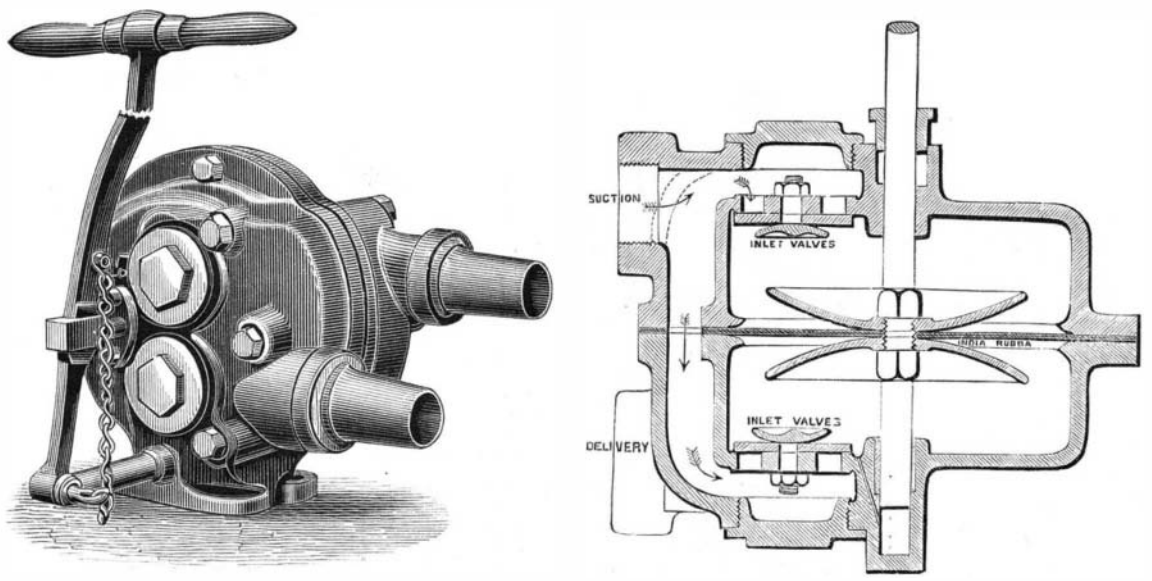
DIAPHRAGM PUMP.

This was one of the exhibits at the recent show at Tynemouth, Eng., relating to ships, boats, etc. The pump, says the *Engineer*, is suitable for short lifts, and is more particularly intended for ships, boats, fishing smacks, etc. It is simple in construction, and little liable to derangement. The pump is double acting, with separate suction and delivery valves on each side. In the center of pump is a sheet of soft flexible India-rubber, dividing it into two parts. On each side of this rubber are iron shields secured to a rod guided at both ends; one end of the rod is attached to a handle in the usual way. The suction and discharge of water is caused by alternately raising or depressing the India-rubber diaphragm. The general arrangement can be understood from the engraving.



IMPROVED DIAPHRAGM PUMP.

Sewer Gas Shampooing.

The London *Lancet* states that "recent and unsatisfactory experience in one or two West End hair cutting saloons" has led it to inquire whether sufficient care has been bestowed on the sanitary management of the shampooing contrivances. Those persons who avail themselves of the very refreshing pleasure of a "shampoo" must have noticed that they are compelled to bend over, and bring their faces in close proximity with the hole in the center of the huge basin used for this purpose. If they watch the soapsuds that form round this hole before any large volume of water is allowed to flow, they may perceive the air coming up the pipe; for it inflates the soap and forms a large bubble that bursts close under them. Whatever may be within, it is too near to avoid breathing its contents. Nor does the absence of any suspicious odor inspire a sense of security; for it is very evident that even a strong whiff of sewer gas would be lost in the scent that perfumes the soap and surrounding atmosphere. If, therefore, the pipes attached to the basins communicate direct with the house drains and the sewer, there is danger that the atmosphere breathed within a couple of inches of the aperture may carry, disguised under the fragrancy of the rose or jasmine, the virus of disease.

Shampooers on this side of the Atlantic may derive useful hints from the above.

An Electric Wagon.

The improvements in the storage of electric energy and in electro-motors have so far advanced, says *Knowledge*, that tricycles can be lighted and propelled by electricity, as was seen from the tricycle lately ridden by Professor Ayrton in London. The Faure accumulators in which the energy was stored for the lighting and driving were placed on the footboard of the tricycle, and the motion was produced by one of Professors Ayrton and Perry's newly patented electro-motors, placed under the seat of the rider. Using one of these specially made tricycle electro-motors and the newest type of the Faure accumulators, the total dead weight to be added to a tricycle to light and propel it electrically is only 1½ cwt., a little more than that of one additional person. In the tricycle ridden by Professor Ayrton the ordinary foot treadles were entirely absent, but with ordinary electric tricycles it may be desirable to leave the treadles, so that while electric propulsion alone is used on the level, the rider can, on going up a steep hill, supplement it by using the treadles, instead of, as at present with the ordinary non-electric tricycle, having to get out and ignominiously push his tricycle up the hill before him.

A New Dye.

The young growth of the poplar tree yields a dye which may be extracted as follows: The young twigs and branches are bruised and boiled for twenty minutes with a solution of alum, 10 pounds of wood requiring 1 pound of alum, in 3 gallons of water. The solution is filtered hot and allowed to cool, and, after standing some time, is again filtered from a resinous deposit. On exposure to air and light it develops a rich gold color, and may be used directly for dyeing orange and yellow shades upon all classes of goods.—*Deut. Farb. Zeitung.*

FIREPROOF STEAMERS.—The New Orleans *Times-Democrat* say that the steamer, Will S. Hays, now building, will have her upper deck made of corrugated iron, to protect the cabin passengers in case of fire. This is a movement in the right direction. We already have seven steamers with iron hulls. The final step is to make both hulls and upper works of the same boat, and all such boats, of incombustible materials.

The Four Forces in Nature.

BY GEORGE WHEWELL, F.I.C., F.C.S.

In a previous article we ventured to enunciate a theory to explain the fact that the same piece of carbon (or any other element) in different states of combination had in one case the power of motion, and was what is called living matter, and in the other case had not the power of motion, and was what is called dead.

In nature we recognized four forces, which we ventured to call atomic viva, organic viva, animal viva, and mensic viva (mind).

The same piece of carbon, in one condition having no power of motion, as when forming a portion of the root or stem of a plant, possesses atomic and organic viva. When it forms a portion of a nerve it possesses atomic, organic, and animal viva; and when it forms a portion of the brain, and causes man to think and act, it possesses all the four forces—atomic, organic, animal, and mensic (mind) viva.

We assume that the elements contain these four forces in a state of activity or otherwise, according to circumstances. When the element belongs to the mineral kingdom it possesses only atomic viva, the other three forces being latent. When it belongs to the animal kingdom the other three are either active or latent, according to circumstances—that is, according to the position they occupy in the body of a living animal or plant.

Take the life history of our theoretical molecule of carbon. Suppose that a molecule of carbonic acid gas floats about in the atmosphere, and is driven hither and thither at the caprice of every wind that blows. In this condition atomic viva is alone active, the other three being latent. In its passage over the earth it strikes against the leaves of an edible plant; the sun is shining, and the molecule of carbonic acid gas is absorbed by one of the leaves of the plant; the carbon is retained, and the oxygen is given off again. The carbon becomes a portion of the substance of the plant. It has changed its condition from being a portion of a poisonous gas to be nutriment for man or animals. From being a portion of dead matter it becomes a portion of living matter. The gardener takes the plant, cooks and eats it; by and by it is converted into blood, and is then in a condition to have its latent forces developed. It can become a portion of a muscle, and possess atomic, organic, and animal viva, and be a portion of a living body. It can become a portion of the brain, and produce thoughts—violent, demoniac, or sublime—at its own caprice. In this condition it possesses all the four forces in a state of activity. When it has produced these effects it again becomes carbonic acid gas, and finds its way into the outer world to be tossed hither and thither at the mercy of the winds.

This same molecule of carbonic acid gas may go through this endless change from century to century.

New forces must of necessity develop, and become latent in the molecule, in passing and repassing through this endless variety of changes.—*Journal of Science.*

The Fees in the President's Case.

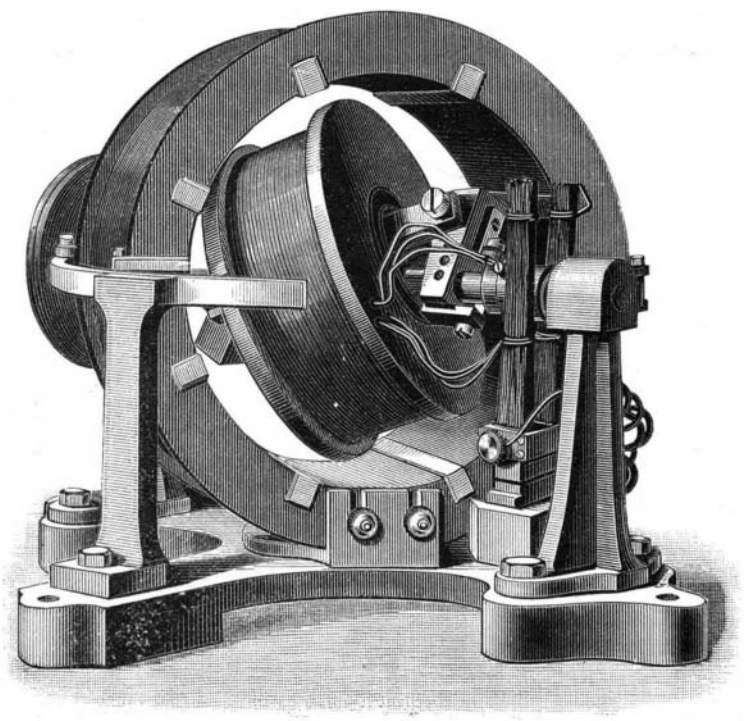
The public is at present being treated to a discussion about the fees of physicians and surgeons in connection with those handed in by the attendants on President Garfield. It is obvious, says the *Med. and Surg. Reporter*, from the amount of money placed at the disposal of the committee, that Congress did not contemplate paying claims of any such magnitude as have been put in. Probably the public also are of this way of thinking. The total amount of the fees claimed by the physicians is $85,000, or, including the relative claim, $110,000—considerably more than $1,000 a day. In spite of our desire to support the profession in its just rights, we acknowledge that this staggers us.

Improvement in the Paris Morgue.

The bodies in the Paris morgue are now frozen and kept in this condition until their final disposition. The freezing apparatus consists of a modification of the Carré method, in which the cold is produced by the evaporation of previously liquefied gaseous ammonia. But instead of water, a solution of calcium chloride, which remains liquid at a temperature of 20° F., is made the direct recipient of the cold thus generated, and is carried in pipes to the top of the building, whence it falls in cascades. The same fluid is again collected and re-exposed to the freezing machine. In this way the temperature of the room is kept well below the freezing point constantly. When bodies have become putrid or require to be kept longer than usual, they are placed in a row of cases like a set of pigeon holes, where, by means of the same apparatus, the temperature is maintained at a much lower point. The bodies which have been kept at 20° F., and which have been for weeks of stony hardness, show very little tendency to putrefaction.

JABLOCHKOFF'S NEW ELECTRIC MOTOR, THE "ECLIPTIC."

Electric motors evidently constitute one of the most enticing applications of electricity, and it is therefore not astonishing to find a goodly number of inventors always engaged with the question, notwithstanding the narrow field that limits the improvements and progress of which such apparatus are susceptible.



JABLOCHKOFF'S NEW ELECTRIC MOTOR, THE "ECLIPTIC."

In effect, the Gramme and Siemens machines which are employed as electric motors convert into mechanical power as much as 80 per cent of the electric energy furnished them, and their performance may even reach, under certain special conditions, 90 *per cent.* There is, then, little progress to be expected as regards performance. Unfortunately, these machines are as yet relatively high priced, especially when they come to be constructed of small dimensions in order to make motors of them which develop a few kilogrammeters only, for actuating sewing machines, lathes, and in general, all machine tools for small industries. For such applications there is required a motor of simple construction and of as low a cost price as possible, since the saving in price is found to more than compensate for their inferiority as regards the work yielded. It was this line of thought that led to the invention, successively, of the motors of Marcel Deprez, Trouvé, and Griscom, all of which are derived from the Siemens bobbin, and constitute more or less happy modifications of the machine constructed in 1854 by the learned German physicist. In all these motors we find two essential parts: (1) a magnetic field obtained either by the aid of permanent magnets (as in the Deprez motor), or by the aid of electro-magnets (as in the Trouvé and Griscom apparatus); (2) a Siemens double-T bobbin traversed by the current furnished by the electric source, and which, by the aid of a shell commutator arranged on the axis of revolution, changes polarity twice per revolution. It is this reversal of the bobbin's polarities that produces its rotation. Experiments have demonstrated one fact that theory should have allowed to be foreseen, to wit, that it is necessary to give the parts submitted to changes of polarity as small a size as practicable so as to reduce magnetic inertia as much as possible; the effect of the latter being to dimin-

ish the performance and velocity of the motor because of the retardation that it effects in the successive magnetizations and demagnetizations. It was Marcel Deprez, we believe, who was the first to enunciate this fact, and to thus explain the relatively feeble performance of the first motors constructed by Froment, Jacobi, Leroux, Larmenjeat, and others. It is this also that explains the relative power and effective performance of the Siemens bobbin motors, in which the magnetic mass in motion submitted to reversals of current is much smaller than in the first motors that we have just mentioned. And it explains, too, the good performance of the Gramme machines employed as motors, in which the changes of polarity are effected through successive sections.

A few inventors have gone a step further in this direction and *completely* done away with magnetic masses in that part of the motor submitted to reversals of current. The *Ecliptic* of Paul Jablochkoff, the inventor of the electric candle, belongs to this latter category, and the proem that the reader has just perused will permit us to give a description of the apparatus in a few lines.

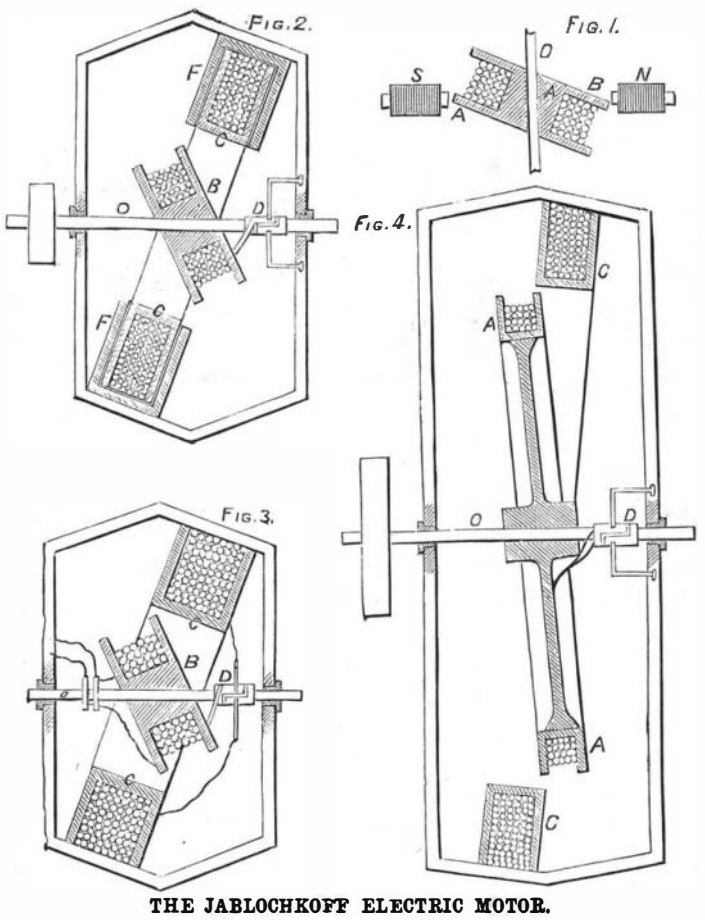
This motor consists essentially of two bobbins, one of them stationary and arranged in a vertical plane, and the other movable and fixed on a horizontal axis in an inclined position. It is to this latter position, which recalls that of the ecliptic to the equator, that Mr. Jablochkoff's apparatus owes its name. The stationary vertical bobbin is not in a vertical plane, perpendicular to the axis of rotation of the motor, but makes with such plane a certain angle that has been determined by experiment, and depends on the conditions of the apparatus's work.

The stationary bobbin is wound on a copper frame, and the movable one is fixed on an iron shell which, under the influence of the current traversing it, is converted into a short electro-magnet whose poles are formed of two circular disks. On the axis of rotation there is a commutator against which rub four brushes. This commutator is so formed that, during the rotation of the axle, the movable bobbin is traversed by a current *which never changes direction*, and preserves a permanent polarity in the flat electro-magnet; but at every half revolution the current is reversed in the fixed bobbin. The motor works, then, through the reciprocal attractions and repulsions of a movable permanent magnet, and of a fixed solenoid traversed by currents that are alternately of opposite direction. These reciprocal actions tend to produce a pivoting of the movable electro-magnet located in the interior of the fixed solenoid. The effect of the commutator's play is to cause a concurrence of these actions in the same direction, and thus to produce a continuous motion. Mr. Jablochkoff's motor is reversible, that is to say, it develops mechanical power at the expense of electricity and is capable of producing electricity at the expense of power.

We must remark here that, although the arrangement of this motor may appear to be new and original, the idea of preserving a fixed polarity in the movable part provided with an iron armature, and of reversing the current in the fixed part without iron, had already been applied by Mr. Bürgin, of Bale, to a motor which was exhibited at the Exhibition of Electricity in 1881, and which the inventor styled, because of its form, the *spherical motor*. As the experiments being made by the house Breguet with this motor are not finished, it is impossible to estimate its value from the standpoint of effective performance. But it appears to be simple in its construction; and its plainness, along with the low price at which it will be possible to offer it, constitute qualities sufficient to secure for it a goodly number of applications, provided its performance be, as is to be hoped, superior or at least equal to that of its predecessors.

Referring to the diagrams, Fig. 1 shows a simple form of machine, such as is described above. The bobbin, A, having cheeks, *a b*, of soft iron and wound with a coil of insulated wire, is fixed obliquely on the axis, O, and revolves between the poles of the electro-magnets, N and S. The obliquity of the coil is such that, in each revolution it presents the edges of *a* and *b* alternately to the poles of N and S, and alternating electric currents are set up in the coil of A. Fig. 2 shows a construction in which the coil, B, fixed obliquely on the axis, O, revolves within an oblique bobbin, C, which has an iron sheath, F, presenting interior polar edges toward the edges of B. The electric currents set up in the coil of B are collected and converted into currents of uniform direction by means of a commutator, D, of ordinary construction. In the construction shown in Fig. 3, the exterior bobbin, C, is of soft iron, constituting a solenoid.

The commutator, D, may be applied as shown, to alternate the currents in the coil of C, those in the coil of B being constant in direction, collected in the usual way, by rubbers bearing on rings, E. In this case, the internal bobbin, B, need not be of soft iron. When the machine is of large diameter, the interior coil, A, may be merely a ring of iron fixed on a wheel of non-magnetic material.—*E. Hospitalier, in Nature.*

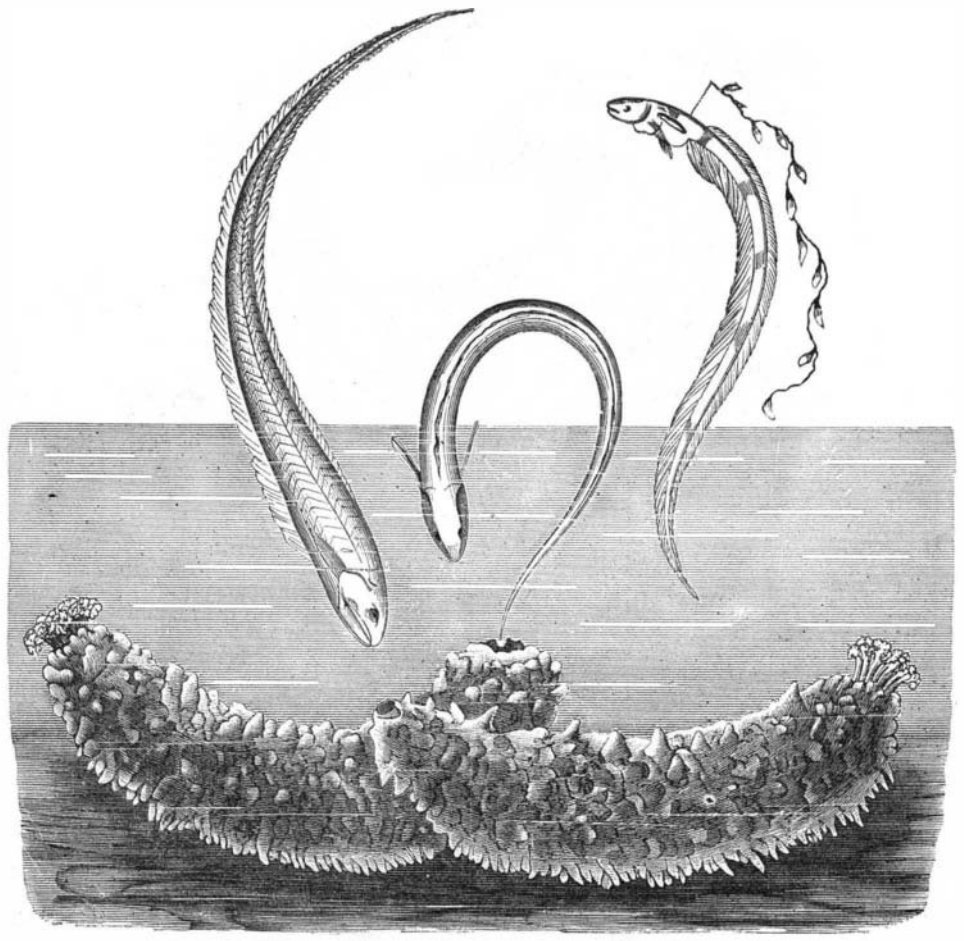


THE JABLOCHKOFF ELECTRIC MOTOR.

THE SEA CUCUMBER'S TENANT.

Among the curious phases of parasitic life which prying naturalists have discovered, the fish that lives in the stomach of the sea cucumber presents one of the most remarkable. Ordinarily the parasite is of a markedly lower type of organism than its unwilling host—the worm infests the vertebrate. In the case illustrated in the accompanying engraving, the host is greatly the inferior; the vertebrate finds its home within, if it does not also feed upon, the worm; and so far as trustworthy observation goes, the mature fish does not appear to long survive a separation from the holothurian.

The position in which the fish are shown in the engraving may, accordingly, be properly understood to be one suiting the artist's convenience only. The life history of this remarkable parasite is yet a mystery; it is probable that it enters the holothurian in early life and grows up with its host.



THE SEA CUCUMBER AND ITS TENANT.

The holothurian, thus strangely tenanted, is found on the coral reefs of Florida, in shallow water, and has received the specific name *Floridana*. It is a large species, dark brown in color, and with smaller tentacles than those of the species inhabiting our more northern coasts. It feeds upon pieces of corals and small shell fish.

An examination of the stomach of the parasitic fish, to which the name *fierasfer* has been given, would determine whether the fish shares the dinner of the host or dines upon him. The latter ingratitude is suspected, and the holothurian could probably endure it without material injury, as it is capable of ejecting its viscera entirely and speedily reproducing a new set of digestive apparatus; but the observed position of the fish, with its head to the holothurian's mouth, would rather indicate that it sought its food in materials selected and swallowed by the host. The *fierasfer* attains a length of eight inches; it is quite slender and of a silvery white color.

The *Leipziger Illustrirte Zeitung*, to which we owe our illustration, states that the young *fierasfer* carries on its back a sharp spine, to which is attached a long thread bearing a series of black and white flaps, thus mimicking a colony of jelly fish. In view of the stinging capacity of many jelly fish, it is suspected that the young *fierasfer* may secure a degree of exemption from the attacks of other fish by means of this delusive yet threatening flag.

Wire Cloth.

Wire cloth, such as is used by paper mills and for sieves, corn poppers, and hundreds of other purposes, is woven in the same manner as cotton or woolen goods, save that a large portion of the work is done on hand looms, samples of which can be seen in operation any day in factories on Cornhill, in this city, or near the Cottage Farm station on the Boston and Albany railroad. Wire cloth for window screens, requiring less care in its manufacture, is woven on power looms, and a single concern at Clinton, Mass., makes 15,000,000 square feet of this cloth per annum. The total amount of wire cloth woven by machinery for window screens alone in the United States is put down at 30,000,000 square feet per annum. For this purpose light and cheap iron wire is used.

For paper mills, cloth made of fine and strong brass wire is employed. There is no other process for making paper except by running the pulp over brass wire cloth, and this cloth has to be renewed every few months. A single firm of paper manufacturers in this city is put to an annual expenditure of $2,000 to replenish the wire cloth in its mills. As there are about 950 paper mills in the United States, it will be seen that the quantity of wire cloth required by them all is considerable.

Wire cloth, says the *Commercial Bulletin*, is sold by the square foot, and is graded according to the number of wires in an inch. Cloth which contains two meshes per linear inch or four per square inch, is designated as No. 2. That which contains 100 meshes per linear inch or 10,000 per square inch, is designated as No. 100. Cloth as fine as No. 120 is sometimes made, but it is always of brass or copper. No iron wire is used in any numbers above 40. The wire cloth used in window screens is No. 13, and that employed in flour sieves is principally No. 20. The brass cloth used by paper mills is mostly No. 60. The price of No. 2 iron wire cloth is 10 cents per square foot; that of No. 2 brass is 40 cents; and No. 2 copper is 45 cents. No. 100 brass cloth sells at $1.25 in small lots at retail, and at about $1.00 in large lots at wholesale. These prices will serve as fair examples of the value of wire cloth in general.

The Corn Starch Industry.

A conference of Western starch manufacturers was held in Cincinnati, in the latter part of October, to devise means for stopping a war of prices. Ten firms, claiming two-thirds of the manufacturing capacity of the country, agreed to consolidate their business to form a single joint stock company, and others were expected to join the combination. This action brings out the notable fact that two New York starch establishments, at Oswego and at Glen Cove, control the Eastern and foreign trade. They cannot compete for the Western trade with manufacturers in the West, owing to the double freight charges, the corn having to be brought from the West. The circumstance that the freight on corn is less than that on the starch made from it, however, together with the higher quality of the Eastern product, prevents the Western makers from controlling the entire trade.

RUSSIA estimates the value of the Siberian gold mines at $6,000,000 a year.