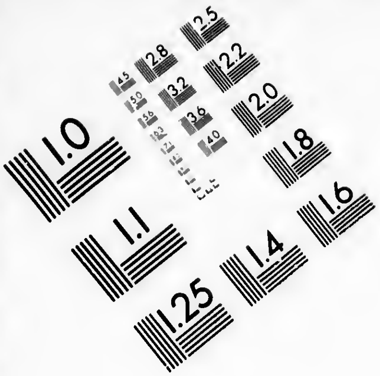

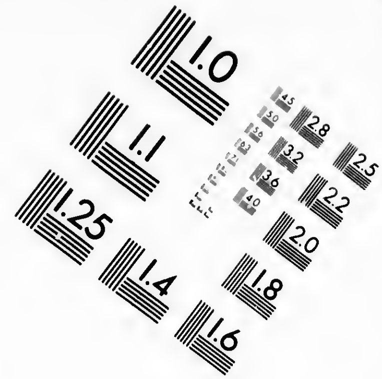

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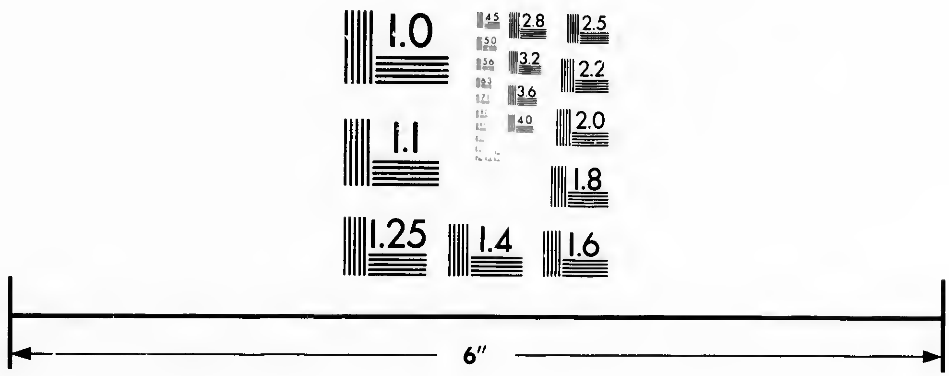

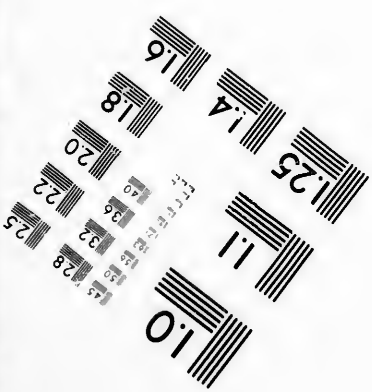

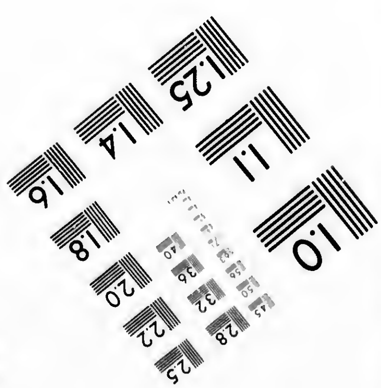

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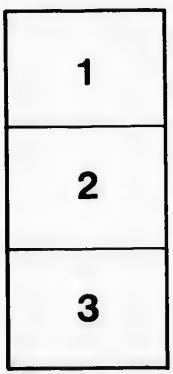

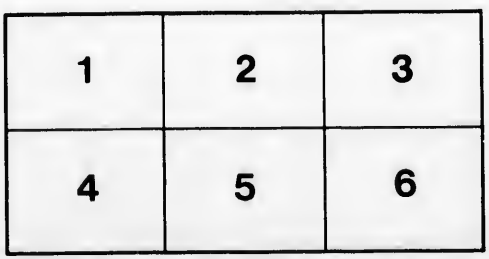

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A SUMMARY

OF

PAPERS READ AT DIFFERENT TIMES

BEFORE THE

ROYAL SOCIETY OF CANADA,

THE

Canadian Association of Civil Engineers

AND

Architects, and Literary, and Scientific Societies, or which have appeared occasionally in scientific and other publications

— BY —

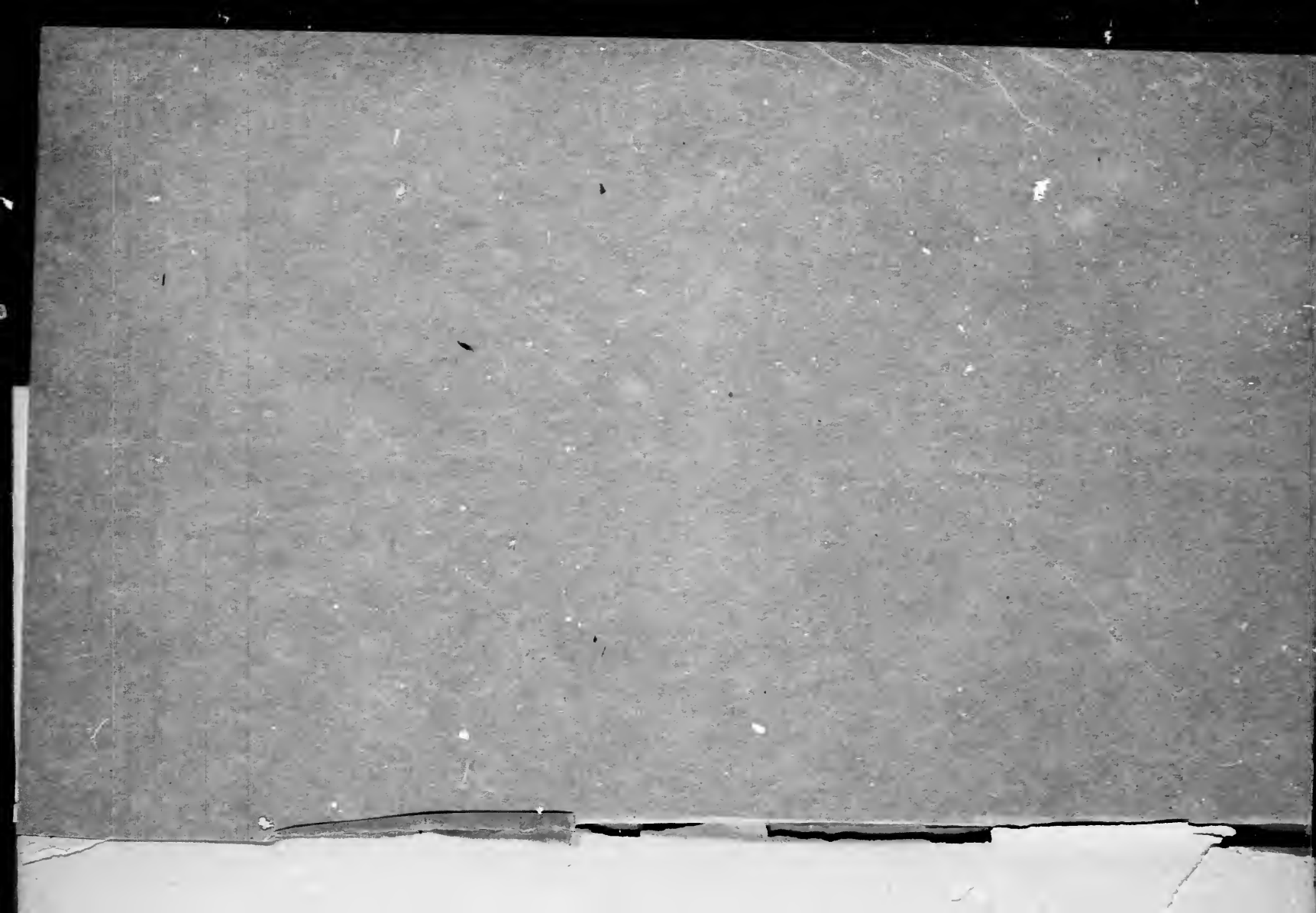
C. BAILLARGE, M. A., C. E., F. R. S. C. and M. CAN. A. C. E.

BEING

EXPLANATIONS OF CERTAIN PHYSICAL PHENOMENA OF AN APPARENTLY PARADOXICAL NATURE

THE SOLUTION OF MATHEMATICAL, PHYSICAL AND ENGINEERING PROBLEMS, Etc., Etc. (See Table of contents)

H. CHARE PRINTING, QUEBEC.



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ERRATA

No doubt many of the typographical errors in this summary will be put down to the french typo's unfamiliarity with the english language ; while others are due to the writer's untutored calligraphy and others to his habit of long winded and inadequately punctuated phrases ; and as to those unnoticed in the following list of errata, it is taken for granted that the reader will immediately see for himself and correctly interpret the author's short comings.

For *angula*, page 3, lines 7 and 13, read *ungula*.
For *rector*, page 3, line 16, read *sector*.
For *a* height, page 4, line 8, read *or* height.
For *on* doubly, page 4, line 9, read *or* doubly.
For *sterometrican*, article 2, line 2, read *stereometricon*.
For *mines*, page 5, line 15, read *minus*.
For *on* angle, article 3, line 3, read *an* angle.
For *from*, article 3, line 11, read *form*.
For *base*, page 8, line 16, read *bases*.
For *that the placing*, page 8, line 19, read *that by or in the placing*.
For *inequality*, page 9, line 5, read *in equality*.
For *if*, page 10, line 3, read *in*.
For *same*, page 12, line 4, read *some*.
For *or*, page 12, line 16, read *in*.
For *hept*, page 12, line 17, read *kept*.
For *them*, page 12, line 19, read *that of*.
For *down*, page 12, line 22, read *drawn*.
For *on*, art. 13, par. 4, line 5, read *or*.
For *perephery*, art. 14, par. 3, line 9, read *periphery*.
Omit *in*, art. 14, par 4, line 4.
For *is*, page 17, line 4, read *us*.
For *the radius*, page 17, line 13, read *to the radius*.
For *radies*, page 17, line 19, read *radius*.
For *introdos*, page 17, line 19, read *intrados*.
For *stickness*, page 19, par. 3, line 3, read *stickiness*.
For *pusshing*, page 19, par. 3, line 4, read *pushing*.
For *aerophane*, art. 20, line 5, read *aeroplane*.

For *is*, page 22, line 2, read *in*.
For *Now*, page 22, par. 2, line 1, read *Nor*.
For *foam*, art. 22, line 8, read *from*.
For *suffered*, page 23, line 3, read *supposed*.
For *susmic*, page 23, par. 3, line 5, read *siesmic*.
For *soll*. page 23, par. 3, line 12, read *and so*.
For *though*, page 30, last line, read *through*.
For *or*, art. 35, par. 2, line 2, read *for*.
For *whoever*, page 36, par. 4, line 5, read *however*.
For *live*, page 40, line 3, read *line*.
For *first word*, page 40, par. 2, last line, read *plumb*.
For *its*, art. 43, line 10, read *their*.
For at, page 47, par. 3, line 4, read *to*.
For *Masnawipi*, page 48, line 13, read *Wasnawipi*.

A retrospective summary of the solution of certain problems of a mathematical, physical and engineering nature, considered at the time more or less paradoxical : papers read at different times before the Royal Society of Canada, the Can. Ass. of Civil Engineers, or which have occasionally appeared in scientific and other public publications.

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EXPLANATION

BY C. BAILLARGE, M. S. — C. E.—F. R. S. C. — ETC., OF CERTAIN PHENOMENA CONSIDERED AT THE TIME PARADOXICAL.

Solution of certain Problems of a physical, mathematical, technical, and of others of an engineering nature.

Being a review of Papers read at different times by the writer before the Royal Society of Canada, the Canadian Association of Civil Engineers, et al. or which have appeared from time to time in scientific and other publications ; with addenda.

MATHEMATICAL

1.—Application of the *Prismoïdal Formula* to the measurement of all solid forms including vessels of capacity of every description.

When in 1866, the writer in his Treatise on Geom., Trig., etc—plane and Spherical — with tables of areas, natural and log. sines, etc., (a vol. of some 900 pages oct.) but of which the then edition of 1000 copies has now been long exhausted) announced his application of the " prismoïdal formula " to the cubing or finding the solid contents of all solids, by one and the same rule ; the mathematical world stood aloof in astonishment. Many doubted the truth of the assertion, the possibility of such a thing ; until the rule was overhauled by scientists and its veracity demonstrated and proclaimed by them ; and amongst others by the Rd. Mr. Maingui of the Laval University ; and the author was invited to Paris, where on the 15th of March 1874 he was awarded a diploma therefor and a medal at the " Grand Conservatoire des Arts et Métiers " ; and received on the same occasion the gold medal founded by the Baronne de Pages for the most useful invention or discovery of the year.

What seemed strange was that such a formula could apply at the same time to a prism or prismoid, a cone or pyramid, a sphere or spheroid, a paraboloid, hyperboloid, as well as to any segment of such solids and again to any frustum of all of them, contained between parellel bases ; thus reducing the calculation of volume of a tub or tank or coppers of any kind or size, that of a bin or other such vessel of capacity to the work of a few minutes, on account of the substitution in the computation, of an arithmetic mean area for a geometric one which could only be arrived at as being the square root of the product of the end parallel areas of the solid ; the formula being : *to the sum of the parallel end areas of the solid, add four times the middle area and multiply the whole or sum by one sixth of the height or length of the solid,* perpendicular to such areas.

Of course this could be immediately seen to be true as applied to the prism and cylinder, and whether right or oblique ; as six equal areas into one sixth the length or height of solid, is the same thing as once the area of base into the whole height or length.

The truth of the formula in the case of pyramids, and cones, erect or oblique could also be, almost immediately grasped — where the apex of the cone or pyramid being put down as naught or null or zero, the middle section with its factors, arithmetic means between those of the ends, and one end being zero, would therefore be half the corresponding factors of the base or other end ; and $\frac{1}{2} \times \frac{1}{2}$ being $\frac{1}{4}$; four times the middle base or section would be equal to the base, and twice the base into $\frac{1}{6}$ the height would be equivalent to the sum of the end bases with 4 times the middle base or section into $\frac{1}{6}$ the height, or the base into $\frac{1}{3}$ the height.

In stating the problem, where one or both of the bases is a mere point or where a plane could only touch it in a single point, such base is always entered in the formula as zero as above stated in the case of a cone or pyramid.

For a sphere or spheroid both of the end bases are again entered as zero. And as the area of a sphere is equal to that of 4 of its great circles, and its solidity to that area into one third its radius, it is seen immediately that the prismoidal formula as

applied to the sphere reduces to that of 4 times the middle area into ⅓ the diam, and the same with the spheroid where any area passing thro the center will answer the purpose, provided the height be taken perpendicular to the parallel planes tangent to the opposite sides of the solid. In the paraboloid, hyperboloid or any segment thereof, as well the segment of a sphere or spheroid, one of the bases only is zero, and again for any angula of the latter solids with limiting planes or arris passing through the axis of the solid, the opposite ends would each be zero, and in the case of an ungula of a segment and whether right or oblique, one end or base of the angula would be a zero, and the formula still true.

How easy then to arrive at the solidity of such a fac simile of the angula of an orange or of that of a ribbed or musk melon, such as a component section of a dome or cupola, when the end areas or one of them are null or zero and the middle section a mere rector of a circle or the like.

Of course this formula applied to spindles would give a result foreign from the true solidity ; but as a maximum, the difference between a true ellipsoid, and one in which the figure or solid were reduced to two cones base to base ; would not exceed 16⅔ per cent or ⅙. Spindles therefore should be treated as half spindles and the result doubled ; as in that way the half way diam. or area between the end and centre would approximate the calculation of a cone or pyramid and thus be in close proximity to the truth, or differ from it by only a fractional percentage of the true content.

In the case of casks and though the formula if applied would approximate the truth, more nearly than in any system of cask gauging, the true content may be arrived at in working on one half of the cask or butt and thus taking in the factor expressive of the bulge of the cask between the head and bung, and gives results correct to within 1/10 to 1/40 of one per cent of the whole ; while it is known that the most correct ganging varies at least one per cent and even as much as $4_{o}/^{\circ}$ from the truth ; and if the true rule for the exact content of a cask, it would require half a day to work it out and as such a rule never would or will be used, it follows that the prismoïdal formula applied as above stated to half the cask and the result doubled will be absolute exactitude in comparison to any system of gauging.

Neither does the formula apply mathematically to "hoofs" but again does the result approach to within a mere fraction of one per cent of the true content.

Therefore is it true to say of all solids that is of all solids with the exception of spindles, casks and hoofs, that the exact solid contents are equal to the product of the sum of the opposite and parallel end bases and four times the parallel middle section into one sixth the total length a height perpendicular to such bases or parallel sections and the same holds evidently in the case of wedges on doubly wedged solids, where each base being a mere line, and its area nought or null is entered in the calculation as a mere zero.

In 1876, in a volume of some 273 pp. oct., including tables of areas, but of which the edition is also exhausted, the writer applied his theory to all elementary solids, 200 in number, of which an engraving is given in a tabular form at the beginning of the work ; and in 1884 in another volume of 130 pp. including tables, were given the nature, in each of the 200 cases, of the middle area or section entering as a factor into the calculation, and examples of what each elementary form was representative of in the arts and trades and as objects of every day life.

Spherical areas.

2.—At page 55 to 58 of the last above mentioned work styled " The Sterometricon " the writer introduces a new and succinct process for finding the areas of spherical triangles and polygons by mere interpolation of areas to diameter I, calculated for one degree, one minute, one second, or the " Spherical excess " of bi-rectangular triangles where the contained angle at the apex is one degree, one minute, one second, and the decimals of a second 0.1, 0.01, 0.001 that is for tenths, hundrehths and thousandths of a second, or the spherical excess of bi-rectangular triangles, where the contained angle at the apex is one degree, one minute, one second or the fraction of a second as above ; and where it suffices, the spherical excess above two right angles of any triangle being obtained, to multiply the value for one degree by the No. of degrees in the spherical excess ; the

number of minutes by the value for one minute ; the number of seconds and of decimals thereof successively by the figures opposite the second and its subdivisions, and then add the whole together and mutiply by the square of the diam. of the sphere of which the triangle under study is a component element, to arrive in a minute or two at the area required.

The values for a degree, minute, second, etc; being calculated to 15 or more decimal places, of which any number can be taken in, to arrive at any degree of exactitude required, will allow of computing the area sought for, to within a mile, a foot, an inch or fraction of an inch of the true or total area.

For polygonal areas, the process is analogous to what it is with plane polygons where the sum of all the plane angles of the component triangles of the figure — equal to the number of sides mines two – is to be taken from the sum of spherical angles of the polygon to arrive at the total Spherical excess, and thence at the area of the spherical polygon under consideration.

The trisection of an angle.

3. –At page 330 of the writer's treatise of 1866, is to be found a refutation or demonstration of the fallacy of Thorpe's pretended solution of the geometrical trisection of on angle, for which the then Govt. of Canada enjoys the unenviable reputation of granting the would be inventor or discoverer of a geometrical process of solving the problem, letters patent ; but as the writer showed, as just stated, that the solution was false, two certain portions of one of the lines of his figure (which he had engraved on a brass plate) supposed by him to be in one and the same straight line though very nearly so, being shewn by the writer to from two sides of a very obtuse angled triangle of which said straight line formed the base or third side. No wonder then at M. Thorpe's discomfiture in receiving no answer from England in reply to his demand for the £25,000.00 sterling offered for the solution of the problem—while the thing is of course the easiest in the world of solution either by repeated trial or by " fudging " as the process is called, or by an arithmetical division of the

degrees, minutes and seconds, etc, in the proposed angle and by radii drawn from its apex to the corresponding subdivisions of its subtending arc.

4.—*The problem of the interpolation of a base line* or to find the middle portion of a straight line, the other portions of which are known with the angles taken from a 5th point to each of the four points of the straight line, and the position of the 5th point from which the angles are taken : has been elegantly solved by M. R. Steckel of the Public Works Dept. at Ottawa, Canada : it having been theretofore held that this problem could not be solved except analytically. See page 251 of same treatise of 1866.

5.—The writer, with the help of a theorem by M. Steckel to the effect (see page 189 of said treatise of 1866) that " Each of the " complements of the parallelograms about the diam. of a paral- " lelogram is a mean proportional between the component paralle- " lograms"; has been enabled to solve geometrically and in an easy and elegant manner the problem of *dividing any figure into two portions of given area by a straight line passing through a point within or without the figure* to be divided. (See pages 190 and 268 of same treatise).

6.—And finally at page 277 of same treatise of 1866, is, by Mr Steckel, the solution of the problem, hitherto unsolved by geometry of *finding in a quadrilateral of which the area is given and one side with the angles adjacent to that side and the ratio between the sides adjacent to the given side, the other sides of the figure.*

7.—Hints to Geometers for a new and improved edition of Euclid.

In the writer's Introductory chapter to his forthcoming volume on " The Origin, Signification, Translation, Classification "and Etymology of proper names"—read before section II of the Royal Society of Canada in May 1902—he says :

If it be asked why, being a member of section III, the author who has always professed and practised engineering, architecture and technology, appears now to be entering on a subject foreign to said section ; he must explain that having been in 1880 chosen as one of the foundation members of the Society, because in 1866 he had written a treatise on practical Geometry, in which the counsellors of the Marquis of Lorne, founder of the Society, must have found something worthy of notice, and that in 1874 he had been called to Europe there to be honored at the "Great Conservatory of Arts and Trades" with a gold medal and diploma for his new system of measuring all bodies by one and the same rule, and on the same occasion was the recipient of the gold medal founded by the baroness de Pages, for the most useful and meritorious invention or discovery of the year; he, in 1884, submitted for the appreciation of the Section a paper under the heading of " Hints to Geometers for a new edition of Euclid " : a system which had it been made known in England, would have very considerably curtailed or by several months the study of the Greek Geometer, thus saving thousands of pounds sterling annually in the cost of the full course of studies, or in time to be devoted to the study of other sciences.

The author's paper was submitted for their appreciation to non-geometers, men who had never taught Euclid in their lives, and in fact who knew nothing of Euclid, absolutely nothing. They of course then could not see the philosophy of what the author proposed and a system which would have subserved the requirements of the masses of mankind, remained unedited and unheeded, it not having been considered of sufficient importance to be published in the yearly volume of the Society's transactions or merely by title as with the first reading of a paper in Parliament.

A 5th section or a committee of practical geometers would have been required to see the value of what the author proposed; for as it is : of the four sections which make up the Society, the two first are literary (french and english) the fourth geological ; and the third has more to do than it can well handle in physics, mechanics, astronomy, chemistry, magnetism and electricity, meteorology and analytical mathematics.

Hence it is in a few words, that the author of this paper on

the origin of proper-names, being debarred (by the action of referees who undertook to appreciate a subject they knew nothing about) from utilizing his aptitudes in geometry in a way which would have so effectually benefited mankind, thought he might be useful to his fellows and may-be to the world in general, in setting his hand at something else ; but which at any rate has always been to him a labor of love : that of a study of the origin and etymology of words or names where his knowledge of both languages would fit him for a translation of the characteristics expressed in each of them.

It is well however here to give an idea of the author's curtailing process. For instance, in the 1st Book of Euclid, the great geometer after demonstrating that " *parallelograms on the same base and between the same parallels are equal in area*, makes another theorem to prove that *the same is true of parallelograms on equal base.* Now when it is asked why he did not apply the equal bases the one to the other, and make the second theoren a mere corollary of the first ; the argument is that pure geometry discards all idea of motion, and that the placing of one of the equal bases on the other, to fit both cases to the one demonstration, motion is inferred and that that is not allowable; but Euclid himself while supposed by his interpreters to argue thus, is made or supposed to he oblivious of the fact, or the defenders of his theory of " no motion " overlook the fact that Euclid himself has already admitted the necessity of such motion when in a previous theorem of the same book : that which is demonstrative of the fact that *if one side and the adjacent angles* of any *triangle* be equal to one side and the adjacent angles of another triangle *the triangles are equal in all things*, Euclid implies the idea of motion by saying : for if the given line and angles of the one triangle be applied to the given side and corresponding angles of the other triangle, the other sides must meet in one and the same point or apex and thus there equality be demonstrated.

Again two additional theorems are given to prove that triangles on the same, and on equal bases are equal ; but it having already been proved that every triangle is the half of its corresponding parallelogram, and by axioms, that what is true of the wholes is true of the halves, these two additional propositions

should have been made mere corollaries of the other two and thus the whole four merged into one.

The many theorems relating to parallel lines and alternate angles can also be notably abridged by defining equality of angular space to be implied inequality of inclination of one line to another and in many other ways could Euclid be simplified.

At pages XLVI and XLVII of the author's aforesaid treatise of 1866 will be found a tabular statement of all the propositions of the six first books of Playfairs Euclid in numerical order, and opposite to each the corresponding proposition, whether a theorem, a problem, a corollary, a lemma or an axiom etc of Mr. Baillargé's work, where very many corollaries are substituted for separately demonstrated theorems—but the "Hints to Geometers for a new edition of Euclid" are argumentative of the process of simplification in each case.

8.—The Piston Problem.

At page 40 of the "Canadian Engineer" for June 1894 published in Toronto Ont. by Biggar and Samuel, is an answer by G. Sinclair Smith of McGill University to a "query, by a "London subscriber, as to whether the piston of a steam engine "that is connected in the usual way by cross head and connect-"ing rod to a crank plate, travels faster in one end of the "cylinder than in the other, the fly-wheel running, at a regular "speed."

Mr. Sinclair having solved the problem analytically and in a way therefore unintelligible to mechanics or mechanical engineers in general; the writer published in the same journal a simplified geometrical solution or explanation of the problem with a diagram showing how such in reality is the case, which at first sight seems to be quite doubtful; but on drawing a rectangle to represent vertical medial section though cylinder and a line across its centre of length parallel to base; and at a distance from cylinder with centre in prolongation of cylinder axis, a circle to represent path described by crank arm, it is immediately seen by drawing the connecting rod from any point of prolonged axis

of cylinder to contact with circle or tangent thereto ; that the portion of the circle or circular path described by crank arm, which is towards the cylinder, if its concave portion between the two positions of the connecting rod, is shorter than the convex portion of the circ on that portion of the path of the crank arm which is most remote from the cylinder ; and as this can be seen with the eye, it is more satisfactory than a proof which can not be thus transferred thro the eye to the mind.

9.—The necessity of the Concrete with the Abstract in Geometry for the intelligence of the utility of the latter

The author insists on the necessity of giving at least occasionally, an example of the concrete as illustrative of the utility of an abstract theorem of which the pupil cannot at first sight see the bearing or utility in practice.

There is a theorem for instance to the effect that where two secants meet outside the circumference of a circle, the exterior portions thereof are proportional to the entire secants.

This is so abstract as not to be in any way suggestive of the use it can be put to in the solution of any case in practice ; and yet it is by a knowledge of the conclusions of this proposition that the engineer in the field can solve the problem of running a railway curve thro two given points and to be at the same time tangent to an existing line of railway.

The abstract proposition has the advantage of being also much more easily remembered by the student when he has an inkling of the use he may make of it in after life.

PHYSICAL AND TECHNICAL

10.—The St. Louis, M. cyclone when the walls of houses were blown outwards, instead of inwards.

As it was supposed they should have been, by the direct force and impact of the wind ; were so projected towards the streets or

highways ; by the fact, as explained by the writer, in answer to the paradoxical ravings as to the cause of such a phenomena ; because the velocity of the wind was such as to cause a partial vacuum in its wake as it went along : a rarefaction of the air, a diminution of its pressure, against which the pressure from within which was still normal, prevailed and pushed the walls outwards ; this pressure, or difference of pressure, even if only 5 lbs to the square inch, being over 700 lbs. to the square ft. or 35 tons to a section of wall of 10 x 10 or 100 ft. sup. and less than half such pressure would have sufficed to throw out the walls.

11.—The so-called Chicago "ball nozzel mystery or paradox"

This mystification arose in the following manner. To spread the fire jet of water in a way to attack at a time a greater sweep or area of fire, a funnel was adapted to the end of the jet pipe, and to spread the stream of water a ball was placed within the funnel ; as it was rightly supposed that the water would pass around the ball or between it and the funnel shaped outlet and be thus spread into a fan like shape.

Well, in garden or monumental fountains, it had been noticed by every one, that a ball thrown into the jet, was blown away from it and in falling again into or coming in contact with the jet, was again and again projected by the force of the issueing water to a distance therefrom.

It was therefore surmised. that the ball in the funnel around the nozzle of the jet pipe, would in the same way be blown away from it by the force of the jet behind it, and to prevent this, a screen of wire was applied to the mouth of the funnel to retain the ball in position ; when, what was the surprise of all concerned in witnessing the fact that the ball instead of manifesting any tendency to fly way, did on the contrary hug the apex of the funnel as closely as it possibly could.

The Chicago press and other United States papers were full of the anomaly of the occurrence—they pleaded paradox and even mystery. Our Quebec fire chief Dorval waited on me at the City

Hall where I had my office and with a Chicago paper in hand confronted me with the solution or explanation of the strange phenomenon.

Having been for same time occupied in the study of sewer ventilation where it was known that running water sucked away a film with it of the superincumbent air, the idea struck me immediately that some action of the kind would explain the mystery, and I then wrote out for our chief a solution to the effect that the jet of water on being turned on would at first force the ball towards the open, or away from the funnel ; but that as the ball could go no further, retained as it was by the impeding wires, the jet in dividing to pass around the ball, thus formed itself into a hollow cone of water, the water behind the ball remaining quiescent ; that then the out going peripheral water by friction against the quiescent water behind the ball, sucked out that water and left an air vacuum or its stead against which, the atmospheric pressure from the opposite side reacted, and hept the ball in place, and the more so that the outer convex area of the ball against which the air pressed inwards was greater than then the portion of the ball having the vacuum behind it—this being evident from the fact of the tangents from the jet to the ball being at right angles to the radii down from the centre of the ball, and thus dividing the outer and inner areas of the ball by a "small circle" of the sphere towards the apex of the cone.

After the writer's solution of the problem (some three weeks after), an analogous explanation of the phenomena appeared in the "Scientific American" but of a more complicated nature and not by any means as plain and easy to be understood by the world at large as that of the writer.

12.—The broken plate glass at "The Vendome" St. Joseph St. Quebec.

Here was another apparent mystery or which, at first sight appeared to the general public to be one. A suit at law arose out of the occurrence, masons, architects and builders attributing the breaking of the glass to settlement of the building, and to the side

or lateral stress on the glass of the cast iron flanking columns of the windows of the hotel.

Mr. Baillargé on being subpoenaed in the case explained that the phenomena was due to the play of the sun's rays upon the glass.

It is well known not only to scientists or physicists, that the suns rays in passing through glass heats up things beyond it, but not the glass itself which remains absolutely cold on unaffected, provided of course, the glass be clear and offer no impediment to the rays passing through it ; while, on the contrary if the glass be painted on the inside, the painted portion becomes heated, and especially if the paint be of a dark colour.

Well, at the Vendome, to prevent outsiders from peering in, the lower portion of the plate glass had been painted inside of a deep or dark green while the upper portions remained unpainted or were left clear.

Now the sun's heat becoming concentrated in the painted portion of the glass, heated and expanded them until they tore themselves away from the cold and unexpanded portions above and this was made doubly sure by the fact of the separation occuring in almost the identical line of curvature of the painted portion of each of the several windows which had suffered.

This action of the sun is absolutely identical to or analogous to that which occurs when hot water is poured into a tumbler with thin sides and a thick bottom, and their tearing themselves away therefrom.

Mgr. Laflamme, a professor of the Laval University here fully corroborated my evidence in the premises and judgment was rendered in the case in exact conformity to our opinion in the premises or as to the cause of fracture.

13—The broken glass at the so-called Flat Iron Building New York.

The New York Sun having lately or during the present year 1903) called on "scientists, for an explanation of the fact, that during the late high winds, — velocity 40 to 64 and 70 miles per hour — the glass of the smashed windows in the vicinity of this building at corner of Broadway, 4th avenue and 23rd street, instead of being burst inwards as it was supposed to be under the direct action of the hurricane ; was on the contrary found strewed upon the adjoining streets and side walks, — the writer has reason to believe that he was again first to explain, as he had done in the case of walls fallen outwards during the St. Louis M. cyclone, that the phenomenon is to be accounted for in the same way ; to wit, that the velocity of the wind created in its wake a vacuum against which the normal pressure from the inside, reacting, forced the glass outwards.

Velocity is of course destructive or diminutive of pressure. You can skid fast over thin ice, where, if stationary, you would be sure to go through it.

Why are you cautioned not to venture too near to a railway train in quick motion ? because the train leaves a vacuum in its rear towards which any light objects in the vicinity are seen to fly, and you actually feel yourself to some extent drawn or sucked in by the passing express as the air around you rushes in or towards the void left by the on rushing train.

Velocity, we say again is destructive of pressure, as witnessed in the case of the so-called Venturi meter, where the water while forced at greater speed through the throttled portion of the tube, between the full sized portions of the conduit on either side thereof, causes the mercury in the piezometer on pressure tube at the necking, to rise less high than in the piezometers on each side of the throating. And again, the heavybird when it wants to rise in the air, takes a long run, its velocity thus reducing its weight or counteracting by so much the effect of gravity or attraction towards the Earth.

Anomalous wind pressures.

14.—At the " Tower Bridge ", London, and at the " Firth of Forth " bridge, Scotland, as compared with the readings of the " anemometer ".

European engineers were at a loss to account for the disagreement between the indications of the wind measurer or anemometer, on the occasion of the wind tests made at the above mentioned bridges ; amounting in the latter case to 20 per cent in defect and in the former to not less than 40 per cent ; when the writer of this paper explained that in greatly extended areas, as compared with that of the anemometer, the wind in separating to pass around the outer edges of the areas experimented on, caused a so to say neutral or partially neutral action or zone of action at what one would suppose to be or call the centre of pressure.

In fact, as in M. Baillargé's explanation of the Chicago Ball Nozzle mystery, so called (No 11) the wind having to pass around the object experimented on, left within the atmospheric column in motion a conical, or wedge like area on the weather side thereof, a space filled with quiescent air, against which the force of the wind expended itself as against a cushion or buffer or spring destructive or dimunitive to same extent, of its pressure ; while at the same time the frictional effect of the air in motion towards the perephery of the surface to be passed by, had a sucking-out tendency of the enclosed air within the space so left neutral or of no effect ; the velocity of the wind around the edges of the obstacle being also at the same time accentuated or increased by so much as that towards the centre of the column was diminished.

This is no mere conjecture and can be verified by any one who with his back to an isolated structure, as is the " Château Frontenac " here " Dufferin Terrace ", will notice a very perceptible difference on between the force of the wind which reaches him and that where it passes around the outer edges of the structure.

The writer's views in the premises, were, as they could not but be, accepted as explanatory of the anomaly alluded to in the heading to the present article.

The plasticity of Ice

15.—Has been abundantly witnessed and discussed, as seen in its progressive daily flow among the Alpine glaciers, the Alaskan and others : and as evidenced by icebergs which are the broken off portions of fields of ice from the high or mountainous regions towards the sea, when the portion which has been pushed forward by the pressure of that behind it, becomes so heavy as to vanquish its cohesion, its stickiness or tendency to hug the parent glacier.

It has been given to me to be witness to, may be as beautiful and striking an example and proof of the plasticity of ice as any one has ever been fortunate enough to look upon.

Our water conductor for roof water, which from the eaves gutter reaches to within a few inches of sidewalk level, is, instead of being terminated below in a spout or outlet at an angle with the conductor, bent or, curved, being so cast from molten iron, into the quarter of a circle of say 3 inches radius of intrados. During cold weather or winter, the conductor becomes filled or partly so with frozen or congealed water from the eaves or roof ; that is, the lower end of the conductor becomes congested with freezing water then out of or beyond the influence of the sun's rays ; while they are still playing upon the upper portions of the conductor and filling it to a less or greater height with the simultaneous thaw at the eaves. This column of water held in position by the ice blockade or stopper below, congeals in turn, at first around the periphery of the conduit and then towards and to and including the central space.

The next day's sun in warming up the metal of the conduit, whether it be tin, copper, cast iron or other metallic substance, causes it to thaw a film of the contained ice in contact with the metal. The friction then against, or adhesion of the ice to the inner periphery of the containing tube ceases and the ice begins to flow or push forward and downward, absolutely as with glaciers, until that portion of the column which is below is pushed out at the spout or outlet and further and further out as the pressure from above can vanquish the peripheral resistance.

If the outlet were without a spout and sufficiently above

street level, the protruding column would continue to be a straight one and reach a length of very many feet ere its weight could pull it asunder from the mother column, as we see icicles hanging from roofs which with is often attain a length of ten ft. more or less ere their own weight or the wind or thaw causes them to part or break off.

If the outlet or spout were at an angle, the protruding ice would and does project in a straight column tangential to the direction of the outlet ; but when the outlet is a curve, the protruding ice being part of the curved portion at the foot of the conductor, or the quarter or less of a cylindrical ring of ice, this ringed shape of the ice is maintained, by the column from above having to conform itself the radius of the outlet, and thus I say it was my good fortune, and that, only a year ago and for the first time in my life, and from the spout of a house not far from the one I live in St. Lewis St. to see the projecting ice bent upwards into a beautiful crystal semi circle, or semi circular ring, or the half of a circular ring of some 3½ inches in diameter of cross section, and to a radies of 3 inches introdos ; which, with the portion within the spout to which the protruding portion still adhered, made up three quarters of a complete ring of ice and as perfect a one as man ever produced in the turning lathe or by other process.

I have also occasionally, that is when snow is of the proper consistency—for snows are of all textures, according to temperature, and size and form of component crystals,—been witness to its extreme plasticity and adhesiveness as I have seen it hang from the over hanging eaves of buildings in streets and from outhouses, and only from 3 to 4 inches in thickness and to a vertical depth or height of as much as 20 to 30 inches, ere the over hanging portion became heavy enough to break away from its parent stock upon the roof ; the over hanging sheet not being only due to the sliding or pushing forward of the supply from above or from the roof, but by the adhesion to it or cohesion of crystals apparently attracted toward it from the direct down fall from the sky or clouds.

Ice phenomenon.

16—For the formation of "Spicae" or horn-like protuberances of ice projected upward from or beyond the upper or frozen surface of a vessel of water altogether or only partly frozen throughout.

This is a phenomenon already known to the scientific world, and noticed either in the "Canadian Engineer", or in the "Scientific American" which now calls on scientists to explain the happening.

I have written the last mentioned paper as published in its columns that its surmise as to a spurt of water from beneath the frozen surface of a bowl of water or other vessel, and brought about by expansion or pressure from the interior or confined water in its tendency or effort to expand into ice, is untenable, as no natural temperature known to us could produce such a result, as the solidification or congelation of such a jet of water ere it had time to fall again and spread instantaneous, and probably no degree of cold short of that of liquefied air would be capable of such action.

Of course, as the "Scientific American" surmises, the vessel of water which, had it been buried up to its surface in earth or wrapped in some non conducting medium, would have only had an ice crust formed at its surface. The continued freezing would have merely raised up this crust by so much, or say by a height or depth equivalent to an increase in bulk of about one eighth of the volume of water; but in the open air there would be formed, simultaneously with the surface ice a coating of, we may call it, anchor ice attached to, or all over adhering to the peripheral surface of the vessel, bottom and all.

Now this peripheral coating of ice adhering of course to the crust of ice at the surface, such surface ice could not in that case be bodily raised by the expansion of inclosed water in freezing in its turn, the effect then being as any one may have noticed, the bulging up of the ice crust at its centre into a more or less convex or dome-like probuterance, according as the peripheral ice was formed either after or simultaneously with the ice at the surface ice to rise more or less before its attachment or adherence to the

peripheral ice prevented further motion in that direction ; and this bulging of the ice at its centre of surface is again, corroborative of the phenomenon of ice plasticity alluded to in the last article No. 15.

No ; what does happen in such a case, is and by theory is corroborated by the protruding ice from the water conductor mentioned in the foregoing article on the plasticity of ice, that the continued expansion or pressure from within upwards of the freezing or congealing water found vent at one or more points, the weaker of course or less resisting portions of the ice crust, and that then the protruding water as forced out by its expansion in the act of freezing, frozen or congealed as it was forced out gradually through the vent hole or holes, until the freezing or expansion process was over, and hence a good sized spica or more than one may originate since as already remarked, water congeals into a solid of less specific gravity than itself and adding about one eight on about 12½ per cent to the original volume of the water.

Again as to the periphery or edges of the crater or craters of eruption in the surface ice, to let the expanding waters pass out the plasticity of the ice or its tendency not to break, its stickness, adhesiveness, its non brittleness will account for this pusshing upward of the " spica " or " spicae " without detriment to the solidity and resistance to ice friction around the opening or vents in the surface.

Sewer ventilation.

18.---That our *sewer ventilation*, here or in climates where all sewer vents are closed and sealed during from 3 to 6 or more months in the year, should be as good or may be even better than in summer ; with open grids or perforated man hole covers, may be accounted for by the fact that nothing then interferes with the draught through the 4 inch stand pipes which in every house reach out to and thro the roof and above attic or dormer window level, and thus ventilate all soil pipes emptying into them, and the sewers themselves with which they are connected ; but a thing not generally known or thought of is that all drain and sewer water, by its frictional action on the superincumbent air

in the sewer, drains or sucks away with it a film of air towards the outfall and that this action is less interfered with by counter currents, which in summer may obtain towards open grids and gully wells, thus nullyfying to some extent the frictional power of the current.

This might lead one to infer that there had better be no open grids or breathers, and at any rate no untrapped vents along side walks, where if emanations there be, the slower passer-by may notice them, while the quicker vehicular transit along the centre of the street, affords less time to inhale the emanations and be inconvenienced thereby.

In fact there is rarely any such thing as the so called sewer air or gas, for the domestic or other sewage decomposes and becomes putrescent but slowly and hardly ever before it has had time to reach the outfall, a proof of which is that there are no healthier set of men than sewers scavengers, and when if ever an accident occurs it may be generally traced to some effluent into the sewers from adjoining worn out or broken gas pipes, or from exhaust steam which should by law be excluded from sewers and made to exit by pipes running up to and above roof level.

The writer with a party of 100 gentlemen and ladies—english, french, german and other has been through the Paris sewers and no one had even to raise his kerchief to his nose, and Mr. Gallagher our present W. W. and drainage engineer and myself have more than once been in and through our sewers or portions of them and never in the least inconvenienced thereby.

Engineers might perhaps infer from the fact of our closed sewers during several months of the year that those who advocate "no ventilation of them at all" may after all be on the right scent.

19—A contradiction or anomaly of our human nature.

We call out for or require — so say the doctors — from 1000 to 3000 cubic ft. of fresh air per individual per hour ; and yet I remember attending a sitting of our "Health committee" of 5 members which lasted for 3 hours, with closed doors in a room

8′ x 12′ x 8′ over the old police station in Ursule St. Quebec— where the hourly supply of air to each was therefore but 43½ cubic ft., and from which we emerged without in any way noticing the transition or as safe and sound as if the Committee had been held in the open street.

Again we do not allow proportionately for the want of air, when breathing hard, as after a long run or a hockey or other match ; and the very small quantity of it we require when in a quiescent state when we only inspire of it, a mere fraction of a pint. Then when in bed we can muffle ourselves up, head and all in but slightly porous blankets and, like a child buried in its swathing clothes, breathe and rebreathe over and over again the air expired from our lungs without much inconvenience and thus proving that the discarded carbon from the blood, acts as a mere and harmless opiate or soporific, so slightly do we breathe when fast asleep.

How a bird soars in air.

20. — *How a bird soars in air without a tendency to fall.* I have already had occasion to explain in my letter to the Montreal "Presse" on the subject of aerial navigation, and it is just this I believe that in addition to the action of the birds wings in the way of a kite or an aerophane, the comparative additional weight of the bird, little in the sea gull, greater in the wild goose and others birds, the soaring bird by means of its developed wings from beneath them a hollow somewhat in the shape of a segment of a sphere or spheroid, in fact a parachute, and that in addition to this, carnivorous, and icthivorous birds emit from their bodies on the down on stomach side much greater heat than do other winged denizens of the air due to the excess of carbon from their fatty and oily food, and the quick combustion of their carbon in presence of the oxygen component of the air they take in on inspiration or in the act of breathing.

This great heat which may be noticed on contact of the hand with the birds abdomen and stomach has the effect of heating the air in the parachute beneath it, and of thus rarefying it and thus causing a partial vacuum which again helps to account for the birds buoyancy under the circumstances.

The age of the Earth.

21.—*The possible age of the Earth* has been treated of by the writer is a pamphlet on the subject read before the Royal Society of Canada. In eliminating other indications of the age of the crust of the Earth—I have by me a piece of the crust or deposit from the inside of the steam boiler of a vessel here, used in bot.. fresh and salt water navigation of the river and gulf of the St. Lawrence. This specimen, a very valuable one, on account of its being perfectly petrified or reduced to a stony substance, is made up of nearly a dozen strata each of only the fraction of an inch in thickness, the whole specimen being but ⅝ of an inch thick, and the boiler having been in use for some 25 years, we may therefore conclude that its growth did not exceed about 1/40 of an inch per annum or an inch in 400 years, a foot in 480 years,—say in round number a foot in 500 years. Now if the crust of the Earth be as, by its increasing heat downwards until hot enough to be incandescent and even in an igneous and molten or liquid states, (50 ft. deep to the degree) 4000° of heat for the most refractory substances, the total thickness would thus be some 200,000 ft. or 40 miles and this into a thickness of an inch in 500 years, would make the Earth's crust to be 100,000,000 years old.

Now can the analogy be well denied, the constituents of water being oxygen, hydrogen, salt and the sedimentary elements : silex, carbonates. clay or aluminum, etc and the same forces at work : heat, pressure, etc.

22.—*The puckering of the face or crust of the earth into mountain ridges, valleys and the formation thereafter of oceans, seas and lakes, etc.* have been illustrated to the author of the present paper, as he has already in his writings on varied subjects had occasion to explain, and a manner which though apparently trivial and unscientific, is in reality a most striking proof of the modus operandi, to wit : the throwing up into ridges and peaks and craters of eruption of the crust of a pie where the steam foam the inside in its efforts to escape has pierced and bulged up this crust in the way every one must have noticed.

But there is also the further or cooling down process which

has been at work as evidenced to me in the slower or quicker cooling down and congealing of liquids or fluid substances, the body of the Earth being suffered to have at first been in a liquid state.

It will be noticed and must have been that water in freezing as mentioned under article 16 of the present summary, b 'ges up the surface when confined laterally into a dome-like surface due to the expansion of water in freezing, and not only into more or less convex protuberances, but even into spurs, spice or horn-like excrescencies, and so do other liquid, fluid or semi-fluid substances.

Again is this action beautifully evidenced in the cooling, congealing or freezing of oily or greasy substances such as in the refrigeration of pork dripping, where the surface is distorted into, hills and hollows, folds and creases, and these folds or plice are representative of the susmic action of the Earth's crust in cooling, as is evidenced in portions of Canada, along and in the midst of the waters of the St. Lawrence, as Isle Madame, Isle aux reaux, the beautiful triple and parallel ridges and valleys throughout the length of Grosse Isle, and in fact the general lay and direction of the longer axes of other islands as Orleans, Les Pèlerins, l'Isle aux lièvres, Isle Verte, l'Isle aux Grues, l'Isle aux Condres, l'Isle aux Oies, in 146 milles soll. of Anticosti etc, and on terra firma the successive ridges on the South shore, along the Intercolonial as at Ste Anne, Riv. du loup, etc.

Then, when the earth had thus become cooled down into ridges, mountains and valleys, the atmosphere surrounding the Earth slowly condensed from its vaporized state into water, which of course running from the heights, or elevated portions into the ruts and valleys, filled them in and left the oceans, the seas, the lakes and creeks we know of.

The Glaciary or ice Era or Period.

23. — There is no doubt that such a thing as a Sea of ice, thousands of feet in thickness, and the mentioning of such a thing as *the Glaciary era or period* is quite incompatible with popular

opinion in general ; and yet, strange as it may seem, any one who argues the thing out in his own wind, can but become convinced of the truth of the thing. If the mere telling or reading of the thickness and motion and plasticity of Alpine, Alaskan, arctic and antartic glaciers is not convincing, because they have not, cannot be seen moving, due to their slowness of motion, only a few inches a day, though the scientist knows of this motion and can measure it ; if we can not take in a change of climate due to the precession of the equinoxes and the displacement of the earth's axis in space, bringing about difference in latitude, can not account for an upheval of the Earths surface in the arctic regions, into a greater and colder altitude where, years of unmelting snow may have formed an ice cap of sufficient thickness to over top and flow over mountains and reach us from the North —still is there one thing which every one can see and believe, to wit, that the land South of the Laurentians is every where strewn with immense deposits of detritus composed of rounded stones and sand and gravel covered with immense bowlders composed of stone different from that of our own latitudes ; we can not encape the conclusion that these materials, the components of other rocks than ours must have been brought here by some powerful agency.

We see it on a smaller scale in the morains left by receding glaciers, and we still see it every year in the displacement of large stones which become attached to the underside of the "battures" of our rivers and are moved forward and generally downward but may also be woved up stream in tidal rivers and become dedatched and drop or fall from the ice on its melting or torn from it by friction along the bottom. Another thing which causes one to douth the accuracy of the geologist's theory of the moving forward of a sea or field or mountain of ice, is that we associate this adamantine looking substance with, and imagine it to be as unflowing as solid rock, while in reality ice is absolutely though slowly plastic as seen under article 15 of this paper, and it must be concieved to have pushed forward like the ice from the Alpine, Alaskan and other summits as would be done by very thick treacle, not may be advancing bodily from the bottom upwards; but by the upper portion gradually overflowing the lower and thus in the course of ages producing the results we see to day

and in the rolling over and over of the fragments of rock, their reduction into rounded masses, and in the striae of stone upon stone, still to be seen at this day, further evidences of the pushing forward of this detritus, sand, gravel and heavy rocks, by some irressistible force from behind.

Anchor Ice.

24.—With regard to "*Anchor Ice*" and "*Frazil Ice*" and how they are formed - I will merely refer for the present to the excellent paper on the subject of M. T. C. Keeper M. C. A. C. E.—F. R. S. C. read before this Society and to be found illustrated in the bulletins of the society — but the exact theory of formation of this ice over the bottom of rivers, etc ; the formation of the frazil in running water ; how water can and does become ice while running rapidly down the face of a cataract—are subjects requiring further inquiry into.

25.—The Earth at the Centre of the Universe

Though not in these terms, M. Alfred Russell Wallace, D. M. G., and a member of the Royal Society of London, discusses in a remarkable article in the last or, March 1903, No. of the London "Fortnightly Review" "*Man's Place in the Universe.*"

The Church had always advocated this since its establishment after the birth of our Saviour; its reasons being amongst others, that it seemed to be the centre from the fact of the whole starry heavens apparently revolving around it, and more especially that this globe having been chosen by God for the creation and residence of man and thereafter, on account of man's prevarication, when the deity honoured it, with the birth and residence of the Redeemer—But up to the present time, nothing went to prove that we were at or near the centre of the stellar universe, or on its out-skirts—when N. Wallace considers he has accumulated evidence enough to show that we really are at the very hub of the world ; for at the hub of a wheel every portion of its circumference must appear to us to be travelling with equal velocity ; and that is what for the last 30 years Wallace has beem striving to prove and has at last been successful in demonstrating to wit : that the annual displacement of the stars is the same on each and every side of us or saya proper motion, a motion of their own of some 7 seconds a year

for the nearest, as at 61 cygni and others, while those more and more remote, have a real motion in space of only 6″, 5″, 4″, 3″, 2″ and 1″ per annum, and those ten times further off, the mere 10th of a second and so on, and how we know of their several and relative distances is by their varying annual parallaxes or the distances which the diameter of the Earth's orbit around the sun would subtend, if seen from the distance of the stars.

And this is analogous to Herschell's mode of studying the direction in which our system is moving through space, namely toward the constellation Orion ; or, by the expanding distances between the stars towards which we are travelling and the closing in of those behind us or from which we are receding — just as a mariner knows he is getting farther and farther from the port he has left by the closing in of the lights behind him and his coming nearer to those before him by their opening out as he approaches.

Nor need we be apprehensive that our own proper motion towards Orion, may dislodge us from this centrality of position at least for centuries to come—when we consider that the whole diam. of orbit about the same would seem a mere point, if seen from 61 cygni, and that even the whole distance which separates us from Orion would itself be but as a mere point if, viewed from stars remoter and more remote by ten, a thousand, a million times than those nearest us, and still then might we be found to be after thousands of centuries to come, in the axial line of the hub of our universe.

A Plurality of Worlds

26.—As to there being, as Brewster argues " More worlds than one " - " Other Worlds that ours ", as Proctor expresses it —a " Plurality of Worlds " as Flammarion puts it ; Wallace seems to incline to the belief that, due to our physiological make up, we seem at any rate better fitted here or at this distance from the sun, to the conditions of our existence, than if we were elsewhere—more remote from or nearer to the centre of our system ; but he argues properly that if other worlds than ours be inhabited, it must be by beings like unto ourselves, from the fact that since the spectroscope bears witness to the correctness of the theory that the component materials which make up other worlds are

the same as ours, it is natural to suppose there would be the same analogy in vegetable, and animal life thereon ; for, like soil or earth must be productive of like flora and like flora of like flesh or fauna ; and thus we are, so to say, forced to incline to this theory of "Other worlds than Ours" except for the question that if man also prevaricated there, there must have been redemption there as here, and hence the difficulty of our conceiving how this redemption can have been carried out ; while again it seems irrelevant to believe that God should have created all these lovely worlds that shine forth His glory, without endowing them with sentient beings capable, as we are here on Earth, of proclaiming His Immensity and Omnipotence.

And again adverting to the question of redemption and since there are and were myriads of Angels ; why not suppose that God Almighty told off one of these to be offered as a sacrifice for man's misconduct in those "other worlds than ours" in imitation of Abraham's would be sacrifice of his own son Isaac in preliminary atonement for the sins of the world before the advent of Our Saviour.

ENGINEERING ITEMS.

How the overthrow of a bridge was brought about.

27.—*The fall of the Louisville and Jeffersonville bridge in the United States* by the swaying to and fro with the wind, of the unfinished span supported on piles, which, had that portion of them which was out of water (a height of 40 ft) been properly braced, could not have moved ; was due, though no one seemed at the time to notice it, to the fact that the bracing in the direction of the wind and flow of the river, instead of extending down from top of piles to surface of water and even beneath that level, was only put in at the top or 30 ft from or above the level of the river and hence both piles of each bent could move and sway simultaneously until they broke under the effort, and that the span was thus projected from them ; and as to the finished span of 500 ft. which went over with the wind, some sidewards opposition to its being thus pushed over should have been at hand on the piers to prevent the wind from overcoming its friction on the piers.

The strength of Dams.

28.—A word as to *the strength of dams* to resist weight due to pressure of water impounded and possible depth of overflow.

The many Dam failures, over a hundred cases in America alone during the last 30 years, including that at Johnstown where some 10,000 persons are said to have perished ; the Bonzey in France with its 300 and odd victims ; the Austin dam, erected at a cost of $1,400,000, the Chambly dam, of which the first was by overflow and all the others, bodily pushed forward or down stream from shear want of weight to resist pressure from behind ; and notwithstanding the following out of rules and formulæ by practical scientists and considered reliable, seem to bear me out in my theory enunciated before the Society of Civil Engineers of Canada of which I am a member, published in its transactions, rehearsed in the columns of Biggar's "Canadian Engineer", reproduced in those of the New York "Engineering Record" and reechoed in an important engineering periodical of London ; that masonry being but twice the weight of water, or to be considered so (to be on the safe side) and as the initial friction of stone on stone is but 0.7 and the thereafter continued friction but 0.5 ; that when a dam is not so toothed into or anchored to the bed rock, and the masonry keyed together as at the Eddystone light-house in the British channel, or built in layers normal to the outer apron, and where the dam, to give, must be forced up and over an incline ; its weight should be double that due to the pressure of the water held up, and so calculated, by taking in, as a factor of the depth of water impounded such depth and in addition thereto the greatest possible height of overflow :— that at the Austin, and unprovided for, having been as such as 12 ft.— In other words the breadth or thickness of dam at bottom should equal the height including overflow, excepting where the breadth of dam at top is so thickened, to make a roadway of it, as to be an equivalent for the extra thickness at base beyond the depth of the impounded water.

And from the difficulties which sir Benjamin Baker met with at Asyut, in building the upper of the two dams across the Nile for purposes of irrigation, in putting in his foundation on a sandy bottom, with only 20 ft. depth of masonry by some 87 in breadth,

with, both up and down stream, cast iron tongued and grooved sheet piling driven to 13 ft. below bottom of foundation or 33 ft. altogether below bed of river — I say that I am anxious to see whether he will not still have trouble in keeping the water from percolating and creeping below the foundation in a way to necessitate the driving of additional sheet piling, and even only of wood, to such a depth as to reach rock or stiff clay bottom, if attainable.

Tidal Energy.

29. — *Tidal Energy* or can the rise and fall of tides he made economically subservient to the industrial requirements of man.

The writer would invite attention to his last conference before the Society of Canadian Engineers under the above heading, and would ask members to go over his reasoning and figures and see if he is borne out in arriving at the conclusion that, where, as in the St. Lawrence from a little above Quebec and down to the Gulf. the tides may be taken to average 10 or 12 ft., the waste by friction in such multiplied gearing as necessary to increase the speed to a practical figure for industrial purposes, can leave but 25 per cent of the tidal force for useful work — though of course, in such situations as the bay of Fundy and others where greater amplitude of tide obtains, the useful effect may be indefinitely greater.

The construction of a vessel for and other conditions essential to a discovery of the North Pole of the Earth.

30. — At the next general meeting of the Royal Society of Canada (may 1903), the writer will read an illustrated paper on *"The conditions of a successful voyage of discovery to the North Pole"*; the route to be followed to get there; how to know when the extremity of the Earth's axis has been reached; the construction of an indestructible vessel for the purpose and the objects scientific and other of the expedition.

Of course, the writer's principal aim in such a discussion is to show how an *indestructible* vessel can be made to resist ice pressure ; the general idea of cross section thereof being : stayed bents at 4 ft. centres and thus allowing for bunks and storage of provisions ; while the centre of the vessel throughout its entire length remains free for domestic and other purposes, coal storage, engines and boilers, machinists, etc, etc., with the new and improved rig of only boom sails to save having to go aloft, to furl or unfurl sails with heavily bemittened hands against cold, and thus reduce the crew and expenses to a minimum.

Aerial navigation.

31. —*No* successful *navigation of the air* possible or reliable without a balloon of some kind or shape or other medium of buoyancy to prevent accidents or fatalities.

The writer some few years ago expressed himself to this effect in a letter to the Montreal "Presse", and all attempts since and before that conclusion of his, fully bear him out in the correctness of his enunciation of such a conclusion.

32.—Composite bridge superstructure : Trussed Cables for extended spans

The writer would remind the engineering world that he believes himself to be the first engineer to propose the stiffening of a suspension bridge by a lattice work structure of steel ; as witness his plans for the construction of a (three 1200 ft. spans and two half spans, together 4800) bridge across the St. Lawrence at Quebec in 1847 or some 56 years ago. The superstructure at 135 ft. above high tide level of the river, was to have had a stiffening tube of 40 ft. in height, the railway traffic on its under deck or floor, coming out on the Quebec side at Frontenac park level, some 40 ft. below that of Dufferin terrace, and following along the outer side of Rampart street, passing over the several hills which from the lower levels of the city reach the upper town, would have hugged the cliff along the Northern side of the city, descending with a grade of one in 100 to and though St.

Sauveur and thence looping around to its junction with the C. P. R. at the Palais, while curving around on the opposite or Levis side to a junction with the " Intercolonial " or "Grand Trunk. "

The upper deck of the reinforcing tube would have been used for ordinary vehicular, and electric car travel and sidewalks, coming out at Dufferin terrace level, 180 ft. above base.

One of the alledged reasons for the non carrying out of a bridge opposite the city proper was that it would interfere with military strategy and the defence of the city in case of war, and that it would cost twice or three times as much as the present bridge now being built at Carouge—7 miles west of the city ; but the truth is that none of our engineers had conceived and planned, as the writer did, a mode of founding piers in a depth of 160 ft. of water which there is said to be towards the Levis side, and which forms the subject of the ensueing article.

33. — Bridge or other piers on foundations in a depth of 160 ft. of water or more.

At the City Hall, Quebec, on the 3rd floor corridor back of the gallery floor of the Recorders' Court, may be seen to this day, a plan some 22 ft. in length, being the general design by the writer, for a bridge across the St. Lawrence opposite the city—see preceding article for a description of the superstructure thereof.

In his drawers may be found larger sized plans, views and sections of pier construction in 160 ft. depth of water, and the auxiliary crib work for founding these piers may also be seen in the general design alluded to in last paragraph.

The idea's was, in a few words, to build and sink crib work piers of wood and stone, leaving spaces or wells within them for two supporting legs to each pier, these wells to be lined with iron caissons or rather bottomless tubes, well stayed by struts radiating from two focal columns or newelposts of iron, to be subsequently pumped out if required, and filled with concrete, or left unpumped, as, now a days, concrete can be deposited efficiently at any depth in still water.

The auxiliary crib work so called, as without such a surrounding, the caissons and concrete could not be put in and made stable at such a depth, was to have been of a size, allowing for batter, to leave above high tide level a utilizable wharf surface of at least 60 ft. at sides of piers and say 100 ft. up and down stream, for materials and scaffolding, while building the supporting towers above water level, starting from stone foundations reaching down to top of concrete or a few ft. below ebb tide level and thereafter utilizable for deposit of coals, lumber, etc and cranes and facilities for loading into vessels moored alongside, while ; the towers themselves then supposed to be of masonry, could now be made of steel, and, may-be, utilized as grain elevators or for other or storage purposes.

This bridge might possibly have cost two or three additional millions as compared with the Cap-rouge bridge now under construction ; but the revenue derivable from the crossing of street cars, vehicular traffic and foot passengers on the one hand, and the revenue from the mooring and loading piers below, would have gone far to pay interest on additionnal cost.

However, as said in preceding article, the idea was repudiated by our local engineers at the time and since, from the fact that not one of them had been able to conceive by what process the foundations of the piers could be laid in such a depth of water (160 f.)

A Spiral Slide.

34.—There may be no harm in again calling attention to my *Spiral Slide* where a truncated cone 60 ft. high, 60 ft. diam. at base and say 12 to 15 ft. at top, as a platform to start from, while leaving an open well in the centre for an elevator, would allow of so many sweeps around the conic frustum, as in the aggregate to give a slide of 1000 ft. in extent, and still leave you within 10 paces of the elevator and thus ready to mount again, instead of, as in straight slides, having to walk back one fifth of a mile for another slide.

An Electric chromatic revolving fountain.

35.— My proposed *electro-lit, chromatic, revolving-fountain* can be built of any size. It has 3 tiers or series of jets throwing 12 jets each, together 36, and all made to appear of different colours by revolving mechanism within it, bringing successively before the lens through which the jet is illuminated, coloured glass of constantly varying tint or colour, and while one series of colours revolves to the right, the other does so to the left and the middle series remaining stationary, the jets thus appear to be constantly playing at leap frog the one over the other, while the receiving basin gleams during the play of jets with coloured fire as if of melted gold, silver, ruby, topaz, sapphire, etc, etc.

For a small fountain a single central arc light might suffice or each superposed tier of jets ; but in a larger fountain the effect of giving each jet its own arc light would enhance the splendor of the exhibition. The author would like to see some of our millionnaire cousins take hold of this and carry it out. $3000.00 and upwards, to $30,000, or even $300,000.

The writer can loudly and safely proclaim that of all the electric fountains ever built or imagined, this would prove the most beautiful and fairy-like.

The London Eiffel Tower as proposed in 1890

36.—The " *London Eiffel Tower* " was designed on an invitation in 1889 of a Committee of that name to erect a tower not less than 1200 ft. high. 65 designs were submitted from every part of the world. The writer's, design was considered 5th in merit but should have been awarded first prize of £500 sterling— his, being the only structure capable of subdivision into horizontal sections or stories of 20, 40, 60 or more ft. in height ; and this was one of the sine-qua-non conditions of the competition; but unfortunately, partiality and favoritism must always exist somewhere and the Committee awarded the prize to one of its own engineers or architects, who being on the spot, could help in having things his own way.

The writer's design was for a tower 1600 ft. high, 280 ft. diam at base, and receding or tapering by 10 ft. all around at

every 200 ft. of its total height to a final diam. of 20 and 10 ft. at the summit.

The proposed structure was one of stone and concrete foundation, cast and wrought iron and steel superstructure, glazed in, with electro-lit galleries over recesses at each 200 ft. in height. The weight computed at 14,000 tons and the estimated cost over a million of dollars, including double stairways and multiple elevators.

The idea of being able to decompose it into sections, was that in case it did not pay, it might be sold in sections to provincial towns for exhibition or other purposes.

It was not erected however on account of its savouring too much of an idea borrowed from the French, and the English being too proud and conservative to encourage any thing of the kind.

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A tower for gala and other purposes.

37.—The then (1897) proposed *Victoria Jubilee tower* over the jet d'eau, Place d'Armes, Quebec, was to have been 150 ft. high of ornamental open iron and steel work composed of 16 legs or columns of say 4 " gas pipe below, and being 10 stories high, with horizontal rings of connecting and stiffening arches. The columns decreased in size as they rose, by using piping or tubing of constantly smaller diam. and screwing the one length into the other to the apex.

In each of the 10 tiers of 16 arches (160) an electric arc or an incandescent light. Lower diameter of spread 50 ft., a 10 ft. diam. crow's nest at top and convenient rostra or rungs to columns to ascend by.

This tower may still and should be erected as it would cost the city but some $3000.00, subserve all purposes of public rejoicing and then to be clad in colours or painted, or both with wreaths of flowers etc — while, on the occasion of the birth or death of a sovereign or pope, etc, it could be painted in tints and decorated in a way befitting the occasion.

On an occasion of illumination or fire works, 1000 rockets

could by simultaneous firing by electricity from the Crow's nest at top, be sprung upon the sky and descend like a parachute of coloured fire upon the city from a height of nearly a thousand feet or several hundred ft. above the apex or highest point at the " Chateau Frontenac " which stands on Dufferin terrace at nearly 200 ft. above the level of the St. Lawrence.

Within the precincts of the tower, at grond level, the *Electrolit, chromatic revolving* fountain described in article 35 would be at play the while, throwing out gay or sombre jets expressive of the joy or grief of the occurrence at hand.

This tower of course need not be confined to Quebec and whoever takes hold of the concern will have no occasion to regret it pecuniarily or otherwise.

Escape in case of fire.

38. — In 1884 the writer read before the Royal Society of Can., his illustrated paper on *Escape in case of fire*, his system since exhibited at the Paris exposition in 1900. Though the proposed system is the only one which would insure absolute safety under all circonstances, there is an apathy with governments as with individuals and societies in dealing with a subject that no one likes to set their mind on, as if the very word "fire" must be as is the abhorrent word " death " — and yet it is a most humanitarian subject to deal with and which our Legislatures should enact and enfoce a law to carry out.

Singular it is indeed this disposition of our human nature to forget after a day or two the most apalling catastrophies either by shipwreck, railway accidents or fire, etc : the Vienna theatre fire, 600 or more victims, the Broklyn theatre—276 fatalities, the Paris Bazar fire when over 200 perished, and hundreds of other like eventualities were no sooner over, than forgotten — At the Paris Bazaar fire there had been provided 7 emergency doors and yet no one had had the idea of stationing a hand at each door to throw it open in an instant; and where every one could have been saved, it even with scorched head and shoulders from the falling draperies, but which in three months thereafter would all have disappeared.

Any scheme or mode of escape in case of fire or an emergency, which may never occur, though it so frequently does, must be acceptable to proprietors, or tenants and interfere in no way with the every day avocations of any institution, as a theatre, a hotel, a convent or college, an asylum, a hospital. There must be absolutely no hindrance to the domestic or public service.

The fire escape stairway must not be placed in front where space is too precious to devote any of it to an uncertain eventuality ; thus for instance in a 10 story hotel where each room may bring in a profit of $100 to $1000 per annum would cause the proprietor a yearly loss of $1000.00 to $10,000.00.

The stairway must therefore be relegated to the rear, and according to size of building, there may be required more than one such, with facilities to reach them by stepping over a window sill on to a light trellis work or open (for light below) balcony, continuous or not as the case may be.

This stairway must have no direct communication whatever with the building, as in the case of the Macdonald factory Montreal, where what was supposed to be a safety stairway in case of fire, was built in the very centre of the establishment, the architect whoever forgetting that what would let the inmates out woud let in the smoke and heated gases from below— and so proved, as a lot of hands from the upper flats on endeavouring to rush down stairs were met by suffocating smoke and heated gazes from below and had to return upwards and throw themselves from the high stories of the building to certain death on the pavement below.

No, there must be absolutely no communication with the stairway, except by first passing out on to a balcony to enter it from the outside and thus eliminate any tendency for the stairway enclosure, of say 8″ brick work, to act as a chimney flue.

Now this stairs being in the rear, if there be no way from yard level to reach the street, for instance through a walled in or fire proof gateway, there must a fire proof corridor, again of say 8″ brick-work, be made through the building ; but this corridor must not, can not be made on first floor level ; as the inside

economy of the institution must not be in any way interfered with as said before.

There is a way at hand out of this difficulty : it is to elevate this fire proof corridor to the ceiling, supporting it on columns with a flooring of iron joists and concrete, and as the first story of any building should be 13 to 15 ft. high or more, there will be ample room to pass beneath as may be required; and more over if for instance there be required a proper sized door to pass from one important room on one side the corridor to another on the opposite side, space will be found for it under the landing of the lower flight of stairs, said stairs not needing to be continued below level of corridor floor, when the door in question may be made of the fall heigth of the first story or ground floor if necessary.

In the case of the burning of and loss of life at the Windsor Hotel New York, the writer wrote both Sir Wilfrid Laurier and M. McKinley then president of the United States as to the necessity of some legislative enactment in the premises, when he was informed by each of Them that it pertains to the component states or provincial legislatures to deal with such matters.

This proposed system is not only one to be relied on as certain, but is at the same time simultaneous and instantaneous.

Escape in case of disaster at sea.

39. — The writer in answer to the Pollok prize proposal of $20,000.00 for *a mode of escape in case of disaster at sea*, sent in designs and models to be submitted to a committee at Havre France. The committee did not award the prize, declaring that none of the designs afforded complete security in the premisses —that of the author of this paper consisting in side rafts, one or more on each side of the vessel, supported on a side gallery— each raft holding 200 or more passengers and which could be thown over into the water by any unskilled hand or child.

The author notwithstanding the declaration of the committee, composed of superanuated individuals and know nothings in engineering, declares his to be the only sure mode of escape as set forth in detail in his papers submitted with the models ; but

which probably were not even read, there not being time in a few days to thoroughly examine and report on the relative merits of some 400 exhibits.

The system proposed would, by the side galleries a few ft. above water level, steady the vessel against rolling—the elimination of boats was so much less resistance to the wind — the side rafts were pierced with embrazured openings so as to interfere in no way with the light and in a word the writer was corroborated by hundreds in his certitude of his invention being the best; but which as in the case of the Santos Dumont balloon, the committee refused him the prize at first and in the end made it over to him when they were forced by public opinion to do so, it is said, the decision is to be reconsidered.

Again, it has been abundantly proved that in a case of panic, or imminent wreck, the sailors or crew look to their own safety and on one of our present Ocean liners, a captain could not command half the number of hands to man the boats, thus showing the advantage of the detachable side raft held up on edge and braced to flanks or side of vessel, and which, as said before, can be detached by any unskilled hand amongst the passengers themselves.

To put an end to steam boiler explosions.

40.—*Steam boiler explosions* can and should be prevented. They are due to, when the water goes down, the fact that a heating to redness of the shell then occurs, the formation of vapor in such quantities and so instantaneously that the ordinary so called safety valve is impotent to let it escape as fast as created; and the area of valve should, to ensure this, be made of a size some 4 to 5 times as great or of a diam. two to three times the usual opening.

The writer has already more than once, in engineering publications, called attention to this matter; but our boiler makers will stick to old rules, and accidents with numerous fatalites continue to be recorded in the daily press.

The first automobile in America in 1847

41. — M. Baillargé at a dinner given by him to the engineering profession on the 31st December 1900 at the Chateau Frontenac Quebec, to see the old century out and inaugurate the new, showed in his after dinner resume of " The Progres of the 19th century that he was the first one in America to build an automobile in 1847; and it was a blow off of steam from the boiler thereof, which sent the plug a flying into the air, that impressed him with the idea that the safety valve was not large enough ; for had not the boiler been tested up to 300 lbs to the inch and was strong enough to stand 500, he probably would not have been here now to tell of the occurrence which led him to make the suggestion set forth in the preceding article.

To prevent vessels when stoven at sea, from tilting over and foundering.

42. — *To prevent vessels when stoven in from tilting over and foundering at sea* as did the Victoria with 404 souls on board when struck by the ram of the Camperdown on the occasion of the naval review given by Her Majesty Queen Victoria in honor of the visit to England of the emporer of Germany.

How strange that naval architects or engineers, should be guilty of such criminal oversight as not to have thought of the fact that with a longitudinal bulk head, some means, and they were easy ones, should have been provided of allowing the in rushing water from the one side to find its way to some compartment on the opposite side which would have kept the vessel upright, instead of which the flooding, confined as it was to one side of the vessel, tilted it over to that side, till the port holes reached the water's edge, when the Victoria quickly filled and went over with every one on board.

And when the french naval engineers built the Gascoigne, untaught by the terrible lesson of the foundering of the Victoria, they committed the same blunder and that vessel also went down and for the same reason with over 200 souls on board. And since that again, I see by the Scientific American that the french liner " La Bretagne ", still untaught, has had the same error repeated

in her construction and she also will go down if the same thing happens to her.

Of course the longitudinal bulk head on the median live is necessary where the double nests of boilers are, so placed that an inrush of water putting out the fires on the one side may be prevented from doing the same thing on the other, and thus instead of stopping the vessel completely, allow of its proceeding at half speed. This is simple and by a longitudinal conduit between the outer and inner skins of the vessel and branches therefrom between the ribs of the vessel to each water tight compartment with regulating keys which could be worked from the main dock, the inrushing water could be conducted to such a compartment, fore or aft as would insure its stability and keep it plura in the water.

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The Quebec land slide of 1889 and 53 deaths.

43. -- *The Quebec land slide of sept. 1889* when some 80,000 tons of the cliff opposite the Citadel and Dufferin terrace were precipitated over Champlain St. crushing the houses on the opposite or river side of the street, with the casualty of some 53 lives ; was due to the fact, as fully explained and illustrated in a paper by the author read before the Canadian Ass. of C. E. and published in the transactions of the society ; the strata there being nearly vertical, having been by, seismic action tilted up into that position from their originally horizontally disposed arrangement by subsidence of its components ; the surface water from the citadel ditches finding their way by percolation into and between the strata, opening them out into a fan like structure and thus pushing out the outer ones at top by a quantity which caused the overthrown rock to lean forward 6 ft. from the vertical in a height of 60 ft. or 1 in 10.

Now one of the crevasses mentioned and which by measurement attained a depth of 120 ft. and was three ft. wide at its outcrop at the surface, and which formed a procket by being closed or diminishing off to nothing at each end, became filled with water to a depth of 100 ft., when with the tilting forward of the strata, the angle of cleavage of the component slaty makeup

of the structure, the hydrostotic pressure caused the overfall of the cliff.

I use the word "overfall" advisedly, as the gentlemen sent here from the Kingston school of technology, to investigate and report on the occurrence and its cause, erroneously arrived at the result that the rock had slid out on its base, which would have left the surface growith of grasses immediately below their former position or about in the same vertical plain, while on the contrary, these witnesses to the nature of the accident, were found on the very outskirts of the fallen rock, showing the cliff, as already said, to have fallen out and not to have slid forward as pretended by the Kingston wiseacres. And even col. Strange himself, surprised at the almost absolute verticality of the strata, would have it that the planes of stratification were the planes of cleavage and vice versa.

Tunnel and Subway Ventilation.

44.—In a recent issue of the Engineering Record New York, the conclusion is arrived at based on the allowance of the Massachussets school commissioners of 1800 cubic ft. of air per pupil ; that a one mile section of four tracks, Subway, would require 7,000,000 cubic ft. of renewed air to be forced into or through it per hour, the cross section being 650 ft. area and number of passengers 4000, or equivalent to a flow of about 2 miles per hour or, if you will, the gentlest of breezes.

Well, this of course would be pleasant on a warm day, though disagreeable may be during cold weather ; and at any rate as others have arrived at the conclusion that 1000 cubic ft. of fresh air per hour suffice per individual ; and as even this may be deemed exaggerated on consideration of the fact that even the necessity of sewer ventilation is a matter for discussion, that sewer scavengers are known to be amongst the healthiest persons in the community ; that the Paris "Grand Collecteur" and smaller sewers are visited every month by hundreds of ladies and gentlemen without any unpleasantness other than a mere closeness as of an unaired bedroom in the morning ; that the writer

has seen himself shut up for 3 consecutive hours with 5 members of a "Health Committee" discussing this very question of ventilation, and that, in a room only 12′ x 8′ x 8′ or affording but 40 cubic ft. of air per hour to each inmate instead of the stipulated 1000 ; I say, that considering all this, and supported by the evidence of the fact that an adult, and a child especially can, while wrapped head and all in not over porous blankets, breathe and breathe over and over again the same long-expelled carbon, and which acts only as an opiate, a soporific ; that the 7,000,000 ft. of air advocated might possibly be reduced to 1,000,000 and the solution of the problem be therely rendered so much more easy. and less costly.

An inclined factory chimney made plumb.

45.—This was some 80 ft. in height and say 7 ft. square at base. A settlement of the foundation had caused the chimney to lean over or out of plumb by about 2½ to 3 ft. at top, to rectify which, after shoring it up at less than half height by struts and jacks, the writer had a wedge like piece cut from the bottom of it, and then let the shaft down gradually to a level bottom.

The arched water mains over the river St. Charles.

46.—In 1873, the submerged water main of the Quebec aqueduct, having sprung a leak, it was decided to carry one over the river. A wooden bridge was erected for the purpose and to give head room beneath it for river navigation of the St. Charles, this bridge was curved up into an arch. of 120 ft. shan. The 18″ water main from lake St. Charles had to follow suit and was also curved to a concentric radius ; the writer's idea being that should the wooden surrounding tube or bridge, boxed in against frost, and other accidents, be destroyed by fire, the curved or convex line of piping would stand of itself without the supporting wood work ; the eventuality however having since been eliminated by replacing the surrounding wooden tunnel by one of steel and iron.

The rectification of an 18″ water main without turning off the water.

47—The Arched structure across the St. Charles river for the Quebec aqueduct, alluded to in last paragraph No. 46 having in 1873 been pushed out of its vertical plane by some 3 ft. at centre, by ice pressure (the ice having piled up on the occasion to a height of over 20 ft. above normal level) the writer had the whole structure, water main and all pushed back into true position by the application of stancheons resting on gravel bed of river, with a jack to each, which were worked simultaneously by as many men, until perfect verticality of tube and bridge had been restored and, the jointing of the pipes being of lead, the pipe did not even spring a leak under the ordeal, though a slight oozing at some of the joints necessitated a little restaving.

The fall of the Montmorency suspension bridge.

48—Though some forty odd years ago, it may still be instructive to engineers to know how this occurred, as in general the instructiveness of failure is untold; while nothing is to be gleaned from the fact that a structure holds its own; since its weakest part may still be 10 or 100 times stronger than need be.

This bridge, 400 ft. span, right over the cataract at Montmorency and of which the four towers are still standing and as good as ever, was of the chain suspension type of iron links 7 ft. long x 1″ thick by 7″ in the vertical, in nests of seven with articulated or pin joints. The monolith cutstone blocks or cushions which were to have been laid under the joints at the anchorages, were, by false economy, replaced by concrete which being of poor quality and laid in winter settled as much as 8″ under stress and thus brought the component links to bear on sharp edges of the underlying tilted strata of the bearing rock formation, when they snapped asunder one by one until the whole chain had parted.

The Manhattan "Sky-Scrapers" or tall buildings and City Hygiene.

49—A well timed article by Dr Langton C.E. in the last issue of the "Canadian Architect" induces me to suggest that as sun and air can not safely be eliminated from the streets of a city without entailing comparative darkness, dampness and altogether an unhealty state of being for those who have to ply their daily avocations in such localities ; a compromise be made by legislatively enacting that while what may be called the general height be limited, as along the Paris boulevards, to 5, 6 or 7 stories, according to breadth of thoroughfare ; every two successive buildings out of three, be allowed to rise to such additional height of 10 to 20 stories more or less, as may be considered advisable ; while to offset advantages or equalize revenue with those so debarred from any super elevation, the proprietors of the taller structures on either side, after deduction of interest on cost of additional height and other charges considered legitimate and fair, make over to the proprietor of the low building one third each of the net profits derivable from the higher structures.

This system while productive of a so to say crenelated line of street architecture, pleasing to the eye, would (the lots being 25 to 30 ft. more or less in breadth or frontage) allow of air and sunshine at every 60 or 70 ft. or through every third lot along line of street, which, with such ventilation as would obtain at every cross street, would solve the problem of fitting the locality for the ordinary traffic and run of business to be hygienically dealt with.

Would a barrage across the Straits of Belle Isle soften the climate around the Gulf of St. Lawrence ?

50—This, with we Canadians is still a pertinent subject of enquiry. The writer and since then some scientist of the United States has expressed the idea that while, may-be, costing 10 or 12 millions for a dump of that length and proper width with an assumed mean depth of say 200 ft. across the Straits of Belle-Isle and answering as a connection for a future railway from Canada

to Newfoundland, such a barrage might by preventing the inflow of the colder waters and icebergs from the North, beneficially influence the climate westward, though of course there would still remain the cold bearing winds from the icy region.

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The Human mechanism the most marvellous.

51 —A rehearsal of this subject—the heading to which is from Dr Lardner in his "Lectures on Science and Art" of some 50 years ago, was entered into, by the writer, but at much greater length, and with tenfold more points of comparison between the mechanism of the human body with its 200 bones and 500 muscles, and mechanical engineering devices to this day invented and utilized by man. The paper on the subject was read before the Royal Society of Canada in 1901, going over and comparing as it does the osseous, muscular, nervous and vascular systems of our make-up and the diversity of action they are capable of with that of every machine created by man's genius : whether in hydrodynamics, hydraulics, the filtering and purification of fluids and of their distribution, the collection of sewage and its antiseptic treatment, electric telegraphing and locomotion ; as in a comparison of our strength of structure, our infinite variety of motion and action due to the articulations, extensor, flexor and abductor and other muscles.

The human machine ministers to all its own requirements : supplies itself with food fuel which becomes elaborated into the life-sustaining, life-repairing fluid which gives it power, as does steam to the steam engine, wind and water and electricity to the world at large.

It is its own lubricator having constantly on hand at all its articulations and rubbing surfaces, the synovia which the system is as constantly secreting to keep up the supply.

It is its own caretaker, cleanser, scavenger : getting rid of its waste products, eliminating them from the system—while the duplex pumping mechanism of the heart, after forcing the arterial fluid, to the remotest ramifications of the body, whence it returns by the veins to the heart again, sends it off anew on its

way to the septic apparatus of the lungs, where it becomes revivified ; and during the process of cremation of impurities or carbon of the blood by contact with the oxygen of the air, creates the heat which keeps up the temperature necessary to the vital energy of which the machine is in need.

The human machine is a most perfect "traveller" and when its work can not be brought to or towards it, it can easily reach it and operate upon it in any position. It also endures the longest and in a word it comprises within itself every known or conceivable mechanical device, motion and combination of motions ; and it is adequate to perform any and every duty which future discoveries, inventions, industries may require of it—in the same way as the possible combinations of the traits of which the human physionomy is made up, explain the non resemblances of the human race since the creation of man, and are in number sufficient to provide for like differences for all time to come.

Copies of the memoir are still on hand and may be had for the mere asking.

The Venturi Meter

52—While M. R. Steckel C. E. and one of Canada's greatest mathematicians, is dealing scientifically with an elucidation of the question of how a body of water can be driven though a throttled portion of a tube ; I may prepare to wed practical engineers to the fact that such a thing does in reality occur. And when I say : wed or gain them over to the belief that water can be so forced through a narrow passage and lose nothing of its initial velocity in so doing ; it is because, water being incompressible, engineers had not conceived before Venturi's time of the possibility of an equivalent action in increased velocity.

The secret was of course in the length of the throttling which in fact must be only a fraction of the diameter of the conduit. It is conceivable and in fact evident that a body of water in motion, acts as a ram and that, the throttled portion of the tube against which it acts must either burst under the stress, or that the water must pass through it at an increased velocity proportional to the relative bores of the tube or conduit and its knecking.

It was not admissable that a fluid could be made to pass from a tube having a certain area of cross section, through one of lesser area without an ancrease of velocity. No one had happened to consider, how it might be in passing through a very short pipe or a mere ring and that in that case, the fluid might be forced through it at increased velocity by the ram-like action of the water from behind when suddenly impeded in its motion by the throttling of the conduit.

The water then does pass through this smaller portion of the tube with increased velocity, and allows of the throttled tube acting as a meter or water measurer ; which is evidenced by the fact that the so-called piezometer or tube appended to the throating of the conduit indicates a diminution of pressure, which of course implies an increase of velocity, and as the piezometers on the main conduit, at each side of its narrowing indicate pressures due to normal flow through full sized conduit, the difference of pressure and therefore of velocity is made the factor of computation of water delivery.

It is fortunate also that such be the case, for any direct system of measuring water delivery through tubes of several ft. in diam. is entirely out of the question, and calculation of the flow based on the delivery of smaller and measurable conduits has ot be resorted to, while on the other hand to build meters of such a size as to register the volume from a large pipe would on account of their cost be rendered so to say prohibitory.

The proposed Hudson Bay Railway.

53. — In 1895 and 96, the writer in a pamphlet of some 40 pages oct. in both languages, read before the Institut Canadien, and the Quebec Literary and Historical Society, advocated the exploiting of the land and maritime resources of Hudson Bay which our neighbours, of the New England States had been robbing us of during the last 50 years or more ; though it requires two years on the expedition ; while, argued the writer, if we built a fleet of fishing vessels which could go there once for all and remain there, we could have 4 fishings in the interval, the fall and spring in each year. This of course suggested a colony at

James bay for the wintering of the fishermen, with berths near at hand for the vessels; and then for the transportation and disposal of the proceeds a railway from lake St. John to James Bay, the section from the lake to Quebec being already completed.

This railway to Hudson Bay was the next day alluded to by some fool in the "Quebec Mercury" as a railroad to the moon, while at the time Ontario was seriously preparing for one from that province though of greater length than that from the lake which was but some 380 miles in extent. The province of Quebec is however now bent on this railway as a portion of the proposed "Trans-Canada" and an almost direct route is by nature laid out for it through the valleys of the Chamouchouan, the Mattawai and the Masnawipi and Quebec is sorely in want of it as a back country for colonization because of its many pulp wood, timber and mineral resources coupled with the many magnificent and desirable water powers to be met with in such an extent of county, while not forgetting the fish, flesh and fowl at the locality.

The So-called Chicago Drainage Canal.

54.—As early as 1894 I called the attention of our Federal Legislators to the spoliation of a comparatively large portion of our Laurentian waters to be diverted from their natural course towards the Gulf of Mexico on pretence of merely diluting the drainage waters of Chicago, to cause them to be less repulsive on their way through the Illinois and Mississippi rivers to the ocean. I showed that the 600,000 cubic ft. of water per minute which it was eventually decided on robbing us of, was or would be not less than one thirtieth and possibly up to 5 per cent of the flow over Niagara into Ontario and thence by Kingston into the St. Lawrence, reducing by so much our depth in lake St. Peter and thus allowing Montreal to call on Canada for more millions to restore the former depth by dredging, but still leaving our splendid water way with a foot less draught of Quebec for vessels, as well all estuaries above Quebec or Three Rivers; while even below Quebec vessels having such a draft, as to have to wait on tide for passage over shallows, would have to wait still longer than of yore for sufficient buoyancy. This canal will before long be made a maritime canal of for communication between Chicago,

and other cities on the way to the Gulf ; but our legislators were too busy with the comparatively unimportant matters before Parliament or may be rather too blind to see how a canal from the far off south end of lake Michigan could possibly produce the effect predicted by the writer and which is now every day becoming more and more of a reality.

Foundations on doubtful soils.

55.—Architects should insist on getting proprietors to incur the expense of ascertaining before building, what they are about to build on. Already during the past few years a number of churches have crumbled, or failed to some extent by not being founded on piles where possible : say where a solid bottom can be had even at 50 to 60 ft. below the surface ; or on proper platforms where, as at Nicolet, St. Casimir, Joliette etc. a reliable foundation can not be met with at a less depth than from 50 to 100 ft. more or less ; and what is here meant by a proper platform foundation of timber is one, the breadth or area of which has been calculated to support an absolutely equal weight on every square ft. of its area.

The proportionate weight per square ft. of area or surface of soil in the case of a church especially, where the portal or front wall is generally thicker and higher than the side walls is often as much as double that which the latter bring to bear upon the soil, and as regards the tower or steeple, the comparative weight to be supported may be from there to five times that per foot to be born by the soil supporting the side walls. Well, the conclusion is evident, that the supporting platforms must be in like ratio or that of the front wall from 2 to 3 times that on which the flanks rest, and of the steeple, tower or towers from 3 to 4 or 5 times the same area.

Of course such excessive breadths of foundation platforms as say. 7 ft. to side walls, 14 or more to portal and from 20 to 30 under tower walls may at first sight appear absurd ; but if not, the above mentioned results may be looked for.

A building can be made to ride plumb even on an absolutely

fluid soil, as does a vessel on water ; but if the front of a vessel were not which it always is, built to be of only equal weight to the remainder, area for area, the vessel would pitch and remain pitched for all time ; though it must of course be admitted that the structure of a vessel is so braced by keel and keelsons against deflection at the centre that an extra weight forward may be counter balanced by an extra weight aft., or the extra weight of those portions compensated by the weight of machinery at or near the centre.

The architect should relieve his responsability in specifying proper foundations; his specifications then, if he be not employed to superintend the work, remaining as a protest in his favor and thus relieving him of all responsibility of failure ; whilst if he is in charge of the work and it be not intended to carry out his foundations as specified by him ; his duty, for self protection, and to uphold the good name of the profession, is to send in a protest in his own name to the effect that he willl not be responsible for the consequences.

In 1860 the writer erected the " St Foy Monument Quebec, some 60 ft. high of cast iron and concrete, three corners of it bearing on solid rock, the fourth corner on a pile of proper size driven to an unyielding depth and now after 43 years, the whole is as plumb as when erected.

An Aquarium under Dufferin Terrace.

56. –To supplement what nature has done for Quebec to wit : its magnificent harbour, its heights and points of view from which can be seen a dozen surrounding parishes—what, the City, the Local and Federal Govts., in the way of public improvements, buildings, etc — the Canadian Pacific in the erection on such a site of the Château Frontenac — something more remains to be done to render the City still further attractive to tourists.

The range of hovels at the foot of the cliff beneath the terrace should either be eliminated and the cliff sloped off with earth and grass or, to hide the unsighty back yards now disagreably visible from the terrace, *a second terrace at a lower level, as at Monaco in*

Europe, should be built above level of said houses, and opening on to Mountain Hill at about level of Routhier's jewellery store, or at such a height as to command a view of the St. Lawrence, above houses on river side of street.

But preferably there should be made a roadway along the site of these houses when demolished, reaching from Mountain hill at or above Routhier's store, by a gradual incline such as that of " Côte Abraham " to opposite the Gate way leading to the " Queens wharf. "

This is much called for, to save the narrow and disagreeable circuit around by the Cul de Sac and Notre Dame street to the foot of Mountain hill at the Neptune Inn, and eliminate, as it would fully two thirds of this street entrance to inside the City walls from lower town.

The present abutting walls against the cliff should remain and others be erected all along, under the incline to prevent any danger of land slides and thus endanger portions of the terrace, especially that adjoining the site of the land slide of 1841 where the cliff is rather shaky and a portion of which might some day give way if not secured as here recommended.

The face of the proposed hill deviation, towards Little Champlain St. should be a strongly built and battered wall of heavy masonry and of proper thickness; and the space between it and the cliff, filled in with the stone debris of the old houses and material added and well dumped down to form a solid substratum for the roadway ; and thus more and more secure the cliff under the terrace from any tendency which it may come to have in years to come of disentegrating under the influence of time and of running itself out into loose shale along foot of cliff as it is seen to do and has beeu doing for years all along Champlain St. and Cap Blanc.

This hill deviation was proposed by the writer already many years ago, while City Engr. Arch. Berlinguet would have the hill continued in rear of Beauchamp's, Ald. Foleys prop. and the Mercury office into the Extend of Ann St. ; but this would be of too steep a grade, a eliminate all light from rear of the aforesaid properties, and not come out as it should do, at Buade St., the

very centre or heart of the city.

The principal drift however of the present article is as to *an aquarium* beneath the Terrace flooring and extending as does the Brighton aquarium in England a distance of some 700 ft. or from the Lorne and Louise Kiosque to that at the Western end of the Terrace, the whole as described a year or two ago in an illustrated article published by the writer in " Le Soleil ". The site is certainly the best situated for such a vivarium of any to be found in the city or that any other city than Quebec could boast of, overlooking as it does the St. Lawrence from an elevation of nearly 200 ft. and where the present piers and spaces between them are just such as to accommodate an uninterrupted line of crystal tanks of inch plate glass in delicate steel framings supported on a row of tables at proper height for inspection of the aquatic plants and animals within the tanks.

A continuous corridor of some 20 or more ft. in width would of course lead the way along the line of reservoirs or cisterns ; and this would be made weather tight all around and heated throughout the winter season as is now done in the severa vivaria, or batcheries at Tadoussac, Ottawa and elsewhere.

The Aquarium would be reached by stairways under each of the three kiosks, enclosed of course against weather and frost.

The marine species would of course be accommodated with water made artificially salt, and the water constantly renewed by a supply main along the whole length of structure, with tranch to each cistern and the drainage therefrom of the spent fluid taken off by a conduit running beneath the line of tanks to proper outlets through the terrace wall.

A small admittance fee—that at Brighton is, or was, if I remember well when I visited it, 50 cts. ; but as we shall not have so many attractions under the terrace as there are at Brighton or at Sydenham, in the way of gardens, libraries and games of all kinds, a 25 ct. fee may be sufficient, not only to pay keeper and assistants and interest on cost (say $50,000.00) but to pay off capital in course of time.

Other Quebec City Improvements. Dufferin Terrace.

57.—I have advocated during my 33 years as City Engineer, among other things · the renewal in a permanent manner of Dufferin Terrace of which Princess Louise when she inaugurated it with the Marquis of Lorne then Gov. Gen. of Canada, said shaking me by the hand " Mr Baillarge, this is the finest promenade in the world " ; (the present wooden structure due to the citys want of means at the time (1872) to do the needful) consisting in a series of cross walls at distances of 60 ft. along length of terrace — iron girders over these at 20 ft. centres, with iron columns under girders — over these iron joists at 4 to 5 ft. centres with half brick arches between them, concrete spandrels, asphalt flooring with slight incline (say 6″ in 60 ft. of breadth of terrace) towards cliff - and over all, as more pleasant to walk on, a wooden flooring of 2″ pine with open joints (¼″) bevel edges in strictly straight lines, to satisfy the eye. Would probably cost $60,000.00 but must be done some day.

The Victoria-Parent Park.

58.—Should be improved by transplanting on to it, full grown trees here and there for shade, as done in other cities and even if they should cost $50 or $100 a piece.

The Bickel bridge should, as designed by me in 1898, be renewed on modern lines of steel construction and especially with the view of *a barrage* to keep up water around the park to half tide level and thus eliminate from view the now unsightly low tide beach mud.

Facilities should be offerded for *a Regatta* around the park, by cutting *a channel through the neck of land*, which joins it to the main land. Boats and yachts could then sail and race quite around the whole circuit, which would be such an attraction as to cause the park to spring immediately into popularity.

A tunnel through the cliff.

59. — From the South end of Boulevard Langelier (old St. Ours st.) the writer has advocated long ago and when the new bridge at Carouge has been completed, it may thrust itself on public attention as of almost indispensible necessity to relieve and shorten by nearly 2 miles the traffic around by Champlain St.

(*a*) *A carriage way over the cove fields* and *down the cliff to Cap Blanc* as planned by the writer some 10 years ago must eventually be carried out if it were only for fire service at the remote extremity, or the hill or inclined portion of the way down the cliff, replaced by an elevator, though this would hardly pay interest on outlay in such a vicinity.

(*b*) *The carriage way* commenced some 12 years ago Eastward of the Skating Rink should be completed, giving direct access from Grande Allée to the citadel heights overlooking the St. Lawrence.

(*c*) *A 4 to 6 inch water main should also be taken over and down the cliff from the Salaberry St. or Grande Allee to Cap Blanc* to supplement the present 4 inch main there, which, due to its almost 2 miles length and though fed by 6, 8 and 12 inch pipes from the city proper, looses so much in friction as to be only capable of a 20 to 30 ft. fire jet or hardly enough to reach the ordinary one to two storied buildings of the locality.

(*d*) *A stairway down the cliff from the St. Charles Battery at the East end of Hebert St.*

This much needed improvement which, while eliminating the rise of 50 ft. from Duquet's or Livernoi's to Darlington's or the Post Office, and the corresponding fall again and a quarter of a mile around, would have increased value and assessment from property along Couillard and Hebert streets ; was shelved, but I hope not for long, by the shop keepers along Mountain hill who were afraid of a little less grist to their respective mills. It would bring all the suburban district and half of the intra-mural wards into almost immediate connection with the business portion of the City at the Banks, Ware and Custom houses, Board of Trade rooms, Harbor commissioners, Docks etc. and a neat iron structure down the cliff just there would but be another attraction of the quasi sensational type.

(*e*) *The continuation of our City Electric Railway around Carouge* must follow immediately on the completion of the Carouge Bridge and the Park now being laid out on the Plains of Abraham by my son Mr. D. Baillargé — the 5th of that name as City Engineer since 1833. This extension even if it did pay in winter would like its prototype at Ottawa extension to "Britannia on the Bay" fully make up, the during our 8 summer months for all winter deficiency.

(*f*) *The cleanliness of the City* to render it agreeable or acceptable to tourists and to our own people must be better attended to—by instructing the police to cause contractors or proprietors who make repairs to clean up after them—by, as in Boston, preventing people from tearing up envelopes and throwing the remnants on the public highway—by forbiddings, as is done in other cities, the throwing of banana, orange or other peelings or the envelopes of fruit, or vegetable refuse, on the street — by enacting that the stuffings of paper, wadding, etc around winter sashes, be not left for every gust of wind to blow opposite your neighbours premises, —to prevent men and boys with wheel and hand barrows, others with edge tools and saws dangling over their shoulders from occupying the side walk to the exclusion of passers by.

(*i*) Attend to buyers and vendors of hay and straw who never clean up after them.

(*h*) See that shops keepers in unpacking goods do not let the wrappings blow all over the city streets.

(*j*) See that fire wood is no longer cut on our thoroughfares, as it can be purchased ready cut, or at any rate that saw dust and chips be immediately removed thereafter.

(*k*) Keep an eye on whittlers and prevent them from endeavouring to hand their remembrance down to posterity by engraving their names on our terrace seats and railings of city property.

(*m*) Now all or nearly all these nuisances are provided against by our city-by-laws; but if ever put in force, seem to have become a dead letter at the present day.

A re-erection of the bridge across the falls at Montmorency.

60. —The time has come when this bridge of some 50 years ago must be reerected ; not however, as a highway bridge for vehicular traffic, but as a mere foot way between the separate halves of the Kent House and Bureau park. It would be as sensational a structure as to be found in any part of the world, thus hanging vertically over one of the world's highest (270 ft.) and grandest cataracts. The bridge is a thing it may be said, and every one says so, of absolute necessity to avoid the long circuit around by the turnpike or highway bridge. The lower or Eastern side is also, as a park, the loveliest part of the site and reminds one of the park at Halifax with its secular trees and well cared for paths and drives as from this side also is to be had a better, a more direct face or front view of the falling sheet of water threshed and torn into foam, and like liquid and sparkling carrara marble plunging headlong as would a continuous Alpine avalanche of snow, from he giddy height into the abyss below.

Striking examples of how friction through long stretches of small bore (4 inch) pipe, affect height of delivery.

61. — At the Jail, Quebec, water at first reached up to the tanks in the attics through a 4 inch pipe 2800 ft. long. As the conduit in course of years became encrusted, its effective diam. thus diminished, and friction through it increased ; the water fell off in height until the cisterns had to be made in basement of bdg., and the water pumped up to attic floor level.

The incriminated 4″ pipe lying beside the 18″ main delivering from Mount Pleasant up De Salaberry St. to Grande Allée and the St. Louis or Montcalm ward heights, I caused to be inserted between the two a piece of 2″ pipe, when the water immediately leaped up again some 40 ft. or to former attic floor level, the supply then being from the 18″, through the 2″ into the 4″ and thence to the Jail ; while the friction through the first 1800 ft. of the pipe was thus eliminated.

(*a*) *At Sherbrooke,* some 8 to 10 years ago, though the gauge shewed a static pressure of a hundred pounds at Wellington St., during the fire at the National Bank property, corresponding to a height of delivery through a vertical tube, of over 200 ft., the fire jets, from the hydrants only reached to less than 30 ft. or to 3rd floor of bdg, and the whole block had to go.

(*b*) At Quebec, from experiments made by the writer in 1885 or after the completion of the new 30″main from Lorette, and due to the long stretches, of small bore pipe—some 7000 ft. of 8″, 6″ and 4″ distributing mains — the water at the Pion factory in Caron St., and that at the woolen factory at "Pointe aux lièvres" would not flow to a height of over 25 to 30 ft. or less, notwithstanding that the pressure at the gauge were 100 lbs., the drag on the moving column by friction, being responsible for this great discrepancy.

(*c*) I would, under this head caution hydraulic engineers or those having charge of water works or called on to lay them out, to *avoid small bore pipes,* which though always sufficient or even more than ample for domestic requirements, become a total failure the moment they are called on to deliver quickly, large volumes of water for fire purposes — a four inch pipe being only adequate to one line of 2½″ fire hose, where a 6″ could supply four of same size—still better an 8″. Large pipes act as reservoirs.

The unreliability of temporary structures for street shows and outside demonstrations.

62. — Proofs of which reach us every day through the Press, is due in nearly every case, not to any vertical inability of the structure to hold its own against the crushing weight it is called on to support; but to want of lateral stability, to prevent the structure going over sideways which is generally found to be the case. If this is attended to, it matters not how flimsy the structure ; it is likely to persist ; but side struts must be put in at every supporting bent as even if the end ones only are stayed, and something happens to an intermediary one, there may be a

collapse of a section of the stand, without the whole following suit.

Small piers supporting heavy weights should be of homogeneous construction, right through their entire thickness.

63. When the writer built the St. Jean Baptiste church in 1854—the two piers between the three front doors some $2\frac{1}{2}$ x 3 ft. only, were put in of solid cutstone layers as well inside as out to insure equality of settlement.

When the same church was rebuilt after its destruction by fire in 1882, under another architect, the same piers were rebuilt with outside cut stone facings and inside rubble though good, but where (there being thinner layers and therefore more of them, and as a consequence, more numerous joints or layers of intervening montar) ; the settlement of the inner facing being greater than that of the outer, where thinner and less numerous horizontal joints prevailed, the effect was that the inner and outer faces parted companionship, so I could thrust my arm in between the two. The thing was left unattended to in time and the settlement extending to the upper portions of the portal of the church, the whole central portion of the superincumbent masonry between the flanking towers had to be taken down and rebuilt at a cost of not less than $35,000.00.

Walls may fall inwards or outwards according to circumstances.

64. — The fall of many structures is due to inequality of settlement between the outer and inner masonry—a case in point being that at Terreault's new block on St. André St. corner of St. Thomas, where, the outer facing being in 12″ stone courses, and the inner in 3″ brick layers, inequality of settlement caused the piers to buckle or bend and bring down a large section of the superincumbent wall.

Now the peculiarity in this case is that the piers fell inward

because, though there were more layers of mortar inside than outside, the very dry bricks had sucked all the water out of and left the mortar dry and incompressible, while the same thing not happening with the mortar between the stone ashlaring, the latter settled and caused the wall to buckle or bend inwards.

It must be noted also that in the falling of walls by bulging out at the centre, the lower portion will often fall outwards, while the upper half of the wall will fold and fall inwards; and if it is the top of the wall which falls out first, this portion or upper half will kick the lower portion inwards. It only requires frequent observation of and close attention to these phenomena or happenings, to see results which otherwise generally remain unnoticed by the ordinary passer by.

The Engineer, the Master Spirit of the Age.

65. — I would call attention to my paper, under the above heading, read before the Canadian Society of Civil Engineers, published in its transactions, reproduced in the columns of the "Canadian Engineer", by the New York "Engineering Record" and some of the magazines of Europe— which sums up in saying that "of almost any man one can make, a town councillor, a mayor, a member of parliament, a minister of public works, railways, canals, etc— nay, even a Premier, a Governor, the President of a Republic, an Emperor, a King ; but of no man can you make an engineer without years of technical tuition, observation and practical training.

The Instructiveness of Failure

66.—I would again allude, as of paramount importance to the Engineer and Architect in every line, to the fact that nothing is to be learned from failure, unless the exact or technical cause thereof be known :

Failures of structures of all kinds are reported every day here and there, and there are many which are never commented on and not even known. The true cause of failure is seldom found or even guessed at, and all such cases are absolutely uninstruc-

tive, unless the thing be immediately investigated and before anything has been altered by parties interested in preventing the cause of failure from being known.

(*a*) The fall of the Louisville and Jeffersonville bridge No. 27 of this series must have taught the lesson, that such portions of the temporary supporting bents, as were out of water should have been braced, not merely at top, as they were ; but that the bracing should have extended down to and even below water level.

(*b*) Had the cause of the foundering of *the War Ship Victoria* (article No. 42) been inquired into, the terrible lesson would surely not have been lost on the builders of *the Bourgogne* and again of *the Bretagne.*

(*c*) Now that I have shown (No. 60) the technical cause of the failure of *the Montmorency Suspension Bridge,* let us hope that the lesson will be heeded and the same thing not occur again.

(*d*) *The broken glass at the Vendome Quebec*—must teach the lesson that glass (especially plate or thiek) can not reliably have one portion of its inside surface painted of a deep or dark colour, while other portions of it remain unpainted. See No. 12.

(*e*) *The failure of Churches,* etc, *at Joliette, Nicolet, St. Casimir,* and *elsewhere* to hold their own on a soil where there is but a comparatively thin (5′ to 7′) crust of land overlying 20 to 100 ft. or more of soft substratum, shows the necessity of piling or at least of proportioning area of supporting foundation platforms of timber or large stone, foot per foot, to the superincumbent weight to come upon them, to secure equality of settlement.

(*f*) *The many cases,* No. 63 being one of them, *where walls or supporting piers have failed and brought down their superstructures* show how guarded one must be in so building them, of homogeneous construction throughout, that there be no inequality of settlement, causing one portion of the pier to buckle and separate from the other, which we so often see in walls with dressed stone facings and few and thin joints as against the more numerous and thicker mortar joints of the backing of rubble or of brick masonry bearing also in mind the particular case of the fallen front at Terrault's No. 64 of this series.

(*g*) *The numerous failures of Dam Walls where the dam has been moved bodily forward* as at Bouzey in France, at Austin United States, at Chambly in Canada, point unmistakeably to the fact that they were not heavy enough to resist the thrust of water from behind, and to the necessity of carrying out the writer's theory of " weight of dam equal to twice the weight, due to height or depth of the water impounded, including possible height or depth of overflow ; the friction of stone on stone being but 0.5 of the weight thereof.

The land Slide at St. Valier.

67. — Some 20 years ago there occurred at St. Valier de Bellechasse, Q. a land slide illustrative of how such local phenomena are brought about and suggestive of like occurrences elsewhere. It happened along the border of a river whose banks at the site of the accident were some 15 ft. in height. The area of land moved was wooded with spruce trees of long standing which were carried bodily forward into the bed of the stream or river of which it of course brought about change in direction. The area thrust forward with the trees still standing or in an upright position was only a few hundred ft. in extent along the river and may-be a hundred ft. or so in breadth or depth, while the thickness of the soil was some 5 to 6 ft. in the rear and 15 ft. at its front edge.—The cause was that the land so displaced was a mere mass of sandy detritus or alluvium through which the rains of years percolating to the inclined or sloped upper surface of the underlying clay of a stiff and impenetrable nature, and thence along said impenetrable flooring to the adjoining stream, had in course of years honey-combed the under surface of the superincumbent stratum of sand until it slid down the inclined surface as if on rollers, the sand and water acting as a lubricant ; as when a vessel is made to slide into the sea by the introduction of a soapy medium between the ways and vessel. The trees as said before remained standing and are there to this day though of course at a level so much lower than the original elevation as due to the descent along the incline.

The Land Slide at St. Albans.

68.—Some miles Eastward of St. Anne de la Pérade, P.Q. on the right bank of the river of that name, is to be born in mind on account of its vast extent or area of ground moved forward, which while some thousand ft. or more along the river reached back or inland for say 500 ft. or more.

The soil moved forward, thrust into the river and carried away as so much mud towards and into the St. Lawrence was some 60 ft. to 70 ft. in depth or thickness along the river and about 20 ft. towards the rear, thus (its upper surface being originally that of a level field) forming a truncated wedge-like mass of material reposing on a base sloping towards the river at a rate of more than 1 in 12.

As in the case last above mentioned of the land slide at St. Valier—the determining cause was that in the course of years or may-be centuries, the filtering through the sandy material composing the ground moved forward, of the rain or surface waters until arrested by the clayey and impermeable soil beneath, and the running of these percolated waters down the inclined surface of the clay, had excavated out for themselves a net-work of tiny tunnels or galleries which in course of time undermine the whole under surface of the sandy superincumbent mass, prepared for the phenomenon a so to say lubricated bed of quicksand and water along which the land gravitated to its destruction.

69.—The recent (1903) Land Slide at Frank B.C.Canada

M.M. Editors of the " Canadian Engineer ",

Having seen or been witness to the contemporaneous land slides at Quebec in 1841, of some 300 ft. of the cliff opposite what has since been erected into Dufferin terrace, when over forty lives were lost — one at St. Valier's near St. Michel of 20 years ago—the second Quebec land slide at foot of Citadel in 1889 when 83,000 tons of rock fell over, reaching and demolishing a dozen houses on the river side of Champlain street with the casualty of 53 lives—the land slide at Ste Anne La Pérade extending some 2000 ft. along the river of that name, 500 ft. in depth

or breadth and an average of from 20 to 60 (40) in thickness (nearly one and a half million cubic yards) — the land slide or wash out at Chicoutimi of half a million tons of earth ; and being at present engaged as consulting engineer on law suits arising out of recent land slides at Ste Anne de Beaupré below Quebec ; I had much satisfaction in reading in your last issue your correspondent's description of the land slide at Frank or from the so called Turtle Mountain.

It will of course have struck you M.M. Editors, and your readers, that if, as stated, the debris reached away so far from the mountain, or to a horizontal distance equal to several times the height of the mountain, and even up the incline on the opposite side of the valley ; this could not occur through the natural tendency of the rock to be propelled so far ; and hence, it must be conceded that some explosive and therefore repulsive force was exerted from behind the mass to thus thrust it almost as far as if it had fallen down the slope of a hill. This fact of approximately, at least, how far the rock fell forward, or to what horizontal distance it was projected or rolled over, can and must be estimated to prove whether or not, the force acting in rear of the mass, was anything more than to just move it forward or beyond the vertical.

The Quebec land or rock slide of 1889 was brought about—as explained by the writer in a memoir on the subject read before the Society of Civil Engineers of Canada and published with diagrams in the Society's " Transactions " — by percolation, for years then past, of water from the Citadel ditches above, into and between the strata of the cliff. This water on freezing in winter and expanding, thrust apart the almost vertical strata (or which from their former horizontal position had been tilted up by seismic action, so that they actually leaned backwards ; when in course of years or may be centuries, the foliations or separate layers opened out at top until the portion of the rock that fell over projected, before the thing occurred, not less than 6 ft. beyond the vertical, or overhang the ground beneath by that number of feet.

The shove which the fallen cliff experienced on the night, or at the moment it fell, was but one of six inches or less, due to hydrostalic pressure by the water in a crevasse at a distance

of some 80 ft. from the portion which was, by that in rear of it pushed forward ; and the debris from a height of cliff of say 100 ft. were only projected, and that, down hill or to the level of the wharves, some 40 ft. below, to a horizontal distance of not over 150 ft.

Therefore again I say that if the so-called rough sketch you give of the general features of the occurrence, be reliable, some additional force or of an explosive nature, as conjectured, must have been at hand to thrust the debris to the distance shown in the engraving.

If at any time MM. Editors, more precise data are afforded of how the cliff behaved, a vertical cross section for instance of the slide or fall or avalanch, to scale and showing thickness of deposit along the route, be forth coming ; I hope dear sirs you will reproduce the same in your ever increasingly interesting and instructive journal—for as says my paper on "The Instructiveness of failure" nothing in view of explaining future happenings of the kind, and if possible of guarding against them, can be so pertinent as when the exact cause of failure is made known ; and only by failure are we really made wise, for if a structure holds its own, it only teaches that it is strong enough to do so, while its weekest part may be many times stronger and more costly than it need be.

N. B. —Pending further information in the premises -- there being a coal mine under exploitation near of even under the foot of the mountain, an explosion may have been brought about by "fire-damp" from the coal measures penetrating the lime stone strata of which the mountain is said to be composed, accumulating in pockets, and the ignition thereof through some accidental cause ; or the burning fire damp or other gases from the mine may have reduced the carbonate to quick lime, and the subsequent penetration of water hydrating and swelling the lime may have burst out the fallen rock with such an effort as to project the debris to the distance recorded.

C. BAILLARGÉ, C. E.

70 — The Freaks of Lightning.

The Editor, the Scientific American,

Dear sir,

Anent the article in your issue of May 30, under the heading "A man who was struck by lightning (his clothes torn into shreds) and lives" I would say that some 50 and odd years ago I was a personal witness to the fact that one Polette of St. Michel de Bellechasse P. Q., and then about 80 years old, while in kneeling altitude in the little chapel Ste. Anne about a quarter of a mile Eastward of the parish church, was struck by lightning, with the effect that while he was only dazed for a while by the stroke, his clothes were torn asunder all along his back bone from neck to base of trunk where the lightning bifurcated and thence following along each of his legs, finally escaped through the heels of his boots.

This tendency to bifurcation of the current, from trunk to limbs, when as in the human system, the nerves of the legs exert an equal pull upon the central column, is further illustrated by the fact that at Peoria Ill. now many years ago and as vouched for by the late F. D. Tims an ex-president of the Quebec Geographical Society : an individual, struck by lightning, and who, was otherwise uninjured except by being for a moment dazed as in the case of old Polette, found that the electric fluid had after traversing his nervous system from head to foot or rather feet, had finally passed out through the soles of his boots again as in the Polette case ; the fact evidenced by two tiny holes, one in each sole through which the fluid had tunneled for itself an exit.

Some 20 years ago the apex of the roof of a house in the same village was struck by lightning which trifurcated or divided into three branches or currents : the one descending West along the roof sloping towards that side, the second North and the third South respectively, tearing away the shingles on their way to and following down the central iron bolts or fastenings of as many windows situated one on each of the three sides of the house, tearing away the fastenings and portions of the woodwork of each window in their respective trajectories towards the earth, and projecting them to a distance from the house of some 30 to 60 ft.

At St. Michel again, near Beaumont I was witness to the fact that, as I passed by, during a thunder storm, a man trending towards his home in an adjoining field, was struck dead by a flash of the electric fluid from the clouds, and remained suddenly motionless, erect, and in the same attitude as when overtaken by the death dealing shaft of fire.

But the strangest and most beautiful display of lightning or atmospheric electric currents, which it was my good fortune to witness, it being the only time in my life I ever witnessed anything of the kind, was out on the Beauport flats near Quebec when as I then wrote Flammarion of the "Société d'Astronomie de France' two electrically laden clouds, as though two trees lying horizontally, their heads towards each other, with their longer branches interwoven ; kept on for fully more than 10 minutes, interchanging horizontal flashes of beautifully coloured fire, not one of which ever reached the earth ; while occasionally a flash would shoot upwards as if towards some cloud in that direction, but which I could not see any sign of.

You would have given atmost anything Mr. Editor, to have been witness to this, of all the displays witnessed during my life, the most enchanting.

C. BAILLARGÉ.

71.—Synoptical review of a busy career.

(*a*) The writer of this memoir, while studying Architecture with the late T. Baillargé, after a course of education at the Quebec Seminary — was once handed in through the window wicket, and that accompanied by a protective smile, by one Delorbaez, the munificent sum of 75 cents for a complete set of plans, sections, elevations, specifications and estimated cost of a dwelling house.

(*b*) He since planned and superintended the construction of —1o. The Laval University buildings about 1854 — 2o. The Beauport Church under curé Bernard, since burned down and rebuilt under Mr. Berlinguet—3o. The St. Jean Baptiste Church, since destroyed by fire in 1882 and rebuilt by a former pupil of

his, Mr. Peachy — 4o. The Church of the Monastery of the Bon Pasteur — 5o. The Asylum and Church of the Sisters of Charity — 6o. The Academy of Music — 7o. The new wing of the Ursulines couvent, to prevent the extension of Ursulines St. through to Donacona street, under the Rd. Chaplin Lemoine — 8o. The Desbarrats (Queens printer) block, since, the Clarendon Hotel — 9o. The Churches at River du Loup, — L'Isle Verte, — St. Romuald — Ste. Marguerite — that at Ste Marie, Beauce, one of the finest gothic interiors ot Canada — and again others including the interior of the parish church at St. Laurent I. O. — etc. etc. — 10o. Numerous presbyteries, city residences and country villas — 11o. The then new Jail Quebec about 1860 — 12o. Was for two years superintending architect over the Govt. Departmental Bdgs. Ottawa — 13o. Laid out and erected numerous monuments for the St. Charles and Belmont cemeteries.

(*c*) In 1848, a sworn surveyor of lands. Surveyed Grosse-Isle, Govt. quarantine station, etc. ; Surveyor to Quebec turnpike commission, and Hydrographical Engineer for several years to the Quebec Board of Harbor Commissioners ; President, and for many years member of the Board of examiners of Land surveyors ; arbitrator or expert on numerous cases on the St. Charles branch of Interc. Rly., and in fact at different times all over city and surrounding parishes ; etc, etc.

(*d*) In 1866 became City Engineer and held that position for 33 years or up to 1898, during which time he erected many fire and police stations, market halls, civic hospital and quarantine bdgs., etc., etc. — laid out the new Victoria Parent Park, planned and superintended erection of the park hot houses or conservatories.

(*e*) As Civil Engineer, superintended construction, on part of Corporation of Quebec, of the Quebec and lake St. John Railway, Quebec and Montreal Rly. Piles Rly., the city being a contributor to the cost thereof. Designed and carried out aqueducts at several places. Consulted and reports on aqueducts at Sherbrooke, Malbaie, St. Thomas, Levis, Chicoutimi, etc, etc.

(*f*) In 1883 planned and superintended construction of the new 30″ aqueduct from Lorette (9 miles) to Quebec — with iron

and steel tubular bridge, therefor, over river Des Mères, and of the arched tubular bridge over the St. Charles near Scott's bridge.

(*g*) Planned and suptd. constr. of the two steel swing bridges over the St. Charles from City to Victoria park.

(*h*) Was for several years professor of architectural and engineering design, and technology at the Provincial school of Arts, Quebec.

72.—A shabby trick on part of the Corporation of Quebec.

From 1870 to 1874 — $500.00 a year ($2000.00) off City Engineer's salary and proportionally of salary of other Corp. employees to help cover the deficit of $64,000 of an ex-city treasurer. Mayor Chambers was at the time advised by Corp. Legal advisers that the thing was illegal, but they were weak enough to add that the difficulty could be got over by saying to each employee " that or the door ".

I defy the ransacking of the records of any civilized community for such another act of spoliation ; but the then finance committee had thus to be held scathless by pretending to cover the deficit, and unblamable by the tax-payers for their want of vigilance in the premises.

73. — The City Engnr's salary from 1866 to 1898 (33 years) was $2000.00 for doing every thing — acting as secretary, and accountant of the Dept. of Works—doing all surveying, architectural and engineering work without assistance, while City Engrs. of Montreal and Toronto were getting from $5000.00 to $6000.00 a year and each of them two to three assistants at $2,500.00 to $3,500 respectively.

The size and population of the City is sometimes invoked as an argument ; but it must be remembered that a specification, an estimate, a report as to a limited extent of paving, drainage, etc, entails the same labor for 100 or 1000 ft. lineal as for 10,000 or 100,000 ft. in a larger city.

While the City Engr's time, by law and agreement was 9 A.M. to 4 P.M. or 7 hours ; his actual time from 1866 to 1881 figured up to 11½ hours per diem, and from 1888 when the new aqueduct was put in, his time on corporation work was 14 hours per diem—exclusive of meals.

His whole time since a boy at school has been 18 hours—thus still leaving him a few hours for his literary and scientific labors with sundays and holidays to boot ; sleep average 6 hours all his life.

His overtime therefore on Corp. work and at the low fig. of his salary, amounted during the 33 years to $54,800.00 of which of course he never got a cent ; but instead of that, as above stated, was robbed of $2000.00 from 1870 to 1874 to help make up another man's deficit.

However as the Scriptures say " Blessed are they who expect " little, for they shall not be disappointed. "

" Gagner sa vie à la sueur de son front. "

74.— Another shabby Corp. transaction.

St. Sauveur was annexed to the City in 1889—the City Engr. preparing the way with a $500.00 claim, for extra or night work in estimating cost of W. W. and drge, macadamizing, side walks, crossings, gully wells, etc. for the additional 20 miles of street extension, the City proper street mileage being 36 : a budget of probable expenditure of nearly half a million dollars.

Not a cent of this did the City Engr. ever lay his eyes on.

Worse than that, a report of a special committee of 1895 to increase his salary by $500.00 due to this annexation of St. Sauveur, was subscribed to by Ex Mayor Fremont, and Alderman Bassière president of the Road etc. ; but because Ald. Hearn took the report home to sign it and died with it in his pigeon holes, those 10 years planning and superintending of works of paving, macadamizing, kerbing, side-walks, water channels, gully wells, crossings ; of St. Sauveur police and fire stations, electric lighting etc, etc., have never been paid for, and there again is another

sum of $5000.00 lost to the City Engr. or of which it would be more proper to say that he has been robbed by the City, since, the report in favor of granting him an increase of $500.00 a year since the annexation of St. S. was signed by a majority of 2, and the third person composing the special committee had promised to follow suit.

A nice civic record indeed ! ! !

SUNDRY.

75 —In an oct. vol. called "*Divers ou Les Enseignements de la vie*" of over 600 pages published in 1898 and covering more than one thousand different subjects, and to which the author of this digest begs to refer for many interesting and instructive items of information, he would call attention to his articles on *communism* or *socialism* and the practical solution of the problem reduced by him to approximately reliable figures.

(*a*) Questions of "*boodling*" and *corruptive* are also therein treated at length. In a word the book has been pronounced by competent judges, an absolute code of proper conduct and good morals, with many subjects of a technical and scientific nature interspersed with anecdotes suggestive of the peculiarities, idiosyncracies, and greed of our human nature.

(*b*) On another occasion I have indited a 40 pages pamphlet on "*Technical Education in Untechnical Language*" (*c*) another on the use of *Greek* and *Latin* in our Modern code of education (*d*) one on "*Evolution and Materialism*", another on a trip to the Island of *Anticosti*—another again on "*Educational word lessons*, with (*g*) *a mode, the easiest and shortest of learning to speak a foreign language* —and a host of other subjects for which see my "*Bibliography* as published a few years ago in a volume of the yearly bulletin of the Royal Society of Canada, and since considerably added to.

(*h*) My *Dictionnaire d' Homonymes*, a work of say 600 pp. Oct., found a ready sale in Europe and M. Flamant member of the "Institut" whom I have as yet never seen, wrote me from Paris,

avenue de Villiers, 76, 10 Oct. 1893 : " pour moi c'est toujours " un moment agréable que celui où j'ouvre votre si original " Dictionnaire d'homonymes qui ne me quitte plus. Il y a là une " somme de travail si considérable et des idées si nombreuses, si " nouvelles que je ne me lasse pas de le parcourir. "

(*j*) I am now engaged on what is tome, a labor of love, to wit : the " *Origin, Signification, Translation, Classification and Etimology* " *of Proper Names.* "

EPILOGUE

The Exaggerated Advantages of Education

76. The *disadvantages* or I would rather have it : *the exaggerated advantages of education*, with a list of many men who, while non educated, have made their mark in the World's record.

Goethe once said, "The greater the knowledge, the greater the doubt," and Hazlitt, "The most learned are often the most narrow-minded men." These sayings are quoted in a striking article in "*The Nineteenth Century*" magazine for (February 1903), in which we are reminded that education has its disadvantages, as well as its advantages, and that " the most prominent men in nearly every province of human activity have been amateurs." The writer, Mr. O. Eltzbacher, declares :

" Amateurs, and not professionnals, are selected to rule our great public departments. Our great administrators have nearly all been amateurs and autodidacts. To take a few of the best known examples : Cromwell was a farmer, Warren Hastings and Clive were clerks, Mr. Chamberlain was brought up for trade, Lord Goschen for commerce, and Lord Cromer for the army. Other countries have had the same experience with self-taught amateurs. Prince Bismark was brought up for law, failed twice to pass his examinations, became a country squire, and drifted without any training into the Prussian diplomatic service and the cabinet, and founded the German empire. George Washington was a surveyor, Benjamin Franklin a printer, Abraham Lincoln a lumberman, M. de Witte a railway official.

" In a less exalted sphere we meet with the same phenomenon. Sir William Herschell was a musician, Faraday a bookbinder, Scott a lawyer's clerk, Murat a student of theology, Ney a notary's clerk. Arkwright, the inventor of the spinning-machine and the first cotton manufacturer, a barber ; Spinoza a glass-blower, Adam Smith a clergyman, Lord Armstrong an attorney, Herbert Spencer an engineer, Pasteur, the father of modern medicine and chirurgy, a chemist ; Edison a news-vendor ; George Stephenson and most of the great inventors and creators of industry of his time were ordinary workingmen.

" When we look round we find not only that many leaders of men were devoid of a highly specialized training in that particular branch of human activity in which they excel, that they were self-taught amateurs ; but that many of the ablest politicians and of the most successful business men have not even had the advantage of a fair general education. Abraham Lincoln had learned at school only the three R's. and those very incompletely ; President Garfield worked with a boatman when only ten years old ; President Jackson was a saddler and never spelled correctly ; President Benjamin Harrison started life as a farmer, and President Andrew Johnson, former tailor, visited no school, and learned reading only from his wife. George Peabody started work when only eleven years old ; the late Sir Edward Harland was apprenticed at the age of fifteen years ; Andrew Carnegie began his commercial career when twelve years old as a factory hand ; Charles Schwab, president of the United States Steel Corporation, drove a coach as a boy, and then became a stake-driver at an iron-works. Josiah Wedgewood started work when only eleven years old ; Arkwright, the father of our cotton industry, was never at school ; Edison was engaged in selling papers when twelve years of age, and Sir Hiram Maxim was with a carriage-builder when he was fourteen. 'Commodore' Cornelius Vanderbilt, the railway king, who left more than a hundred million dollars, started as a ferryman at a tender age ; the founder of the wealth of the Astors was a butcher's boy, Baron Amsel Mayer von Rothschild a pedler. Alfred Krupp a smith, Rockfeller, the head of the Standard Oil trust, a clerk All these most successful men were autodidacts. "

In view of these numerous well-known instances of greatness achieved by men uneducated, is it to be wondered at if "even the learned begin to waver and te ask themselves whether the much-vaunted benefits of learning have not been largely over-estimated?" We quote further :

"It has been truly said "Knowledge is power." but knowledge in itself is not power, only *applied* knowledge is power. Knowledge is like money, not valuable in itself, but only valuable for what it will buy. Knowledge is like a strong weapon, but the best weapon is useless to a man who does not know how to wield it. Knowledge is an elementary power, but the power of the Niagara, or of steam, or of electricity, would be useless to mankind unless intelligence directs that power to some practical purpose. The Chinese knew magnetic iron long before the Europeans knew it. To them it was a piece of iron and nothing more. Handled by European intelligence, magnetic iron became a useful power in the compass, which gave Europe the rule of the seas. The Chinese knew also gunpowder before the Europeans knew it, but to them it was only a plaything used in fireworks. A man who has read endless treatises on boxing, and who has studied the fights of all great boxers, gets knocked out while he is reflecting how Jackson or Fitzimmons would have behaved. The officer whose mind is soaked in military literature, and who can tell why Napoleon won the battle of Austerlitz and why Frederick the Great lost the battle of Hochkirch, has lost in nine cases out of ten his common sense, the buoyancy, resourcefulness, and impartiality of mind with which a less erudite officer would tackle a difficult question."

New ideas, continues Mr. Eltzbacher, are hardly ever welcomed in schools. On the contrary, "schools have ever proved reactionary and inimical to new ideas"

"Great minds have ever been persecuted owing to the narrow-mindedness and the jealousy of the schools from Socrates onward. Galileo, Columbus, and many other great discoverers were imprisoned and treated like criminals with the approval, and largely at the instigation, of schools of science because their discoveries threatened the tenets of accepted learning. Even the heavy artillery of theology has been advanced by the universities of the Middle Ages, and also of later days, against geological and

astronomical discoveries. Newton and Darwin were laughed at by the faculties, and in Roman Catholic universities Darwin is still ostracized, according to report. Kant became a professor only when he was forty-six years old, after fifteen years' lecturing ; Schopenhauer never became a professor owing to the jealousy of the universities. Liebig and Pasteur were jeered at by the profession, vaccination and homeapathy had to fight for decades against the envy of the medical schools. David Strauss and Renan were compelled to leave their universities ; Beethoven and Wagner were persecuted by the schools of music, and were treated like madmen because they did not conform with musical traditions. Millet was neglected by the Salon in Paris, and Whistler snubbed by the Royal Academy in London. The inventions of Edison, Marconi, Roentgen, Koch, could not be explained away by modern science schools, but their discoveries have been greeted by the universities with personal attacks full of animosity, and these men have been pictured as the commercially successful exploiters of other people's ideas. A late correspondance in *The Times* with regard to discoveries of Mr. Marconi is typical in that respect. "

The writer comes to the conclusion that in order to improve education, it " may have to be individualized. " That is to say, " the present uniformity of the schools may have to give way to schools catering directly for the practical needs of the various classes of the population. " " Let us hope, " he adds, that the spirit of combination which seems to be growing, tho somewhat slowly, within the community, will in due course dot the whole country with technical schools founded and supervised by the various industries themselves, and planted under the very eye of these industries in their business center.