COUVREUX'S EXCAVATOR WITH PIVOTING BUCKET FRAME.

Ever since the epoch at which Mr. A. Couvreux constructed his first type of excavator, which rendered so great services in excavating the Suez Canal, the use of the apparatus has been extending, and, at the present time, any work must be of small importance that does not employ it. Mr. Couvreux, who has made use of it in all his undertakings on public works, has successively introduced numerous improvements into it which we have already described.

For making large cuttings the most advantageous excavator is the one that is capable of moving over a roadway parallel with the axis thereof, and it is by means of successive diggings that the trench is enlarged to the desired dimensions. In this case the chute is on the side opposite to the chain and buckets, the car track is parallel with that of the excavator, and the loading is effected by causing all the cars to pass in succession under the spout.

This mode of operating is extremely simple, and is known to all those who have had occasion to see an excavator work. In works of less importance, such as ditching on single rail railways, a heading is made in which an advance is made right straight ahead. As the type of excavator under consideration is not adapted for working according to this method, Mr. Couvreux has studied out a new apparatus, which appears to us to be fitted to satisfy all the needs of practice.

We must, in the first place, observe that on account of the mode of working it is more difficult to remove the excavated material where the excavator is moving forward in a trench than where it is working laterally; so it becomes necessary to study out arrangements for cheaply maneuvering the cars designed to receive the excavated material. Moreover, as this new engine was to be applicable to works of small importance, it became necessary to make it of small dimensions and of great simplicity, in order that it should be light and cheap.

In principle the bucket chain of this excavator attacks the ground, not by a forward motion of the whole, but by means of a revolution around a pivot. The forward motion occurs only at the moment when the apparatus is moved in advance over the excavated portion.

It is not without interest to remark that the similar apparatus that have already been built are got up after the type of steam cranes, where engine, boiler, and jib revolve upon a frame mounted upon rails; while the new pivoting excavator has a stationary engine and boiler that actuate a bucket chain which alone moves around a rotary axis. The excavated material falls into a chute of sufficient width to receive the earth, whatever be the angle at which the work is being done, and to carry it to the rear where the cars are to be loaded with it. Upon referring to the accompanying engravings our readers will readily understand the construction of this apparatus, the detailed study of which was made by Mr. C. Bourdon according to directions from Mr. Couvreux. As may be seen, the entire affair is fixed upon an iron frame supported by two strong axles, with the interposition of suspension springs behind only. Upon this frame there rests a large cast iron plate which receives in its center a very strong vertical boiler that serves as a frame and pivot for a great portion of the mechanism. The cylindrical shell of this generator is elevated above the smoke box, in order to receive a boiler iron disk that forms a seat for the pillow blocks of the engine and the pivot of the revolving portion.

The motor consists of two single cylinder vertical engines, fixed here and there to the boiler. They are reversible, but the eccentrics are keyed in such a way as to revolve in contrary directions. At one of the extremities of each driving shaft there is a bevel pinion that gears with a wheel which is keyed upon a vertical shaft that actuates the bucket chain.

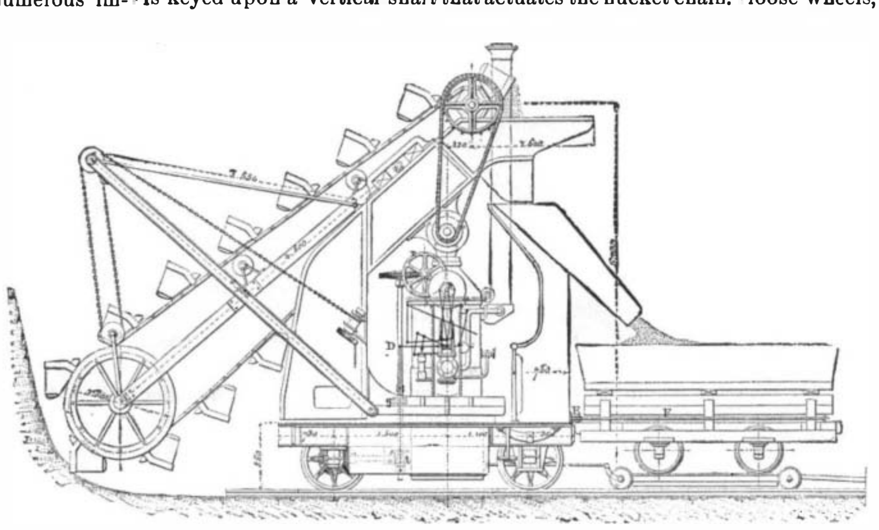

Fig. 1.—ELEVATION.—EXCAVATOR WORKING IN A TRENCH.

As a consequence of this arrangement the two engines are coupled; and, moreover, as the cranks make an angle of 90° with each other, there is no dead center.

This arrangement has been adopted with the object of simplifying the control of the various motions. As a single motor has, in fact, to actuate all the parts, it will be seen that it was necessary, during a revolution always in the same direction, to be able to turn the mechanism that actuates the upper part either to the right or left. Now as the two engines revolve in opposite directions, it is only necessary to throw the turning mechanism into gear with one or the other of the crank shafts, according to the direction in which the bucket chain is to be pivoted.

The various motions are obtained by means of a very simple mechanism that presents some analogy with the system adopted for controlling radial drills. Upon an inspection of Fig. 3 it will be seen that the vertical shaft, A, rests at its lower part upon a step bearing between the two driving pinions, and that it carries at its other extremity the pinion, B, of a wheel, C, that is keyed to a horizontal shaft. This intermediate axle is supported by a cast iron piece mounted on a second step and connected with the bucket frame. It always remains parallel with the bucket chain wheel, and actuates the latter by means of two pinions, over which runs a pitch chain that passes over two corresponding wheels on the chain wheel axle. Owing to this mechanism the bucket chain, no matter what the angle be, is capable of receiving the action of the motor.

This chain is constructed in the ordinary way, and is provided with different kinds of buckets, according to the kind of work to be done. The bucket frame, which is provided with rollers and kept at the proper height by a jib and windlass, carries a chain wheel at its extremity. It passes into a boiler plate frame, which is supported above by the step bearing that we have mentioned, and below by horizontal rollers, and which rests, through the intermedium of rollers with vertical axes, against a strong circular projection cast in a piece with the bed plate.

The vertical rollers are fixed in a casting in which there is a crown wheel that serves to move the apparatus right and left. This motion comes from the engine through the intermedium of two straight pinions, *p*, which gear with the loose wheels, *r*, of an intermediate axle. These pinions and the transmitting shaft are rendered interdependent by means of coupling boxes. Consequently, this shaft revolves to the right or left, according to the pinion which actuates it. Moreover, this shaft is provided at the center with an endless screw, which, through a helicoidal wheel, revolves the vertical shaft, D. This latter carries a pinion, *g*, which drives the large crown wheel above mentioned. Finally, it is through the elongation of this axle that the mechanism, *t*, which gives the forward motion is actuated. Both the motions that we have mentioned are started or stopped by means of a lever within reach of the engineman.

At the moment of their passage over the upper tumbler the buckets empty their contents into a hopper, whence they run into a chute placed over the roof of the engineman's cab. This chute is sufficiently wide to receive the earth when the apparatus, with its hopper, is pivoting around its axis, provided, however, that the angle formed on each side of the longitudinal axis does not exceed 60°. All the excavated products are thus brought to a single point, whence they fall into the ears.

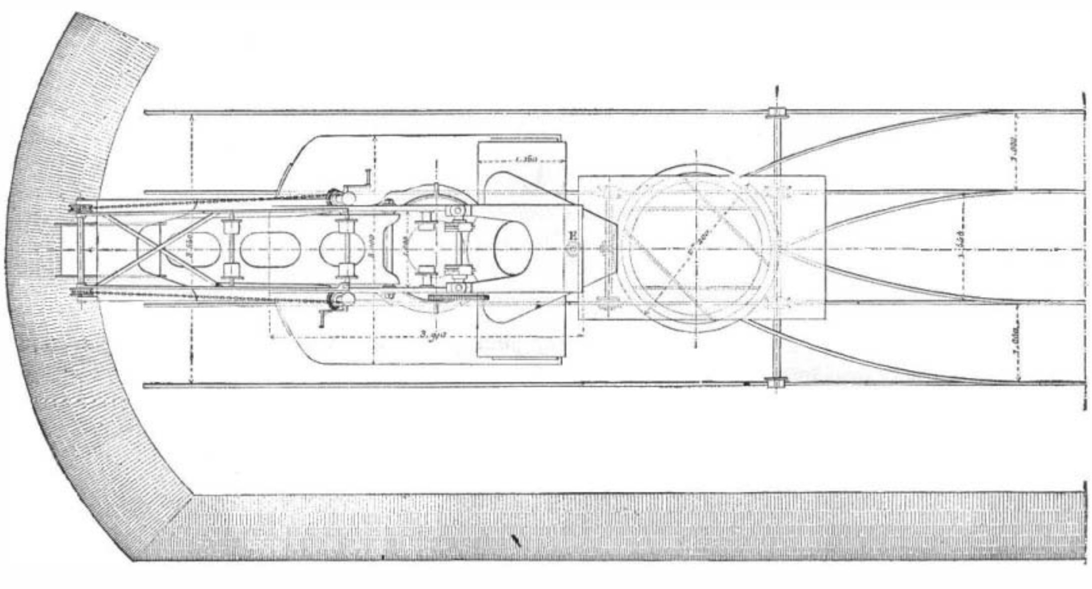

Fig. 2.—PLAN.

In our engravings we give two applications of this apparatus—one of them relating to trench cutting and the other to lateral excavation or widening; the cars, in the latter case, being upon a track parallel with that of the excavator. Fig. 4 shows, on a larger scale, the motion of the bucket on the upper tumbler, which actuates the endless chain through six flat surfaces, three of which are provided with teeth. The chain consists of a series of four elements each, these latter being made up of a male link which carries the bucket and three female ones. It is with the middle one of these two latter that the teeth of the tumbler engage. Finally, upon the second element of each series is fixed the movable bottom of the bucket. While the apparatus is in operation, the movable bottom remains fixed against the bucket at the points where the chain is taut, but, at the moment the bucket is passing over the surfaces of the tumbler, the two forward links of each series form an angle with each other that brings about the opening of the bucket and allows the material that it contains to drop into the hopper.

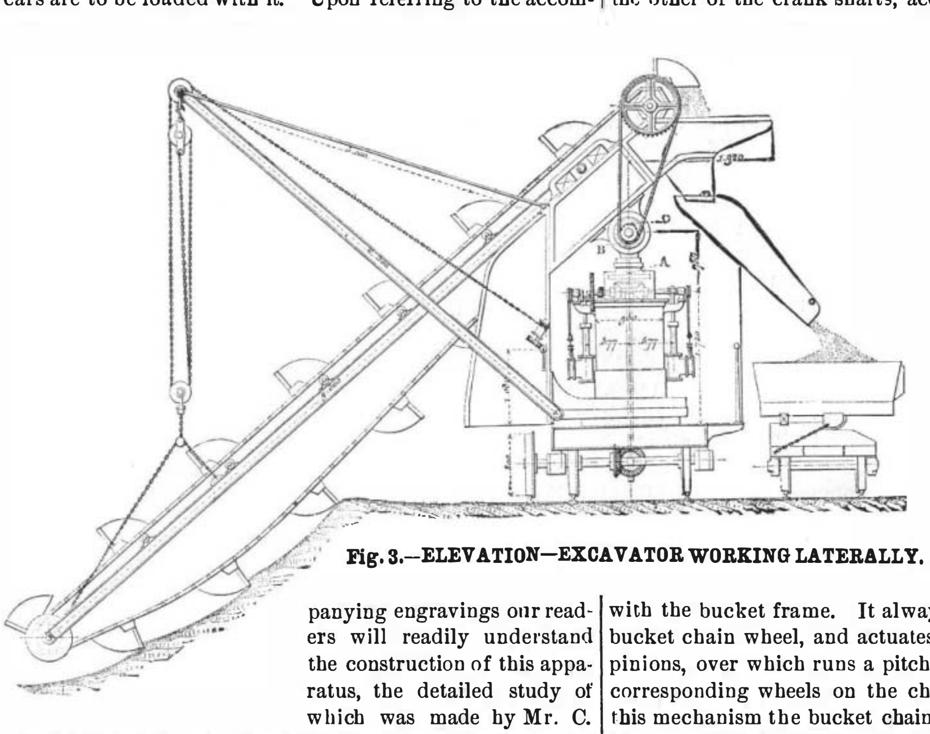

Fig. 3.—ELEVATION—EXCAVATOR WORKING LATERALLY.

Loading the Cars.—When a pivoting excavator is employed in cases of trench cutting where the material has to be emptied to the rear, it is very difficult to dispose of the material. The majority of the methods that have been employed up to the present for substituting empty cars for full ones cause great loss of time, and necessitate long maneuvers that result from the complication of the tracks.

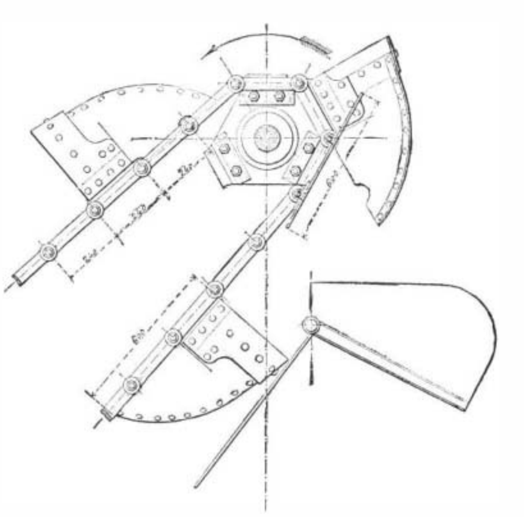

Fig. 4.—DETAILS OF UPPER TUMBLER AND BUCKET CHAIN.

In order to render his work complete, Mr. Couvreux has devised an accessory which, it seems to us, is called upon to render genuine services. In principle the carriage ought to be performed upon two parallel tracks, one of them for the empty and the other for the full cars. During the operation of loading, the engine that has hauled the empty train runs to a switch at a sufficient distance away to allow it to run on the other track and place itself at the head of the loaded train. As for the excavator, it must evidently advance in the axis of the trench. The width of the track upon which it runs may, at a minimum, be 1·44 m., while cars are frequently found that require a 1 meter track.

In order, then, to satisfy the two conditions of the problem without involving considerable expense in laying the tracks, the ingenious idea has struck Mr. Couvreux to utilize the center track for the excavator and to thus empty the material in the axis of the trench. It now becomes a question as to how the loaded cars shall pass. This is effected as follows: At the rear of the excavator there is a stiff bar, which is connected with a turn table carried by wheels that run on the car tracks. The top of this table is about 0·15 m. above the rails, and these two levels are connected by means of inclined planes that converge toward the center of the table. The maneuver is easily understood: An empty car is shoved up on to table, and when it is full is pushed down on to the other track, and so on, care being taken at each change of cars to close the chute so that the operation of the bucket chain need not be interrupted. It is proper to remark that in causing the car to pivot upon the table it is made to present its two extremities in succession under the spout, thus permitting of its being loaded uniformly. The stress necessary to push the empty car on to the table may be perceptibly reduced by a very simple means. To the rear of the excavator there is fixed a pulley, E (Fig. 1), over which passes a cord, F, that is attached at one of its extremities to the empty car, and at the other to the full one. Upon descending the inclined plane the full car hauls up the other, and the stress that it has to undergo moderates its speed.

In the apparatus that we have here described, the diameter of the cylinder is 0·12 m.; stroke of piston, 0·2 m.; number of revolutions, 150; register of boiler, 150 kilos.; heating surface, 7·6 square meters; capacity of water tank, 1 cubic meter; number of buckets, 15; capacity of buckets, 50 liters.—*Revue Industrielle.*

Experience with a Water Tank of Tinned Copper.

BY THEODORE DEECKE, SPECIAL PATHOLOGIST, NEW YORK STATE LUNATIC ASYLUM.

On the first of July, 1875, a water tank seventeen feet in length and eight feet in width, holding about five thousand gallons of water, was completed and taken into use in the New York State Lunatic Asylum, at Utica, N. Y. In August, the same year, its use had to be discontinued on account of leakage, and on examination it was found that at a number of places the tin lining in more or less large flakes was peeling off. The copper was not affected, and the leaks were discovered only where the plates had been soldered. Upon consultation with the writer, and from experiments made with the plates used, it was concluded that the trouble was due to a defective tinning. On direction of the Superintendent, Dr. John P. Gray, a number of samples of tinned copper were procured and subjected to suitable tests, and one selected of which a new tank was built. This stood well, and was in permanent use until May, 1884, when, in cleaning and brushing out the tank, it was found that the copper plates at the bottom were covered with small circular or oblong perforations. On closer inspection peculiar tracings in the metal were discovered in connection with these perforations, irregularly radiating in all directions from a center commonly formed by the hole. They presented an appearance as if they were excavated by a graving tool. The holes and furrows were filled out with an earthy and, when dry, quite hard material, consisting mostly of carbonate of copper. The weight of the copper was twenty ounces to the square foot; the amount of tin used could not be exactly ascertained.

The water in the tank had been in constant motion and replacement. It contained in the average, according to a number of analyses made by the writer, of inorganic salts: 16·9 grains of carbonate of lime, and 0·20 alumina, silica, etc., and 0 72 of nitrate of potassa per imperial gallon, and only traces of organic matter. Besides, rain water flowed into the tank whenever it rained.

The question arose, what produced the corrosion of the copper? Similar tanks had been in use for over twenty years without having shown evidences of similar injury.

On an inquiry by Mr. Joseph Graham, the chief engineer of the institution, at the editorial department of the SCIENTIFIC AMERICAN, accompanied by a sample of the corroded plates, the following answer was received: "Galvanic action is brought about by the influence of the water on the copper treated by the tinning process, and it would be only a question of time when the entire mass of metal would be eaten away. Munn & Co."

The writer had entertained originally the same view, yet for the following reasons regarded the explanation as unsatisfactory. First, the water constituting a slightly alkaline liquid, from the amount of carbonate of lime in it, certainly did not favor the production of galvanic action between the two metals. Secondly, the effect of the galvanic action can be but proportionate to the quantity of the metals present, and it cannot be seen why and how the comparatively small amount of tin should have led to the comparatively large consumption of copper. Besides, the corrosion of the latter is not uniformly spread over the whole surface, but confined to certain spots. Thirdly, experience had shown, for a time covering some twenty years, that the corrosion of the metal was neither of constant nor of necessary occurrence, which it would be if it was due to galvanic action.

The phenomenon, therefore invited further investigations.

Upon microscopic examination of the earthy material which filled out the furrows I found the following:

When a small piece of this substance, still moist, was placed in the center of a drop of water on a so-called life slide provided with a circular air space, and covered with a cover glass, the clear water surrounding the opaque mass was filled out in a short time with a protozoon belonging to the class of prot-amœbæ. It was not difficult to see them, in all possible shapes and sizes, creep out from the dark mass and wander slowly toward the margin of the drop bordering the air space, and the more numerous they were the more the air contained in the water was consumed.

This is a very convenient method, to which I have often resorted, of bringing micro organisms, which live in hiding places, into view. It is air that they, like all living beings, need for their existence, and the scarcer this becomes in the isolated drop of water the more they approach from the center of the drop to its margin, which remains in contact with the air. The prot-amœbæ here observed differ from the ordinary species not so much in the peculiar shapes they assume as in the dark color of their contents, or rather in the presence of a dark, finely divided substance embedded in the otherwise transparent and colorless gelatinous little mass. By the action of diluted hydrochloric acid, under the development of a gaseous product (carbonic acid), the dark contents are dissolved into a colorless fluid, while the bodies of the prot-amœbæ mostly assume more or less spherical forms, resembling drops of oil.

Considering the great numbers in which these micro-organisms are present, their peculiar mode of life by adhering to, and of locomotion by slowly creeping over a surface, their feeding by the simple extension of their sarcode body over any material on their way, a process very likely associated with some secretory function, it seems quite probable that they exert an observable influence wherever they happen to locate. This influence is probably of a mechanical as well as of a chemical nature. When the material which fills out the furrows is removed, the perfectly pure metallic surface of the copper is brought to view, as if acted upon by the use of an acid. Thus, at first, as it seems, the copper is dissolved in minute quantities, which afterward, by the interchange of the acid with the carbonic acid of the lime salt contained in the water, form a soluble organic lime compound and carbonate of copper, the latter of which is deposited in the furrows. That a portion of this as a comparatively indifferent material is taken up by the prot-amœbæ is not surprising. They certainly do not feed on the copper. Its presence is merely accidental, and the whole phenomena, as I believe, should be looked upon from this point of view.

The species, even if brought into existence only by this peculiar combination of circumstances, may be regarded as distinct, since it has developed peculiar qualities and a mode of life of its own. The origin of the protozoon is easily explained, and must be sought in the rain water which occasionally flows into the tank, carrying down from the roof of the buildings microscopic forms of life, of which, in most places on the top of all buildings, innumerable species can be observed, and among which the prot-amœbæ are of quite common occurrence.

It is not improbable that, in perhaps many other instances, where simple experiences hitherto have been ascribed to either galvanic action or the combined and successive action of air and water, processes associated with micro-organic life are of greater importance than is known at the present time. The phenomena unquestionably invite to further researches in that direction.

Utica, June, 1884.

The Finland Polar Expedition.

M. Lemstrom has published the chief results of the Finland Polar expedition of 1883–84. The scientific observations were made at Sodankyla (latitude 67 deg. 24·6 min. north; longitude 27 deg. 17·3 min. east of Greenwich) and at Kultala (latitude 68 deg. 29 5 min. north; longitude 26 deg. 39·4 min. east). The earth currents were studied from September, 1882, to September, 1883, at the same time as the magnetic variations. Two conductors of copper wire, running from north to south and east to west for about 5 kilometers, terminated in platinum plates buried to a depth of 1·3 meters. The wires were insulated on telegraph poles, and a sensitive galvanometer was interposed in the circuit of each. Wires of iron were also used with plates about 2·5 kilometers apart.

At Kultala the earth plates were plunged in the river Fralo and its tributaries. With a Mascart electrometer giving 18 divisions for a volt, and with the galvanometer, the perturbing forces due to the polarization could be eliminated. From the fact that the variations of current in the east and west wires were very slight, M. Lemstrom is inclined to believe that there is a belt of earth currents round the pole. The magnetic variations were found to be intimately associated with those of the earth currents. The atmospheric currents were observed with the wire network, which we have already referred to in a former note. At Kultala four of these nettings of wire, with brass discharging points and zinc earth connections, were erected at different heights on a mountain side. With these it was found if two discharging nets of similar construction and at the same height were connected together through a galvanometer, no current was observed. With one net higher than the other, and both connected, a current was sent from the higher to the lower. The electromotive force of the currents observed did not rise above 0·326 volt (on March 20).

Near the surface of the earth there is a layer of air which has a much greater electric density than layers higher up. The minimum density was formed at a height of 3 to 9 meters. During the aurora the atmospheric current was always positive, that is to say, going from the atmosphere to the earth; at some other times it was negative. With regard to the artificial aurora sometimes seen crowning the discharging networks, M. Lemstrom states that they showed either diffused light or visible rays. They were observed by the naked eye and by the spectroscope, which showed the lines of the polar aurora. A Holtz machine working in connection with the wires could re-enforce the effect under favorable circumstances. If the moon was high, the phenomenon was never seen with the naked eye.

Tides and Tidal Currents.

W. O. Ayres, M.D., in the *Manufacturers' Gazette*, says: At Rio Janeiro the tide rises four feet only. On the northeast side of South America, being at the narrowest part, the rise and fall are four feet or a little over. All through the Windward Islands, the Lesser Antilles, as they are marked on many maps, the range is four to five feet. Along the coast of South Carolina the rise is about 4·6 and at the Bermudas four feet; at the Delaware breakwater 4·5, and at Sandy Hook 5·6. Passing, therefore, through all the narrowing and then the subsequent widening, we have found but small change and none at latitude 40°; being at about the same width as our line of origination we have a tide equal to that of the Southern Ocean, from which it is separated by an interval of 5,000 miles.

But here, without apparently any change in the correlated surroundings, anything which can develop new vigor, a strong change commences, and presently it has become a mighty change; and it is quite apparent that this change cannot have anything to do with the shape of the land, for its potentiality is displayed on both sides of the Atlantic, the European as well as the American. We will look first to our own waters. Passing Montauk and Block Island, and striking the sandy shore of Massachusetts, we find no five foot tide, such as we had at Sandy Hook, for at Provincetown the rise is 10·8 and at Boston Light 10·9. Reaching the coast of Maine and passing on northeastward we find a tide of 20·6, and still further at St. John, N. B., of twenty-three feet. Nor is the European side to be outdone, for at Cape Finisterre, which is in the same latitude as Boston, the regular rise and fall is fifteen feet; at Brest it is nineteen, and across the channel at the Scilly Isles it is sixteen. On the west coast of Ireland it is fourteen; in Galway, though for local reasons, at Cape Clear it is only nine. Up the English Channel at Dover, the one side it is eighteen, while across in France, at Havre, it is twenty-two, and at St. Malo thirty-five, though this latter is somewhat influenced locally.

Now herein is much that is remarkable. We are passing further and further away from our originating impulse, and the tides, instead of losing power, are growing stronger and stronger as we get into increasing height of latitude. The fury with which their currents sweep through the contracted passages north of Scotland, separating the small islands which make the Orkney and Shetland groups, is something fearful. Even the Pentland Firth itself with all its breadth is nearly impassable except when the tide is favorable, and whoever has read Sir Walter Scott's "Pirate" needs no reminding of the dreadful rush of the current through the Roost of Sumburgh, and then over toward Norway as far up as the Arctic Circle. The world renowned Malstrom (Maelstrom we used to spell it), which is a wonderful representation of power and fury even when stripped of all its former romance of ignorance, is barely a necessary result of the dash and tear of the Lofoden tide around the south end of the little rocky island of Moskenaes between that and Mosken.

Returning now for a moment to the coast of Great Britain, we notice two mighty examples of tidal exaltation, where the great normal rise is picked up by a local configuration and made to display its points to great advantage. On the west side of the island are two funnels, so to speak, the Bristol Channel and the Firth of the Solway. The current of flood tide entering at the wide end of the funnel finds itself so restricted by the approaching sides that it has no way to expand its energy but by dashing straight forward, and away it goes, and in the head waters of each a normal daily rise and fall takes place which is immense. At Bristol it is reported at forty-four feet, and at the head of the Solway as much as fifty or more.

But in this matter of local results the whole world knows there is unbounded opportunity for "Yankee boasting," though the precise glory is rather over our line, and New Brunswick leads. The Bay of Fundy has not its equal in the world for the might of its tides. Of course they are due to the peculiar shape of the bay shores, and having greater sweep than even in the Solway they mount up most astonishingly, and while claiming only sixty feet as a common occurrence, it is asserted that when driven in by the coincidence of a favoring storm with the date of a spring tide they have been known to reach an elevation of 120 feet. This seems incredible, but I see nothing impossible in it, judging merely from the ratio of addition to a normal high tide which we often see at any of the points along our shores.

The "Separation" Method for Sugar.

The "separation" method of sugar extraction from the beet, we are informed, has been adopted in several German factories with satisfactory results. The present method is composed of three operations: First, the preparation of the caustic lime; second, formation of the *sucrate* by precipitation; third, purification of the saccharate.

1st.—The caustic lime should be pulverized as soon as possible after leaving the lime kiln. The powdered product is thrown on a magnetized surface, where any particles of iron in the lime are separated. Every precaution is taken to prevent the absorption of moisture from the air, and for this reason the various pulverizing operations take place in hermetically sealed vessels. The thoroughly pulverized caustic lime is received in a weighing apparatus—in this latter is placed a revolving device emptying a given quantity for one operation into the saccharine solution.

2d.—The precipitation of the saccharate is effected in an apparatus called the *cooling macerator*. By suitable pipes there is circulated a cooling liquor by which the saccharine solution is kept at a very low temperature. Above the cooler is located the pulverized caustic lime measurer and two reservoirs—one for molasses to be worked, and the other for water to dilute both the molasses and the subsequent washings of the saccharate press. A certain quantity of molasses is diluted until 25 hectoliters contain 7 per cent of sugar. When the solution reaches a very low temperature in the cooling apparatus, the caustic lime is added, 5 kilos. at a time; and in about an hour nearly all the sugar is in the form of a saccharate with an excess of lime.

3d. *Purification of the Saccharate.*—The cooling apparatus is duplicate in form; one vessel being emptied by an exhaust and force pump, at a pressure of one to two atmospheres, into filter presses, the other being filled in the mean time. From the filter presses runs a liquor containing 4 to 5 per cent sugar. This is not used, however, but emptied into the waste pipe. The liquor which subsequently comes from the presses is used, as already explained, for diluting the molasses to be mixed with the caustic lime. The saccharate remaining in the filter presses is white, and of great purity.

The Method of Using the Saccharate.—The saccharate contains 100 parts of sugar to 130 of lime. If the molasses to be worked represents about 5 per cent of the weight of the beets, the saccharate obtained is mixed with the beet juice. In cases where the molasses is to be worked at once for its sugar, it is found desirable to eliminate from the saccharate the excess of lime. This is accomplished by mixing the saccharate with weak juices. The tri-basic saccharate is transformed into a calcic-mono-basic and hydrated lime, and this latter is easily separated by suitable filter presses. The liquor from the latter apparatus contains all the sugar and only 30 parts of lime to 100 of sugar. The residuum is then washed, and from it is usually obtained 4 per cent of sugar.

The Possibilities of Speed.

In a recent article on the limits of speed of ocean steamers the Boston *Herald* took the ground, substantially, that their enlargement depended upon improvements—and decided improvements—in the generation and application of power. It is not a little curious, however, that, as to at least one of the cardinal factors in locomotion, the possibilities of speed should be so much greater on water than on land, since both the average and highest speed made on the railway leave those of the ocean steamer far back in the distance. We mean what is commonly called friction.

This signifies the rubbing of the moving body upon or against the ground or water, as the case may be, when in motion. It results from the action of gravity pressing vertically down upon the body, and thus causing it to adhere to whatever it rests upon. And since gravity also enables the moving body on land to exert its own force against itself, and thus to move from place to place, it has passed into a trite saying that gravity is at once the main impediment and the indispensable auxiliary to locomotion.

Now, the degree or potency of friction depends always on the weight of the moving body; then, on land, on the manner of its adhesion to the ground and the smoothness and grade of the ground. Hence, a smooth, level, straight steel railway, and well oiled freely moving rolling gear of car, reduce friction to the minimum. On water, depth and placidity and proper shape of vessel do the same.

Now, to determine the relative potency of friction between water and land locomotion, the common incidents of canal navigation and railway freight car propulsion by horses furnish at once accurate and conclusive data.

Two horses tow all day a loaded canal boat, of a total weight of as much as 300 tons, at a speed of two miles an hour. An equal load transferred on the railway would make up a freight train of 15 loaded cars, car and load weighing ten tons each. Now, those two horses pulling on that train with the same force which they exerted in starting and towing that canal boat, so far from propelling it at the above speed of two miles an hour, would not move it at all. But load, power, and application of power being the same in both instances, the difference in the result is evidently due to the difference in the degree of potency of adhesion of the load, which is thus proved to be greater on land than on water, therefore requiring a greater force to be overcome. Now, assuming that the ratio of increase of power with increase of speed is the same on water that it is on land, since it takes so much less power at low speed to move a load on water than it does on land, always provided the application of power is the same in both cases, it follows that the increase of power demanded by the increase of speed must remain within the same original proportions, and always be much less on water than on land. And this being so, it follows that friction must also be equally less on water than on land. As to this important factor, therefore, the ocean steamer has greater possibilities of speed than the railway express.

The idea of relative friction is well taken by the *Herald* writer, but the reasoning is fallacious in the fact of drawing a deduction relative to high speeds from the comparison of the friction of a body moving in water at a low speed and the power required to overcome the static friction of a train.

These bear no relation to the relative power required to maintain a high speed of a given weight upon rail and water.

The displacement of water by a moving body is the prime factor in the advancement of marine speed, while the displacement of air and safety are the prime factors in the advancement of railway speed.

An Improved Quarantine System.

In a recent address before the representatives of the various exchanges of New Orleans, Dr. Joseph Holt, President of the Board of Health of that city, made the following suggestions:

When a vessel arrives at the mouth of the Mississippi, she is either infected or she is healthy. If we know her to be infected, she is at once removed to the supplemental or lower station, for infected vessels only, where she will be actually cleansed, actually disinfected and fumigated, her sick removed to the local hospital.

She is an exceptional case, and will be dealt with exceptionally.

She will certainly not be allowed to endanger healthy vessels by mooring in their vicinity.

If at any time she wishes to put back to sea, she is at liberty to do so; but if she desires to come to our port, she will be detained until the board can safely venture upon allowing her up.

We will understand better the particulars of treatment when we have described the course of a sailing ship through quarantine—no record of sickness on the voyage; a cargo of 30,000 bags of coffee; yellow fever epidemic in Rio, from whence she has cleared. She is brought alongside the wharf at the upper quarantine station, where she finds every arrangement for the rapid discharging and reloading of cargo. The crew with all their effects is at once taken ashore, where, in a room provided, everything they carry, apparel and baggage, is subjected to powerful disinfection. Their clothing exchanged for other clothing already treated, and this, in turn, disinfected. They are then received at a commodious boarding house, comfortably prepared for them, there to undergo the prescribed detention. If one should fall ill, he is instantly removed to the hospital as distant as can be located.

Hospital experience proves that yellow fever is conveyed through the medium, not of persons, but of things. Yellow fever has never invaded the Charity Hospital except in the regular march of an epidemic. In the mean time a full corps of acclimated stevedores are busily engaged in breaking out the cargo and transferring it to the warehouse, already built by the United States Government for that accommodation, or directly into barges, there to undergo fumigation. As soon as compactly emptied, or at least sufficiently so to permit of thorough cleansing and fumigation, the quarantine tug, a compactly built small vessel somewhat after the fashion of a fire tug for harbor protection, is run alongside the ship. A hose attached to a powerful forcing pump aboard the tug is let through the forward hatchway down into the hold.

In order to flush the bilge quickly, it might be necessary to take up the limber plank, as a better examination could be had and the real condition ascertained. But whether this is done or not, or the ship be in ballast or not, she can be speedily and thoroughly washed. The pump is started and the washing begins, while the ship's pumps are set to discharging the foul bilge water. This continues until she is washed clean, not only in the limbers and floors of the hold, but the ceiling and every available part. She is now pumped out, the hose removed, and then begins the disinfection and fumigation. Another large hose attached to a powerful exhaust fan is lowered into the same position as the first. The hatches and every other outlet are closely battened, with the exception of a small ventilating hatchway, either at the bow or stern. A quantity of sulphur is put into the furnace connected with the fan, and ignited. The exhaust fan is started, and sulphuric acid gas in immense volume and with tremendous force is driven into the limbers and air stakes, into every crevice and part of that ship until she is completely filled. We go through her with an atmosphere, as it were, of fire.

In doing this we displace the mephitic and dangerous atmosphere closed in her when she started from Rio, and which, if allowed, would have been set free at our levee—the infected atmosphere of Rio to commingle with the atmosphere of New Orleans, deadly ripe, perhaps, for its reception.

We have displaced this not only with a non-infected atmosphere, but with one intensely germicidal—one that destroys organic elements in the air or on exposed surfaces with instant greediness. As for the fumigating agent to be selected, we may use through this apparatus sulphurous acid gas, chlorine, or the nitric acid fumes produced by pouring nitric acid upon copper filings, of which Dr. Wiblin, of Southampton, says that all the goods may be safely and satisfactorily disinfected by this agent. The fumes so produced are so powerful that no animalcules can exist in them for more than two seconds, and the portholes being closed for twelve hours, the process cannot fail to be effective. For my own part, I believe that the sulphurous acid is all that we can desire.

After a few hours the hatches are removed, and pure air is driven in to facilitate clearing the ship of the fumes. She is reloaded, or her freight already sent by barge, and with her captain on board proceeds at once to the city, there to be discharged only by an acclimated gang. Her export freights must be ready. She is at once reloaded, and starts on her voyage. If the term of detention of her crew has not already expired, she touches at quarantine to take on such as have engaged to reship, and puts to sea, with no more detention than was required to cleanse her, with the utmost expedition, which alone was worth the trouble.

This method having once been enforced, we may boldly proclaim that for the first time in the history of our quarantine a ship has been actually cleansed and disinfected, purged of her suspicion.

Burning of Barns.

It is noticeable that a larger number of the burnings of barns is mentioned by the periodical press in the summer than at any other time. Some of the fires are undoubtedly caused by lightning, the moist vapor from the uncured hay making a favorable conductor for the electric fluid. But there are barn fires which cannot be attributed to lightning, to lighting of matches, to light from lanterns, nor to the invasions of careless tramps. It may be that the spontaneous combustion of hay is as possible as the spontaneous firing of cotton waste. All fibrous material, when moist, and compressed, and defended from the cooling influences of the outward air, is subjected to a heating similar to that of fermentation; and in some instances the degree of heat is sufficient to cause actual, visible combustion. In the case of recently "cured" hay this danger is as great as, in similar circumstances, other materials may be. Frequently the grass is cut in the early morning, while wet with dew; is turned twice during the day, and gathered and packed in the "mow" or the "bay" before nightfall, with perhaps a sparse sprinkling of salt. Such a compressed mass of fibrous, moist matter will heat. How far the heat will go toward generating a combustion may be inferred from a foolish trick which the writer witnessed several years ago.

A large meadow of hay had been cut, cured, and cocked, previous to removal. A shower threatening, the cocks were covered with caps of canvas and left for the night. While getting the hay in, the next day, one of the workmen dropped an unlighted match from his pocket into a cock of hay, and in a few minutes it was ablaze. It afterward was ascertained that he had spoken of the warmth of the hay as he lifted it on his fork, when a companion remarked that it might be hot enough to light a match, on which he put a match into a rick, and before they had passed on five minutes the rick was on fire.

Everybody conversant with farm life, where hay is a permanent and important crop, knows that for weeks after getting in the hay the barn is warm when the doors are opened in the morning. There is an amount of heat that is absolutely unpleasant when the thermometer outside registers 60°, but which is quite welcome with the outside temperature at 40°. This barn heat is undoubtedly from the moist hay, compacted and inclosed. The cure for the possible danger of possible spontaneous barn burning would seem to be the thorough curing—drying—of the hay before it is housed. We dry all our herbs and some of our vegetables without injuring their peculiar and individual qualities. There is no reason why hay or other fodder material stored in large masses should not be rendered equally innoxious to the influences of heat by thorough drying.

The Liquefaction of Gases.

The process of liquefying gases, such as oxygen, has been recently advanced a considerable step by the labors of M. Cailletet, who has communicated to the *Comptes Rendus* a brief preliminary account of his successful use of marsh gas for this purpose. The author recounts that, by the use of boiling ethylene, MM. Wroblewski and Olszewski have succeeded in obtaining the meniscus of liquid oxygen, which he has not himself been able to detect in any of his previous experiments. It appeared to M. Cailletet, however, that if he could find liquid bodies boiling at a temperature below that of ethylene it would thereby be possible to liquefy oxygen without being compelled to use pneumatic machines for the purpose of lowering the boiling point of the refrigerating liquid. All the necessary conditions for this purpose are fulfilled by marsh gas. In effect, this gas, slightly compressed and cooled in ethylene boiling under the ordinary atmospheric pressure, produces a colorless, exceedingly mobile liquid, which in resuming the gaseous state causes a cold sufficient for the instant liquefaction of oxygen. Under these conditions the liquefaction of oxygen becomes one of the simplest laboratory operations. M. Cailletet announces this discovery at the earliest possible moment, in order to secure priority of date; reserving the description of his methods and actual results until he has completed a course of experiments upon which he is at present engaged.