and eighteen ounces of liquid fuel, works about ten minutes. Weight of engine, boiler, water, and fuel, sixteen and one fourth pounds.

Aluminum steam engine.—Viscount de Pouton d'Amecourt, 36 Rue de Lille, Paris.

Working model of the Brighton oil engine (Dr. Money's patent). In this engine power is derived from explosion within the cylinder of inflammable gas or vapor mixed with atmospheric air. The vapor is produced by volatilization of certain liquid hydrocarbons, the heat resulting from the explosion being made available for this purpose.

CLASS II.—*Complete working aerial apparatus.*

Flying machine, which, being attached to the body, enables a person to take short flights.

Complete working aerial apparatus by muscular power.

CLASS III.—*Models.*

Model of a balloon, with a ring or belt attached which, in ascent or descent, is placed in an inclined position, relative to the axis of the balloon, the current of air rushing through the open side of the bell, urging the whole in that direction.

Model of the framework of a car, adapted to receive the machinery described in a drawing (class 5), the object of which is, by a system of levers, to raise the car two or three or more inches, according to the force required, which suddenly dropped on to its supports, produces a rapid succession of jerks, thereby effecting descent without loss of gas.

Model of an improved balloon. By this model it will be seen that the car is done away with, and that a structure of bamboo or wicker work is to be built round the balloon, which is used as an ascending agent only.

Model of the aeromotive, constructed for rising in and steering through the air by the rapid rotation of a screw (one on each side of the machine), which, by creating a reaction in the air, overcomes gravitation, and thus rises. Fixed to the top is a parachute for gradual descent in case of accident The aeromotive is propelled by a screw and guided like an ordinary vessel. The principle of the screw is the same as Rennie's conoidal.

Model of an aerial steamship, propelled by four wings, giving alternate stroke, and two screw fans, one of which is placed vertically for assisting in ascension, the other placed horizontally for propelling ahead, with internal space for gas.

Small model of a steam or hot air engine, chiefly constructed of vulcanized India rubber for aerial purposes.

Experimental model of a balloon, dispensing with gas and ballast.

Model in demonstration of a proposition to omit ballast in balloon ascents. By this proposition gas would be withdrawn from the balloon by an air pump, which would compress the gas into a chamber carried in the car when a descent becomes necessary. An ascent will be obtained by opening a tap, and thus allowing the compressed gas to escape from the chamber by a tube into the balloon. The advantages of this would be that the natural balance used by fishes would be applied to balloons, gas being reserved for use instead of escaping as now obtains.

Model of an aerostat or aerial float, eight inches long, twenty inches broad, and two inches deep, rendered rigid by inflation. When the two shorter ends are doubled together it assumes the form of an open boat or canoe, and will then balance itself in the air, and can be used as a parachute, for it will always descend with its convex side downwards, and in doing so may be propelled and steered in any direction. It is expected, however, that when made on a large scale, inflated with gas and propelled horizontally, it will support itself. The engine intended to be employed is an ammoniacal one.

CLASS IV.—*Working Models.*

INSIDE.

Working model to illustrate a mode of flying vertically by direct action on the air, without any screw motion in the wing. This machine will ascend in a vertical line.

Working model to illustrate natural flying, the wings being used to propel and sustain, the tail to sustain only. This model will fly horizontally for a short distance.

Working model of an air ship, lifting itself by motive power, and capable of being governed in every direction, based upon a system supposed to be not hitherto known, which enables it to work against any lesser currents of air; therefore a certain horizontal direction can be pursued, inasmuch as the cubic contents of the apparatus are comparatively little in proportion to its carrying powers. Each cubic foot of the space occupied by the apparatus is capable of carrying half a pound (Vienna weight).

CLASS IV.—*Outside the Main Buildings.*

A working model of an aerial machine, raising and sustaining itself in the air for several minutes, being worked by a power evolved from the combustion of materials similar to those used in the original fire annihilator, steam and gaseous products of combustion being intermixed within the boiler, and forced at high pressure into a rotary engine, turning, lifting, or driving fans.

CLASS V.—*Plans and Illustrative Drawings.*

In this class we notice only the following, chiefly on account of its absurdity. The expectation that a body floating in a current of air, and propelled by no other force, could be guided by sails, is a folly which our readers will appreciate without further remark.

Drawing and plan of an aeronautic machine. — This machine consists of an oblong frame of light wood, which supports a platform and tent for the aeronaut. To this frame are attached two spherical balloons, fastened at their center to the frame in the usual way. A light shaft supported on the lower side of the frame gives motion to the steering apparatus, which is worked by hand, and by which the aeronaut can change the position of the machine at will. There are sails attached at the forward end of the machine by which it is expected an oblique course can be given to it.

CLASS VI.—*Separate Articles connected with Aeronautics.*

CLASS VII.—*Kites or other similar Apparatus proposed to be used in cases of Shipwreck, Traction, or in the Attainment of other Useful Ends.*

INSIDE.

A rough kite made of materials most likely to be found on board ship, suggesting to the unprovided mariner in peril of being driven upon a lee shore, a ready way of making a kite to be flown with 'two strings.' When about one third out, attach a small wooden weight to the second line; pay out again until the kite reach the distance required; then cut and let go the second line, which will swing to the shore, and communication is accomplished. On an uninhabited coast, attach the second line to the man swimming thereto. The inventor, John Neale, a working man, freely gives this very simple, rough, and common invention of "two strings to the kite" for the benefit of maritime populations of all nations, humbly requesting of all persons interested therein to extend, translate, and further advance the knowledge of the same.

Model apparatus for throwing a line of communication to persons in danger, either from fire or water.

OUTSIDE.

Rogers' patent projectile anchor and block, for launching life boats, etc, in rough weather, and for other life saving and useful purposes. Working model, scale $\frac{1}{8}$, with diagrams, to effect direct communication with a wreck on shore, or between a ship and the shore, or between two vessels at sea, or for assisting boats to leave the ship's side, when at anchor or in a rough sea, or for use in club hauling a vessel off a lee shore; also as a means of aid in case of fire occurring in high buildings.

An arrangement of kites showing Cordner's application to the saving of life, etc., from shipwreck, and to other purposes This consists in applying to the saving of life and property from shipwreck, etc., a set or succession of kites, or several combined sets, so arranged that the power exerted by the several kites of a set shall be at one point or upon a single line, the line of the first or uppermost kite being attached to the adjacent kite, and the line of this to the next adjacent, and so on through all the series.

A patent kite and apparatus showing, by experiment upon a smaller object, how it is possible for a man to ascend the line of a kite by the draft power of another kite attached to a car. The exhibitor has himself ascended by these means to the hight of several hundred feet.

The exhibition only confirms our doubts in regard to the practicability of aeronautic machines.

One difficulty which seems not to be fully appreciated by inventors in this field, we will briefly notice. It is the extraordinary velocity of air currents in proportion to the density of the medium. Did currents of equal velocity in proportion to density occur in water as occur commonly in air, no method at present known would enable us to navigate water. In extreme cases, birds, albeit adapted to flying as no human device can ever be, are driven miles by the force of winds, or compelled to take refuge from its fury.

MECHANICAL NOTES.

TO MAKE A "KNURL."

The "knurl," beading or milling tool, as it is variously named, is often called into requisition by the mechanic for the purpose of ornamenting the beads or swells of the work he is engaged upon. These knurls are generally purchased at some of the hardware stores, and are used by inserting them on the end of an iron shank, where they are free to be rotated by any moving body being held in contact with them, and if they be held rigidly enough they will make upon it a figure the reverse form of that upon their periphery. Knurls are generally made with about three forms of face—straight, hollow, and rounding—and these forms are cut with straight or beveled teeth, or designs of different degrees of coarseness.

If at any time the mechanic has one of these forms, a hollow for instance, which is suitable for beading a swell, and he wishes to produce the opposite of this, or a round faced knurl, he can turn up a steel blank of the required form and hold the hollow knurl against it until the form of its teeth is fully impressed in the surface of the blank. This then can be hardened and tempered ready to be used for the production of its reverse. In this way a sharp knurl may be used to produce a great number of others, or when they become dull by usage they can be restored by it to their original excellence.

But as it is often desired by the mechanic to make a knurl the teeth of which are required to be coarser or finer than any he possesses or can purchase, he can readily do it by first turning a blank to the form required, and then cutting a small screw with the same pitch of thread that the knurl is wanted to be, then cut grooves across it the same as a hob is made for cutting screw-chasers. Temper this screw and fit it to revolve in the lathe. Attach the blank knurl to a shank, the same as it is used in actual work, and hold it in a vertical position so that it will revolve by the action of the screw as it is held against it. The rotation of the screw will cause the blank to revolve, and a serrated surface will be formed upon it at the same time. While doing this it will be necessary to support the shank that carries the blank upon a T-rest.

If the blank knurl be made with a hollow face, the screw to cut it must of a necessity be of a size proportionate to the hollow; but if the blank be made with a flat or rounding form then it must be moved in such a manner that the screw will cut every portion of the face evenly and alike, and this can be done by moving the handle that carries the shank, as it lays upon the rest up and down, and by so doing presenting the blank correspondingly to the cutting surface of the screw.

If ornamental knurls are wanted, the services of the die-sinker must be brought into requisition, who will produce a reverse of the ornament needed, and then reverses of this can be made in the manner mentioned, or they may be so made that they can be used upon the work without the necessity of using them as patterns to form working tools.

HOW TO MAKE METAL TUBES.

Tubes of metal are used for a variety of purposes, and in all large cities and towns are easily obtained of almost any size; but there are times when the mechanic finds it an impossibility to obtain what he wants of this kind of material, and he must manufacture a tube for himself. If the tube is required to be of two inches diameter inside, a narrow strip of metal is cut off and bent close about a mandrel or spindle of that size, until the ends just meet; this slip when straightened out gives the breadth of the piece which is to form the tube. Cut a piece of this breadth from the metal, taking care that the edges are exactly straight and the breadth uniform; brighten the surface for about a quarter of an inch by filing it at the opposite edges on the same side. Then place the piece of metal upon a spindle and with a mallet bend it round it until the edges come in contact and lie very close and even together, the brightened parts coming together on the inside and presenting a clean surface for the reception of the solder.

If the tube be exposed to the fire for soldering in this state, especially if the metal be thin, the heat would cause the suture to open, and it would be impossible to solder it: to prevent this, place loops of small wire, at an interval of about an inch or so apart, around the entire length of the tube, and twist them so as to bring the edge of the metal in close contact.

The tube so prepared is ready for soldering, and borax and spelter must be used for that purpose. The borax being previously burned or made to swell into a friable mass by exposure to heat upon an iron plate, is triturated with water to the consistency of cream, in which state it is rubbed along the inside of the tube upon the seam; upon the borax a portion of spelter solder must be laid. Place the tube over a good charcoal fire with the suture downward, until it becomes slightly red hot; at a cherry-red heat the borax will melt, and presently the solder will fuse, and as this fusion proceeds draw the tube along so as to expose every part of the line or joint to the action of the heat.

When finished remove the wires, and put it in a pickle of sulphuric acid diluted with water; after half an hour remove it, wash and scour it clean, and it is ready to be wrought as may be desired.

GRINDING CYLINDRICAL SURFACES.

The turning of long and slender rods in the lathe, so as to have them of a true cylindrical form, is quite difficult even when a back-rest is used; irregularities which are unobservable by the eye are easily detected by passing the rod between the fingers. Even short and thick rods, that are too rigid to spring under the action of the turning tool, are found to have slight irregularities, which may be accounted for by imperfections of the lathe or by the wearing of the tool, or from hard or soft places in the metal. It will be observed, then, that to produce a perfect cylindrical surface in the lathe is a matter of some difficulty, and the only method seems to be to turn the work as true as possible, and then complete it by grinding with some abrasive substance, as powdered emery, moistened with water or oil, which is the material generally employed.

The application of emery as an abrasive means for producing cylindrical surfaces is quite simple, as it is evident that the cylinder must be confined between surfaces the counterpart of those to be produced, and then well supplied with the abrading material; it is quickly revolved and operated upon until the requisite surface is produced. If a block of metal, as iron, steel, or brass, be bored with a hole of the size to which the rod is to be reduced, and one end of the rod made to enter this hole, both rod and aperture being supplied with oil and emery, it is evident that by moving the block in which the rod is inserted over the length of the work, it will be reduced so that it will correspond to the diameter of the hole. A block of lead or tin may be cast around the rod and supplied with emery and oil and operated as mentioned. This perhaps is the readiest way of forming a block, as it is easier to melt and recast the soft metal than it is to prepare and accurately drill the iron or steel block. The latter is useless unless of the proper size, but the former can be often remelted and used as as first.

For the use of the amateur an adjustable tool which may be recommended, consists of two cast iron or brass shells, cylindrical in form, and of a length sufficient to keep them steady upon the work. These shells have ears upon each side, and screws pass through these ears and confine the two parts or halves together. Two middle ears may be made with set screws to prevent the shells being closed beyond a certain point. To each of these shells handles are attached, so as to enable the operator to hold the tool and also to enable him to traverse it over the rod to be ground. The interior circles of the shells are made so that when the tool is placed around the rod it is much larger than its circumference, and this space is filled with molten tin, lead, or babbitt-metal. If a difficulty should present of the soft metal not retaining its place, several small holes may be drilled a little distance in the shells, and the metal filling these holes when cast will form a sufficient hold to retain it. By slacking the set screws and tightening the binding screws, the size may be varied, to suit small variations of diameter in rods.

For the purpose of casting the lead or tin within the shells, the set screws are withdrawn and the binding screws are slackened so as to leave an opening of about a quarter of an inch between the flat faces of the shells. They are then placed edgewise upon a block or some level support, and a short cylinder or core of the same diameter as the cylinder to be ground is placed centrally in the aperture of the shells, and two slips of wood are placed so that they form a continuation of the circle where this circle is broken by the separation, and then the parts are firmly pinched together by the binding screws, the melted metal poured in, so that it fills the cavity and encloses the core. The slips of wood serve to keep the shells at the required distance apart, and also serve to retain the metal, which otherwise would flow out at those places. It is almost unnecessary to repeat that the aperture of the shells should be much larger than the work to be ground, and the slips of wood taken out when the tool is to be used.

To keep the core centrally in the aperture of the shells, while the metal is being poured, it may have a portion of its length inserted in a hole in the block or board on which it is placed. If it be desired to cast the metal round the work itself, it may be so fixed and the metal poured. To prevent the flowing out and waste of the metal, all such points as would be likely to afford such escape are luted with clay,or even common putty such as is used by glaziers to fasten in windows may be used.

In using a tool of this character after the rod to be ground is put in rapid rotation, the tool is grasped with the hands and transversed backward and forward over the rod, and as the parts presented to its action are reduced the set screws are loosened and the binding screws are correspondingly tightened in order to decrease the circle and enable it to clasp the work with the requisite pressure. Adjust the tool and pass it over the rod until it continues to slide smoothly and with uniform resistance from one end to the other; oil and emery are to be applied during the entire operation.

It is advisable to make the grinding surface as near a counterpart of the cylinder as possible, and if a very perfect surface be desired, it would be well to reduce the inequalities with the application of one set of soft-metal castings, and then remove them and cast a fresh set with which to complete the operation.

Another application of this method is to fix the grinding tool in the tool-post of the lathe, and let it traverse the work from end to end, as it is rotated, keeping it supplied with oil and emery and advancing it to the work as it is reduced. In this case it is not necessary to encircle the cylinder or rod with a metal block, as an encircling of one third or one half the circumference is sufficient.

In some kinds of machinery it is necessary to accurately grind large rolls so that they may be perfectly true, and after these rolls are turned in the lathe as true as possible, they are mounted on their own bearings in a frame similar to that in which they are to be employed, and made capable of a slow rotation. A wooden cylinder supplied with a coating of emery is revolved with great velocity just in contact with the roll, which as it slowly turns is reduced by the quick-running emery wheel. The roll must revolve in a direction opposite to that of the emery wheel.

The same application may be made in the lathe, by slowly revolving the work and fixing the emery wheel in the tool post of the lathe and letting it traverse the work, the necessary speed being communicated to the grinding wheel from any convenient pulley.

This method is used for trueing the hardened plugs of templets for gaging the caliber of rifle barrels, a wheel of corundum being employed instead of the emery wheel.—*Mechanic's Tool Book.*

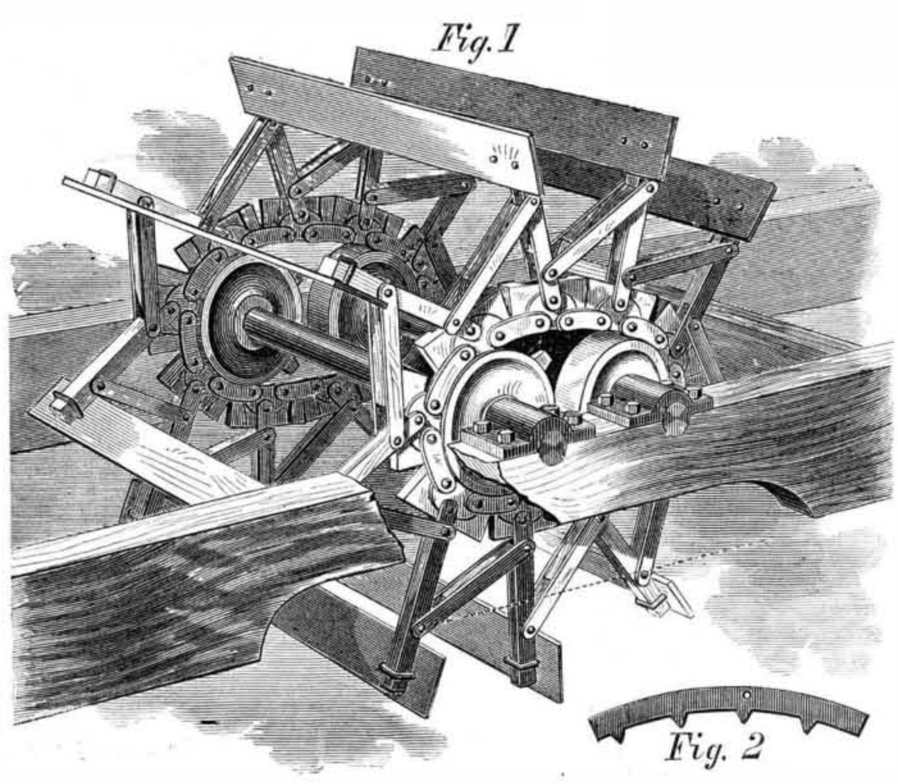
The Latest Novelty in Printing.

The foreign journals report that an American has taken out a patent in France for a style of printing which may be read in absolute darkness. We have not seen an account of the details of this invention, but have no doubt that the process is similar to that of certain photographs, which we described, Vol. XVIII., page 407, under the title of the "Latest Novelty in Photography." Nothing is easier than to print with an ink made of powdered phosphorescent substance mixed with some gum or varnish, as described on the page mentioned. Such a print may be either visible or entirely invisible by daylight, according as the color of the ink differs from or resembles the color of the paper upon which the print is made; but in order to render it visible in the dark, all that is required is simply to expose it for a few seconds to the sun, strong daylight, or to electric, calcium, or magnesium light; and, when after some time it becomes invisible, a renewed exposure to light will make it again visible. In this respect it has a great advantage over the luminous photographs which cannot be exposed to daylight except under the glass positive, as the whole surface of the paper is covered with the phosphorescent substance, and must therefore be preserved in the dark. The printing here described, however, improves and becomes more luminous the more it is exposed to light, as only the letters consist of the strongly phosphorescent substance, and the rest of the paper is in its natural condition, that is, it requires a very strong light to make it feebly phosphorescent.

So-called Soda Water.—Most of the beverage sold as soda water has not a particle of soda in it, but is simply water with carbonic acid forced into it by using mechanical pressure, as that of a condensing syringe or a powerful force pump. Carbonic acid water is an agreeable and healthful drink, especially in hot weather, when taken in moderate quantities.

Improvement in Steamboat Wheels.

Many attempts have been made to produce a more uniform action of the buckets of a steamboat wheel on the water, to overcome the loss of power in lifting the water and to preserve the paddles in an upright position while immersed. For this, automatic and eccentric wheels have been contrived, and various devices have been experimented with to ensure a more continuous action on the water by the buckets. The engravings illustrate an attempt in this direction, which has been tested on tow boats and found by experienced boatmen to give very excellent results, one of them stating that the gain in effective power over other boats of equal capacity, but



GRANGER'S EXTENSION CHAIN PADDLE WHEEL.

with the common wheel, to be fifty per cent. The improved wheel has a longitudinal or horizontal diameter of more than double that of a true or circular wheel, of the same general diameter as the short diameter of the chain wheel.

Instead of a central axis to a round wheel, this has two axes, the rim or paddles forming an oval. Each of the shafts has guiding wheels for the chain which supports the arms on which the buckets are secured. The wheels on the driving shaft are furnished with projections, like those of any chain wheel, to fit into the interspaces between the side links and rivets, and insure the action of the chain. Each pair of links is connected to the adjoining pair by a piece that may be called a bridge, designed to support the chain with its buckets in preserving a segment of the arch forming the oval. To the center of these bridges are pivoted upright arms, on each side sustaining between them the buckets, and connected one to the other by diagonal bars, also pivoted, as seen in the large engraving.

This arrangement insures a perfect connection and uniform action between the parts, and gives a much longer contact between the paddle blades and the water than is possible by the ordinary circular wheel. To insure keeping the chains in place on the wheels, and to prevent sagging where the two shafts are at considerable distance apart, the bridge or connection shown in Fig. 2, is contrived. It is curved to suit itself to the radius of the wheel, and has projections on its inner side to engage with the spaces in the chains. The ends of these bridges are squared at such an angle that as they pass over the top they form a rigid arch, preventing all trembling, jar, or sagging, and working as smoothly as a belt over pulleys.

The principal device was patented through the Scientific American Patent Agency, some time ago, and an application is pending on other improvements by James Granger, whom address at Zanesville, Ohio.

The Suez Canal.

The financial descent of the Suez Canal to the level of the great Hamburgh State distribution, etc., is a step from the sublime to the ridiculous, which we must regret, but which, taking all the circumstances into consideration, we can scarcely reprehend. A grand undertaking, commenced in the halcyon days of speculation, is found, as many others have been, to be impossible of completion with the amount of capital at first subscribed. In the meantime, such has been the flagrant abuse of the confidence reposed by both the English and French public, in most classes of financial operators, that money is no longer forthcoming, even for what may be considered as eminently safe investments, which, with all its merits, the Suez Canal is not. It is, however, an undertaking of that class, and has already progressed to that stage which gives it a kind of prescriptive right to capital, if capital can, by any fair means, be collected for it; and in the present proposition we recognize a more open and fair mode of procedure than that which failed last year to obtain more than a third of the £4,000,000 now said to be necessary for the completion of the canal. The *modus operandi* then was the very ordinary and exceedingly specious one of placing a nominal value on the self constituted property of the company and proposing a species of mortgage on landed estates, consisting mainly of sandbanks situated either below or above water. In the report which we published recently we find that the directors, who, like many other mortals, gain wisdom by experience, almost abstain from referring to this class of security for the advance which they ask from the public, and the spirit of their present appeal is one to the candor of which we can take no exception. They say that, from the extraordinary state of European financial affairs, even more than from the peculiar nature of their undertaking, special inducements must be put forward to obtain the capital which is absolutely necessary for the completion of the enterprise. That inducement they provide in the glorious uncertainty of the lottery, and to our mind not a few of the undertakings of modern days would have been much more fairly dealt with if direct and open recourse to gambling, with all its sins, had been made, rather than the money drawn from a too credulous public by representations having very slender foundations in fact. It is curious that just at the moment when the directors themselves have, under the coercion of the times, practically thrown overboard the question of the ultimate remunerativeness of the undertaking, a rather more serious discussion than usual should have arisen on that very subject which is still quite as unfit for discussion with a view to absolute solution as it has ever been. The letters of Mr. Daniel A. Lange in the *Times*, though evidently written in good faith, and containing a fair popular idea of the views of the directors on the future of the canal, is almost of necessity without any practical basis for the calculation of the future receipts and expenditure of the canal, assuming it to be ready for traffic in 1869; in fact, the only matters of certainty which he puts forward are the facts that the interest and sinking funds for the present "loan" will amount to £360,000 a year, and that a margin of £800,000, when obtained, will pay 10 per cent on the original capital. When he computes the maintenance of the canal he makes a guess which may or may not prove to be correct, and a guess the truth of which no man living can affirm or deny, for the simple reason that the world has as yet no experience as to the cost of maintaining a canal through a sandy desert, nor any adequate experience in the maintenance of colossal ports amid coral reefs and shifting shallow banks. The probable revenue of the canal, though depending to a certain extent on the realization of the estimates of gross tunnage to and from India, depends far more on one condition of the carrying of that tunnage to which Mr. Lange has not alluded, viz., the proportion of it now carried, or which will hereafter be carried, by steam or in sailing vessels. That almost every merchant steamer trading to the East will pass through the canal when opened there is no reason to doubt, but the Eastern tunnage carried by steamers at present is a mere fraction of the aggregate of over 6,000,000 tuns assumed as the total trade; and for sailing vessels, especially for that greater portion of the fleet which comes from the Indian Peninsula, the canal offers scarcely any advantages; in fact, they could not possibly avail themselves of it if a most extensive system of towage both in the Red Sea and the Indian Ocean be not organized for their assistance. The Red Sea, from the reefs with which it abounds, is perhaps the most dangerous navigation in the world, even for steamers, and sailing vessels have been known to take longer from Aden to Suez than the average voyage of an English clipper from Shanghai to the Thames. Now the tolls for passage through the canal, set down at 8s. per tun, will form no serious obstacle to the transit through it of any class of eastern goods, whether in steam or sailing ships, but steam towage is a very different matter, and will scarcely come to be counted in shillings a tun if sailing vessels are to be brought from Suez to points in the Indian Ocean where steady winds can be relied on. We think, therefore, that the future prosperity of the canal, assuming that it can be maintained at a reasonable cost, depends far more on the increasing employment of steamers for the conveyance of all classes of merchandise than upon any other condition that can now be foreseen. At present our experience of the working of unsubsidized steamers for long voyages is decidedly unfavorable. The case of the Indian trade will, however, be exceptional when the canal is opened, and the question of the shorter steam route competing with the longer sailing voyage will be one of great interest to solve.

The steady progress of the works since the commencement of Messrs. Borel, Lavally & Co.'s contract is a matter on which we cordially congratulate the company. They have promised even less than they seem to be capable of performing, and the great enterprise to which M. Lesseps has devoted a life of energy was never more lucky than in its forced recourse to mechanical excavation, and in the fortunate circumstance that its machinery has been introduced and wielded by such able hands. The engineering world will be indebted to him whatever the commercial value of the canal.—*Engineer.*