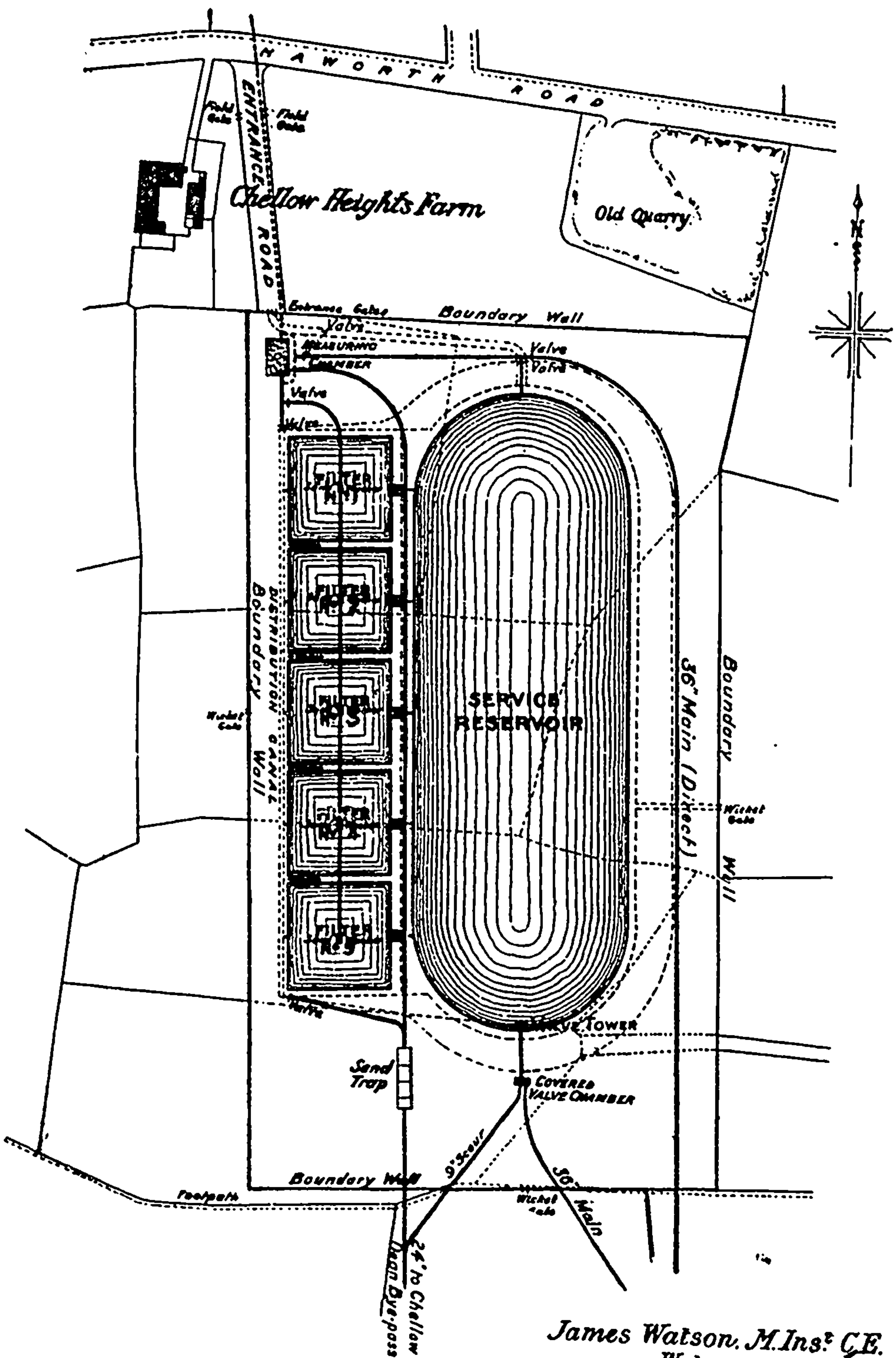


— CROSS SECTION —
— OF —
— CANDY'S PATENT —
— SELF CLEANSING CIRCULAR TANK —

The sewage is passed through a strainer into a tank divided by walls into three sections; nothing is mixed with it, but during its passage through the three sections of the tank most of the heavy matter is left. After passing through the tank the sewage is distributed over the four filters in small streams, and passing downward through them, runs out a bright, clear water. Double the quantity of tanks and filters are made, so

population, yet not the least offensive smell is noticeable in or out of the works, except in the shed, where the night soil is tipped and thrown into the fire. No fuel of any kind is used, a fierce fire being always kept up of night soil, ashes and garbage, aided by steam injectors which are placed under the grate bars of each fire-section. The amount of material destroyed is over 24,000 tons per year, and the income from sale of products is $4,500.

Scale $\frac{1}{2300}$.



James Watson. M.Inst. C.E.
Waterworks Engineer.

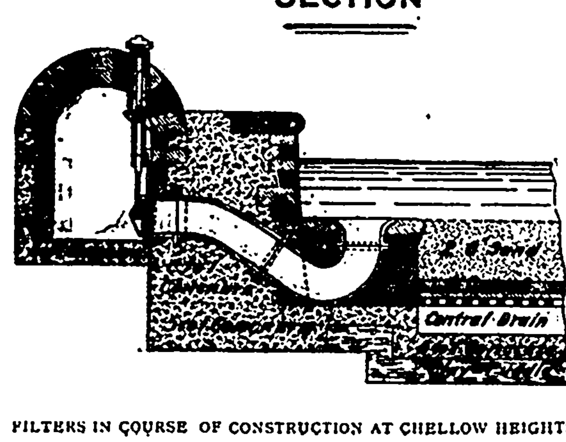
Bradford Filtering Beds at Gilstead Moor.

About fifteen years ago a demand for purer water for Bradford, Eng., had arisen, as much from the exigencies of recent developments of the worsted and stuff trades as from the more exacting standard set up by the public, and in 1886 the Gilstead Moor filtering tanks were built, capable of purifying over 7,000,000 gallons daily.

The works are built on the line of the conduit by which the water is brought from the Barden to the Heaton distributing reservoir.

There are six tanks, 300 feet long, 110 feet wide and 14½ feet deep. The lowest, 5 feet, is occupied by the filtering material. The floor is covered by coarse rubble in the whalebone fashion. Above this is another layer of smaller stone, then a layer of stone broken to the size of road material, the total thickness being about two feet, which forms the drainage portion of the filters. On the top of this is three feet of clean gravel and washed sand, which purifies the water. Shafts are

SECTION



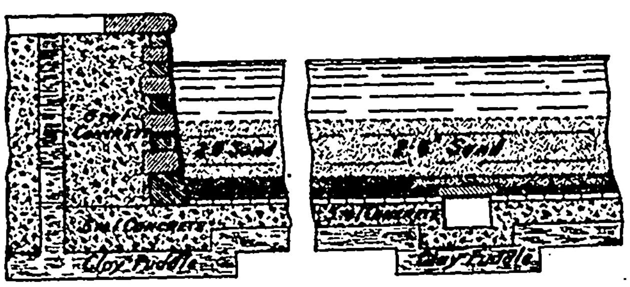
FILTERS IN COURSE OF CONSTRUCTION AT CHELLOW HEIGHTS.

built in the walls of the tanks to expel the air from the bottom.

Each tank has a level trough across one end, about three feet above the water line, which delivers the water to the filters in a thin film over a lip 110 feet long. The filter water is drawn from the tanks into a basin holding 1,000,000 gallons. Each filter tank is provided with inlet and outlet valves, and first-class appliances for quickly cleaning and washing over the sand when the filters become so dirty that they fail to work properly.

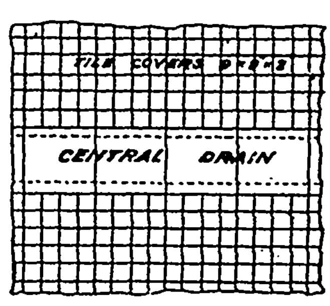
The six tanks are side by side, and each on the same level; five are always kept working, and one cleaning, which is done by scraping about two inches of the sand from the top, which is riddled and carefully washed, then spread out again.

SECTION ACROSS CENTRAL DRAIN SHOWING FILTERING MATERIAL



The Bradford supply is chiefly rain water collected from the hills in North Yorkshire, and is passed downward through the sand, leaving any dirt it may contain on the surface of the filters. The works were erected from designs prepared by the town engineer, Mr. Binnie, who has since left the corporation. They are now erecting another set of five filters at Chellow Heights, together with a reservoir, from plans prepared by James Watson, C.E., the present Bradford waterworks engineer. It will be seen by the accompanying

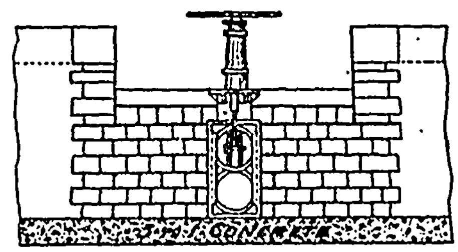
PLAN SHOWING TILE FLOOR COVERING



sketches that the inlet and the outlets of the filters are differently and better arranged on a less expensive style, while the mode of filtering is similar to the ones at Gilstead Moor.

The Bradford waterworks are all gravitation works. They supply 31 small towns having a population of 440,000, together with 226,610 of their own people, besides water for trade purposes to numerous dye works and manufacturers. The levels supplied vary from 200 feet to 1,200 feet above sea level. The rain fall, which is the source of supply, averages 42 inches per year.

ELEVATION



The collecting hills are about 50 miles from the town, and their elevations range from 600 to 1,475 feet above the level of the sea, and they measure over 13,000 acres. The water is stored when collected in nineteen reservoirs having a total capacity of 3,076,365,000 imperial gallons. The quantity used daily for manufacturing purposes through meters averages 21¾ gallons per head, and for domestic use, without being locally measured, is 20½ gallons per head, making a total consumption of over 27,897,620 gallons of water per day, and is supplied at a pressure up to 200 lbs. to the square inch. The income amounts to nearly $700,000 per year; the expenditure being a little more for the year 1895.

NO SMOKE.

The development of manufacturing interests in Canada has not yet reached a stage in which smoke prevention becomes a topic of great importance. Our large industries are not always in our large cities. Where this is the case, the drier atmosphere of Canada makes less noticeable the evil effects of smoke than are they in England. Existence in some English manufacturing cities, such as Sheffield for example, is rendered burdensome to all but those inured through a life-long experience to the noisome and dingy fumes. From a scientific standpoint smoke is a nuisance, and a preventable one, but, commercially, manufacturers claim smoke is a necessary evil. In England they have a Smoke Prevention Act, but legislation which demands the impossible, or that which is generally believed to be impossible, is usually more honored in the breach than in the observance. A movement has been under way for some time in England to demonstrate the fact that smoke prevention may be carried on upon an economical scale, the promoters believing that no argument in favor of reform is so potent as the short and simple statement, "it pays."

A large number of gentlemen eminent in science and commerce are included in the executive of the committee for testing smoke-preventing appliances. The president is Lord Egerton, of Tatton, while a duke, two bishops, two or three earls, and about a dozen mayors are members of the committee. A. E. Fletcher, formerly chief inspector of Alkali works, is the originator of the movement.

The object of the movement is told in the opening passages of the report of the committee.* The task of selecting the best method of effecting the reduction of smoke is not an easy one for the coal consumer. Very costly appliances sometimes fail to produce this end, and this has deterred others under the fear they will make large outlays in vain. Under these circumstances those interested in forming the committee came to a conclusion that a great step towards smoke-prevention

*Published by the *Guardian* Printing Works, Manchester.

would be made if manufacturers could learn on trustworthy authority that suitable smokeless furnaces exist; and could obtain information from users, rather than from makers, as to efficiency, cost and economy in working. It would also tend towards the same desirable end if local authorities and magistrates were provided with accurate information as to the kinds of manufacturing processes in which it had been proved that the production of smoke can be economically prevented. To this end the committee set about, firstly, collecting and arranging the results of past experience; secondly, making examinations and tests by the aid of experts. The report under notice embodies the chief results of their labors.

We have here said engineers know "that factory smoke is a preventable evil," but that is a fact which is not always acknowledged willingly. Reference is made in the report to the theory—which is still largely held, and is a favorite argument with some writers in the press—that if there is not black smoke at a chimney top, carbon monoxide, a highly poisonous gas, must be generated. Mr. Fletcher has investigated this matter, and it is only necessary here to say that he refutes the argument. His reasons for negativing the statement are given in the report. It is also unnecessary for us to follow the report in the explanation of the phenomena which occur in the burning of coal in a boiler furnace. Our readers are aware that, in the words of the report, "the problem to be solved is that of effecting the complete combustion of coal with a minimum of air." Excess of air is heat carried to waste; deficiency in air leads to smoke, although the presence of smoke is not necessarily a proof of deficient air supply. Ideal stoking practice would be reached if the exact quantity of air required for combustion of the fuel were admitted to the furnace, and the whole of this air were properly used. Such a perfect balance is, of course, not to be secured, and practically an excess of air must be admitted.

The committee decided in making special tests to use both the chemical and mechanical methods, setting one as a check against the other. The chemical tests included examination for temperature and analyses of chimney gases. The mechanical tests were of the nature of discovering the performance of the boiler or engines, and comparing the coal burnt with the work done. Of course, these were combined with observations of chimneys and records of smoke emitted. It was further decided the tests should be carried out under the ordinary conditions of factory working, those makers who might be interested in apparatus to be tried not being informed, so that the machinery would not be specially prepared, and the working being of the nature of a *tour de force*.

The information collected is presented in five elaborate and extensive tables, which will require close study in order to afford instruction to the manufacturer. Values are given for smoke emitted. Three degrees of density were taken as standards, namely, dense, medium, and faint. From whole-day observations made at Bolton and Oldham, it appeared that with hand firing and admitting air at the front, at the back, or at both back and front of the furnaces, the average duration of smoke, in 12 examples of each process, was 104, 81, and 82 minutes respectively during 10 hours. With four kinds of sprinkling stokers the average duration of smoke per 10 hours was respectively 97, 103, 117, and 108 minutes. With 21 examples of coking stokers, the average duration of smoke was only 16 minutes per day of 10 hours. These latter do not come far short of standing first in power and economy, whilst six of them are far the best in the competition, both by the water evaporated per pound of carbon value and by the proportion of carbonic acid in the waste gases. "This," the report adds, "shows that the action of the machine was attended by the letting in of less unnecessary and heat-absorbing air than any of the other machines or systems." As before stated, very full details of these tests are given in the tables, and to these we refer our readers.

In regard to hand-firing, the report has some pregnant remarks. The two best examples of smokeless hand-firing gave 10 and 17 minutes' smoke, but the same results do not appear to have been attained when the firemen were not aware that their chimneys were being observed; the records going up to 86 and 40 minutes respectively. In other cases bad results are attributed to want of skill or care on the part of the firemen.

Returning to the mechanical stokers, we find that one only gave four minutes' smoke per day of 10 hours, as an average of two days, with three boilers burning 72 tons of coal per week. In other cases two and three minutes are recorded. In the case of an alkali works, where 11 boilers with a coking stoker discharged into one chimney, there was only 2½ minutes faint smoke per hour.

It is needless to give further isolated details here, and we will conclude with one or two expressions of opinion from the report. Firstly, there is a quotation from the Glasgow branch: "The committee is of opinion that whilst future experiments and inventions may be the means of introducing new and better methods of treatment in the combustion of fuel, enough is known at present to enable steam users to work their boilers with a fair degree of economy and practically without smoke." The Sheffield committee say: "While it is certain that smoke may be almost entirely and completely prevented from steam-boiler chimneys, the conditions of working are so varied that no single arrangement can be expected to meet every individual case, and, further, whatever device is applied to a boiler to prevent smoke, its success will, in a great measure, depend upon intelligent handling and management." The main committee for themselves say: "A manufacturing district may be free from manufacturing smoke—at least from steam boilers, with which alone the committee have concerned themselves—and as to the means by which it may be freed, this report contains ample information."

For THE CANADIAN ENGINEER.

DYNAMOS AND MOTORS—MAINTENANCE AND CONSTRUCTION.

BY J. B. HALL, E.E.

As a great many commutators are constructed a slight blow on the surface will produce a flat, *a*, Fig. 1, which can only be removed by turning off the surface in a lathe. An excellent method of prevention is to leave the space below segments *b*, Fig. 1, vacant, and after assembling drill two holes, *c*, Fig. 1, in the sleeve *d* and washer *e*, and after warming the commutator to about 212° Fahr., pour molten sulphur in one hole until it is full, jarring the commutator to cause adhering air bubbles to escape. Thus the possibility of developing a flat is minimized; in fact some prepared thus have been struck with a hammer and nothing occur but a dent in the segments.

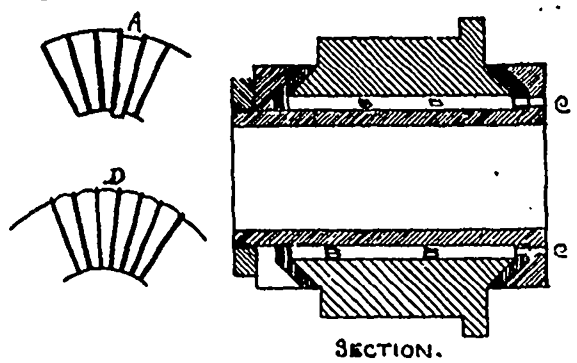
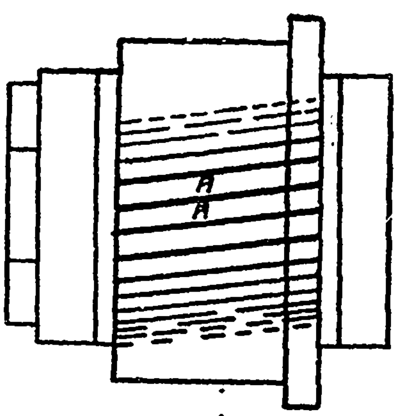


FIG. 1.

A great many machines on the market have hastily filled up commutator bars which are not true to gauge, the mica insulation between having the same fault, and as a result there is a shifting of the neutral point backward and forward over a small space, which, though not very important alone, in connection with a distorted field at full load (caused by the armature reaction) greatly aggravates the evil of sparking. Sometimes the bars pinch. In that case, when the bars have worn some depth, they become slightly loose, and the friction of the brushes, with the pull of the connecting wires, throw the bars on a stagger, *a*, Fig. 2, causing two bars to be short circuited under each of the brushes at a time thus doubling the tendency to spark. Bars pinching on



SIDE VIEW
FIG 2.

their inner side are not so bad as the case just mentioned, for in a machine running in one direction the bars cant over in the direction of rotation (*b*, Fig. 2) as far as the washers will permit; then the leading edge (in the direction of rotation) is slightly raised, although in time it will wear down some, faint sparking generally sets in, which increases the trouble as the area of brush contact is diminished, increasing the resistance, causing a greater loss of watts, which manifests itself in heat. Mica over 0.05 inch thick is likely to wear less than the copper segments between, and create ridges which will make the brushes jump and cause a spark at *d*, Fig. 1, which will gradually increase until the whole surface is pitted, and the only remedy is to turn the commutator in a lathe. When the trouble is slight, the mica can be levelled by backing a piece of 000 sandpaper with a smooth piece of wood, and rubbing it over the surface until no irregularity of the surface is perceptible to the touch.

Another source of loss in certain makes of machines is in the brush-holder. This brush-holder has nothing to recommend itself except its cheapness of manufacture. Fig. 3 shows its appearance. The passage of

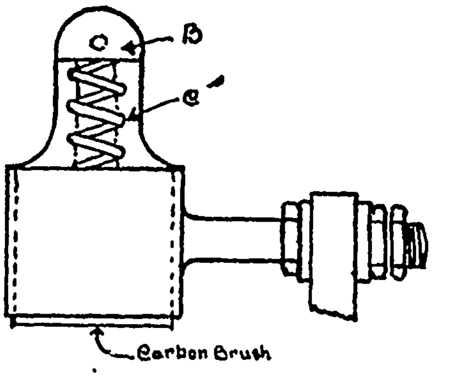


FIG 3.

the current to the carbon is almost altogether through the spring and pressure plate, *b*, *c*, and with large currents the resistance of the spring, even if it is of large wire, is material; but the worst point is that the moment of inertia of the spring is too great to permit it to press the carbon evenly when passing over slight irregularities in the commutator's surface, therefore increasing the friction loss. Or, if the spring is of fine wire, the tendency to buckle out of shape is manifest, and the resistance to the current soon heats up the wire, and its temper soon leaves it, the resistance of the sliding contact increases and sparking sets in, and the commutator shows the l--s by a rise of temperature.

Quite a number of armatures are constructed with a very low magnetic flux and a large number of turns of wire; the latter in certain machines whose rated capacity is about twice the safe limit, both as regards sparking, heating and torque. Most of these are rated from 1 to 10 h.p., have a loss of over 25 per cent., and have a rise of temperature of 130° Fahr. above the atmosphere, and these are sometimes pointed out as successes and they command a large sale. The only reason of their failing to break down is that they are seldom loaded to their full-rated capacity, and if that should occasionally happen, the sputtering, sparking and steaming of the commutator and bearings scare the user, and he hastens to lighten the load.

A very liberal rule to go by when examining a motor is to note the decrease of speed when loaded, and if the difference is more than 80 in a 1,000, a rejection of any of that kind should follow as being unsuitable for any purpose. Motors should be so designed to sustain their full load without movement of the brushes, for not one person out of a thousand would care to take the trouble to do it by hand. In dynamos, failure to adjust the brushes on a machine of the kind noted, shows itself in the dimming of the lamps.

In regard to the ultimate heating of a machine, 212° Fahr. should never be exceeded. Taking the maximum temperature of the room in which the machine is at 100°, 112° Fahr. is the greatest allowable rise of temperature of any machine, and although such a temperature is safe as far as charring the insulation is concerned, most lubricating oils vaporize below that temperature (212° Fahr.), and the resistance of the electrical circuits increase roughly, about 20 per cent. more than an 80° rise. While such a high temperature is allowable, yet it is generally safe to assume that a machine having a rise of over 85° Fahr. is very inefficient. Bearings are now generally well proportioned by all manufacturers, and in considering them, a rough and ready rule is to allow for machines having over 1,000 revolutions per minute length of bearing (actual surface in contact with the shaft) = 4 times the diameter of shaft, and for speeds under 1,000 R. p.m. length of bearing = 3 times diameter of shaft. Oil rings are to be preferred to chains if they are seamless, as chains have a tendency to stick. The oil should be changed at the greatest interval of time of one month, and the reservoir cleaned out of all brass dust that may have accumulated. The small amount of trouble involved in so doing will save the replacing of bearings at frequent intervals

Motor and isolated dynamo users have a very wise (?) plan of placing their machines in an out of the way corner where dust gathers in quantity, and neglecting to pay attention to the requirements until some day the motor fails to "mote" and the dynamo fails to "pick-up;" then in hot haste they send for the maker, and with the "finger of scorn" upraised, they, by their language and gestures, blame the machine for failing to operate under treatment that they would be ashamed to give a steam or gas engine, or even a water motor.

THE DISCHARGE OF THE ST. LAWRENCE RIVER.*

BY PROF. C. H. M'LEOD, MA. E., M. CAN. SOC. C.E.

The extreme low water of the St. Lawrence in the autumn of the past year called especial attention to the variations in the discharge of the river, and it seemed to the writer to be a matter of no small importance to obtain a measurement of it at the exceptionally low stage existing in the early part of November.

From enquiry made at the time, it was learned that it was not the business of anyone in Canada to gauge the St. Lawrence, and that the only measurement ever made below Montreal was that by W. J. Sproule, M. Can. Soc. C.E., under the direction of the Montreal Flood Commission, in 1886.†

Having in view the interest of a measurement at this special time, and as the work happened to fall into line with one of the courses of surveying lectures then in progress in McGill College, the writer induced some of the students of the University to undertake the work under his direction, assisted by Prof. C. B. Smith, M. Can. Soc. C.E., and J. G. Kerry, A.M. Can. Soc. C.E. The Hon. G. A. Drummond very kindly placed his private yacht at the disposal of the college for the purpose, and Frank Redpath gave up two days of his valuable time to take charge of the yacht during the work.

The position chosen for the gauging is situated about forty miles below Montreal, its upper limit being approximately 6,200 feet below the wharf on the north shore of the river, at Lanoraie. This choice was made not only because it is the position best suited for the work within easy reach of Montreal, but also chiefly for the purpose of comparison with Mr. Sproule's work, the position being that in which his measurements were made.

It was intended that the gauging should be made during the first week in November, but owing to unavoidable circumstances it had to be postponed, and was not made until the 13th and 14th of the month. The lowest water levels occurred on Oct. 28th, Nov. 2nd and 7th. On the first day of the measurement, Nov. 13th, the water level was seven inches above its lowest point, and it rose three inches while the work was in progress.

For a mile or more both above and below the gauging area, the river runs a straight course and has a very uniform cross section. Over this distance also, the levels which were taken under the direction of the Flood Commission in 1886 showed a constant surface slope.

In order that the measurements might be entirely comparable with those of Mr. Sproule, similar methods to those employed by him were adopted. The velocity observations were made on rod floats immersed to the greatest possible depths. In the reduction of the work, the observed velocities were corrected by reference to a vertical velocity curve obtained from measurements with an electrical current meter, by Amsler. The rods were of uniform section, and were loaded with lead weights within tin cylinders, having the same section as the rods. The immersed depths of the rods ranged from 6 feet to 42½ feet. The average velocities were obtained from the times of crossing of the two ranges, and were checked by the velocities between the stations along the lines, the positions of which were fixed by box sextant angles to points on the shore. All data as to soundings were, through the kindness of Mr. John Kennedy, taken from the plans of the Montreal Flood Commission.

The plate No. 8 shows the contour lines of the river bottom and shore lines for the length of 3,000 feet, over which the float observations were made. It shows also the courses of the several floats, with their observed velocities and the immersed depth of each float. The plate No. 9 gives similar information for Mr. Sproule's measurements. The plate No. 10 shows the average cross sections for the entire length of 3,000 feet. The upper section refers to the work in 1886, and the lower one to that in 1895. The mean position and lateral range of each float is also shown on the diagrams. The dotted lines below represent the most probable velocity curves resulting from the observations. In both cases the plotted velocity curve is that which results from the float observations, after applying the small correction due to depth of immersion, as compared with the average depth of the water along its path. This method of reduction gives, of course, slightly smaller values than those arising from the observed velocities, and the discharge as here computed for 1886 is somewhat less than the official figures of the Flood Commission. The area of the cross-section in 1886 was 115,298 square feet, and the discharge 311,101 cubic feet per second. The area of the 1895 cross-section—when the water was one foot nine inches below official low water—was 105,432 square feet, and the discharge amounted to 216,621 cubic feet per second. At the period of lowest low water in 1895, in which the water level was, as nearly as can be ascertained, two feet seven inches below official low water, or corresponded to a depth of seven feet eleven inches on the flats of Lake St. Peter, and 24·9 feet minimum depth in the navigable channel of the river, the cross-section was reduced about two per cent. below that of November 13th and 14th, 1895. Assuming that the discharge of the river varies proportionally to the area of the cross-section, and taking as data the results of the measurements above given, the discharge at the lowest water stage of 1895 amounted to about 196,000 cubic feet per second.

Referring now to the degree of accuracy which should be expected in work of this kind, the positions of the lines I, III, VII, VIII, X, XI, XIV and XV, Plate No. 8, will be found to accord somewhat closely with those upon which the 1886 discharge depends. The addi-

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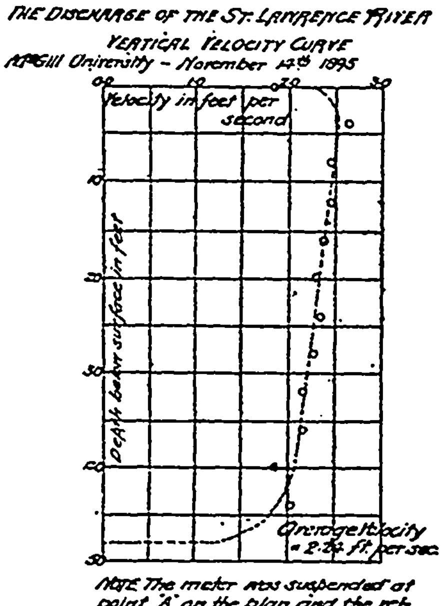
* A paper read before the Canadian Society of Civil Engineers.

† Some measurements as to the discharge of the St. Lawrence were made by the late Mr. Guerin in 1832, at Montreal, and are referred to in the report of H. F. Perley, then chief engineer of public works, for 1892-93.

tional lines in groups near to some of these afford an excellent means of estimating the limits of precision of such measurements. The lines V, VI and VII were practically in the same position and the rods were all immersed to the depth of 42 feet, yet there was a difference in the average velocities of two of the rods of 13-100ths of a foot per second, amounting to over six per cent. of the whole velocity. The two lines which show the extreme velocities 2.07 feet per second and 2.19 feet per second, were run within a few minutes of each other, and under precisely similar conditions, on the morning of the second day of the work, with a strong wind blowing at right angles to their directions, whereas No. VII was run on the previous day during very calm weather. It is, perhaps, worth noting that although about 10 per cent. of the length of the poles projected above the water surface, there was no appreciable drift in the lines.

A similar, but not quite so great discrepancy, occurred in the velocities of the rods IX and X. There the difference amounted to about 5 per cent. of the whole.

The writer cannot but confess to some surprise that under conditions so very favorable to uniform motion in the vertical filaments of water, such great discrepancies as these should be found.



In the small diagram, the vertical velocity curve resulting from the measurements by meter at the position marked (A) on the plate 8 is exhibited. The velocities at the several depths are the averages of two independent measurements extending over about three minutes each. The velocities at the surface and at the 4 feet depth are discordant, owing to their proximity to the yacht. Similarly, the variations in the two lower positions arise, probably, from deflected currents due to irregularities in the bottom. The average velocity given by the curve agrees very closely with that which would be obtained from a float passing through this position. Owing to lack of time, it was impossible to obtain more than one set of measurements, and this curve has been taken as a typical one in the reduction of the work.

The great question of the causes which led to so phenomenal a low water period is one which the author has at present not had time to discuss. He is, however, glad to state here that it has recently been the subject of a paper by Mr. Stupart, director of the Meteorological Service, an extract of which referring to the low water period under consideration may perhaps be quoted: . . . . . . "We can now see why Lake Huron is so decidedly low; it is due to Lake Superior having been low for some years, until 1894, combined with the effect of an abnormal deficiency of rainfall from 1887 to 1895, excepting the years 1892 and 1893. At the beginning of this same period in 1887, Lake Ontario was high, but two years of exceedingly small rainfall rapidly lowered the level. In 1889 and 1890, the rainfall was above average, and temporarily checked the fall which would have resulted from the low water in the upper lakes; but in 1891, a marked deficiency of precipitation brought a very low winter stage. Two years, 1892 and 1893, of above average rainfall now improved the level a little, but the deficiency of rainfall in 1894 and 1895, and particularly in the latter year, in conjunction with the effect of a small intake of water by the Niagara River, doubtless produced the almost phenomenally low stage of the past year. I believe that these facts are amply sufficient to explain the present state of affairs. . . . In view of these facts it is quite unreasonable to suppose that Lake Ontario will this year, or even next year, attain a high stage; the increase is likely to be gradual. Lake Superior is, as we have seen already, high; this will help to raise the level of Huron, which lake will rise if the rainfall be even up to the average, and then with an improving head of water in that lake, and consequently in Erie, the flow by the Niagara will improve and assist in raising the level of Ontario; but with so many factors to be considered, it is impossible to predict with any certainty how long it will be before a really high stage is again reached."

HINGED CONCRETE BRIDGE ACROSS THE DANUBE.*

This bridge, which was designed and built under the supervision of Max Leibbrand, engineer, connects the village of Inzigkofen with its railway station on the opposite side of the Danube River. The traffic being very small, the appropriation had been put at the lowest possible limit, and it was necessary to observe the greatest economy in deciding upon the kind of structure and the materials to be used in designing the structure. The condition of the river and river bed was not suitable for the use of intermediate piers, but the presence of solid rock on the right bank of the river and a hard gravel on the left favored the adoption of an arch.

As there were no stone quarries in the vicinity, while a factory producing most excellent cement was located within a short distance, it was decided to build the arch of concrete. Comparative estimates showed this to be a cheaper construction than either a Monier arch, or one of iron alone, or of cement blocks. An important feature of the design is the placing of open cast-iron links or joints at the crown and at the abutments. The arch hinged in this manner is statically determinate, and may be rationally and economically computed; moreover, any danger through settlement, after the false work has been removed, is eliminated, as are also any secondary strains due to changes in temperature or to variations in the vertical loading, to which the arch can freely accommodate itself.

The following dimensions were adopted: Span, 43 meters (about 141 ft.) and a rise of 4.38 meters (about 14 ft. 4 ins.) There is one roadway, 2.5 meters

* From "Zeitschrift fuer Bauwesen."

(8 ft. 3 ins.) wide, and two sidewalks, each 0.65 meters (2 ft. 1½ ins.), aggregating 3.8 meters (12 ft. 6 ins.) as the width between railings. The width of the arch proper is 3.6 meters (11 ft. 9½ ins.) at the crown, and increases to 4.6 meters (15 ft. 1 in.) at the abutments, thus affording an increased resistance to all lateral pressures, such as wind, high water and ice. The arch ring is 0.7 m. at the crown, 1.1 m. at the joint of rupture, and 0.78 m. at the abutments. The roadway is carried on 36 small posts standing upon the extrados of the arch, except in the middle portion, where it is carried directly on the arch. Each three of these pillars forms a bent, the two outer ones being curved at the bottom on account of the greater width of the arch ring; longitudinally the pillars are joined by arches. On top of the abutment are rollers to provide for expansion and contraction of the roadway structure. At the crown joint the wrought-iron hand rail is connected to a cast-iron post in which it is free to move, and at this point the roadway is supported on trough plates.

Without entering into the details of calculation, it is of interest to note that the usual method of establishing the line of pressure by loading one-half of the arch ring was not followed in this case, but the arch was divided into sections, and the effect of concentrated loads at these sections was determined. Indeed, the hinged construction demands this method of calculation, as the problem is a determinate one, and the arch cannot be regarded as one elastic mass.

Construction was started in July, 1895, with blasting and excavation for the abutments, and the bridge was opened to traffic in November of the same year. All concrete used was mixed by hand. The bents of the lightly constructed falsework were carried on four piles each; resting on the cap-pieces of these piles were sand boxes and wedges, as shown. The planking under the arch projected sufficiently beyond the face to allow the side-boarding to be braced against it. The abutment links were supported on saddles bolted to the arch ring of the falsework. These saddles served the purpose of resisting the thrust of the arch before it had been closed and filled in at the abutments. The abutment plates were each provided with four lugs and bolts in order to hold them in position during the concreting. Before the falsework was removed the lugs were knocked off and the bolts drawn out, leaving the hinge free to turn on its axis. The crown hinge was supported on timbers directly over the arch planking.

It is of the greatest importance that the axis of each set of links should be in true alignment, and perpendicular to the arch, as otherwise it would not be possible for the links to turn simultaneously, and secondary strains would arise, rendering the hinge construction useless. Behind the abutment links a space of 25 cm. (about 10 ins.) was left open to admit of the hinge following the settlement of the falsework; this space was not filled in until the arch was closed. The joints in the planking on the face of the arch were caulked with gypsum, and the interior surface covered with brown paper. The model of the arch ring, formed in gypsum, was then screwed on, and the whole coated with shellac. The planking below the arching was left rough, except for a space of 20 cm. next to the face, this strip being treated similarly to the front. Before concreting was commenced the falsework was loaded at the crown with the links and a number of sandbags, aggregating 40,000 kg. (about 88,200 lbs.). On Aug. 29th the concreting of the arch was started at the abutment links. The material was placed in sections boarded off perpendicular to the line of pressure, and from 1 to 1.3 m. long, and tamped in horizontal layers. The arch thus consists in reality of a number of concrete blocks of that length, which, however, through the speedy progress of the work were most completely united. The concreting was advanced from both sides towards the joint of rupture; here a space of 1.2 m. was left open and work continued beyond this space towards the crown, the loading placed on the falsework being gradually removed. The open spaces at the abutments, and at the crown, were then closed, and finally those at the joints of rupture while concreting the spaces at the abutments. The end plates were supported on set screws, the strength of which was sufficient to withstand the slight thrust of the uncompleted arch, but not that of the arch when unsupported by the falsework. In this manner it was insured that the joints distributed the pressure over the whole surface, and not merely at the points of support.

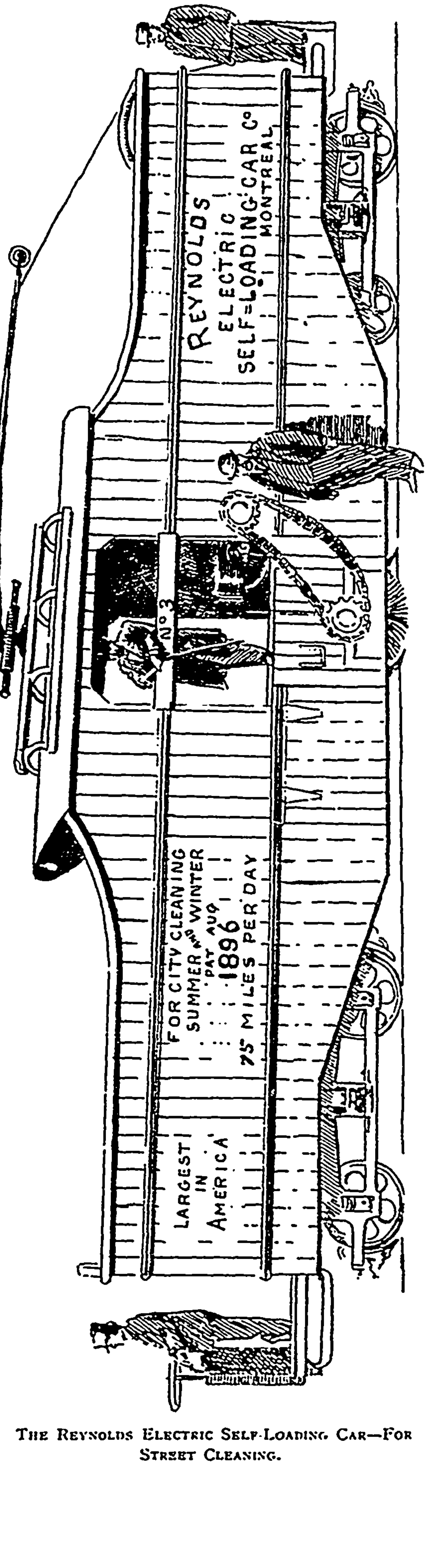
The abutment piers were built next, and finally the pillars and arches supporting the roadway. On all visible parts of the bridge a layer of colored cement and sand from 10 to 15 cm. thick was put in simultaneously with the concrete and closely united to it.

Immediately after the roadway was completed, and five weeks after closing the arch, the falsework was removed. The settlements at the crown and at the abutments were closely observed from time to time The total settlement at the crown amounted to 32 mm., about 1¼ inches, estimated at a temperature of 20° C. This was up to Feb. 10th, 1896, the bridge in the meantime having been subjected to a test load. The roadway plates were covered with asphalted felt, ¼-inch thick, upon which was a layer of sand 4 inches thick, then gravel 3 inches thick, which was finally covered with a thin layer of sand. The roadway is drained in the centre and the water carried down the first row of pillars from the abutment. The total amount of concrete in the bridge is 634 cu. m., or about 830 cu. yds. The amount of cast iron in the hinges is about 33,000 lbs., and the whole work was executed at the estimated amount of 22,310 M., about $5,310.

THE ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

A. E. Edkins, registrar of the association, reports that the following engineers have recently passed these examinations.—Third Class—Geo. H. Bull, Roseneath; C. Kemp, Petrolia; A. Ritchie, Orillia; C. Labarge, Hull, P.Q.; J. Radmore, Buckingham, P.Q.; Fred. Nagle, Paris, Ont.; J. Carol, Hamilton; Albert Martin, Toronto; F. C. Corrie, Stratford; D. Anderson, Mt. Forest; J. Wilson, Hamilton, Geo. E. Bower, Lucknow; G. H. Cooper, Oakville. Second Class—D. H. Vincent, Belleville, B. Deo, St. Thomas; T. R. Seaton, Toronto. In all twenty engineers presented themselves for examination, of whom four failed.

We are glad to be informed that enquiries are coming in daily regarding examinations from all parts of the Province, and even some from Quebec, where all engineers are required to hold a certificate. The city council of Hamilton has recently passed a resolution providing that no engineer be employed by the corporation unless he hold an Ontario certificate. This is a good move and might well be followed by our city council in Toronto. There are about 40 certificate-holders who have not paid their renewal fees so far this year. The registrar will be glad if these members will send their old certificates in to his office at once, either with or without fee, as they may see fit, because the certificates are the property of the board and must be returned when they expire. Information regarding examinations will be forwarded to any engineer desiring, on receipt of post card by the registrar.



THE REYNOLDS ELECTRIC SELF-LOADING CAR—FOR STREET CLEANING.

THE REYNOLDS ELECTRIC SELF-LOADING CAR.

THE LARGEST STREET SWEEPER IN THE WORLD.

In our June number we gave the first notice of this car that appeared in any Canadian paper. We are now able to announce various improvements in the mechanism and the construction of a car capable of cleaning a whole town in one day. The special features of the invention are well known to our readers. The new car, here illustrated, is 53 feet in length, and will carry 100 cart loads of refuse. It has three G. E. 200 motors, developing 30 h.p. each. The broom is 9 feet long, 44 inches in diameter, and protected by aprons which adjust themselves according to the direction of movement, and is driven direct by a 30 h.p. motor, and the car rests on double four-wheel Brill trucks. This car, like that previously described, can be run back or forward with the utmost facility; by adjustable auxiliary brooms its operations can be extended so as to cover the whole width of a street, if necessary, and it is able to dump its load of snow or other sweepings wherever specified, or carry it entire to some distant spot. It can do its work on any rail track, and will easily clean a street at the rate of one mile in 20 minutes. It is as useful in the removal of snow as in ordinary scavengering, and such a sweeper on any street would, it is claimed, keep the track clear and prevent any necessity for the congestion of traffic. A contrivance which can do the work of 100 carters on a given mile, at a cost of $3, is destined to become a necessity to every city having a rail track. A model of the car will be at the street railway exhibition at St Louis, which will open on the 20th inst., and the original will daily give a practical proof of its utility on the St. Louis streets. A company of Montreal capitalists has been formed, with a capital of $200,000, under the title of the Reynolds Self-Loading Car Company, for the purpose of manufacturing the invention. The directors are A. J. Reynolds, J. Quinn, M. Guerin, G. G. Foster, and J. A. C. Madore. Offices, 157 St. James street, Montreal.

THE ECONOMY OF THE MODERN ENGINE ROOM.

BY CHARLES E. EMERY.

The elementary principles involved in the construction and operation of a steam boiler are of the simplest character, and may be deduced from the ordinary operation of boiling water in a kettle over an open fire or upon an ordinary stove. In fact, if an ordinary tea-kettle containing a little water have its cover tightly closed, it typifies a steam boiler. If the outlet through the spout be free, the steam formed will escape at atmospheric pressure and a temperature of 212°; if the outlet be closed, the pressure will rise as well as the temperature of the water and steam, and this operation will continue until an explosion takes place, unless the steam is permitted to escape as fast as formed after the desired pressure is reached. This is accomplished, in the case of the steam boiler, by admitting the steam to the piston of the steam engine or to radiators for heating buildings, or by releasing it through the familiar safety-valve. The kettle may be so placed in relation to the fire that steam will be formed at times with such rapidity as to carry water out with it; the same operation occurs with steam boilers, and is known as "priming."

Although the principles of construction and operation of the kettle and steam boiler are the same, the details are very different, on account of differing conditions. First, as to operation; the kettle is to be boiled but a short time, and may then be removed to a cooler position in the fireplace or upon the stove, so as to permit other cooking operations to go on, while the fire, though sometimes regulated, is generally maintained at maximum intensity, so that, when little cooking is being done, there is a great waste of heat up the chimney. On the contrary, the purpose of the steam boiler is to maintain steam pressure for long periods, and to utilize all the heat in the fuel as nearly as possible. If we suppose all the holes in the cover of a cooking stove filled with kettles containing water, evidently a large proportion of the heat of the fire will be absorbed by the water in such kettles, but in different degrees. Those directly over the fire will necessarily receive the most intense heat by direct radiation from the incandescent fuel, while the kettles farther back will be heated principally by the escaping products of combustion which give up heat and are thus cooled as they approach the chimney. The rate of transfer of heat to the several kettles will decrease progressively as the temperature of the gases falls from exposure to the successive kettles. If all the kettles be united in one, the operation will be exactly the same; the greatest quantity of heat will be transmitted to the water nearest the fire, and the heating operation will be less intense as the products of combustion approach the chimney. If, as in some stoves, a direct draft be opened, making a short route to the chimney, the kettles or heating surface along the route will be heated, while other kettles or other portions of the heating surfaces over which the products of combustion are not required to pass will receive little or no heat. The heating surfaces along the route taken by the gases will be efficient, but in different degrees, depending upon the heating surface encountered and consequent cooling of the gases between the fire and the chimney, while the surfaces over which the gases are not required to circulate will be inefficient.

The underlying principles of boiler proportions may be gathered from these simple illustrations All the heat of the fire not directly radiated to the heating surfaces surrounding the furnace is carried by the products of combustion, and represented by the high temperature of the same, and such products must be passed in immediate proximity to other heating surfaces of the boiler, through which the heat is transmitted to the water and the gases correspondingly cooled. In general, the heating surface is increased so as to reduce the temperature of the gases to the lowest point consistent with a sufficient draft. The best boilers are so proportioned that all the surface is efficient, though in different degrees due, as explained, to the lowering of the temperature of the gases as they move toward the chimney There, are, however, plenty of poorly designed boilers in which, at some part of the circuit, the gases are not distributed uniformly over the heating surfaces, and in which there are short cuts enabling such gases to take a direct course, as illustrated by the stove, making the portion of the heating surface encountered efficient, but leaving large areas of the normal heating surface over which the gases are not forced to circulate, and which, therefore, are inefficient. The evaporative efficiency of such a boiler is not as high in proportion to the total surface as one in which the gases are distributed over all the surfaces with substantial uniformity

The general features of construction of a steam boiler are First, a "furnace," in which the fire is made, second, a "combustion chamber," for the thorough mixing of unconsumed combustible gases from the fuel with the surplus air that has passed through the grate, thereby completing the combustion, third, a large area of "water-heating surface," generally formed of tubes, fourth, in some cases, "superheating surface," for heating the steam, lastly, an escape for the products of combustion, generally a chimney of considerable height to produce the requisite draft

The furnace may be described as a "fire-box," and is often so called, the fire being usually built upon grates directly under cylindrical boilers or inside marine and locomotive boilers. An "ash-pit" is provided below the grate. For "hand firing" of "anthracite" or "semi-bituminous" coals the construction of the furnace is simple. For externally-fired boilers, the side walls, the front about the fire door, and a low wall limiting the length of the furnace, called the "bridge wall," are fire-brick. With internally-fired boilers the fire is enclosed by metal plates in contact with the water in the boiler. For burning highly bituminous coal a fire-brick arch is arranged above the fire to prevent chilling the products of combustion before they arrive at the proper temperature for full ignition. Automatic firing apparatus is largely coming into use, particularly for soft coals, in which the grates generally incline rapidly from the fire door, and the coal, which is shoved in at the front by some form of feeding device, is gradually worked down the grate by a slight movement of alternate bars effected by a small engine. In one form the coal is mechanically pushed up from below, and in another the air is admitted from above and drawn downward through the bed of coal lying upon grates formed of pipes containing water. Each of these forms has a special value for burning particular kinds of coal.

The "combustion chamber" may be wholly or partly in the furnace proper above the fire, or may be partly a chamber in continuation of the furnace, which is frequently turned upward, forming a so-called "uptake," or large passage connecting the furnace with the tubes

The tubes of land boilers generally run horizontally through the lower portions of the shells of "cylindrical boilers," or vertically through the water in "vertical tubular boilers" In "marine boilers" tubes of different sizes are employed. The products of combustion pass from the upper part of the furnace, forming a combustion chamber through large tubes called "flues," thence through a connecting chamber or uptake to smaller tubes, and thence by another connection or uptake to the chimney This is called a "return tubular boiler," and in some cases several returns are employed In some forms of marine boilers, and in land boilers of the sectional type, the products of combustion are passed across or along tubes containing water. In marine boilers such water tubes cross large flues, generally rectangular, arranged inside an outer shell. In sectional boilers the tubes are collected in headers, which in turn connect at either end to drums in which the water-level is located. In boilers of this kind the gases are directed over different parts of the heating surface by means of fire-brick partitions. In some cases such gases are required to cross long tubes several times before reaching the chimney, or to make several circuits back and forth along the tubes between fire-brick partitions laid upon the same.

In some boilers the escaping gases pass through tubes or flues, or between tubes in the steam space, so as to evaporate any moisture contained in the steam, and "superheat" the steam, or raise it above the temperature due to the pressure.

The draft is easily produced by a comparatively high chimney, but at times a shorter chimney is employed, and the necessary draft induced by jets of steam or by a suction-blower in the stack. More frequently the draft is increased by forcing air at moderate pressure under the grates, by means of a fan-blower.

In order to secure the best results, the several parts above described must be properly proportioned. Definite rules for "boiler proportions" have been established for a number of years for marine boilers, and most of such rules are applicable to all kinds of boilers, but many novelties of construction, both in the internally fired and sectional types of boilers, have been introduced, which in many cases fix some of the governing proportions, so that the existence of any rules on the subject has been entirely lost sight of in many quarters, and questions long since settled are being tried over and over again in practical work, frequently with unsatisfactory results.

We have already shown that, to secure economy, the gases should be distributed uniformly over the heating surfaces In some of the sectional types of boilers it is exceedingly difficult to do this without so obstructing the passages that accumulations of ashes, etc, cannot properly be removed. It is, however, apparently easy to design a tubular boiler originally so that the gases will be uniformly distributed The tubes are of the same size and of the same length, and it seems that, by properly proportioning the connections, the difference in pressure at the two ends of the tubes, caused by the draft, could be made the same, so that the same quantity of gases would be driven through each tube, and therefore uniform and consequently maximum action obtained for the heating surface employed Frequently no attempt is made to accomplish this result, and very slight misproportions will make a very considerable difference in the efficiency. Even with very large connections, permitting only slight differences of pressure in different parts of the same, it is found in practice that in many cases more of the gases pass through the lower tubes than the upper—a thing which has been overcome to some extent by putting ferrules or small rings in the ends of some of the tubes, so as to prevent free flow of the gases to the tubes having the greater draft. The more philosophical way, however, as determined by practice, is to reduce the area of the tubes as a whole, thereby increasing the "resistance," so to speak, so that the gases cannot be readily carried by a few tubes, but are forced to distribute themselves throughout all the routes to the chimney. Moreover, with the higher resistances, small differences of pressure in different parts of the connections do not so much affect the results.

It was found at an early date that boilers built with a certain ratio of "cross area of tubes" for draft to "grate surface," did better than others of different proportions, and that, with a certain fixed relation of cross area of tubes to grate surface, the evaporative efficiency of the boiler could be pretty well forecast from the proportion of heating surface to grate surface. For anthracite coal consumed at the rate of twelve to sixteen pounds per square foot of grate, the cross area of tubes for draft should be about one-eighth of the grate. For bituminous coal one-seventh or even one-sixth the area of the grate is permissible. For marine boilers there is generally provided twenty-five square feet of heating surface to one of grate, but in different types of boilers this proportion is much varied, with results that will be explained later.

The simple rules above given apply only to the rate of combustion per square foot of grate stated, so that in all cases the proportions are better referred to the average amount of coal burned per square foot of heating surface. The grate in any case must be of such size that the desired quantity of coal, to produce the requisite quantity of steam, may be readily burned with the draft available. This may be readily calculated from the fact that ordinary boilers will evaporate eight pounds of water per pound of coal under actual conditions, and that nine pounds of evaporation, and occasionally ten pounds, may be obtained with boilers of the best proportions using the best fuel, while, with coals of less calorific value or boilers of less efficiency, the evaporation falls to seven or even six pounds. The grate is usually made of such size that nine to ten pounds of coal are burned per square foot per hour in land boilers, twelve to sixteen pounds in marine boilers with natural draft, and twenty to thirty pounds in marine boilers with forced draft, whereas in locomotives, where the size of the grate is necessarily restricted, as high as one hundred or even one hundred and fifty pounds of coal are frequently burned per square foot of grate area. The rate of combustion per square foot of grate makes little difference in economy, when the thickness of the bed of coal is proportioned to the required draft and the fire is not allowed to burn in holes or with irregular intensity at different points Practically, however, the fires cannot be so well attended to at high rates of combustion, and waste results So also, when the grate is too large, thereby requiring a low rate of combustion per square foot of grate, it is difficult for the fireman to obtain a uniform fire in different parts of the grate, and holes are liable to burn through, admitting cold air above the fire, which effects the economical results.

On account of the variation in the quantity of coal burned per square foot of grate, the cross area of the tubes for draft should be such that one hundred to one hundred and twenty pounds of coal and upwards will be burned per square foot of cross area. The area of the passages leading to the tubes is generally fifteen to twenty-five per cent greater than the joint area of the tubes themselves, and, to reduce friction, generally the area of the uptake leading to the chimney is made in about the same proportion. The smoke pipe or chimney, however, need not be so large proportionally, for the reason that there is less friction in a single large pipe than in a number of small ones.

The proportion of heating to grate surface varies in different types of boilers For the old-fashioned cylinder boilers fired externally, containing no heating surface except that of the external shells below the water line, there is generally but ten to twelve square feet of heating surface per square foot of grate. With flue boilers—which term distinguishes horizontal cylinders upon which the products of combustion impinge externally below the water line, the gases returning through large flues—there are usually but fifteen to seventeen square feet of heating surface per square foot of grate. For boilers containing a large number of flues or tubes the proportion of heating surface to grate rises to 22 and 25 to 1 for many purposes, and particularly for small tubes, is increased to 30, and sometimes 40, 50 and 60 to 1 As the quantity of coal burned is practically the same per square foot of grate in each case, the quantity of coal burned per square foot of heating surface for the boilers with a low proportion of heating surface is very much larger than for those with a higher proportion; and at first blush it would seem that the cylindrical and flue boilers would be very much lacking in economy, for the reason that all the heat in the gases would not be absorbed and a large part would pass to waste in the chimney. This is true, but not to the extent indicated by the relative proportions, for the reason that the heating surface over the fire, and that exposed to the hotter products of combustion near the fire, are so much more effective than that to which the products of combustion are exposed when partly cooled, as explained already in the case of the kettles. In an ordinary boiler the furnace, containing only about one-twelfth of the total heating surface, evaporates fully one-half of the water, and the remaining eleven-twelfths of this surface less than one-half of the water. As illustrative of the decrease in efficiency rather than an exact statement, it may be stated approximately that, if five pounds of water were evaporated by the heating surface in the furnace, the remaining surface would evaporate about four pounds, of which the surface nearest the furnace and equal to the area of the surfaces therein would evaporate substantially one-half, or two pounds of water, making six in all. An equal amount of surface added would evaporate about one-half as much as that preceding, or one pound, making seven in all, and additional areas would evaporate successively $\frac{1}{4}$ lb., $\frac{1}{8}$ lb., $\frac{1}{16}$ lb., $\frac{1}{32}$ lb., and so on, so that a surface eight or twelve times that in the furnace would cause an evaporation of not quite eight pounds. This progression is somewhat more rapid than actually obtained in practice, but shows that the saving by increasing the heating surface may be so small as not to be warranted.

We have approached the "Problem of Boiler Selection" by stating in an elementary, but elaborate, manner the principles underlying the operation of a steam boiler. An article of this kind should be, in a sense, educational, and therefore indicate the highest aims, as well as the reason why they may not in all cases be attained. We have, therefore, pointed out that a steam boiler should absorb as much heat from the fuel as is practicable; that, in order to do this, a large area of heating surface is necessary; that in order to make this heating surface efficient, the products of combustion must be uniformly distributed over the heating surface, and the passages in some cases be contracted so that the gases will be forced to divide among the different routes to the chimney. These cardinal principles, as we have stated, are very much neglected. We desire, however, to further point out that, in this case as in others, there are exceptions to the general rule. We have indicated correctly the proportions which should be adopted in order to secure high economy. We now call attention to the fact that, since the passages for the products of combustion must be contracted to secure high economy, it is not possible to burn larger amounts of fuel than originally provided for without some method of increasing the draft. Moreover, the extra resistance introduced prevents prompt action in case of emergency, that is, the boiler is poorly adapted to respond to an immediate demand for a large amount of steam.

It therefore follows that boilers specially designed for economy are what is called "slow steamers," available where steady power is required and not adapted for variable power. As the power is variable in many locations, a different type of boiler is necessary, and in a great number of cases what is called a "free" boiler is employed, that is, one which will, when the draft is open, burn coal quickly and furnish steam rapidly, although at some sacrifice of economy. The illustration given shows that this sacrifice is not very great, though important where economy is a pre-requisite.

Originally boilers were constructed with large flues, and undoubtedly wasted fuel to some extent, but they certainly showed marvellous work in furnishing steam. A reaction occurred, and boilers were made with small long tubes; such boilers undoubtedly furnished steam very economically, when there were a sufficient number to supply the maximum demand. It was found, however, as readily explained by the table, that by putting larger tubes in the boilers very much more power could be obtained, and that the economy was so near that obtained with the boilers having longer tubes that the owners would rarely discover the difference. For these reasons most of the boilers sold regularly are of the free, uneconomical type, but they give satisfaction for the reason that they furnish the steam required promptly and without difficulty. This is true both of the ordinary cylinder tubular boilers in so common use throughout a large portion of the country, and of the sectional boilers which have more recently come into the field. Tubular boilers made free in order to supply quick demands for steam are about equal in economy to sectional boilers, but the better examples of sectional boilers can be forced farther above their rated capacity than their competitors, and are, therefore, more satisfactory where the power is variable.

The greatest success with sectional boilers has been obtained by putting in a large area of heating surface per rated horse-power, and an area for draft proportioned to the heating surface. At low rates of combustion such a boiler simply does as well as other free boilers, without fully utilizing its large heating surface, but, as soon as large demands for steam are made, the boiler becomes a phenomenon compared with others rated for the same power. For high powers the gases, being greater in volume, fill the spaces for draft, and thereby make all the heating surface efficient, so that such boilers easily run at double their rated capacity, and are available through the whole range.

The subject is a broad one, but its magnitude should not discourage the reader. Some simple condition may eliminate a large number of the boilers available, so that very few need be considered in making a selection. For very small powers the vertical tubular type of boiler is best; such boilers are also made of large size, but for present purposes the larger boilers come into the general class of tubular boilers. Locomotive boilers are best suited for portable work, or where the space available makes the selection desirable even at increased cost. For larger-sized boilers used on land the selection must be made from two types, viz., tubular boilers and sectional boilers.

The form of tubular boiler almost universally employed in this country is a plain horizontal cylinder, with tubes in the lower portion and steam space above such cylinder being set in brickwork. There are, however, vertical tubular boilers which can be used when the space available is best adapted for the same. One form of these has an interior fire-box and a large number of long small tubes communicating therewith, and is particularly designed for economy, and therefore available where the power is steady, but not for variable powers, for reasons previously explained. Another type with a small shell and bent tubes enclosed in a shell of non-conducting materials directly exposed on the inside to the heat, is of questionable value for use under a large building where the protecting, non-conducting shell would suggest danger from fire, but is largely employed in power stations.

The use of shell boilers is absolutely inexcusable in all dwellings and office-buildings. No matter how contracted the space, the architect should provide sufficient head-room to put in sectional boilers, the details of which are now well established. As to space, the horizontal tubular boilers set in brickwork require most, though such boilers are cheaper. The sectional boilers require more height, but, on the whole, less cubic capacity for the power developed, than any other boiler enclosed in brickwork. Where space is very much restricted, particularly in height, a greater power can be installed by the use of internally-fired boilers of the marine or locomotive type. Such boilers have been used under large buildings, as well as other forms of shell boilers, all of which are perfectly safe so long as managed properly: but, no matter how carefully the engineer and his working force may be originally selected, times of recreation and sickness either of the parties themselves or in their families will require temporary substitution of different men. Moreover, when a plant once runs smoothly, so little labor is required to keep it up that the best of men become demoralized, and occasionally dangerous conditions are established by neglect or mere oversight. The chance of accident, small as it may be, should not be taken under a building o the kind referred to. So also private owners of means should not for an instant think of taking any chances. In the country the boilers may be isolated from the dwellings, but this is not the case in many locations.

However strong these considerations may be, we cannot, in an article of this kind, overlook the fact that there are very many locations where the simple and cheap tubular boilers will answer every purpose. Manufacturers that build their own boilers will, of course, put in place the ordinary type of boiler made in their own shops, and other parties will naturally take the same course by the advice of such manufacturers. For a comparatively small steam plant, where the engineer both cares for the engine and fires the boiler, his attention is so frequently called to the latter that the risk of accident is reduced. Again, in large plants, the men operating one or two boilers have such a casual oversight over others in the same room as to reduce the risk. These considerations have their influence; so the mere question of impending danger does not prevent parties from using shell boilers, and the selection between the two types will depend entirely upon the importance attached to the different considerations above expressed.

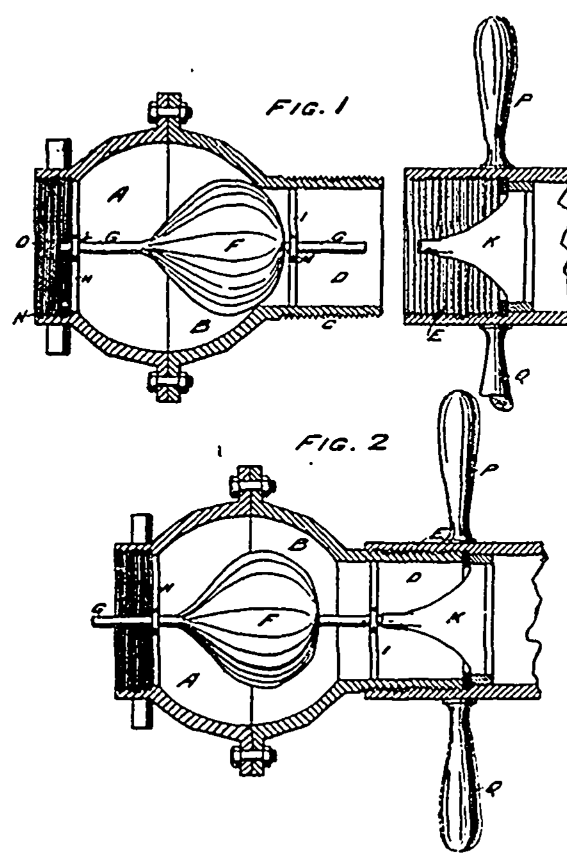
The selection of a particular boiler from many of the same type is at times difficult for one who is not an expert. The expert knows there is little difference between them, if the work is adapted for the purpose originally, and thoroughly inspected. Those not familiar with the details can very well look over the work of the different companies on a mere business basis, and ascertain the volume of business each is doing, the kind of work the boilers are performing, and the standing of the owners as respects both business and engineering experience. It is evidently not good judgment to instal a newly-patented boiler which has not had the test of experience. There are men who will do this simply on account of difference in price and fulsome promises; so progress is not hindered by taking a conservative course and letting others have the experience. When a number of boilers are equally satisfactory, the question may be settled by the difference in price. The purchasers should, however, be satisfied, first, that they have the type of boiler they desire, second, that they have asked for bids from manufacturers of equal standing and experience; when, third, they may weigh the price with the article it is proposed to furnish.

In conclusion, we should be unfair to purchasers, and belittle the engineering profession, if we did not say that the services of an expert engineer could well be employed originally in assisting in the selection, and, finally, in determining whether the terms of the contract have been fulfilled. Perhaps the practical engineer of the purchaser may be sufficient for the latter purpose, but the various difficulties that can occur under such circumstances are best prevented by having expert assistance throughout. Advice given by contractors costs most in the end. A contract in proper form and satisfactory to one's lawyer may, if carried out to the very letter, not secure the delivery of apparatus best adapted for the particular purpose and the conditions under which operation is to take place.

For regular marine purposes the type of boiler for different classes of work has been so well established that little need be said on the subject. There has been for some time a growing desire that sectional boilers be developed for use on shipboard, and several boilers of this kind have been used for the purpose. This use, however, has not become general; so an adaptation must be based on an investigation by one well informed on the subject. The boiler on a steam yacht is always a source of anxiety. One of the ordinary marine type and of sufficient power is so heavy that many water tubular boilers have been designed to overcome the difficulty. They are not generally as substantially constructed as sectional boilers on land, but made up of small pipes put together in many ways merely to get an enormous heating surface in a small space. Such boilers always cause difficulty in a greater or less degree, and the average yacht owner, after selecting a boiler, appears unwilling to tell of its shortcomings to their owners. It is, therefore, desirable to consult some one who has technical information as to the failures of different types, and the conditions under which a reasonable degree of success has been secured in other cases.—*Edinburg Magazine.*

THE NAUD HYDRANT COUPLING.

The accompanying diagrams are illustrations of the latest invention of Captain Jean Naud, of the Montreal Fire Brigade, for the improvement in the couplings of hose to hydrants. It consists of two distinct parts; the one on the left in Fig. 1 is permanently attached to the hydrant by screwing it on to the nozzles; the other, on the right in Fig. 1, which is the part adapted to the hose. The



object of Captain Naud's invention is the large saving of time and the non-interruption of the streams in coupling a hose to the hydrant which is already in use. Under the present system, to couple a hose on an hydrant which has already one or more nozzles in play, the water has to be completely shut off whilst the hose is being adapted to it, which means danger to the firemen in an exposed position, from his supply of water being taken away for several minutes, and also considerable loss from the fire gaining headway during that time. Captain Naud claims to have found the solution to the above long felt defect in the hydrants by the following very simple device: In the illustrations A and B are two cups firmly screwed or bolted together so as to make a water-tight joint, and the bulb so formed is screwed to the nozzles of the hydrants. A screw thread is used to facilitate its adaptation and also removal in case repairs become necessary in the hydrant. Inside the cups A and B is the valve F, which opens and closes by its shaft G G sliding through the holes L and M in the supports H and I. The action of the valve is based on the pressure of the water flowing through the nozzles, which presses on it and closes the flow opening by forcing it against the rim and making a water tight joint (see Fig. 1). The water being turned on, all the nozzles close simultaneously. Now, to adapt a streamer you couple the hose in the ordinary fashion, only in the usual hose coupling is a ram K, and on the coupling are the handles P and Q, Fig. 1, for dispatch and to eliminate the use of a wrench. On securing on the hose, the ram K comes against the shaft G, and as you turn the handles P and Q till this piece comes to rest, you force back with the shaft G, the valve F so removing the obstruction to the free passage of the water, Fig. 2.

The experiments made at Montreal, under different pressures, up to 172 lbs. to the square inch, with Captain Naud's invention, have all been attended with the utmost satisfactory results, the improvement being in no wise an impediment to the height of the jet nor a disfigurement to the hydrants.

Its easy adaptation and usefulness have commended it so much to the public that already several corporations in the district of Montreal have decided to adopt it, and Montreal itself is considering its adaptation to the whole of its fire system.

Further particulars and details of the above invention can be had by applying to Messrs. Belanger & Amos, civil engineers and surveyors, 51 Montreal Street Railway Building, Montreal, Canada.

COMPRESSED GASES.

The report drawn up by the committee appointed by the English Government to inquire into the causes of gas cylinder explosions and the precautions needed to insure the safety of cylinders of compressed gas, is a most interesting and valuable document, though but little further light is thrown on the cause of the particular explosion which was the immediate cause of the investigations carried out by Professor Unwin and his colleagues. It will be remembered, says *Engineering*, that, in a report on the above-mentioned explosion, Dr. Dupre concluded that in some way an explosive mixture had been introduced into the bottle which burst. It was, however, difficult to account for the spontaneous ignition of this mixture, and such experiments as have since been made on behalf of the committee have yielded almost entirely negative results. Dr. Dupre entirely failed in his endeavors to produce a spontaneous ignition of oil in the presence of oxygen, though it is known that this has occurred in pressure gauges, and it is now recognized that such guages must be entirely freed from oil before being connected to an oxygen cylinder. It appears, however, that in these cases the explosion results from the heating of the gas in its sudden admission to the gauge tube, and in some experiments made on this head by C. F. Budenberg and Mr. Whitefield in 1892, tinder inclosed in a tube was ignited when the valve connecting the latter to a supply of oxygen at a pressure of 120 atmospheres was suddenly opened. Since the Frenchurch street accident occurred some hours after the cylinder had been charged, any action of this nature is out of the question, and the most plausible explanation of the occurrence at present available is that some freshly exposed surface of iron in the cylinder became heated by absorption of oxygen, and so caused the ignition In one case Dr. Dupre did succeed in obtaining ignition of tinder in this way, but subsequent experiments resulted in failure. Oily waste is generally credited with a capacity for spontaneous ignition, and Dr. Dupre tried the effect of spreading a few drops of suitable oils on cotton wool and filter paper, and plunging the oiled material into an atmosphere of compressed oxygen, but only negative results were observed. It has to be noted, though, that the maximum duration of any of these experiments was only 48 hours, and it is possible that more success might have been obtained if a longer period had elapsed.

Moreover, the phenomenon in question is not at all well understood, the necessary conditions for such spontaneous ignition being not known with any accuracy, since, though the precautions to prevent its occurrence are now common property, less attention has been paid to the means by which it may be brought about with certainty. On one point only can a positive statement be made, viz., that it is dangerous to charge oxygen and hydrogen into the same bottles. Why the mixture should explode spontaneously is, as already stated, not clear, but the Fenchurch street accident is not the only one attributed to this cause. Thus at Glasgow, in 1890, the foreman of a compressing company inadvertently charged oxygen into a bottle containing some hydrogen, the result being an almost immediate explosion. It was this experience which led the Brin companies to use left-handed screw threads on the valves and nozzles of hydrogen cylinders, a practice which we are glad to note that the committee endorse. Other regulations having a similar object in view have been proposed by certain local authorities. Thus the London County Council, ignoring the practice of by far the largest producers of compressed gas, have seen fit to issue a regulation of their own, requiring the hydrogen cylinders to have nozzles smaller in diameter than those for oxygen. Such local regulations are to be deprecated, especially when, as in the present instance, the fact that in probably some 75 per cent. of the bottles in use at the time of the promulgation of the edict, non-interchangeability was absolutely secured by the use of left-handed threads, was entirely disregarded, and large firms were put to much unnecessary expense. For another somewhat absurd regulation the railway companies are responsible, they having formulated a demand that for transmission by rail the cylinders must be inclosed in closely plaited hemp, or in a box of wickerwork or wood. Major Marindin and the committee both agree as to the uselessness of this requirement, though they apparently desire to maintain it for the present, as an incitement to the compressing companies to agitate for the institution of a Government inspection and testing department, after the creation of which they consider the regulation should be abandoned, as not increasing the safety of the public, whilst substantially raising the cost of distribution. The amount of punishment a good cylinder will stand is very remarkable. Such cylinders charged with gas at a pressure of 120 atmospheres were subjected by Professor Unwin to a drop test, in which the tup weighed 9¾ cwt., and fell a distance of 15 feet or more. The cylinder to be struck was supported on a rigid foundation. In no instance did a cylinder burst under this treatment, though in one case the gun-metal valve was jarred off. Statistical tests made on empty cylinders at the Central Institution showed that when of suitable material and properly annealed they could be crushed flat in the testing machine without any signs of a crack making their appearance. Under similar treatment bad and unannealed cylinders cracked badly.

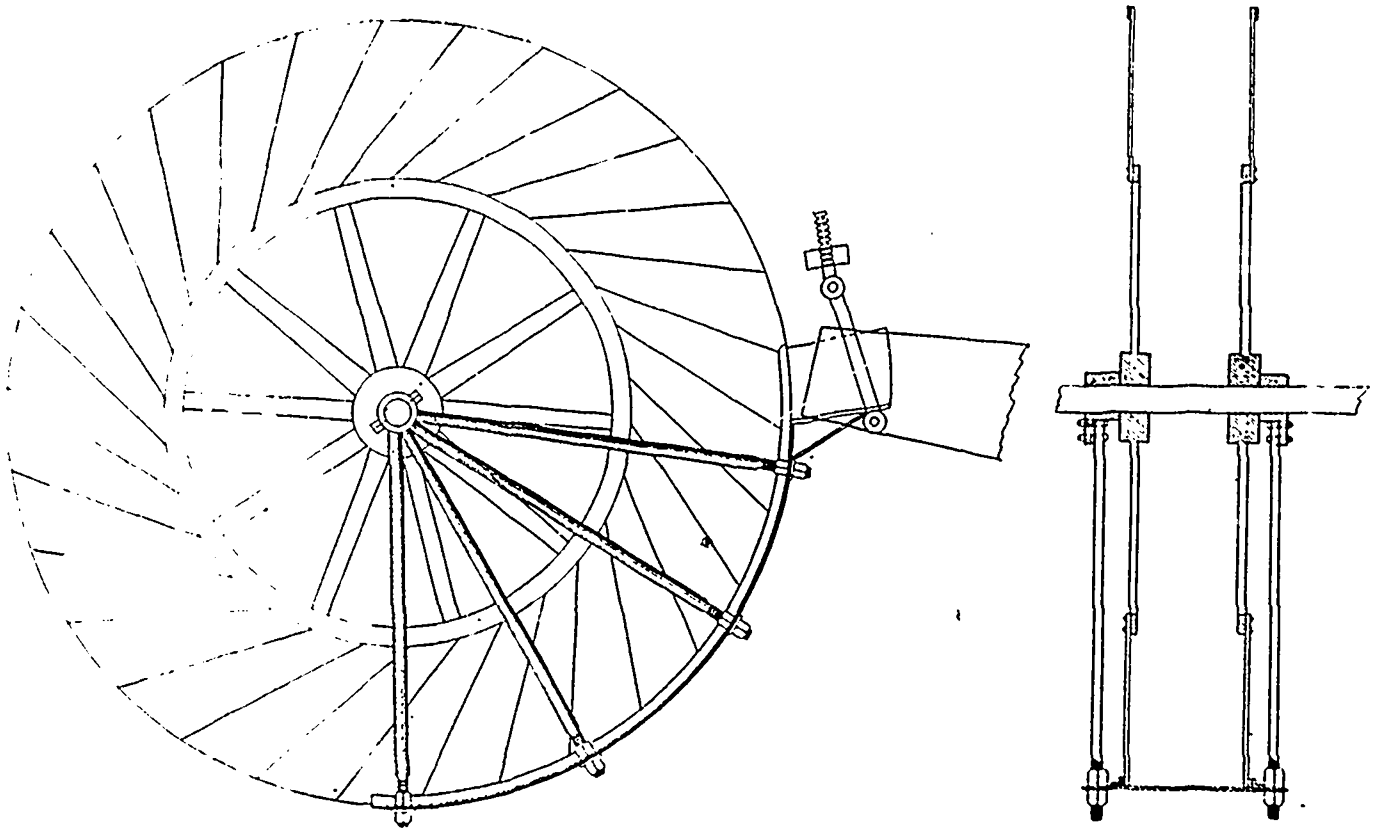
As to precautions to be adopted against explosion in the future the Committee have adopted almost *en bloc* the present regulations of the Brin Oxygen Company, which have been based on the probably unrivalled experience of K. S. Murray. These, it may be added, are much more stringent than the German Government requirements, as cylinders which have successfully passed the latter have failed when subjected to the Brin Company's tests.

The permissible working stress is fixed by the Committee at 6½ tons per square inch for lap-welded iron cylinders, at 7½ tons for lap-welded steel cylinders, and 8 tons per square inch for solid drawn steel cylinders. The carbon in the steel is not to exceed .25 per cent., nor the iron to be less than 99 per cent. This latter requirement may need modification should the present price of nickel steel undergo any substantial reduction. The tenacity of the metal should not, they say, exceed 33 tons per square inch, nor be less than 26 tons per square inch, and the elongation should not be less than 1.2 inches in 8 inches, the test-bar being cut from a finished cylinder. One cylinder in fifty should, they recommend, be subjected to a statical bending test, and stand crushing nearly flat between knife-edges without cracking. The ingenious water-jacket test introduced by the Brin companies has also been adopted. In this, it will be remembered, the reservoir to be tested is inclosed in a water jacket having a gauge tube attached. As the test proceeds, the expansion of the bottle is shown by the rise of water in this tube. Permanent set of the cylinder is shown by the failure of the water in the gauge tube to return to its original level. The cylinder should be rejected if under the proof pressure of 224 atmospheres the permanent set amounts to 10 per cent. of the total expansion. Of course any cylinder may be made to pass this test by giving it an initial stretch, but danger from this source is avoided by proper annealing, which it is recommended should be done every four years, and the testing every two. It is also proposed to appoint inspectors, but we are glad to see that the German precedent is not to be followed. In that country an inspector tests and marks all cylinders when made, and there the matter appears to end, no provision apparently being made for further tests after definite intervals of time, or for the enforcement of suitable methods of operating in the compression works. Such a system does probably more harm than good, as it tends to create a false sense of security. This is clearly shown by the failure of German cylinders thus marked to pass the tests prescribed by the leading compressing companies in this country. The inspection proposed by the committee is concerned mainly with the compressing factories. The inspectors are intended to see the due enforcement of the precautions proposed against the use of the cylinders for more than one gas, the suitability of the pumping plant, the safeguards against over-charging. When satisfied with the arrangements at a factory, a certificate stating the same, and good for, say, six months, should be issued, when a fresh inspection would be made, and a new certificate granted. Certificated factories would be authorized to test and mark cylinders, and it is also suggested that similar licenses should be granted to properly equipped testing firms, which might be, in other respects, unconnected with the trade. The committee think that cylinders thus marked should be accepted by the railway companies unpacked, though in such cases they advise the placing of a steel cap over the valve. We are glad to see that all special local regulations, whether connected with the use of the gas, or with the compressing of it, are, without exception, condemned by the committee. Many of these, in particular those regulating the use of the gas at theatres, tend, if anything, to introduce a fresh source of danger, rather than to increase the security of the public, which was, of course, the ostensible aim of the promulgators.

For THE CANADIAN ENGINEER.

THE WILLIAM GOLDING DRAINING WHEEL.

The accompanying engraving shows an improved draining wheel, the invention of Wm. Golding, of New Orleans, La., and described by him as follows This wheel is constructed entirely of metal, and is 40 feet in diameter at the outer and 24 feet at the inner circle, with a width of six feet; the scale engraving being three-thirty seconds to one foot. The feature of this wheel is the



adjustable breast, which may be raised or lowered to suit the varying height of the lake or river into which the discharge is made, and thus average the extremes of lift. The wheel is operated by an engine 20-inch cylinder, 60-inch stroke; taking steam from three return flue boilers, 26 feet long by 42 inches diameter. The coal consumed will average 500 pounds per hour.

The wheel is submerged in a canal 30 feet wide by 8 feet deep, which runs through the low portion of the land to be drained, the inner circle of the wheel being on line with the surface of the land. Thus constructed and erected the wheel, Mr. Golding claims, will have capacity to discharge 20,000 cubic feet per minute, with lift above level of land to be drained of 12 feet, and at this lift, with the canal full, will deliver in foot pounds of water 98 per cent. of the power actually applied to the wheel shaft. The wheel will deliver water higher than 12 feet, but with less efficiency. The wheel proper will weigh, with all metal parts, not including engine and boiler, 160,000 pounds. This wheel is designed to drain 3,000 acres of land having no natural outfall, under conditions of four inch rain fall per twenty-four hours, and to deliver the water to maxim height of twelve feet.

THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

On Saturday afternoon of the 12th ult. a large party of capitalists and otherwise interested persons drove out from Montreal to Lachine to witness the laying of the corner stone of the main dam and power houses of the Lachine Rapids Hydraulic and Land Company, Montreal, by G. M. Burland, president of the company. Among the visitors were E. McQuaide, New York; J. B. Fraser, Ottawa; Dr. Ami, Ottawa; Jas. Davis, Cornwall; John Yeo, Prince Edward Island; Messrs. Coleman, New York; Dr. Burland, Florida; Robert Ross, San Jose, Costa Rica; Aldermen Lefebvre, Stevenson, Costigan and Prevoneau, of Montreal, the mayor and members of the council of Lachine, Verdun, Cote St. Paul, St. Henri, Ste Cunegonde, Maisonneuve, Westmount and St. Louis du Mile End; Henry Bulmer and Alex Robertson, of the Board of Harbor Commissioners; L. E. Bowin, president of the Chambre de Commerce; Mr. Marceau, superintending engineer of the Lachine Canal; Sir Wm. Hingston, E. P. Hannaford, John Crawford, R. C. Smith, W. W Ogilvie, George Hague, A. Crombie, J. S. Kennedy, Victor Hudon, Alex. Ramsay, J. W. Nelles, Lieut.-Col. Crawford, George Kohl, D. Lockerby, R. A. Daunton, Dr. McPhail, W. Lyall, E. K. Greene George A. Greene, Charles Merton, B. Hal-Brown, Hon. Louis Beaubien, Dr. Roddick, M.P., Rev. Taylor, William Strachan, Henry Hogan, F. B. McNamee, B. J. Coghlin, W. H. Laurie, S J. Doran, J. M. Fortier, David Burke, Robt Mitchell, Wm Angus, Wm. Abbott, Dr. Leprohon, F. Crathern, W G. Turner, Alex. McArthur, J. D. Rolland, W. B. Powell, James Brown, J. McLean, A. Cowan, Fayette Brown, D A. Starr, J Hutchison, L. H. Heneault, F. Dagenais, Dr. Valois, Major Blaiklock, Lieut.-Col. Massey, S. K. Paron, James Brown, Geo. Kelpen, J. L. Galetti, R. E. T. Pringle, A. Dedman, Alex. Pringle S. Lacaille, W. Kane, P. Kane, S. Carsley, George Brush, J. P. B. Casgrain.

The extent of the work already done was surprising to many, and gave silent evidence of the president's remark that it was here to stay. Already 200,000 yards of earth and rock have been removed in the excavating process, and 3,300 feet of the wing dam (which is to extend 5,000 feet) is already built. When this work is complete the company will have a uniform depth of thirteen feet of water 1,000 feet wide. Thirty-two car loads of machinery, consisting of shafting, wheels and yokes, and 5,000 yards of dimension stone ready to be placed in position, are now on the spot.

In order to facilitate the distribution of power at the earliest possible date, the company intend erect a sub-station and testing room at the corner of McCord and Seminary streets, where switchboards will be placed and the current received. The contract for this has been let and the foundations are now being put in. In the words of the president, "We are now all perfectly satisfied that the power obtainable will be permanent and steady, that we have solved the difficulty regarding anchor ice and back water, and by the first of January next, if nothing unforeseen occurs, we will be in a position to supply the citizens of Montreal with cheap light and power." After the inspection of the works under the guidance of the directors, refreshments were served in a large tent pitched on what was formerly the bed of the river, and speeches of congratulation were heard from Sir Wm. Hingston, Jno. Crawford, Hon. Louis Beaubien, J. D. Rolland, G. Boivin and D. L. Lockerby. William Keys and W. McKay were heard in favor of the many men who needed work, and the vast number to whom cheap light would be a permanent benefit.

THE Superintendent of the Cornwall Electric Street Railway Co. (Ltd.), A. Porter, has resigned to take a position in Montreal. The employees of the company presented him with a gold watch on the eve of his departure.

NEW MOTOR TO BE TESTED.

The officials of the Westinghouse Electric and Manufacturing Company are about to make a test to see if their new motor can be used to haul trains on the New York elevated railroad. The test will be made at East Pittsburg, where the Westinghouse works are situated, on a 2½-mile stretch of the Turtle Creek branch of the Pennsylvania Railroad. The road has been divided up into sections, representing the average distance between stations on the New York elevated roads, and other conditions have been made as nearly as possible to correspond with those on the elevated. The train of cars is made up of old railroad coaches, weighted to the average weight of cars and trains on the overhead lines. The locomotive is one of the new Baldwin-Westinghouse type, which is not a locomotive at all, but a motor car. Its relation to the train, however, will be simply that of the steam locomotive in general use, it being equipped with all the appliances, air-brake mechanism for the train, etc., that are found on the steam engine. Two styles or methods of electric traction will be shown Messrs. Gould and Sage at East Pittsburg, both on the same road, for the stretch of track on which the trials will be made is fitted up with both the overhead trolley and the magnetic contact systems, each distinct from the other. Examples of the direct and the alternating current in electric traction will be shown. The new polyphase system of motors, invented by Nikola Tesla, will be used for the first time in actual railroad work. It is this system that it is promised will do away with the disadvantages of the ordinary system. As adapted to traction work by Mr. Westinghouse, it may be used with the overhead trolley or the magnetic contact between the tracks, and with either the direct or the alternating current. The chief advantage claimed for the new motor is that the cost of construction, operation and maintenance of roads equipped with it will be greatly reduced. A voltage of 210 under the new method will do the work of 500 volts by the direct current system. Thus the motive current can be carried on light wires, while at present very heavy and expensive copper conductors are required. Commutators and brushes, which are forever getting out of order, being burned out, are done away with, the armature playing directly into a field. If direct current is transmitted to the motor, it is there transformed into an alternating current, the power of the latter being far greater than that of the direct. If the Manhattan company should elect to use the overhead trolley system the current would be gathered in the same manner as it is gathered, for the motors on surface roads. The other system, being new and little understood, is most interesting. It is also said to be safer than the overhead system, though with the low voltage required by the polyphase motor the danger of persons being shocked to death by contact with the wires is reduced to the minimum.

The method of construction which has seemed to Mr. Westinghouse safest and most efficient is underground. The feed wires are laid in conduits between or alongside the rails. At intervals about the length of a motor car are switch-boxes under ground. Opposite them, between the rails, a trifle higher than the pavement of the street for surface road work, are placed steel caps or buttons about four inches in diameter. These are placed one about a foot from each rail. Under the motor car hang two long steel rods, arranged to rub the buttons as the car passes over them. The current enters the motor through one series of these contact rods and buttons, does its work and passes back to the feed wire via the other. The circuit is closed, and the current is in these buttons only when the motor car is over them, wherein lies the great safety of the system, for there is no possibility of one receiving a shock from standing on the button. This safety is achieved in a most ingenious manner. The motor car has got to pick up the current from the feed wire through the button by a short magnetic circuit supplied by an ordinary cell battery of two to four cells that is part of the equipment of the motor car. This battery is connected with the intake rod by a fine wire. When the rod touches a button the current passes down into the switch-box before mentioned, magnetizes a bar, which attracts another brass bar lying below it in connection with the feed wire, they come in contact, and the circuit between the feed wire and the motor is closed. The heavy current passes up through the intake button and rod to the motor, supplying the energy, and goes back to the trunk wire by the outgo rod and button. When the motor car passes the switch-box and button the short magnetic circuit is broken, the attraction between the bars in the switch-box is gone, the under bar falls back automatically into its original position, and the electric current passes through the box without entering the button until another motor car comes along to gather the power. The motor is handled by a crank the same as the motors on the surface roads now in use. Mr. Westinghouse always has maintained that the question of speed must be decided by the railroad managers and the traveling public. Electric lines using either the direct or the alternating current can acquire any desired velocity if the motor cars are geared properly. This is one thing he promises to demonstrate to Messrs. Gould and Sage The demonstration will take place very soon. Mr. Westinghouse feels confident that he will prove to them the efficiency of his system for use on the elevated roads of New York, and looks forward to being invited to figure on a contract for equipping the Manhattan system with all the electric apparatus needed to replace the steam locomotives.—*Railway World.*

THE ESTIMATES.

The following items of interest to our readers are taken from the estimates presented to the Dominion House by the Laurier Government:—

Railways—	
Intercolonial Railway	$372,850 00
Canadian Pacific Railway	62,000 00
Canals—	
Soulanges—Construction	800,000 00
Cornwall—Enlargement	285,000 00
Rapid Plat "	190,000 00
Galops "	300,000 00
St. Lawrence River and Canals. North Channel and Surveys	20,000 00
Murray—Equipment	10,000 00
Trent—Construction	500,000 00
Sault Ste. Marie—Construction and equipment	273,000 00
Lachine	339,500 00
Lake St. Louis Canal—Straightening and deepening	45,000 00
Grenville—Enlargement	90,000 00
Welland—Improvements	5,000 00
" Land damages, Grand River	3,000 00
North Channel—Deepening, widening and straightening	100,000 00
Rideau Canal—William Davis & Sons (final estimate and interest)	11,200 00
Lachine Canal—	
Stop logs	2,100 00
Extending electric lights along canal	4,550 00
Providing and planting boundary stone	700 00
To complete the electric light station, Beauharnois	3,500 00
Dredging shovel at upper entrance	5,000 00
Replacing cope stones on nine locks	1 600 00
Changing circuit of telephone from ground to metallic.	800 00
To improve channel at upper and lower entrance, Chambly	3,000 00
Build rubble walls along highway	2,500 00
Rebuild abutment walls, etc., Lock 8	4,000 00
Gravel bank of canal	1,500 00
Purchase half acre of land and build shed and fence	1,000 00
To build culvert under canal at St. Johns	6,000 00
Carlton and Grenville Canal—	
Build a set of spare lock gate	2,900 00
To build boom piers and stone	3,100 00
Trent Canal—	
Build a new dam at Chisholm	5,500 00
Remove rock in channel at Hastings	3,500 00
Build guard, booms and piers at Peterboro swing bridge	2,500 00
Dredge channel at Katchanawan Lake	2,500 00
Build landing pier at Burleigh	2,000 00
Remove rock in channel at Bobcaygeon	3,500 00
Provide hoisting engine and boiler	1,000 00
To build a fishway at Lindsay	500 00
Rideau Canal—	
Construct bridge across by-wash at Smith's Falls	5,000 00
Complete sheet piling at Deep Cut, Ottawa	8,500 00
Welland Canal—	
Remove sand bars in Dalhousie and Port Colborne harbors	4,000 00
Towards building superstructure of piers at Dalhousie	30,000 00
Rebuild in cement walls of lock No 24	25,300 00
Renew tow-path bridge	5,000 00
Renew one pair of lock gates and raceway bridge, lock 7, old canal	5,000 00
Clean and deepen feeder back ditches	2,000 00
Renew lock gates at Port Colborne	7,000 00
Renew raceway	3,000 00
Renew swing bridge at Stromness	1,500 00

Farran's Point Canal—	
To complete dredging of prism to original dimensions	$3,500 00
Towards extending the pier at upper entrance and dredging channel through Point Avoyon to slack water in Empey's Bay, to secure 9 feet of water for upward bound vessels	20,000 00
Repairs to glance pier and lock	4,000 00
Rapid Plat Canal—	
Lowering mitre sills, lower recess, Lock No. 23, and repairing foundations of breast and upper recess..	19,000 00
Gate lifter	4,000 00
Galop's Canal—	
Dredging prism where required to original dimensions	10,000 00
New gates, lower recess, lock 26	4,000 00
Iroquois Canal—	
New gates, lower recess, lock 25 (re-vote)	4,000 00
To complete renewal of entrance pier	1,000 00
Cornwall Canal—	
Repairs, new locks Nos. 15 and 17 (re-vote $4,000)	7,000 00
NOVA SCOTIA.	
Halifax drill hall	100,000 00
Lunenburg post office, customs house, etc.—to complete	1,000 00
Halifax immigration building—to complete (re-vote) ..	7,500 00
NEW BRUNSWICK.	
Marysville public building	8,000 00
Tracadie Lazaretto	1,348 21
St. John Marine Hospital, pipe fence, grading, etc	2,000 00
MARITIME PROVINCES GENERALLY.	
Dominion Public Buildings—renewals, improvements, repairs, etc.	10,000 00
ONTARIO.	
Dominion Reformatory	30,000 00
Dominion Public Buildings—Renewals, improvements, repairs, etc	21,096 48
Brantford Public Buildings—Settlement of city's claim for constructing sidewalks in front of the Dominion building, and a sewer benefiting the same	932 34
Ottawa Printing Bureau—Fire escapes	1,100 00
Public Buildings, Ottawa—Renewal of sidewalks in front of Parliament buildings	3,500 00
Toronto Dominion Public Buildings—Improvements, renewals, repairs, etc.	8,000 00
Ottawa Public Buildings—Renewals of boilers in eastern block	5,000 00
Arnprior post office, custom-house, etc., under contract	10,000 00
Kingston Custom House—Alterations to heating apparatus	800 00
Grounds Public Buildings, Ottawa, new sidewalks and roadways	17,000 00
QUEBEC.	
Dominion Public Buildings—Renewals, improvements, repairs, etc.	12,604 13
Grosse Isle quarantine station	6,000 00
Montreal Dominion Public Buildings—Improvements, alterations, renewals, repairs, etc.	12,000 00
Quebec Post Office—New wing, and repairs and alterations to old building, furniture, etc	2,655 35
Richmond Post Office and Customs and Inland Revenue Offices—Re-vote of $14,000 lapsed; to complete..	14,000 00
Rimouski Post Office, Custom House, etc., site given free of cost by municipality—Re-vote of $7,300 lapsed; to complete	10,124 47
St. Vincent de Paul Penitentiary	7,618 15
Quebec immigration buildings on Louise embankment, and breakwater and Queen's wharf buildings	5,000 00
MANITOBA.	
Dominion Public Buildings—Renewals, improvements, repairs, etc	5,171 20
Portage la Prairie Post Office, etc	20,000 00
Winnipeg Post Office—Renewals and repairs in connection with heating apparatus	679 22
NORTH-WEST TERRITORIES.	
Court-House, lock-up and police accommodation	2,000 00
Dominion Public Buildings—Renewals, improvements, repairs, etc.	5,000 00
Moosomin Court House—Additions, etc.	3,000 00
Prince Albert Court House and Jail accommodation ..	13,000 00
Regina Land Office—Reconstruction of burnt building	16,000 00
BRITISH COLUMBIA.	
Dominion Public Buildings—Renewals, improvements, repairs, etc	$5,000 00
New Westminster Drill Hall—Re-vote of $4,900 lapsed.	6,000 00
Victoria Drill Hall and Accessory Buildings—Re-vote of $2,000 lapsed	4,000 00
Victoria New Post Office	100,000 00
New Westminster Drill Hall—Installation of electric light	600 00
Williams' Head Quarantine Station—Fire protection, fittings, painting, etc.	1,500 00
ONTARIO.	
Harbors and Rivers—	
River Kaministiqua	10,000 00
Collingwood Harbor, Improvement of	20,000 00
Rainy River, Improvement of navigable channel	15,000 00
QUEBEC.	
River St. Lawrence Ship Channel	78,101 39
BRITISH COLUMBIA.	
Nanaimo Harbor, Improvement of south channel	10,000 00
ONTARIO.	
Collingwood—Repairs to breakwater	2,850 00
General repairs and improvements to harbor, river and bridge works	10,000 00
Kingston harbor, Lake Ontario	4,000 00
Lake Simcoe and Couchiching—Regulation of waters of	5,500 00
Owen Sound Harbor—Dredging, etc	20,000 00
Toronto Harbor—Works at Eastern entrance, etc.	25,000 00
Burlington Channel—Repairs to piers	10,000 00
Cobourg—Repairs to piers	3,000 00
Goderich—Reconstruction of breakwater and repairs to piers	28,000 00
Kincardine—Repairs to piers	15,000 00
Kingsville—Repairs to landing pier	10,000 00
L'Orignal—Reconstruction of wharf	14,500 00
Port Burwell—Improvement of harbor, provided interested parties expend a sum of $50,000	15,000 00
River Thames—Dredging at the mouth of	6,000 00
Thornbury—Repairs to wharf	1,000 00
QUEBEC.	
Anse a l'Eau—Tadousac pier	1,500 00
Etang du Nord—Repairs, etc.	1,000 00
Grand Riviere—To complete harbor of refuge by strengthening and extending the wharf, etc.	2,000 00
General repairs and improvements to harbor, river and bridge works	10,000 00
Laprarie—Works in connection with ice piers, dredging steamboat channel, etc.	10,000 00
Phillipsburg pier, the municipality having contributed $4,000	1,250 00
Piers, Lake St. John, including improvement of approaches	2,800 00
River Richelieu—Beloeil channel guide piers	6,000 00
River St. Maurice—Improvement of channel between Grandes Piles and La Tuque, dredging plant, etc.	3,000 00
St. Jean, Ile d'Orleans	400 00
Chicoutimi—Extension of wharf	5,000 00
Coteau du Lac—Repairs of wharf	500 00
Coteau Landing—Repairs to wharf	1,000 00
Grand Pabos—Repairs to breakwater	500 00
Kamouraska—Repairs to wharf	1,000 00
L'Assumption—Improvement of river	1,000 00
Little Metis—Survey for harbor of refuge	3,000 00
Lower St. Lawrence—Landing place for fishing boats..	1,500 00
New Carlisle—Repairs to wharf	850 00
Port Daniel—Repairs to wharf	2,000 00
Riviere Ste. Anne de la Perade—Repairs to protection works	3,000 00
Ste. Anne du Saguenay—Extension of wharf to shore..	5,000 00
Ste. Famille—Repairs to wharf	1,500 00
St. Irenee—Repairs to and extension of wharf to shore.	4,000 00
St. Jean Port Joli—Repairs to wharf	500 00
Three Rivers—Repairs to ice breaker	500 00
Touladie River—Improvement of	1,500 00
NEW BRUNSWICK.	
Gardner's Creek—New wharf	5,500 00
Nego Point breakwater—St. John harbor	20,000 00
River St. John, including tributaries	16,000 00
Anderson's Hollow—Repairs to breakwater	1,110 00

St. John Harbor—Repairs to and extension of protection work at base of Fort Dufferin	$3,400 00
Herring Cove—Repairs to breakwater	1,000 00
PRINCE EDWARD ISLAND.	
General repairs to piers and breakwater	6,000 00
Kier's Shore—Extension of piers, repairs and dredging.	2,500 00
Souris—Reconstruction of breakwater at Knight's Point	37,500 00
China Point—Repairs to piers	500 00
New London—Repairs	750 00
Port Selkirk—Repairs to wharf	600 00
Summerside—Harbor protection works	7,500 00
Tignish—Repairs to breakwater	2,500 00
NORTH-WEST TERRITORIES.	
General repairs and improvements to harbor, river and bridge works, including approaches	5,000 00
MANITOBA.	
General repairs and improvements to harbor, river and bridge works	3,000 00
Wharfs on Lake Winnipeg	8,500 00
MARITIME PROVINCES GENERALLY.	
General improvements to harbor and river works	10,000 00
NOVA SCOTIA.	
Boularderie—Wharf at Ross' Ferry	2,800 00
Church Point—Extension of breakwater	4,000 00
Hantsport—Wharf	6,000 00
Margaretville—Reconstruction of pier	5,000 00
Morden—repairs to wharf	4,000 00
Oyster Pond—Repairs to breakwater	700 00
Port Hood—Repairs to wharf	1,500 00
Port Maitland, Yarmouth Co.—Repairs to breakwater.	3,500 00
Trout Cove—Repairs to breakwater	4,000 00
Yarmouth Harbor—Repairs to protection works	3,000 00
Arisaig—Repairs to wharf	100 00
Digby—Pier	2,800 00
Georgeville—Extension of wharf	1,800 00
Grand Etang	3,000 00
Margaree—Beach protection (to complete)	200 00
Seaside wharf	5,300 00
BRITISH COLUMBIA.	
Columbia River—Improvement above Golden	4,600 00
Victoria Harbor—Dredging in inner harbor	10,000 00
Fraser River—Improvements of ship canal	25,000 00
General repairs and improvements to harbor, river and bridge works	3,000 00
Skeena River	3,500 00
Columbia River—Protection of bank at Revelstoke, Government of British Columbia contributing like amount	10,500 00
Columbia River—Removal of rocks above Revelstoke	2,000 00
Columbia River—Increased facilities for navigation purposes at the foot of Kootenay Rapids; re-vote, $800	1,000 00
Duncan River—Improvement of	3,000 00
Okanagan River—Improvement of	500 00
Williams' Head Quarantine—Repairs to wharf and improvement of water service	2,000 00

SOME HINTS ON RAILWAY PRACTICE.*

BY W. J. CLARK.

We all know that in street railway operation there is not the necessity for the full and constant study of standardizing rolling stock that is being carried on by the master car builders and master mechanics of the steam roads, for in their case the continuous interchange of cars between various lines has necessitated an almost universal standard of draw-bars, couplers, etc., and a close approach to a standard in car body construction. With you this interchange of rolling stock only exists to a slight extent, these, of course, under such conditions that it makes no particular difference what the height of a car body is, the length of its wheel base, the style of its trucks, or what any other of its mechanical details are.

It is also true that the conditions and service of no two electric railways are alike, and that the necessities of one road as to character of car body, style of truck, type of motors, kind and size of engines and generators, may be entirely different from the road next to it. So from the steam road standpoint standardization would be impossible, but in the practical operation of a street railway, different conditions exist from those met with in operation of a steam road, so you must view the special features of your business from a different standpoint than they. Unquestionably it would operate to your advantage, as it would most certainly to the electrical manufacturer, if some definite positive rule for the rating of all of the electrical apparatus were fixed. It makes but little difference what this basis of rating is, provided it is universal, well understood and thoroughly insisted upon by street railway men.

No one can suffer from such an arrangement, which is entirely just to both the manufacturer and user; and with the adoption of such a rule the little remaining mystery concerning the practical side of electrical apparatus would disappear, as it should do.

The electrical manufacturer, while justly entitled to much credit for the advancement of the science and the making of electrical railroading practical, has many sins to answer for under this heading of mystery, and the only power on earth which can absolve him from his remaining sins of this description is the united action of the users of his product to define distinctly and clearly what his product shall be called. And it makes no difference to him whether some particular article of his production is called a horse or an elephant, providing his competitors' production which should do the same work, is similarly designated. But if he uses the term horse and his competitor that of elephant, he is of course at a great disadvantage, while the purchaser who may not be thoroughly conversant with the different terms as applied may supposedly buy the larger animal, and when too late, discover that he has secured only a moderate sized pony.

The manufacturer who has used the larger term is not altogether to blame either, for no class of machinery has ever yet been produced which was susceptible to so many different methods of rating as electrical apparatus, and all of which may be considered honest, all such methods being entirely dependent upon the standpoint from which its producer views the matter—as, for instance, one producer may say, "I will rate a certain sized generator so that it will give a product of 300 kilowatts continuously, and never rise to a dangerous limit of heating," so he calls this a 300-kw. machine. Now this very machine would, for instance, develop say 400-kw. capacity for a period of two hours without rising to a dangerous degree; so some other manufacturer says that in practical operation no generator ever had a continuous load up to its rated capacity; so a safe basis to go on is to rate the machine at what it will do for two hours, and he calls it a 400-kw. machine. The natural sequence is that some one buys a machine that is either larger or smaller than what they supposed they were purchasing, and if they are fortunate enough to escape paying more money than they should for a certain capacity machine, they are exceedingly liable to get tangled up on the proper sized engine unit to go with the machine, and following in the wake of the transaction is the old story of engines being found too large or too small for the generators which they are coupled with. For this trouble our brethren of the engine trade are not by any means guiltless; for, as some of you have learned by experience, methods of engine rating are about as flexible as those followed on generators; and I trust that I will not be accused of giving away state secrets when I say that instances have come within my observation where the engine man and electrical agent have stood in together to make it appear to some prospective purchaser that he was getting, at least, all that he paid for in both engine and dynamo capacity. These evils have, of course, not troubled the larger roads, with their skilled engineers, so much as they have the smaller roads and the newer ones which were about to begin business; yet, it is unquestionably wise and just that all opportunities for mistakes, misunderstandings and misrepresentation on such features should be forever done away with.

What has been said on generator rating applies with equal or even greater force to the rating of street-car motors; for even greater differences exist in defining their capacity than is met with in generator practice. In fact, the varying features necessitated by the construction of motors for various characters of service renders greater opportunity for mystery than in connection with stationary machines, and the best of engineers are occasionally imposed upon by misused terms in connection with some particular class of motor, consequently some definite rule is even more necessary for their rating.

For both generators and motors it is imperative that there be some prescribed rule as regards the character and method of their insulation. In natural sequence to the question of motors comes that of car wiring. It is customary with all the manufacturers of car equipment to furnish a liberal quantity of good material for this purpose, and as to a great extent the work of installing the same is done by the railway companies themselves, troubles from this source are not nearly so numerous as formerly; yet there are cases where installation is done by manufacturing companies, car

*Abstract of paper read before the New York State Street Railway Convention.

builders and outside contractors, which would never pass inspection were the wiring done in any building of our larger cities. While the necessities for good work in this particular are of course far more apparent on a car body that is subjected to all sorts of movements and motions than in connection with the wiring of a building, the need of preparing for the last class of wiring was apparent years ago and has been strictly followed ever since, so no argument is needed for the fixing of standard wiring rules.

On standardizing switches, circuit-breakers, bus-bars, etc., I can offer no better argument than to state that your engineers well know the carrying capacity of certain weights of copper on their line of work, and on the articles which I have mentioned the results should be as well known and established as any other feature in the transmission of current.

In conclusion, a word should be said on the important feature of protection against ligtning No detail of electric railway equipment costs so little, and upon which so much is dependent, as upon its lightning arresters Defects in this particular may cause many thousands of dollars' damage within an instant, so this question cannot be too carefully scanned and considered by your associations, and some standard fixed upon which will effectually protect your machinery.

On every feature of the business, the manufacturers will gladly conform to your actions and requests, and to sum up the whole situation in a nutshell, they exist for your benefit, not you for theirs, and that they now look to you for suggestions instead of making them to you.

LONG DISTANCE AND HEAVY DUTY ELECTRIC RAILWAYS.*

BY F. W. DARLINGTON.

This subject may be treated at length from two standpoints, the scientific and commercial, either of which, to fully discuss, would take up more of your time than I feel justified in doing to-day. I will, therefore, occupy you with glances at both sides of the subject, and call your attention to a few of the important thoughts which I deem pertinent to the times, and of supreme interest to all of you who have roads, suburban, interurban, and local, to operate and earn dividends from.

There are already in operation many long distance, and also some heavy duty, electric railways. The majority of these roads do not fairly come within the scope of this paper for the reason that they have been built as ordinary trolley roads, with roadbeds insecure and unsafe for high speeds. Our subject refers more properly to roads designed to supplant the steam locomotive both for high speed and heavy freight service.

Some few roads have been built, which, though not longer than ten or twenty miles, and consequently not long distance roads, yet are convincing proofs of the ability of the electric motor to perform all work demanded of a steam locomotive. These roads have been installed as experiments, and by such corporations as the P.R.R. Co.; the N.Y., N H. & H.R.R. and the B. & O.R.R., and with all the success obtained on these, the corporations named are yet unconvinced of the advisability of adopting electricity for their entire systems.

This incredulity is not prejudice in favor of steam, as asserted by many writers, for the men at the helm of affairs in these big companies are too broad-minded and too alert for the companies' interests to be blinded by prejudice. Their slowness to be convinced is to be attributed more to the lack of proofs of its desirability from their point of view, as handlers of heavy traffic.

The first electric railway motors were designed to supplant horses in street railway work. And from this point the advances have been made by meeting and overcoming difficulties long since met and overcome by the steam railroadman. For it must not be forgotten that the first railroads were horse roads and when the steam locomotive was put upon them it had to undergo changes, and its use necessitated alterations in the construction of cars and roadbed. Does it not seem absurd, therefore, to ask steam railroad men to go backward some fifty years and begin over again, for this was the proposition advanced when they were asked to take hold of the subject in the shape it was only two years ago. It is to the method in which the question has been taken hold of by these men that is due the credit of the advanced position the electric motor holds to-day as a rival of the steam locomotive.

So far as the motor alone is concerned there is no longer a possibility of doubting its ability to do the work of a steam locomotive. It can make a car move as fast and faster. It can pull heavier loads by reason of its power being supplied from some exterior source, and hence, having practically an unlimited supply, it can climb steeper grades, and it can reduce expenses. Can more than this be asked of it? I think not.

There remains, however, the question of how to transmit the electricity from the stationary engine and boiler plant to the motor on the car. It has been proved beyond doubt that power can be developed in a stationary power house at a very large saving of coal and other expenses. Of this fact, and that of the ability of the motor to do all the work demanded of it, there is no difficulty in convincing the steam railroad man. But the inability to prove beyond a doubt that the power can be transmitted satisfactorily for long distances is where the failure lies. This is the one point to be worked out and demonstrated before there will be any general adoption of electricity for long distance roads.

There have been many theories advanced and systems proposed, but as yet but an insignificant number of them have been tried, and they only for very short distances.

This question must be solved, and all are looking for the solution in the alternating current system, but whether this or the direct current system is the solution is still an open question. There are many who think that the only solution is to come from the alternating current, but in the meantime devices are being added to the art that tend to making the direct current more and more of a success in overcoming long distance. Ultimately, no doubt, the ideal alternating current system will be at our service, and by the ideal system I mean that one requiring no actual current-carrying contact between the car and the track; in other words, some modification of the induction system. But unless this system is developed and made practical before long, it will find the older direct current system so well established and so generally in use that it will be difficult to have it adopted except for new roads, for it must be borne in mind that the depression in the financial situation for the last two years is the reason more than any other that steam roads have not been changed to electricity. So that with the country enjoying even moderate prosperity, there is sure to be extensive and widespread experiment in this line, and it is not too much to say that in five years time there will be such a change in the minds of financial and railroad men that there will be a rush to obtain the benefits of the reduced operating expenses to be derived from using electricity.

This assertion may seem wild and romantic, but any close observer of the thought and the attention given this subject by the large steam railroad companies, will bear out this statement. It does not mean that people will go wild over it, for that period in electric railroad history is past, and all should be thankful for it. But it does mean that with money available there will be a general start to equip both long and short roads, and the start once made, the work will be pushed on increasing numbers of roads, which, taken altogether, will constitute the equivalent of a rush.

The same conclusion is reached when it is remembered that the very conservatism of the steam railroad man, of which so much is said in electrical circles, will keep him and has kept him from adopting electricity until that same wonderful power shall have demonstrated its ability to do, and do continuously and satisfactorily, all of his work. This demonstration once having been made, and made in the manner those engineers abreast of the times are confident it will can and be made, that is, to prove beyond all possibility of doubting that money can be saved by discarding the steam locomotive for the electric motor—even when such change requires an enormous outlay of new money—then the conservatism must give way to progress, and all will be only too anxious to obtain the advantages to be gained.

What has all this to do with suburban and interurban railways as existing to-day? It is a question of vital interest to all those companies operating such roads. For all managers of local roads, whether they be running between towns or are purely local, if they in any measure parallel steam roads, have this fact staring them in the face, that it is only a matter of time, and a short time at that, before they will have real competition from those same roads whose territory they so profitably invaded.

They (the local managers) must know that a trunk line supplied with such power as it will require, can be tapped at any point to run a local road or branch line, at but small expense in comparison with that required to operate the local road independently. Then, too, let him think what it would mean to him to have a competing line with frequent service, and maintaining high speed on safe roadbeds.

All these things must be faced sooner or later, and while the above statement may seem alarming, yet it need not be so to the wise manager who will keep his eyes open and prepare himself in the time at his disposal.

* A paper read before the Pennsylvania Street Railway Association.

Just what this preparation consists of will have to be worked out by each individual. But it is very safe to say here that one of the most important points he will have to consider will be that of expenses; he will have to reduce coal bills and bills all along the ine. He will also have to guard well his policy of management, but as this point is not included in the scope of this paper, it will not be elaborated upon, though there are interesting points for discussion which might be brought out.

The question of expenses is mentioned here for the reason it is safe to say that at least seventy-five per cent. of the electric railroads in this State are paying too much for their power. By power is meant available power at the car axle. Some develop power cheaply and waste it on the line; others may develop it at high cost while they distribute it, and utilize it economically; wl. others again may be losing at only the motor end of the line. Then again, some roads may be so full of heavy grades that they may be eating up their earnings in maintaining them.

At any rate, the fact remains that few, if any, are paying dividends, and many are in the hands of receivers, when it would be possible to make all pay, excepting, of course, those wildcat schemes floated to fleece people of their good dollars. The sooner these latter are weeded out or reorganized on a more reasonable basis, the better it will be for all. There is one thing very sure, and that is, that there is no excuse for any electric road, not saddled with interest for imaginary money spent, to spend more in expenses (which includes salaries and interest) than its receipts amount to.

The reports obtained from many roads vary to such an extent that it is impossible to assume any given amount at any given place without knowing the conditions existing there. It might be stated here that a car mile should be produced for a given number of cents, based on these reports, and nothing of real value towards the solution of the question at hand would be gained, for all the calculations and reports made on power questions have been based on results at the power house, or at the switchboard, which is only a part of the proof, for they take no account of interest or line losses and motor repairs, which are all necessary for determining definitely as to the cost of a car mile For of what use is it to calculate your power in kilowatt hours at the power house, and in that calculation consider only your coal, water, supplies and labor, when you omit all account of your interest except as a lump sum? And of what use is it to define your motor repairs and car expenses in car miles when here, too, you lose sight of interest?

How can you tell how these several items compare unless you base them all on the same unit? This unit should be in car miles, for expenses of every description, and when they are so calculated you have the true basis, for all expenses are incurred for the one object of propelling cars a certain number of miles.

By this means the manager can determine the value of each department under him, and when economies must be undertaken he knows exactly where to turn to accomplish them. It would also enable the manager to tell at all times in what shape his engineering force was, whether his engineer was competent, and if he was attending to his duty. Again, he would be able to calculate to a nicety what each improvement would cost and in what way it would benefit him. His receipts, being readily reduced to earnings per car mile, would enable him at a glance to determine the prospects of his road.

All these points are of importance to know in order that the manager may keep himself posted as to the working of his system as a whole. The managers who do this are not many, and why they do not is to be attributed to the fact that the necessity for so doing has not been made clear to them. There are many who keep elaborate books with the expenses divided up into different classes, when they are principally only of value to keep the book-keeper busy, and really do not enlighten anyone as to the scientific conditions of the road.

This association can broaden its scope of usefulness to its members, and at the same time advance the interests of all electric roads by appointing a committee to gather data from its members and tabulating them, by numbers, not names, for it is not wise or of value to publish the names of roads making reports, and it is not necessary.

This committee can then digest the reports and each year draw impersonal conclusions for the benefit of all. This same method is employed by the National Electric Light Association, and though it has been in use only a few years, it has proved a great benefit to those desiring to avail themselves of its lessons.

It will be well to return once more to the subject of grades and curves, to say that both are expensive luxuries, not only because they cost more to maintain than straight level roads, but also because they are more expensive to operate, and are the cause of greater original investment. And as we have seen in the case of the Columbia and Donegal R R., they may be the source of many and expensive damage suits.

Suppose A and B each build a road from X to Y, and A builds his with long radius curves and as little grade as possible, say a maximum of 1 per cent, while B does not appreciate the gain in this method, and so has some heavy curves and some heavy grades. What will be the result? It is well known that it takes more power to climb the hill than to run on the level, but you say that the motor on the level averages the same power for the whole round trip. That is true, but here is the point, for A can do his work with smaller motors, which will be running more continuously and will be calling for a more even supply of power from the power house, which in itself will be a source of economy both at the motor and at the power house. B will be drawing power intermittently and creeping up the hills to rush down the other side at great risk. B's motors will cost more than A's because of their larger size, and B's engines and generators will have to be larger. His feeders must be larger. Just what these several items will amount to can be determined, and I maintain that they should be calculated before a road is built, and the economical grades figured out.

When it comes to competing with the steam roads as they exist to-day, the electric road attracts local travel because of its cars being run at frequent and regular intervals, whereas a traveller must consult a time-table before taking a train on a steam road. Again in summer time the electric road offers the additional inducement of a cool, clean ride, while on the steam road if one opens the window for fresh air he is treated to a shower of coal dirt, cinders, and dust, to such an extent that when the journey is over the passenger is more uncomfortable than when he started.

All this is destined to change, however, for the undoubted tendency of steam railroad travel between large cities is to move trains at more regular and more frequent intervals. This is indicated by time-table records for some years back. The clean travel will come when electricity is adopted.

The question of the real meaning of the difference in number of trains running on competing roads is shown very clearly on the roads operating between Philadelphia and New York Of these two roads the Pennsylvania gives by far the most trains, and the result is that it gets the most of the travel. This is natural, for the reason that a man bound to New York from Philadelphia will buy his ticket by the route that will give him the greatest choice of times to start on his return. Carrying the comparison farther, suppose an electric road was built between the two cities and built so that it could land passengers in New York as quickly as the steam roads, and a train service every fifteen minutes or a half hour be maintained, there is no doubt that it would get the bulk of the travel.

As for speed, if a speed of seventy-two miles an hour can be obtained on a road seven miles long and maintained for three miles, as has been done on the electric road installed by P.R.R. Co. in New Jersey, it certainly would be no more difficult to obtain a speed of eighty to ninety miles an hour on such a roadbed as possessed by the P.R.R. on its Philadelphia-New York line. As for the length and weight of train, the same road has demonstrated that it can handle a train of three cars, *i.e.*, motor car and two regular Pennsylvania day coaches as trailers, and fulfil its schedule requirements.

I have observed with interest the fact that the majority of trains leaving the Broad street station, Philadelphia, are composed of a combination car and two or three trailers and that trains of more than four trailers are not frequent. It, therefore, seems to indicate that a motor car of sufficient capacity to draw these trailers at the desired speed could be made a standard and do all the work. This might necessitate making two sections of the through trains, but this would prove a benefit to the traveler, especially if the two trains were scheduled to run at different times.

Right here it might be interesting to consider what we are to have in the place of the steam locomotive. It can be demonstrated conclusively that when we discard the steam locomotive, the most economical and convenient method will be to put the motor under a baggage or combination car, for if we attempt to follow steam railroad practice and carry enough weight on an electric locomotive to provide traction for a train, we will have to add useless weight, and one of the chief sources of economy of the electric system over the steam is from the reduction of the weight of train. The weight can be done away with because of the fact that the even pull, at a tangent to the circumference of the motor armature, produces an apparently greater possible traction effort per ton of weight, and in addition reduces the tendency of the wheels to slip at starting.

This feature of the electric motor is the one above all others that establishes the fact that it has come to stay, no matter what developments may be made in air, gas or other motors which have to convert a reciprocating into a rotating motion.

And the fact that an electric motor supplied directly from a central power house gives to that motor a practically unlimited supply to draw from, puts it far ahead of any motor which carries its supplies on its back, whether it be in air tanks, storage batteries, oil reservoirs, or coal and water bunkers. Any storage reservoir must be refilled and this takes time. And all time used in this way is dead loss and means that the motor can not make as many miles in a day.

One more point in favor of the electric motor is that where they are equipped with double motors and two controllers, there is no one thing that can happen to prevent the motorman from getting his train to its terminus, for with the modern apparatus he can cut out the motor or line giving trouble and proceed with one motor. To be sure his speed will be decreased, but still he will be able to move his train, whereas in any of the above cases there are a number of accidents, and trivial ones, that may happen to cause the train to wait for a new motor. Of course, the question of the supply line, or feeder system, is ignored in this statement; but with the advent of electricity on steam roads, will undoubtedly come a feeder system practically impossible to interrupt.

The question arises when considering cars for high speed work as to what kind of motor trucks should be used.

The advocates of maximum traction trucks refer to the steam locomotive as their model, but there are some principles in use on the steam roads which we must avoid, and this is one. The steam locomotive is of necessity a maximum traction machine, but it has been demonstrated that a car can be started and propelled with less power when the trucks have a motor on each axle (*i.e.* four motors on an eight-wheeled car), than where equipped with a motor on each pair of axles (*i.e.*, two motors to an eight-wheeled car), and this too when the four motors are of greater weight than the two larger motors.

These so-called maximum traction trucks with one pair of small wheels are lately provided with some kind of device to hold down the small wheels to keep them from jumping the track. This deprives the truck of most of the efficient traction obtained by putting the weight nearer the axle of the larger wheels, so that the results obtained are practically no better than were the light wheels made the same size as those carrying the motor and the weight of the car placed centrally over the truck.

It will be noticed, too, that a maximum traction truck rides more roughly than a regular truck, this for the reason that the car support is placed more over one axle than the other, and thus gets practically the same hammer motion that the motor does, and does not get the relief given by equalizing and dividing the motion of both axles, as found on regular trucks. In this question of trucks, as we approach nearer the practice of steam roads in other respects, we will find it to our advantage to be guided by their experience, and not attempt to drag with us the crude ideas heretofore held. It is only just to say here that most builders of trucks have recognized this point since the building of these roads mentioned at the beginning of the paper, and have been trying to educate their customers to this belief, and with some measure of success.

In closing, I will remind you that the area of long distance high speed and heavy duty electric railways is at hand. The first experiments have been made and steam railroad men are awake to the facts And those of you having roads that must come in competition with them must bear in mind that the steam railroad men will bring to the subject an experience of great value, and that there are certain matters in connection with your roads that will bear your closest inspection, such as power house, distributing system, motor repairs, track, grades and trucks.

NEW IDEAS.

HOSPITAL CARS ON RAILWAYS.

The Plant System of Railways in Florida has in operation a hospital car for use at accidents It has all the facilities for surgery and medical treatment that the larger city institutions contain. It is expected that other roads will do likewise, as the effect of immediate surgical attendance at railroad wrecks will save many thousands of dollars.

HEADLIGHTS

Theo. N. Ely does not look with favor upon electric headlights, which seem to be gaining ground on some lines. He has been reducing the size of the present oil lights from 30 to 16 inches, which, viewed from the engineer's standpoint, is better, as the temporary blindness inflicted on them when approaching a headlight requires several minutes to be dissipated. The longer distance the electric light rays are visible is of very little value when the road has many sharp turns.

INCANDESCENT ALCOHOL LAMPS.

A late German invention is an incandescent gas lamp fed with alcohol, the temperature of the flame being caused by intermingling alcoholic vapor with air, as in a Bunsen burner. The mantle is probably similar to those of the Welsbach gas light. The idea of using alcohol is to curtail the consumption of petroleum in Germany, which must be imported from the United States or Russia.

CHAINLESS BICYCLES.

It is said that chainless bicycles, in which two pairs of bevel gears are substituted for the chain, have proved their superiority in dynamometric tests, and actual runs amounting to over 39,000 miles.

A LARGE ELECTRIC LOCOMOTIVE.

There was shipped recently to Elkhorn, W. Va, the largest electric mining locomotive yet constructed. It is 200 h-p. and weighs 44,000 pounds. (The largest motors were 80 h.-p.) It is of Westinghouse manufacture.

FUSIBLE PLUGS FOR BOILERS.

"Reading the other day of fusible plugs for boilers, called to my mind an incident which is said to have happened several years ago in a place where an old-fashioned haystack type of boiler was in use," says a writer in *Cassier's Magazine*. "On one occasion a rivet was blown out at a point difficult to get at for repairing, and as a makeshift the engineer put in a pine plug, driving it into the hole from the inside. It is not remembered how long this plug lasted but at any rate it tided over an emergency. The plug, it was found later, burned off until the leakage through it was just sufficient to prevent further charring, and while it was in operation, no doubt, performed the part of a safety plug, for, had it become uncovered, it would, in all probability, have given way with quite as much celerity as the ordinary fusible plug."

IS ALUMINUM POISONOUS?

A correspondent describes the following experiments in the columns of the London *Morning Post:* Recently two healthy and robust physicians, aged 26 and 35 years, were selected by the Imperial German Health Bureau to undergo an interesting experiment. These two gentlemen, in order to test the non-poisonous properties of aluminum, volunteered every morning for one month to swallow 15 grains of aluminum tartrate with their lunch. At the end of the trial neither of them had lost flesh or appetite, or experienced the slightest discomfort during the entire period of their metallic lunch. It is found that the metal is not adapted to contain for a lengthened period brandy, whiskey or wine, as after a time these turn turbid.

ELECTROCUTION.

The Ohio Legislature passed a law, operative after July 1, making electrocution the capital punishment. Bids were asked for alternating electric apparatus, but none received, as no concern wishes to have their apparatus considered deadly, even when life is legally taken by it. The only means of obtaining the machinery is by strategy, such as was resorted to when New York State adopted electrocution.

AUTOMATIC ELECTRIC ELEVATORS.

Automatic electric elevators for residences are now made so that they can be operated with absolute safety, a single pressure on a push button at any floor being all that is necessary to bring the car to that landing. Entering the elevator, a push of any of the buttons on the plate (one for each floor) will cause the elevator to descend or rise to the desired place, provided, however, the door is closed. Should any person on a landing desire to use the elevator while in operation, until the doors are all closed in every floor the elevator is inoperative.

LATHE PRACTICE.

A machine-shop lathe hand was noticed to chuck a piece of cast iron in a lathe, set an old file with one end down on the lathe carriage, put the butt of a tool against the file and force the flat face against the casting. The file took hold and a stream of iron dust poured out, more iron being cut than with a tool. When spoken to about it he said: "I often do it. Don't matter which end 's up. Sometimes it wont work. Don't know the reason. Always bites into soft iron, and wont work on anything but cast iron."—*Machinery*.

STEAM TURBINES.

Rotary steam engines are popularly known as "steam chewers," and when spoken of for practical use the speaker is generally jeered, but reports of a 300 h.-p. DeLaval steam turbine directly coupled to two Desrozier's dynamos (8 poles) by gearing one on each side of the turbine shaft, show a very good comparison with a great many high-class reciprocating engines. This plant is installed at the New York (City) Edison Electric Co.'s plant. The steam pressure was 145 lbs. to the inch, and a vacuum of 26 inches; the steam consumption was to be not more than 18.7 lbs. per brake h.-p. per hour. The turbine disc was about 29½ inches in diameter and ran at a speed of about 9,000 revolutions per minute; the dynamos were geared to run at 750 per minute. The space occupied by the entire plant was 13 feet 3 inches long, by 4 feet 3 inches wide. The efficiency at full load was 17.3 lbs. water per brake h.-p., or 19.27 lbs. water per electric h.-p. hour.

ELECTRO-CHEMISTRY.

The United States, Canada and England are far behind Germany and France in the important branch of electro-chemistry. For literature on that subject one must go to the latter-named countries, and in German and French universities chairs of that branch have been established, and in England but two professorships exist, one each at the Technical College, Finsbury, and one at the Municipal School, and they are devoted to plating and the application of electro-deposition rather than research. Electro-chemistry is fraught with interest and the field is capable of rapid development.

ELECTRIC CURRENTS.

Herr Gold, in *Zeit. f. Elek.*, Germany, mentions that when using an alternating current for producing an arc between electrodes of carbon and iron, that a strong continuous current flows from iron to carbon. Owing to the chance of error from using a magnetic needle he used a copper voltameter. The electrodes were vertical, the carbon being above. When the alternating current was 5, 6 and 7 amperes, the continuous current was 3.2, 4.05 and 4.75, respectively. Similar results were obtained when the electrodes were placed in other positions. He does not mention the voltage of the induced continuous current or the alternating current, that would throw a great amount of light on the question. He offers several explanations as to the cause. (As a suggestion, could it not be a thermo-electric effect of a carbon-iron couple?)

THERMO-ELECTRIC GENERATOR.

The Cox Thermo Electric Generator, as described in the *Electric Engineer*, shows an advance in Thermopiles. Older types gradually became unworkable by the oxydization of the joint. In the above-mentioned one this is obviated by a gradual alloying of the elements. Alloys of antimony-zinc and copper-nickel are used for the elements, each couple giving 0.08 volt. A cell having an output of 12.5 watts, consumes 2.5 cu. feet of gas an hour, and better results are said to be obtained. Mr. Cox is an American, and perfected his invention on this side, but preferred to go to England to promote the sale of the article. His laboratory is at St. Albans.

ELECTROLYTIC IRON.

Electrolytic iron has been found to be like steel in its behavior in a magnetic field, for where soft iron may be "saturated" with 10 units, electrolytic iron requires over 90; the retentiveness, permanent magnetism, of the electrolytic iron was high, about 65 per cent. of the temporary. The plates were thin, only a few millimeters thick, and it was thought that if the plates were quite thick the "permanent" magnetism would approach 100 per cent. A 5 per cent. nickel iron alloy (electrolytic) had the highest permeability on record, viz.: 1830 units.

The *Engineering and Mining Journal*, Aug. 29, announces that M. Patin, of Paris, has devised a new process for producing calcium carbide, but does not state whether it is electric or not. A plant is operating this process at a cost of $40 per ton and with water power $30 or $35.

ACTION OF THE SIPHON.

A correspondent at Purdue University, La Fayette, Ind., takes exception to Mr. Perry's explanation, which appeared in our August number. Our correspondent says: "It is news to know that cohesion of the particles draws the water from the shorter tube into the longer, when one would naturally suppose that a cohesive force would tend to retain the water in the shorter tube. Had he suggested repulsion, instead of cohesion, the case would have been more simple, and probably equally as truthful."

From Gage's Elements of Physics: "The pressure at each opening of the siphon is equal to one atmosphere, less the weight of the vertical column of water in that side of the siphon. The pressure will necessarily be least at the mouth of the longer tube, and the water will flow in that direction."

Industrial Notes.

THE hub and spoke works, Sarnia, Ont., are now being rebuilt.

A NEW passenger station will be built by the G.T.R. at St. Henri, Que.

A NEW Roman Catholic cathedral will be built at Nicolet, Que., immediately.

THE Queen City Oil Company, Toronto, is being incorporated, with a capital stock of $200,000.

RHODES, CURRY & Co., Amherst, N.S., are turning out 1,500 car wheels for the Intercolonial Railway.

T. REID, of Hamilton, Ont., has secured a Canadian patent for a gasoline motor for horseless carriages.

THE Goldie & McCulloch Co., Galt, Ont., has recently supplied a 400 h.p. plant to the Lang Tanning Co., Berlin, Ont.

THE old boiler shops of the Rathbun Company, Deseronto, are being torn down, thereby removing one of the old landmarks.

THE Jenckes Machine Company, Sherbrooke, Que., is working night and day on orders of mining machinery for British Columbia.

THE G.T.R. is preparing to construct a new iron bridge near Timothy street, Bradford, Ont. It will be 65 feet long, with a clear span of 55 feet.

THE underwriters have ordered the town of Welland to put in a $50,000 system of waterworks or incur a penalty of 50 per cent. rise in insurance rates.

THE saw mills of A. Cushing & Co., Union Point, N.B., are to be enlarged, and a considerable amount of new machinery put in, says the St. John *Sun*.

JACKSON & COCHRANE, Berlin, Ont., have recently shipped a large consignment of wood-working machinery to a furniture company in Seaforth, Ont.

CONTRACTOR JOSEPH MCVEY has finished a steel bridge, at Seal Cove Creek, and a stone bridge at Newton's Brook, Grand Harbor, Grand Manan, N.B.

DR. BRYCE, Provincial Health Officer, has approved of the site of the sewage interception works in Hamilton, Ont., and advised similar works for the west end.

R. DITTRICK, of Cleveland, O., will manufacture street car fenders in the works of St. John & Co., St. Catharines, Ont., says the *Evening Journal* of that city.

PARRSBORO, N.S., town council have engaged Prof. W. R. Butler, of King's College, Windsor, to finish a survey, make plans, etc., for water supply for that town.

RHODES, CURRY & Co., of Amherst, N.S., have been awarded the contract for erecting a new building at Campbellton, N.B., for the Bank of Nova Scotia, to cost $15,000.

THE new concrete foundation for the Rideau rink, Ottawa, Ont., will be built by John Foley. The Canadian Bridge Co. will supply the steel pillars and A. Sproule the steel work.

E. J. LENNOX, architect of the new city and county buildings, Toronto, has recommended the letting of contracts for the steam-fitting, ventilation, plumbing, and electric lighting, amounting to $150,000.

PLANS may be seen at the Public Works Department, and at the office of C. E. W. Dodwell, C.E., Halifax, for the construction of a hot water heating apparatus in the immigration building at Halifax, N.S.

JOHNSON CLENCH, county clerk, will receive tenders for building an iron bridge in the village of Grimsby, Ont., to be 20 feet wide and 30 feet long, with stone abutments. Tenderers to furnish their own plans.

ONE of the three boilers of Pettit Bros.' hoop and stave mill, near Comber, Ont., exploded on Sept. 17th, killing the night foreman, Alfred Jacobs. He was about 28 years of age, and was to have been married shortly.

C. F. DACEY, contractor, N.Y., asks for a winding-up order against the Montreal Water and Power Company. Mr. Dacey's claim is for $9,500, amount of balance due him on account of construction of the company's reservoir at Cote des Neiges.

ALEX. THOMPSON has received contracts for a brick round house and frame repair shop on Garth street, Hamilton; cost $10,000 and $4,000 respectively; frame station at Bartonville and a station at Stoney Creek, on the Toronto, Hamilton & Buffalo Railway.

THE C P.R car-shops at Carleton Place are now working full time.

JAMES A CLOSE, brickmaker, Woodstock, Ont., has made an assignment.

LOUIS BOUCHARD, Bay St Paul, Que., has commenced the construction of a steam saw mill in that locality.

LABELLE & PAYETTE, Montreal, have obtained the contract for laying the foundation of the new C.P.R East End Station, Montreal

THE Brotherhood of Locomotive Firemen, recently in session in Galveston, U.S.A., has selected Toronto for the next biennial convention

JAMES MORRIS, C.E., Pembroke, Ont, has prepared plans for the proposed sewage system of Arnprior, Ont., which call for an expenditure of $21,000.

THE Beeton, Ont, *World* says that the old woolen mill site is to be used for the purpose of manufacturing wire nails. A joint stock company will be formed and machinery will be put in at once.

MCNAMEE & SIMPSON, Toronto, have secured the contract for piling and filling over the 900 feet of conduit pipe in Blockhouse Bay, Toronto, where the sand covering has been washed away by the action of the waves.

THE sixth annual convention of the Association of Railway Superintendents of Bridges and Buildings will be held in Chicago on the 20th inst. The association will be in session for four days, and a most interesting series of papers will be read.

H. J. POWELL, the architect of the new Presbyterian Church in Palmerston, Ont., has been investigating the machines for producing acetylene gas from calcium carbide and water, with a view to using the new illuminant in the church, if found practicable.

R. PREFONTAINE, M.P., C J. Q. Coursol, J. N. Hickey, Louis Legat, C.E., T. F. Moore, Chas. Lionais, C.E., Montreal, are applying for a charter as the Moto-Cycle Co of Canada, to manufacture and sell horseless vehicles in Montreal; capital, $150,000

TENDERS for the construction of an aqueduct are being received by the secretary-treasurers of the villages of Chambly Basin and Chambly Canton, Que; the engineers are E L. De La Vallee & Cie., civil engineers, 17 Place d'Armes Hill, Montreal.

WALKERVILLE, Ont, is improving its water service for fire protection by putting in a new waterworks pump of a capacity of 3,000,000 gallons, two new steel boilers of 150 horse-power each, besides laying a number of new water mains in the principal streets.

A TEST which cannot fail to be of great advantage to the manufacturers of asbestic wall plaster in Canada was a trial by the officials of the Supervising Architect's office, Washington, U.S., of the qualities of this new material. It was found thoroughly fire-proof, as well as most elastic, and it is said the United States Government will call for its use in future specifications.

IT is said the Canadian Pacific has in view the erection of large shops for the manufacture of their own rolling stock, and that with this purpose Sir William Van Horne, president; Vice-President Shaughnessy and Master Car Builder Abbs, have been visiting different sites in Ontario. If the shops are built, the company will manufacture passenger coaches, as well as freight, flat, cattle and coal cars.

THE St. John Rolling Mills and Bolt Works Company has purchased the Coldbrook Rolling Mills and the St. John Nut and Bolt Works, and has applied for letters patent. The bolt works proprietors are at present operating both establishments. A large amount of money has been expended on the works since they were acquired by the new company. The combined establishments will employ from 100 to 150 men.

CAPITALISTS have undertaken the re-building of the St. Lawrence Hall, Montreal, one of the most famous hotels in the Dominion. The new building will occupy the site of the present one, and will consist of two distinct structures. One will contain the offices and stores and will be twelve stories high; the other will be the hotel proper and will be fourteen stories in height. The architects are G. F. Hammond, of Cleveland, Ohio, and Maurice Perrault, Montreal.

THE International Patent Bureau—composed of George O. Freeman and Robert A. Kellond—of Toronto, is in no way connected with the International Patentees' Agency, a concern against which inventors have been warned. Messrs. Freeman & Kellond s being a Canadian firm, with Hasseltine, Lake & Co., 48 Chancery Lane, as their London correspondents, while the other company's headquarters are in England.

CONTRACTOR BOURQUE, of Hull, is now engaged in building the new bridge across the Desert River at Maniwaki, Que The bridge is to be of iron, with stone piers, and is estimated to cost $20,000.

THE Dominion Paving and Contracting Company is applying for incorporation, with a capital of $25,000. Headquarters, Toronto. The provisional directors are: D. Van Vlack, C. A. Masten and J Kilgour.

THE contracts for the erection of new G.T.R. car shops at London, Ont., have been awarded, the tenders submitted by J. Mills, of Hamilton, having been accepted by the general manager. Work will be proceeded with immediately. The company is under penalty for every day the works are uncompleted after May 5th, 1897. None of the $100,000 bonus voted by London becomes due till the company has spent $65,000 on the work.

THE Wm. Hamilton Manufacturing Company, Peterboro, Ont., has recently completed for the Sault Ste. Marie Pulp and Paper Co. eighteen sets of gearing for its pulp mills. The company turned out an order for twenty-five sets of these gears last year, and the order this year is simply one given to complete the equipment of the large pulp mills as originally planned. The Wm. Hamilton Company has also built recently a complete sawmill that goes to British Columbia, and another complete mill that goes to Mania, N.B.

THE board of the Toronto Technical School met recently, A. M. Wickens in the chair. Ald. Thomas Davies, Dr. J. O. Orr, Messrs. F. B. Polson, W J. Wilson, D. J. O'Donoghue, Robert Glockling, E. J. Philip, A. F. Wickson, W. A. Longton were present. The work done by John McGowan, who has resigned, was divided between the other teachers, Dr. McMaster and Mr. Hull and Mr. Milne, as follows: Dr. McMaster taking arithmetic and mensuration, Mr. Hull taking trigonometry, Mr. Milne taking mechanics junior. Dr. McMaster was re-engaged at his former salary.

AT the annual meeting of the Canadian Furniture Manufacturers' Association, which was held in the Caledonia rink, Toronto, Sept. 7th, there was a large attendance of manufacturers from various points in Canada, and matters of interest to the trade were discussed. The election of officers took place, with the following result:—J. S. Anthes, of the Anthes Manufacturing Co., Berlin, president; Mayor Sam. Snyder, of Waterloo, vice-president, J. Baird, Plattsville, treasurer, and J. R. Shaw, secretary and solicitor.

THE management of the Londonderry Iron Co., of Londonderry, N.S., has recently turned its attention to the development of new departments of its business. We learn that they have recently completed a contract for turned and bored pipe for waterworks for Moncton, N.B; more are in progress for St. John, N.B. The company has also established a new department for the manufacture of valves, sluice gates, hydrants, and general waterwork fittings Their machine shop and foundry have been working overtime of late to complete a large coke oven and condenser plant for the People's Heat and Light Co., of Halifax, N.S., and on general orders The blast furnace will probably be shut down in a few weeks for the winter, as a new lining is necessary, and other improvements are in contemplation.

Mining Matters.

T. CROSS, Madoc, Ont. is developing a gold mine in that neighborhood.

ADDITIONAL deposits of hematite iron ore have been discovered at Hazzard's Corners, Madoc, Ont.

LEAMINGTON, ONT., is included in the oil-producing territory which is undergoing development at present.

ATTEMPTS to find petroleum are to be made in Muskoka, and in Pakenham township, Lanark county, Ont.

JUDGE ROULEAU is owner of the gold mining plant put in by F. M. Mahan, on the Saskatchewan, near Edmonton, N.W.T.

MCDONALD BROS., the owners of the mine on Lake Memphremagog, which was opened up last April, are showing some excellent copper.

JONATHAN NOSEWORTHY, who, with Geo. Bearns, possesses territory on the west coast of Newfoundland, containing deposits of petroleum, have engaged overseers and bought machinery to develop the property, says the Twillingate *Sun*.

A GANG of men under J. Holmes, is operating the Adams mica mine, Burgess township, Lanark, Ont., says the Perth *Expositor*.

IT is stated that the Canadian Pacific Railway is running over a bed of gold at Bruce Mines, Ont., where copper used to be mined.

BOG ore of fine quality is being mined near Bannockburn, Ont. A few carloads have been smelted and it turned out very well

H. C BECKETT, Hamilton, recently showed his friends a sample of ore taken from the Sawbill, Ont., mine, at the 90 foot level, assaying $400 to the ton

WHAT is said to be the richest find of gold yet made in Nova Scotia, is reported to have been made by a man named Dunbrack, near Bridgewater, Lunenburg Co., N.S.

HON ROBERT DRUMMOND, editor of the *Journal-News*, Stellarton, states that in all probability the output of coal from the mines of Nova Scotia during the present year would exceed that of any previous year by 200,000 tons.

THE extensive deposits of feldspar at Carp, Carleton county, Ont., are to be worked by J W. Taylor, of Ottawa, and W. B. McAllister, of Peterboro, says the Carp *Star*. The mineral is extensively used in the manufacture of porcelain.

THE Dominion Government has given official notice of its intention to extend the time for the free entry of mining and smelting-machinery into Canada to July 1, 1897. This gives those interested in mining a year longer to bring in their machinery.

NOTICE of application for incorporation has been given by Messrs Power, Culton, Falconer, Davies and Mc onald, of Stellarton, and others, to be called "The Little Liscomb Gold Mining Company," with a capital stock of twelve thousand dollars; the office of the company will be in Stellarton, N.S.

THERE is no boom in the Bothwell oil region, but a most extensive development of oil-bearing properties is going on. Within the last few months ten new wells have been put down, of which only one is reported a failure. The owners of the successful ones are Hiram Walker, F. J. Carman, A. M Elliott, and the Detroit Oil Company.

COL ENGLEDUE, an Englishman interested in the Rainy River mining region, writes Arch. Blue, that he learns from Mr. Pickard, an engineer, that the bromo-cyanogen process of extracting ore has been used with great success in Australia There recently 300 tons of tailings were treated in 20 hours, leaving only 10 grains per ton of gold in the refuse, the cost of treatment being only 3s 10d. per ton, and that in a country where fuel and labor are very dear. Mr. Pickard is going to apply the process to the arsenical gold ore to be found in Hastings county, Ont.

A. J G. SWINNEY is manager of the Canadian Gold Fields Company, Ltd., Deloro, Ont., operating in Hastings and Peterborough counties. Mr. Swinney says that his company had been at work over a year; they have all the capital they require, and with a new process which they employed they had got the most satisfactory results, extracting from 90 to 95 per cent. of the gold in the ore The company is composed entirely of Old Country capitalists, and their property covers an area of more than 10,000 acres.

A. P. COLEMAN, of Toronto University, writing from Fort Francis to the Department of Mines, Ont., says that the Sawbill mine looks well and yields quartz in which gold is easily found. He comments favorably on the fact that this mine is in what is known as "hornblende granite gneiss" of the Laurentian, stating that it means a great extension of the possible gold bearing area. The Lake Herald and Foley mines are reported prosperous, free gold coming up in buckets from the latter. Mr. Foley has ordered a new 20-stamp mill and has put on an extra force of men.

THE Edmonton, N.W.T., *Bulletin* reports gold mining on the North Saskatchewan thus: "Potter's gold mining scow is worked by a five-horse power engine. The length of the scow over all is 43 feet. There are two spaces between the platforms in which the scoops work at the back end of the scow. The chain from the scoops works over a block on the derrick to an iron take-up roller provided with slip knuckles, to which levers are attached to operate it The chain passes under a gate situated below the derrick which holds the chain down in the river. As soon as the scoop is full this gate opens automatically, and the scoop rises to the dump box where the dirt is dumped Water is raised by a Chinese pump, from which there are two tubes to conduct the water over the dump boxes. There are three feeders on each of these tubes to start the derrick, and a series of small holes provide a spray of water to thoroughly wash the dirt before it passes over the grizzly."

THE Truro *Daily News* says that Mr. Parker, of Amherst, N S., is opening up a copper mine in New Annan, N S., for New York capitalists.

GEORGE ALEXANDER wants Kaslo, B.C., to exempt him from taxes for ten years on a 240-ton sampling works he proposes to erect in that city.

THE Bell Island hematite iron mine, Newfoundland, employing three hundred men, which sells most of its output in Baltimore, Md., has closed down for twelve months, owing to the unsettled condition of affairs in the United States.

THE Roche Percée Coal Co. has been incorporated to do a general coal mining and manufacturing business. The incorporators are: H E Mitchell, C H. Cordingly, T. H. Gilmore, C. B. Deacon, Winnipeg and R Rodgers, Clearwater, Man. Capital, $50,000.

THE Kootenay Mine Exploration Co. has been incorporated to develop mining properties, capital, $200,000, headquarters, Toronto. Incorporators or directors are: G. Gooderham, T G. Blackstock, J. W. Beatty, D Fasken, Toronto, and R. H. Pope, Cookshire, Que.

THE Kingston School of Mines gives instruction both by practice and by precept. During September a party of students were taken out to camp in the mineral bearing regions north of Kingston for three weeks. The advantages of such a progressive method of imparting instruction are obvious.

THE Gold King Mining and Milling Company has been incorporated in Fairville, St. John county, N.B. The capital is to be $500,000 and the incorporators are E. G. Evans, Hampton, N.B., E C. Elkin, C. T. Ba'i and T. Warren, St. John, N.B., and M. Gallert, Waterville, Maine, U.S.

AT the first regular meeting of the British Columbia Association of Mining Engineers, which was held not long ago, in Nelson, B.C., there were present, the chairman, R. C. Campbell-Johnston, the secretary, G. F. Monckton, and several members of the society, including R. R. Hedley, A. H. Holdich, Howard West and others, After the formal business was concluded, G. F. Monckton read a paper on "What Constitutes Mineral", and Howard West (of New Denver, A.R.S.M.), a paper on the "Valuation of Mineral Claims."

THE Nova Scotia Steel Co. is rapidly developing its valuable hematite mine on Bell Island, Nfld. They have obtained splendid results from the use of the ore at Ferrona and the Nova Scotia steel works. This company may try its luck in developing what is believed to be a valuable coal area near Fort Hood, N.S Two good seams of coal have already been exposed and favorably reported upon by an expert from the office of Emerson Bainbridge, M P., one of the leading English mining engineers. If this mine should be opened the company could obtain their supplies of fuel by barge within five or six hours' tow of their works.

Railway Matters.

THE Ottawa, Arnprior and Parry Sound Railway is to be completed in November.

THE Toronto, Hamilton and Buffalo Railway Co. wishes to build a line to Ridgeville, Ont.

THE C.P.R. is, it is said, preparing to go on with the proposed Montreal and Ottawa South Shore Railway.

THE Grand Trunk Railway is laying new steel rails, 96 pounds to the yard, on the line between Cornwall and Montreal.

THE Dartmouth branch of the Intercolonial Railway at Halifax is now complete. This will be the only construction work carried out by the I.C.R. this year.

THE contract between the Midland Railway Company and the Dominion Government for the construction of a railway between Truro and Windsor, N.S., has been signed.

CONTRACTOR MCCARTY, Sherbrooke, Que., who is grading the Stanstead extension of the Boston and Maine Railroad, is to have the line ready for laying the rails October 15th.

THE T., H. & B. issues tickets to Toronto, travelling by way of the T., H. & B. to Hamilton, thence across that city in street cars to Stuart street depot, and by G.T.R. to Toronto.

THE Quebec Central Railway shops are to remain in Sherbrooke, Que., as the city has deeded a piece of land to the company and given an exemption from taxes for a term of years.

The Drummond County Railway is to apply to Parliament for power to construct an extension of its railway from St. Hyacinthe to St. Lambert, and for power to bridge the St. Lawrence to Montreal.

It is stated that the Canadian Pacific Railway intends building a line from Brantford to Woodstock, Ont, in the near future. This would give the C.P.R. a through line from Detroit to Niagara Falls.

Bell & Wilkie, surveyors, Almonte, Ont., have made a preliminary survey of the proposed new line of railway from Carp to Almonte. Almonte and Carp business men subscribed funds for the survey.

At the annual meeting of the Canada Eastern Railway Co., held at Fredericton, Alex. Gibson was re-elected president and manager, and Jas. S. Neill, E. B. Winslow, Alex. Gibson, jr., and Chas. H. Hatt, directors.

The Crow's Nest Pass Railway Company is applying for an act of incorporation, with power to build a railway from Lethbridge, Alberta, through the Crow's Nest Pass, to connect with the railway at Nelson, in the Kootenay district.

The engineer of the Huron and Ontario Railway has completed his report on the proposed route of the line, and has forwarded it to Miller Bros., of New York, who are expected to undertake the construction of the railway.

The contracts for the Quebec, Montmorency and Charlevoix depot have been awarded as follows: Masonry and brickwork, F. Fackney; painting, J. M. Tardivel; heating, plumbing and roofing, P. P. Giguire. S. Peters is general contractor.

W. A. Lockhart, at Chubb's Corner, N.S., not long ago, offered for sale the Central Railway. The property consists of 70 miles of railway and $680,000 worth of bonds. The railway was offered at the instance of Clarke & Co., of Philadelphia. No bids were made.

The township council of South Elmsley has repealed the by-law passed some years ago, granting a bonus to the Kingston, Smith's Falls and Ottawa Railway Company. The Federal Government recently gave an extension of time in which to begin the construction of this line.

The Amherst *News* says that the line of rails on the ship railway have been laid to within three miles of the Tidnish end of the line. The further laying of the rails had to be suspended until a temporary bridge, which had been washed out, had been repaired. The pumping out of the dock at Fort Lawrence is being vigorously pushed forward.

A recent issue of the British Columbia *Gazette* contains a notice of application for incorporation of a company for the purpose of constructing a railroad from Kaslo by Kootenay Lake to Lardo, thence to Upper Kootenay Lake and head of Duncan River, with a branch beginning at Lardo River to and by Trout Lake, and thence into Lardo on Arrow Lake.

A deputation consisting of James Conmee, Algoma; Geo. T. Marks, mayor of Port Arthur; John McKellar and Geo. Hodde, of Fort William, has visited Ottawa to urge upon the Government the desirability of extending a subsidy to a projected line of railway from Port Arthur to Rainy River. The line will ultimately run through to Winnipeg, for the purpose of affording competition to the Canadian Pacific Railway, but it is only for the portion between Port Arthur and the Rainy River that they now desire the subsidy.

At the annual meeting of the New Brunswick Railway Company, the following directors were elected for the ensuing year: Robert Meighen, president; Sir Donald A. Smith and Mr. John Turnbull, of Montreal; Messrs. John S. Kennedy, Samuel Thorne, H. O. Northcott, J. Kennedy Tod, vice-president; D. Willis James, of New York, E. R. Burpee, of Bangor; H. H. McLean and John McMillan, of St. John. Alfred Seely was appointed secretary-treasurer, and W. T. Whitehead, land agent.

W. Sutherland Taylor, treasurer of the C.P.R., has issued the following circular to all agents of the road: "This company's bankers have notified me that hereafter they will refuse to receive, either for deposit or otherwise, silver coins which have been mutilated or defaced, or which are light weight or worn smooth. Station agents and others making remittances will please note, and in future refuse from customers and others all such mutilated and defaced silver coins, whether Canadian or United States coinage. All Newfoundland silver coins must also be refused, as our bankers will not accept them on deposit. Agents neglecting these instructions will be responsible for the loss which will be incurred thereby."

The C.P.R. station at Windsor street, Montreal, is to be enlarged in accordance with the original plans. A wing will be built on Osborne street.

The extension of the St. Lawrence & Adirondack Railway between Beauharnois and Caughnawaga, which has been in progress for some months, is now complete to connect with the C.P.R. at Caughnawaga.

The St. Catharines and Niagara Central Railway Company will seek from Parliament the right to issue new bonds, and to extend its line to meet the Toronto, Hamilton and Buffalo Railway to a point east of Smithville.

Sir Joseph Hickson, ex-president of the Grand Trunk Railway, Montreal, and D. G. Griffith, Watertown, N.Y., have been selected as two of the three arbitrators in the traffic dispute between the Kingston & Pembroke Railway Company and the Bay of Quinte Railway and Navigation Company.

The Sydney & Louisburg Railway has lately received for the Dominion Coal Co, from the Rhode Island Locomotive Works, Providence, N.S, an unusual locomotive. Its whole structure, engine and tender, is built as one machine, its water tank or tanks being on either side of the boiler and above its driving power or machinery. Its cylinders are 24 x 36 inches, and it has eight driving wheels.

The St. Hyacinthe City and Granby Railway Company applies for incorporation, with a capital stock of $100,000, headquarters at St. Hyacinthe, to build a railway to be worked by steam, electricity, or other motive power, from Bringham, in the county of Brome, Que., to the city of Hyacinthe, with branch lines in said city. The applicants are: Paul F. Payan, H. T. Chalifoux, M. St. Jacques, H. Pugnuelo, of Saint Hyacinthe.

At a meeting of the stockholders of the Manitoulin & North Shore Railway Co., held in Toronto recently, the following directors were elected. Peter Ryan, president; W. P. Chapman; E. S. Townsend; David Isaacs, vice-president; R. H. Bowes, secretary; David Phillips, treasurer; and John Ryan. The company will construct a line of railway from Manitoulin Island to a junction with the Canadian Pacific Railway's Soo branch. The building of the road will open up an extensive timber country and a rich mineral district, and afford an outlet for the farming community of Manitoulin Island.

The Vancouver, Victoria and Eastern Railway is asking the Dominion for a charter to build from Vancouver across the municipalities of South Vancouver, Richmond, Delta, Surrey, Langley, Matsqui, Sumas and Chilliwack, thence across the first mountain range by a pass lately discovered, thence across Nicola valley, Okanagan valley, through the Boundary Creek and Kettle River country, into the great mining district of Kootenay: with power to extend across the continent to some point on the Atlantic seaboard, with branches to New Westminster, Victoria and Nanaimo.

It was believed that the Hamilton and Dundas Railway would soon change from steam to electricity, but the Dundas council failed to meet the views of B. B. Osler, president of the road, and so the steam line is to be rejuvenated at once, and in a couple of months the "Dummy" will have a new track between Hamilton and Dundas, and a large force of men will be put to work at once at reconstructing the road. All the sharp curves will be done away with and the grade improved. Leather & Wilson have received the contract for supplying the rails, spikes, bolts and fish-plates for the road, and these will be shipped at once. The ties are already on the ground. The rails will be 65 pounds.

Marine News.

The St. John, N.B., harbor improvements are progressing rapidly.

J Donnelly, jr., of Kingston, has repaired and relaid the Rathbun Co.'s marine railway at Deseronto recently.

Plans have been prepared by the Department of Public Works at Ottawa for the scows required in connection with the harbor improvements at St. John, N.B.

After holding the position of harbor master at Toronto for sixteen years, Morgan Baldwin has resigned, and his deputy, C. W. Postlethwaite, has received the appointment.

The Stulwart Shipping Co., of Yarmouth, N.S., is applying for incorporation. Capital, $16,000; provisional directors, G. G. Sanderson, G. H. Guest, and G. B. Cann, of Yarmouth.

The Dartmouth, N.S., Ferry Commission has decided to purchase a new steamer, accepting the offer of John Shearer & Son, Glasgow, for a steel boat to cost, delivered, £11,950 sterling.

JOHN GILLIES & SON, Carleton Place, Ont., have had a successful season with their oil launches, and have supplied a number to citizens of the United States making their summer home in Canada.

CONNOLLY'S old plant, used at the dry dock, Kingston, is to be sold. The plant is not good enough to take over to Philadelphia to be used in the contract there, as the duty would amount to more than it is worth.

S. PEARSON & SON, contractors, Westminster, London, have sent the new dredger "Mexico" from Vera Cruz to Halifax, N.S., to take advantage of the excellent dry dock there to have extensive repairs made. The "Mexico" was built last year at a cost of $175,000.

THE steamer "Baltic" was burned to the water's edge at Collingwood, Ont., recently, and the crib work on both sides of the slip was burned, as well as a few cords of wood owned by Craig & Darling, whose tug was burned a few weeks ago at Michael's Bay. The boat was completely destroyed. She was insured for $15,000.

THE Bridgeburg and Black Rock Ferry Company, Ltd., is applying for incorporation, with a capital stock of $30,000, chief place of business, Bridgeburg, Ont.; provisional directors, B. Baxter, E. Baxter, J. Bethune, J. Moss, P. P. Miller, W. H. Davis and E. Maythan.

IT is said that the success of the car ferries between Conneaut, Ohio, and Port Dover, Ont., has induced the Columbus, Sandusky and Hocking, one of the principal coal roads in Ohio, to extend its domain into Canada. The company is said to have chartered several large car ferry boats now operating on Lake Michigan, and will run them from Sandusky to some favorable point on the Canadian shore of Lake Erie, probably Rondeau.

THERE was a meeting of the board of directors of the Richelieu & Ontario Navigation Company in Montreal recently, at which there was present the Hon. L. J. Forget, president; W. Wainwright, vice-president; R. Forget, Colonel F. C. Henshaw, Joseph Louis, E B Garneau, Quebec, C. O. Paradis, Sorel; William Hanson, Montreal. The president submitted the financial statement of the company on Sept. 1. It showed a highly satisfactory state of affairs, and a very large decrease in operating expenses, coupled with an increase in earnings over the previous season. The president emphasized this with the statement that although in the beginning of the season the weather was unfavorable to heavy travel and the usual depression accompanying the general elections both in Canada and on the other side of the line, had also been an adverse factor, the management were happy to be able to announce the usual half yearly dividend of three per cent. which would be payable on Nov. 2. The condition of the company's finances was held to justify the construction of two new boats, to run between Toronto and Prescott, for the better accommodation of the Royal Mail service. It is the intention of the directors, as expressed at the meeting, that the two boats will be of steel, of 275 feet in length, side-wheelers, and rivalling anything of the kind yet known in Canadian waters The speed of these boats must be twenty-two miles an hour.

Electric Flashes.

DUNDALK, Ont., people are discussing the advisability of lighting their town by electricity.

THE Hull electric railway has bought ground for a new park ust outside of Aylmer, Que.

THE City of St. John, N.B., is replacing its arc street lights with incandescent lamps, at a considerable saving to the city purse.

THE Nanaimo, B.C., town council has given a third reading to a by-law authorizing the expenditure of $3,000 for a fire alarm system.

THE power-house of the Brantford Electric and Operating Co. is being constructed rapidly. The company is spending $30,000 in improvements.

THE Hull-Aylmer Electric Railway Company did not get its charter modification through the Railway Committee, as the different provinces were interested.

THE Mather Bridge and Power Co. has got its bill passed by the Railway Committee, and may be soon expected to enter the market, if its promoters realize their expectations.

THE Lamont Glass Company, of New Glasgow, N.S., manufacturers of glass chimneys, fruit jars, bottles, is said to be about to begin the manufacture of electric light bulbs and shades.

PARIS, Ont., wants an electric road to Brantford.

THE Montreal Park & Island Railway Co.'s line to St. Laurent is now in operation.

THE Beaverton Electric Light Co. is adding a 250-light Edison dynamo to their present plant.

THE new flume of the Chaudiere Electric Co.'s power-house, Ottawa, Ont., is nearing completion.

THE Consolidated Railway Company, of Vancouver, has installed a 150-kilowatt monocyclic generator.

THE Canadian General Electric Co. has sold a 150-kilowatt monocyclic generator to the Hull Electric Co.

P. McINTOSH & SONS, Toronto, have purchased a 300-light plant from the Canadian General Electric Co.

J M. CAMPBELL, Kingston, electrician, is preparing plans for the electric station and plant at Peterborough, Ont.

THE O'Keefe Brewing Co., of Toronto, is installing a 500-light direct connected unit. The Canadian General Electric Co. has the contract.

THE New Glasgow Electric Light and Power Co. is installing a 75-kilowatt alternator of the Canadian General Electric Company's monocyclic type.

THE Hamilton Radial Railway Company intends to extend its line from the power house to Port Nelson, and next spring it will be extended to Oakville, Ont.

AT Toronto the loss to the street car company, owing to the bicycle, is set down at $300 per day. How great a loss will result from the advent of the horseless vehicle?

THE Ontario Government is said to be considering the installing of an electric light plant at the Central Prison, Toronto. The question of putting in a plant at the asylum at Brockville is also being considered.

THE St. Jerome Power and Electric Light Company is being incorporated, with a capital stock of $50,000, to take over the electric plant now being operated at St. Jerome, Que., together with the water power and mill privileges. Head office, Montreal.

AN electric railway is to be built at once, it is said, from Liverpool, N.S., to the pulp mill at Milton, to carry its products, as well as passengers, to the seaport. In the meantime, until a suitable electric plant can be obtained, the cars will be run by steam.

THE Chambly Water Power Co. has awarded the contract for the construction of the cement dam of the wheel-house and of all the works of excavation to Peter Lyall & Sons, of Montreal. The work will cost between $300,000 and $400,000, and will be begun at once.

AT the twenty-seventh annual meeting of the Dominion Telegraph Company, Thomas Swinyard was re-appointed president, Sir Frank Smith, vice-president, and Fred. Roper, secretary and treasurer. A pleasing feature of the meeting was the presentation to President Swinyard by his colleagues of a very valuable service of silver plate.

THE Lachine Rapids Hydraulic and Land Co. has closed a contract with the National Underground Conduit Co., of New York, for five hundred thousand feet, to be completed about the 15th November, work to be commenced at once. The duct is a cement-lined pipe, embedded in concrete, and in this will be placed the cables which are to carry the current.

THE Niagara Falls Park and River Electric Railway will, it is said, be extended from Chippewa to Fort Erie, and from Queenston to Niagara-on-the-Lake. The company may also develop and sell power. It is thought that road, if operated more nearly in connection with the Gorge Railway on the United States shore, would be a profitable investment for its shareholders, which it has not hitherto been.

THE Hamilton Street Railway Co. reduced the wages of its employees on October 1st. Motormen and conductors, upon entering the employ of the company, formerly received 12½c. an hour, which has been increased at intervals at the rate of half a cent an hour till it reached 15c. Most of the present employees are now receiving 15c. an hour, but the new maximum will be 13½c. and the minimum 12½c. an hour.

THE new chimney in connection with the extension of the boiler house of the Montreal Street Railway Company will be 255 feet high, and is claimed to be not only the largest, but also the most model structure of its kind in Canada. It has a base of 54 feet square, and before the top is reached, over two million bricks will have been brought into requisition. The whole of the work has been superintended by the construction department of the Montreal Street Railway.

TENDERS in connection with the electric light plant at Goderich, Ont., have been accepted as follows. Goldie & McCulloch, Galt, engine, 10 x 14, $1,400; Packard Electric Co., St. Catharines, transformers, $576; Rogers & Co, London, inside wiring of stores and houses, cleat work, $1.50, and concealed work, $2 per outlet.

THE Bell Telephone Company has completed a new line between Ottawa and Arnprior, Ont, in order to give direct connection to Pembroke and intermediate points. They have also a direct wire from Ottawa to Brockville, at which point Kingston, Prescott and other towns on the St Lawrence can be reached. A new copper line by way of Metcalf and Winchester to Morrisburg is now nearly completed and will give an alternative route to these towns.

THE Hamilton Radial Railway began to run cars on Sept. 7th. Among those who had the honor of having the first trip on the road were Alexander Turner, president of the company, Thomas E. Leather, vice-president; Wm. A. Wood, treasurer, John Moodie, sen., Adam Zimmerman, Jas. Dixon, T. H. Watson, J T. Barnard, Robt Griffith, Percy Donville, and John Patterson. J. G. Laurance, of the Canada General Electric Company, Toronto, ran the car, and T. Foster was the conductor.

THE town of Maisonneuve, in October, 1891, contracted with the Royal Electric Light Company to furnish all the plant and appliances necessary for an electric light service for the municipality for the sum of $9,300. The company were stopped, first by an injunction after beginning the work, and when the injunction had been quashed by the courts, force was used to stop the employees of the company from working. The main contention was that the contract which had been given was not within the charter powers of the town to grant. Judge Pagnuelo recently held the contrary view and found for the company, giving them judgment for $4,861, with interest and costs, against the town.

Personal.

ENGINEER POWELL has returned to Hamilton after five months' absence, spent principally in the United States investigating electric railways.

CHIEF ENGINEER JAMES MCMURRAY, of the steam dredge "Canada," has been promoted to the charge of the new steam dredge lately built at Quebec

R M. HANNAFORD, late engineer of the G.T.R., has resigned his position and will be connected with G. H. Allan in the insurance business in Kingston, Ont

R. M. WANZER has retired from the Wanzer Lamp Manufacturing Co., Hamilton, Ont William Woods, formerly with Walter Woods & Co., has succeeded him

JOHN COGGIN, engineer at the power-house, Moncton, N B., will lose the use of his right hand through injuries recently received while in discharge of his duties.

ROSS MACKENZIE, manager of the Niagara Falls Park and River Electric Railway, who has been ill recently with congestion of the brain, has resigned the managership of the line.

JAMES CLARKE, manager of the Ontario Peat Fuel Company, near Welland, Ont., recently caught his foot in the machinery, mangling it so badly that it is considered impossible to save it.

W. WAINWRIGHT, general assistant manager of the Grand Trunk Railway system, denies that he has been offered and has refused the position of general manager of Government railways

W. S. MACK, president and general manager of the Lakewood Transportation Company, of Cleveland, Ohio, who died recently at his home in that city, was a native of Kingston and began life as a sailor.

THE many friends of City Engineer Keating, of Toronto, were exceedingly sorry to learn of the death of his second daughter, Harriet, which occurred suddenly at Gosport, England, on September 20th.

J. LANSING, who for years was private secretary to L. J. Seargeant, general manager of the G.T.R., and who has been at St. Agathe, Que., for his health, all summer, has returned to Montreal much improved in health.

IT is said that the position of secretary to President Sir Wm. Van Horne, of the C.P.R., will be filled by E. Alexander, a Hamilton man, who was formerly in Charles Stiff's office in the old Great Western Railway.

FORTUNATELY for their widows and families, Engineer Facer and Fireman Johnson, who were killed in the T., H. & B. accident recently, had each $2,000 life insurance.

THE Erie & Huron Railway Company has presented George Gilbert, of Sombra, Ont., with a free pass over their road in consideration of services rendered in saving the depot from destruction by fire recently.

CHAS. M. HAYS, general manager of the Grand Trunk Railway, has settled his family in Montreal. It is said that Mr. Hays intends to buy a summer residence near Gananoque, Ont., in the Thousand Islands.

GEORGE A. MCDONALD, who for several years past has acted as secretary to the president of the Canadian Pacific Railway, has been appointed stationery agent in place of W. A. Grant, who has resigned his position.

E. INGERSOLL, engineer, has completed his work on the Hamilton radial railway, and will make St. Catharines his home for a short time. He is to have charge of the work of construction by the Cataract Power Co.

ALFRED BELL, of Parry Sound, Ont., lost his life while adjusting a belt in Battrick s saw mill, Byng Inlet He attempted to grasp the belt while it was still running at a high speed, though it was thrown off the pulley.

THOS MACFARLANE, Chief Dominion Analyst, has returned from Europe, where he visited by the Government s instruction leading cities of England, Scotland, France and Germany, to examine into methods for disposal of sewerage of large cities.

FRANK LEMON, engineer of the Malleable Iron Works, Toronto Juncton, was badly burned about the face whilst "firing up" recently. It appears that he put some coal oil on the fire to get up steam more quickly, when the flames burst forth from the door of the furnace.

R. G. BLACK, son of G. W. Black, of the Great Northwest Telegraph Company, Hamilton, Ont., was visiting in Hamilton recently for a few days. He is now in charge of the electrical engineering in connection with a new three-million dollar waterworks system which the city of Pittsburg, Pa., is putting in.

MR. NEWEL, bridge inspector of the G.T.R., Stratford, Ont., has been removed to Palmerston, his position having been filled by Mr. Nichol, of Palmerston; Mr. Sanderson, of Niagara Falls, has been appointed foreman of the car shops at Stratford, and Mr. Crawford has taken the position of assistant bridge inspector which was formerly held by A. J. Bailey.

THE Grand Trunk has placed William McNab in charge of the engineers' drawing office in Montreal. Robert Armour is made assistant engineer of the eastern division, and W. P. Chapman becomes assistant engineer of the northern division; while H B. Hollinshead and George Masson take similar positions on the middle and western divisions respectively.

H C. STANLEY, M.I C.E, chief railway engineer of Queensland, Australia, is on a tour for the purpose of studying economical railway construction He will be in Canada about two months, visiting all the principal cities, and will afterwards go to Colorado, returning by way of Chicago, Detroit, and New York. From there he will go to Great Britain, Belgium, and Germany, and in these countries will inspect all the great engineering works.

AT a meeting held at Rat Portage, Ont., Sept. 16th, 1896, for the purpose of organizing a mining exchange, at which were present a large and representative attendance of the leading citizens, the following resolution was passed, the mayor being in the chair. Moved by D. C. Cameron, president of the Ontario and Western Lumber Co, and seconded by C. W Chadwick, "That this meeting extends its hearty congratulation to R. H. Ahn, upon the success which has attended his operations in this district and the business-like methods and ability he has shown in helping forward the development of our mineral resources." The motion was carried unanimously.

FIRES OF THE MONTH.

Sept 9th.—J. W Howry & Son's sawmills, Fenelon Falls, Ont.; loss, $40.000; insurance, $22,000.——Sept 11th.—G. E. Pinco's foundry, Berwick, N.S.; loss, $6,000; insurance, $1.200.——Sept. 12th.—F. F. Dalley & Co., manufacturers, Hamilton, Ont.; loss, $2.500 ——Sept. 15th.—Plant of the Palmerston, Ont., Electric Light Co.; insurance, $1,600 —— Sept. 20th.—The Moncton, N.B., Sugar Refinery; loss, $200,000.—— Sept. 23rd.—T. B Tait's shingle mill, Burk's Falls, Ont.; loss about $4,000.——Sept. 6th.—Sicily Paving Company's buildings, Mill street, Montreal; loss, $15,000; no insurance Inches & Moulton's planing mill, Sudbury, Ont.; loss, $3,500; no insurance.

EXPLOSIONS OF WATER-TUBE BOILERS.

The fact that explosions in this class of boilers are more frequent than they were formerly, indicates that in some of them a departure from sound mechanical principles has been made. It is not a sufficient answer that, as higher steam pressures are used, the liability to explosions has increased. This might account for leaks, or the rupture of single tubes; but the fact is, that in this type of boilers some of the accidents that have occurred have been so general in their effects upon the boilers themselves and in their destruction of adjacent life and property, that they are, and ought to be, called explosions. The *Practical Engineer* describes such an explosion on board the French ironclad "Jaureguiberry," one of the finest and latest additions to the French navy.

The steam on this vessel is furnished by twenty-four water-tube boilers of the Lagrafel-D'Allest type. The vessel had gone for a twenty four hours' trial trip off Toulon on June 9th. Up to the twentieth hour everything went on satisfactorily, and then, without any warning, an explosion occurred in one of the boilers, which blew open the furnace doors and sent a rush of steam and flame into one of the stokeholds, so severely scalding nine stokers who were in it at the time that six died within a few hours.

After the disaster it was found that one of the tubes had drawn from the front tube plate and burst, in addition to which a large number of the other tubes were drawn and bent. Why the tubes should have failed in this way is not satisfactorily explained The fact, however, that one of these water-tube boilers should have given out the first day on raising steam, with such disastrous results, reveals uncomfortable possibilities to those who have so strongly advocated water-tube boilers for use in the British navy.

This will prove a damaging blow to the commercial exploitation of the type of boiler named, which rival interests will not fail to make the most of.

It is worth while to enquire whether the safety that has been claimed for water-tube boilers has not depended much upon the conditions of their use prior to their adoption for marine purposes.

As stationary boilers on land, they are usually provided with ample space, with egress for attendants on the same level, in wide contrast to the limited room that can be allowed for them on board ship The escape of attendants is thus rendered more easy and probable, should a local rupture occur, than it ever can be on board ship, where escape from a stokehold usually means the climbing of stairways or ladders.

But the condition of the boiler above referred to shows that there was a more extensive wreck than the mere rupture of a single tube permitting a gradual efflux of steam.

The precise cause for the occurrence has not been explained; but it is evident that, if the boiler is of a character that permits the rupture of one tube to do all the mischief stated, its construction involves wrong principles, and it is an unsafe steam generator for marine service. Instead of independence, there must be some sort of mutual interdependence of the tubes that renders the rupture of one of them the cause for the effects produced upon the others. The anxiety to make the weight of water-tube boilers a minimum and to increase the rapidity of their action when fired, has, we believe, led to ignoring points essential to safety and durability, not in this particular construction alone, but in other water-tube boilers that have claimed to be superior to fire-tube boilers for use on ships.

This sort of thing is as liable to occur on a warship in action as at any other time, and it might well determine the issue of a naval encounter Clearly, we are not at the end of developments in the attempt to substitute this new system for the old one, which, though not free from faults, has a record of reliability in service that water-tube boilers, as a class, will be long in acquiring.

LITERARY NOTES.

We have just received the 20th edition of the Gas, Water and Electric Lighting Companies' Directory and Statistics, published by Hazell, Watson & Viney, Ltd. (1 Creed Lane, London, E.C). In former years the departments have been separated into two volumes, but this year we have one convenient 8vo. volume. It includes a general index of the officials of gas and water companies in all parts of the world. The various companies are ranged under the headings of the towns to which they belong, and beneath them is given the total population, the number of consumers, the conditions of capital, rate of interest paid, cost of production, estimate of output, actual capacity, officers, etc., and an asterisk indicates the limited liability companies. Manufacturers of gas, water or electric plants will no doubt find in this a useful book of reference. The price is 10s.

The offices of The Colliery Engineer Company, proprietors of *The Colliery Engineer and Metal Miner, Home Study*, and The International Correspondence Schools, in the Coal Exchange Building, Scranton, Pa., were partially destroyed by fire on Sunday morning, August 30th, 1896. Fortunately the printing plant was in another building, and they had reserves of all instruction and question papers, drawing plates and other supplies and stationery used in the schools in still another building, so that the business will not be seriously interfered with. *The Colliery Engineer and Metal Miner* and *Home Study* were out within a few days of the usual time, and they are conducting the instruction in the schools as usual Quarters have been secured on the three upper floors of the new Mears Building, corner of Washington Avenue and Spruce Street, Scranton.

The *National Builder* (Chicago, $2 a year) for this month sustains its character for appearance and general interest. It announces various new features, and one is that the original plans and perspective views of new houses will be printed in several colors. Every month is published a sheet containing all the plans necessary for building a residence, with a careful estimate of cost, and it also generally contains some useful articles on interior decoration and the means of securing beauty and comfort on almost "nothing a year." Its instructions are in the plainest language, and it shows a handy man how to do much for himself.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

C.A.S.E., No. 15, Brockville, Ont, has held a number of most interesting and instructive meetings since the convention in Kingston. The meetings take place on Monday and Friday in each week. President Franklin is not able to be present regularly owing to his duties at the waterworks, and in his absence his duties are ably performed by Past-President Chapman.

At a regular meeting of the Kingston Branch C.A.S.E., on Sept. 15th, the annual installation of officers took place, as follows: Past-president, S. Donnelly; president, F. Simmons; vice-president, J. Taudvin; treasurer, C. Selby; secretary, A. Macdonald; door-keeper, R McDonald; conductor, R. Bajus; trustee, John L. Orr and S Donnelly A number of congratulations were received from delegates who attended the recent convention, on the excellent manner in which the delegates were received and entertained while here. After paying all expenses in connection with the convention the local lodge has a handsome surplus left in the treasury. It cost the city lodge over $400 to entertain the delegates.

THE LATE H. G. C. KETCHUM, C.E.

On September 9th H. G. C. Ketchum, C.E., who is widely known through his connection with the Chignecto Ship Railway, and other works, died suddenly at Amherst, N.S. He was born at Fredericton, N.B., in 1840, and was a grandson of Col. Ketchum, of Woodstock, N.B. Mr. Ketchum was educated at Old Kings College, which is now the University of New Brunswick, and entered upon the study of civil engineering. His first engagement was as draughtsman on the old European and North American Railway, which ran from St. John to Shediac. After remaining here for some time he went to Brazil, and for a number of years was engaged in railway building. Here he was engaged in running the grades on the San Paulo Railway from the coast to the tablelands of San Paulo, a work which brought his full professional powers into play. He returned to Canada and was engaged during the construction of the Intercolonial Railway in running the road from Painsec to the Missiquash River. In 1875, he first suggested the idea of a ship railway across the Isthmus of Chignecto, and since that date has been a constant promoter of the enterprise. Mr. Ketchum married in 1866, Sarah, daughter of the late Christopher Milner, Esq., of Sackville, who survives him.

W R Tiffin, of the G.T.R. staff, at London, Ont., goes to Montreal to act as assistant to Mr. McGuigan.

Wm. Smith, engineer, was terribly scalded by the blowing out of a steam valve in the G.T.R. workshops in Montreal recently.

James Boylan, of Sharbot Lake, Ont., who was disabled by blindness, has received the sum of $3,000 from the Brotherhood of Locomotive Engineers, of which he was a member.

D. C. Phillips and J. C Phillips, brothers, who run the Woodstock Wire Mattress Company, Woodstock, Ont., recently pleaded guilty to the charge of giving cheques on the Molsons Bank and Bank of Commerce, knowing that they had no funds. The Police Magistrate allowed them to go, as they were held in gaol for ten days.

RAILWAYS IN JAPAN.

The Japanese are evidently not going to remain content with building railways and using imported rolling-stock and plant. They are taking steps, says the *Indian and Eastern Engineer*, to supply their own wants. Arrangements have been made for the construction of a large steel works, which should supply a good deal of the material required for railways and for shipbuilding. Viscount Jhonye Masaru, ex-chief of the railway board, supported by well known financiers, is making arrangements for the erection of large works for the construction of locomotives and railway stock generally, and they calculate from some experience which they have already had in the matter that they will be able to turn out engines and wagons at a much lower cost than they can import them from England. Some of the Japanese papers, indeed are already picturing the immense trade which might come to Japan if the Japanese could not only supply their own wants, but also those of China. Evidently the Japanese are determined to do their best to win for themselves the name of the Britons of the East. In the meantime, however, the Britons of the West must not allow themselves to fall behind in efficiency, and as the world grows older, probably it will be found that there is room for both.

PNEUMATIC TIRES.

In connection with the coming use of motor carriages, the construction of the wheels is very important. The pneumatic, full rubber and iron tire, so far as the effort of traction is concerned, have relative values, in round numbers, of 100, 130 and 133, showing a general economy for the pneumatic of about 30 per cent. But besides this economy in power required, there are other and important advantages in the use of the new wheel, and these are the reduction of the effect of sharp shocks, and the marked decrease in noise, and the wear and tear on the vehicle itself. As to this feature of noise, it may be remarked that the pneumatic tire on a low wheel of the bicycle type is now quite common among the cabs of Paris, and over the smooth wooden or asphalt roadways of that city these tires make so little noise that, for the safety of pedestrians, an ordinance has been passed requiring the owners of cabs to put bells upon their horses. In this way, while the rattle of carriage wheels is much reduced, the jingling of bells is substituted for it. But the person using the carriage gains decidedly in comfort, and the low wheels have advantages in getting into and leaving the vehicle. The wearing part of the rim is heavily armed with rubber, and inquiry failed to find any cases of punctured cab tires. The fact that pneumatic tires were actually used fifty years ago, and they practically differed very little in construction from those now placed upon carriages, will be new to many of our readers. But just as the bicycle, or velocipede, was introduced over seventy years ago, and then laid aside and forgotten, so the condition of our streets and highways, in 1846, was not favorable for the improved carriage tire. The modern development of the bicycle, and now the motor carriage, is a direct resultant of the improvement of our roads, and good roads and more of them will always be an important factor in the growth of all efforts towards cheaper and more rapid transit upon them.—*Engineering News*.

A CURIOUS freak of lightning is reported from East Gloucester, Mass., by Superintendent of Waterworks J. W. Moran. During a thunder shower there on September 6 lightning struck the water main on Mount Pleasant avenue and broke it in nine places in a distance of 2,000 feet. These breaks were all that were evident after the storm, but a fuller examination will be necessary to ascertain the exact extent of the damage.—*Engineering Record*.

IT having been reported that an officer of the Russian Government, assigned to duty as inspector during the manufacture of armor plates at the Homestead Works, had become acquainted with the secret processes of manufacture, and had given them to his own government, with the result that no more orders for such plates could be secured here, the report was later denied by the superintendent of the works, who stated that none of their secrets had been stolen, and that the truth is there are very few secrets to steal.

IT was reported this week that John D. Rockefeller is endeavoring to consolidate the Pennsylvania and Ohio pig iron furnaces for the purpose of perfecting ultimately an organization similar in plan to the Standard Oil Company, and that many of the larger companies had agreed to it through fear. The union of the iron interests is a difficult undertaking, and some doubt as to its accomplishment, even by Mr Rockefeller, is to be entertained. A prominent authority upon the iron market has suggested to us, however, as a reasonable conjecture, that it would not be strange if the Carnegie and Illinois Steel Companies and the Rockefeller mining interests should prove to be working in harmony and should effect an arrangement controlling the price of rails, etc., perhaps of structural material. As usual, inactivity has characterized the metal trade.—*American Machinist*.