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THE UNITED STATES DRILLING SCOW, EAST RIVER.

It is now just ten years since the United States Government made its first grant of money for the improvement of Hell Gate and the reduction of the reefs obstructing the East River portion of New York Harbor.

During these years the appropriations have been irregular and sadly inadequate, in view of the magnitude of the work to be done and the commercial interests involved; nevertheless the prosecution of the task has exhibited some of the most noteworthy and successful feats of submarine mining ever accomplished. In no other part of the world has there been so many or such extensive removals of rock masses by blasting under water; and in no place has the work of harbor improvement been carried on under conditions so difficult, complicated, and exacting.

Our readers are already familiar with that phase of this great work which was so splendidly illustrated in the dry mining operations at Hallett's Point. There the work was done by headings run from a shaft sunk at the base of a rocky point near the shore line. At Flood Rock substantially the same method is being employed, except that in the latter case the shallower parts of the reef, which cover several acres, have been converted into an island for the accommodation and protection of the engine house, hoisting apparatus, and other necessities for dry mining.

For the removal of the more or less deeply submerged rocks and reefs, lying in the channel at Hell Gate and in that part of the harbor between New York and Brooklyn, an entirely different method had to be adopted; and though popular interest has centered almost entirely upon the more accessible parts of the work, as at Hallett's Point, the strictly submarine part has been vastly the more difficult, and has called for a far greater degree of boldness and originality in the invention of novel means and processes.

The conditions, as already noted, were peculiar and uncommonly severe. The rock masses to be removed were large; they were washed by tides of unusual force and swiftness; the channel was thronged with shipping, and, at first, the pilots were decidedly unfriendly.

The experience of the earlier contractors had demonstrated that the intentional or accidental destruction of their drilling apparatus, by collisions with passing vessels, was by no means the least of the difficulties to be obviated or overcome. The experiment of surface blasting had proved a failure, save for the removal of projecting points. To break up the broad rock masses nothing short of deep drilling and the use of high explosives would answer. This also had been attempted, but the fixed platforms supporting the drilling engines had been knocked into deep water by colliding vessels, and the devices adopted for protecting the divers

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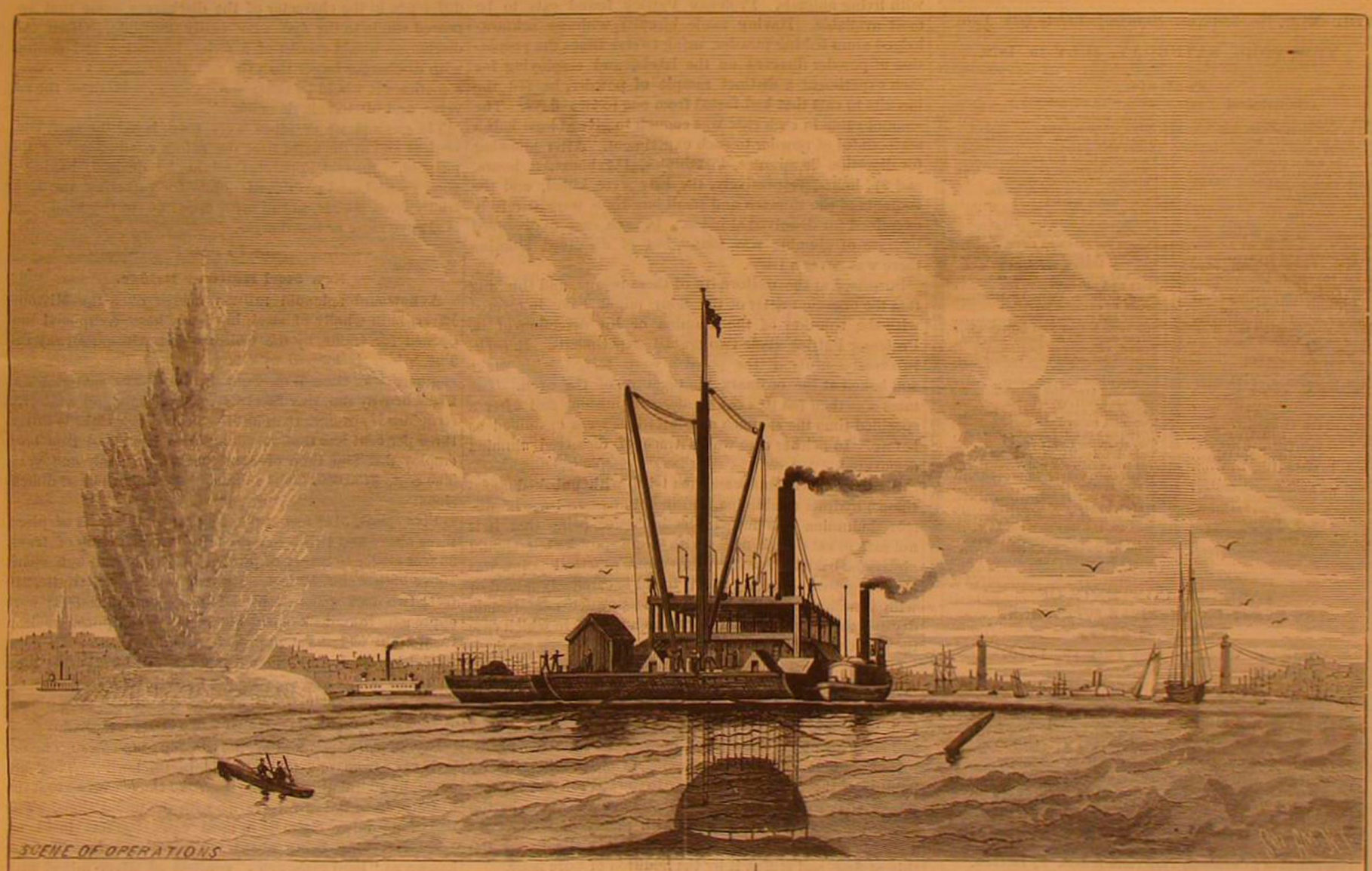
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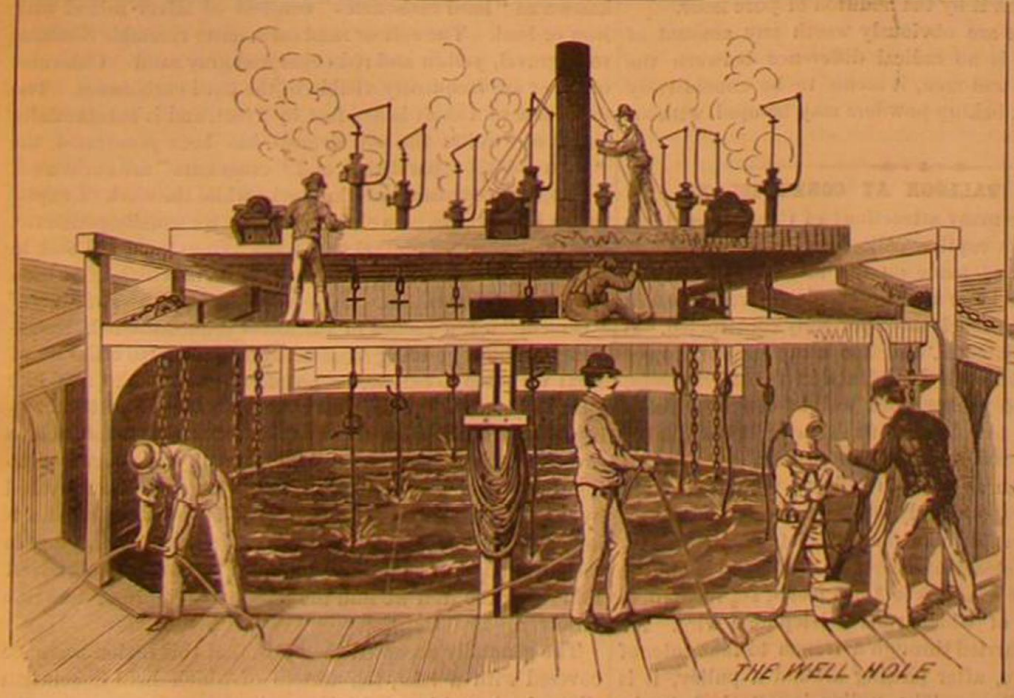
THE WELL HOLE


THE DIVER'S PREPARATIONS

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT
No. 185,
For the Week ending July 19, 1879.

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ALUM IN BAKING POWDERS.

In the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT will be found a communication from G. E. Patrick, Professor of Chemistry in the University of Kansas, giving details of a series of practical tests to determine whether the hydrate of alumina is dissolved by the gastric juice. The question has a vital bearing on the discussion as to the safety of using alum in baking powders. Professor Patrick attacks it without prejudice, by strictly scientific methods, and arrives at results which are certainly gratifying in view of the wide use of alum powders in our kitchens.

Professor Patrick takes his text from the published opinion of a prominent physician, who says, after stating the difficulties attending a thorough mixture of the ingredients of alum baking powders:

"But even if the exact proportions were maintained, the salts formed would retain their injurious properties, as they would dissolve in the gastric juice. The gastric juice contains not only lactic acid, but a large amount of hydrochloric acid, and both the sulphate and hydrate of alumina would be dissolved."

After testing by reference to authorities the statement that the gastric juice contains a large amount of hydrochloric acid, and finding the weight of evidence to be that the quantity is in reality extremely minute, and that little not free, Professor Patrick proceeds to describe his examination of the practical question whether the hydrate of alumina as it exists in bread after baking, when made with alum powders, will be dissolved in the fluids of the alimentary canal.

This question could be determined only by careful tests with living animals. Professor Patrick found cats to be most available. Having made biscuits with an acknowledged alum baking powder, using twelve times the proportion of powder directed on the labels, and employing for each experiment a distinct sample of powder, he fed the biscuits to cats that had fasted from one to two days. The amount eaten in each case was enough to give at least half a teaspoonful of powder to each experiment. After allowing for digestion 20 minutes, 45 minutes, 1½ hours, 2 hours, and 2½ hours, respectively, the cats were killed, and the contents of the stomach and small intestines were carefully examined for dissolved alumina. In each case undissolved hydrate of alumina was found, but of dissolved alumina there was never a trace.

Surprised at the uniformity of these results, and thinking that the organic matter of the flour might have interfered with the solution of the alumina or his detection of it, Professor Patrick made two crucial experiments. In each, two teaspoonfuls of the powder were mixed with water and baked at the ordinary temperature of the oven. The mass was then fed to a cat (under compulsion) and after a specified time the stomach and intestines were examined as before. In neither case was a trace of dissolved alumina discovered.

Similar experiments were then tried with unbaked (gelatinous) hydrate of alumina, and in both cases a trace of dissolved alumina was found; the inference being that it is not safe to eat dough made with alum powder—it should always be baked. Another important practical point was also suggested—namely, that if bread is carelessly mixed or with insufficient water, some of the powder may remain dry and the alum not changed to the hydrate; in which case the effect would probably be injurious.

In order to test this question, and also to furnish a check on the other experiments with biscuits, Professor Patrick had a batch made in which the mixing was less thorough than usual and with less water. These were fed to cats, and subsequent tests developed in every case a trace of dissolved alumina. These experiments, while proving the reliability of those first described, go to show, Professor Patrick thinks, that to insure the entire absence of alum in the bread, the mixing must be done with plenty of water. As a simple precaution it might be well to mix the batter too thin at first, and stiffen it by the addition of pure flour.

Tests of this nature are obviously worth any amount of theory; and if there is no radical difference between the gastric juices of cats and men, it seems to be conclusively established that alum baking powders may be used without injury to health.

THE CAPTIVE BALLOON AT CONEY ISLAND.

Not the least of the many attractions of Coney Island this summer is Mr. King's captive balloon, "Pioneer," the first ascension of which was made on the afternoon of July 1. This balloon is not as large as the Giffard captive balloon at Paris, but is said to be much more perfectly constructed. It is sixty-five feet in diameter, and has a capacity of 150,000 cubic feet. The material is Irish linen in two thicknesses. The basket or car of wicker work weighs 476 lb. Above the balloon is white, to reflect the sun's rays; below it is ornamented with dark red and green, to make it a conspicuous object against the sky. It is inflated with hydrogen, and in calm air shows on the dynamometer a lifting strain of 1,400 lb. The gas is made on the spot by Mr. A. O. Granger, by passing steam over hot iron. Wound about the drum of a very large windlass is 1,215 feet of 1½ inch rope, through the center of which runs a telephone wire. An end of this rope is carried through a trench to the center of the inclosure, where, after passing around a pulley, it is fastened to the balloon. The pulley is attached to the foundation by a universal joint of iron, so that, in whatever direction the balloon may pull, there will be no side strain on the pulley. A good hold on the sand is secured by the use of four sticks of yellow pine, each 12 feet long and 12 inches square. These are planted horizontally nine feet below the surface, and above them is a well, made of concrete. Across the top of the well lie two other similar timbers, which are strongly fastened to their fellows below by long and thick iron bolts. Mr. King says this foundation will resist a strain of 100,000 lb., while the utmost strain that wind and gas united can exert on the connecting rope of the balloon will not exceed 22,000 lb.

On its trial trip the balloon ascended three or four hundred feet, and shortly afterwards a second trip of seven hundred feet was made. At this height the view was pronounced magnificent by the small party making the first venture. All the ocean approaches of New York harbor were at their feet for a radius of thirty miles; and inland they could see the numerous towns and cities about the bay of New York. Along the Sound to Flushing, up the Hudson River as far as Tarrytown, and the Orange Valley, and other parts of New Jersey as far as Paterson, Perth Amboy, and Long Branch.

THE TELEPHONE AS A LIGHTNING INDICATOR.

Mr. George M. Hopkins, of Brooklyn, N. Y., during a recent thunder storm connected the gas and water pipes of his dwelling with an ordinary Bell telephone, and discovered that the electrical discharges were plainly indicated, either by a sharp crack or by a succession of taps. This occurred when the discharge was so distant that the thunder was inaudible. The sound also seemed to be perceived by the ear before the lightning could be seen. There was a marked difference in the character of the discharges, some that appeared single to the eye were really multiple. Often the discharges would consist of a series, beginning and ending with discharges larger than the rest, thus: —- - - - - -—, sometimes it would be thus: —- - - - -, sometimes the reverse, and often a single crack.

The gas and water pipes were used, being the most convenient and at the same time the safest conductors for the purpose. Special apparatus might be devised, having a good ground, and a series of points for gathering the electricity from the air, but in using apparatus of this kind there is always more or less danger.

New Steel Railway Bridge.

A new and splendid railway bridge over the Missouri River, built wholly of steel, has lately been completed and opened for traffic by the Chicago and Alton Railway Co. The bridge is located at Glasgow, Mo. The constructing engineer was Gen. Wm. Sooy Smith. The material was furnished by the Hay Steel Co., of Chicago, and while the structure is stronger than an iron bridge its weight is thirty-three per cent less than it would have been had iron been employed. The time of construction was only one year. The cost, $450,000. The following are the principal dimensions:

Five spans, 314⅔ feet each, from center to center of piers, three above and two below grade; all steel; depth of truss, 36 feet center to center of pins. Height of through spans above high water, 50 feet. East approach, iron trestle, 210 feet; two deck spans of iron, 140 feet each, 280 feet; west approach, iron deck span, 140 feet; west approach, iron trestle, 510 feet; west approach, wooden trestle, 864 feet total length of the bridge proper (steel) 1,573⅓ feet; total length of bridge and approaches, 3,577⅓ feet.

The Silver Deposits of Leadville, Colorado.

Says a correspondent of the Boston *Advertiser:* The ore beds vary from one to forty feet in thickness. They are generally undulating like the waves of the ocean, so that the distance from the surface varies with the undulations. The size of a mining claim is in most cases 300 feet inside by 1,500 feet long, being about ten acres in area. The ore known as "hard carbonates" consists of silver mixed with iron or lead. The soft or sand carbonates resemble common road gravel, yellow and red ocher and gray sand. Chlorides of silver are frequently visible in the hard carbonates. The usual size of a shaft is 3½ feet by 7 feet, and is substantially timbered. After the ore deposit has been penetrated, the "main entry," "parallels," and "cross cuts" are excavated, leaving the remaining ore in blocks while the work of exploration is going on. In sinking a shaft we usually penetrate, first, a deposit of gravel or "wash" from 20 to 100 feet in thickness, frequently containing bowlders which have been subjected to abrasion. Not unfrequently a stratum of "cement" a few inches in thickness is encountered, resembling Roxbury pudding stone or an old cemented cellar floor. Next we come to calcite, or porphyry—sometimes soft like "fire clay," either pure white, gray, or red—the latter showing an iron stain. The soft porphyry runs from one inch to several feet in thickness. The hard porphyry is often "picking ground" (*i. e.*, porphyry rock, which can be excavated by means of a pick), but frequently it is blasting or "shooting rock." Following the porphyry is iron ore, varying in thickness and sometimes containing a few ounces of silver. Following the iron we find the "pay ore," more or less rich in silver.

The generally accepted theory is, that this region was once covered with a lake, the waters of which held in solution silver, lead, and iron, which were in time precipitated on the bottom of the lake. The porphyry, gravel, etc., were subsequently deposited. After the precipitation came the age

of disturbance, when by volcanic action or the shrinkage of the earth's crust the deposits became contorted, sometimes tilted or broken like a "chop sea," or gently undulating like the "ground swell" of the ocean.

Farming Implements in Morocco.

An undeveloped yet promising market for farming implements is reported in Morocco by U. S. Vice-Consul John Cobb at Casablanca. In a recent communication that officer, who takes a lively interest in the promotion of American trade, writes that farming implements are much needed in that country, no improvements having been made there in that line since the days of Mohammed the Great, nearly 1,300 years ago. Mr. Cobb believes that our manufacturers will find a large field for operations there, as many of the Moors have money and are particularly fond of useful inventions. They are very conservative, however, and must see an article in use or under conditions in which it can undergo a thorough investigation before they can be made to believe in it. American goods are favorably received by them, and can be made to take the lead. Possibly our manufacturers interested in the export trade may find it worth while to correspond with Mr. Cobb.

PECULIAR STEAM WHISTLING.

Some of our river pilots have become so proficient in the use of the steam whistles of the boats under their charge as to be able to make sounds that are almost articulate in their signification of the wishes or the feelings of the pilots.

Recently a large steamboat, well laden with passengers, was unable to reach its dock on account of a row-boatman who, while leisurely rowing about, had been surprised by the sudden appearance of the steamboat, and in his efforts to get out of its way became confused, and by rowing first one way and then another, annoyed the steamer's pilot; and he, apparently becoming impatient at the delay, expressed his feelings by causing the steamer's whistle to emit a series of short peculiar whistle sounds, which expressed something to the effect of, "Come! come! take one way or another, and get out of my road some time to-day," so plainly that some of the passengers of a neighboring boat noticed it, and one, laughingly referring to the whistling, said: "That is almost equivalent to swearing by steam." The row-boatman seemed to understand it, for he immediately took one way and got out of the steamer's course.

And again the other day we heard the steam siren whistle of one boat caused to salute another, in a most laughably sarcastic manner, as if to say: "Why! how do you do?" The pilot of the other boat endeavored to respond in the same tone, but probably because his boat's whistle was of a different style, he was only able to make it sound something like the first crowing efforts of a chicken.

We have some of the best pilots in the world to manage our river steamboats; and perhaps very few persons think of the great responsibility resting on these men. At times a moment's delay, resulting, perhaps, from sudden sickness or slight mistake of the pilot or engineer, would end in a fearful loss of life and property, and yet accidents rarely occur. We hope, however, that the steam whistling proficiency above mentioned will not lead to any mistakes in regard to the correct interpretation of the established code of whistle signals.

L. L. D.

MOLECULAR CHEMISTRY.—No. 4.

H. Schroeder began the study of molecular volumes of solid bodies in 1840, and he has continued it up to the present time. His views, which have been repeatedly modified by his researches extending over so long a period, may be stated as follows in their matured form.

In any mechanical fraction of a uniform mixture, or of a compound, the constituents are contained in exactly the same proportions by weight as they are in the whole mass. The same must hold true for the proportions by volume, provided the given substance is homogeneous. Thus, in detonating gas, made by mixing two volumes of hydrogen with 1 volume of oxygen, we may say that H has the volume 2 and O the volume 1, although in reality both are diffused throughout the space represented by their combined volumes, 3. When the mixture is exploded we get only 2 volumes of H_2O instead of 3. The condensation so produced may be viewed in two ways. We may suppose that the compound is condensed as such, or else that its constituents suffer a change of volume before entering into combination, and that the volume of the compound is the sum of the volumes of its condensed constituents. The law of multiple proportions by weight may thus be made applicable to volumes. Experience has shown that every element varies so much in volume throughout the series of combinations into which it enters, that the volume of its molecule may be 2, 3, 4, 5, 6, etc., times as great in one compound as in another.

Among these numbers the factor 2 predominates just as it does in gases, where, for example, H_2 is first condensed to 1 volume and then combines with O to form 2 volumes instead of 3. In the case of solids these condensations of volume seem to depend on the forces that cause bodies to crystallize, since an element belonging to two bodies that have the same crystalline form (isomorphous bodies) is usually condensed equally in both. In other words, the volumes of elements common to a number of isomorphous bodies are generally the same. The volume of potassium (K) found, as has been explained, by dividing its molecular weight by its density, is 45·3; that of sodium (Na) is 23·9; difference, K – Na = 21·4. The difference in the volumes of their chlorides, KCl = 37·4 and NaCl = 27·1, is 10·3, or practically one half the difference of the metallic volumes of K and Na. The same result is obtained from the bromides: KBr = 44·3, NaBr = 33·4; difference, 10·9. And from the iodides: KI = 54, NaI = 43·5; difference, 10·5. Now considering the Cl volume the same in both chlorides, the Br volume the same in both bromides, and the I volume the same in both iodides, it is evident that the metals in these compounds have been condensed to one half their original volumes.

When other metals are compared in this manner with their isomorphous compounds it was found that in pairs containing strontium and lead, sodium and silver, magnesium and nickel, aluminum and iron, the heavy metals often entered into combination with their volume unchanged, while the light metals were condensed one half. Schroeder believes that this occurs too frequently to be accidental. In the rhombic sulphates and carbonates of strontium and of lead, in their oxides, in the bromides, chlorides, and iodides of sodium, and of silver, etc., the differences of volume are equal to the unchanged volume of the heavy metal minus one half the volume of the light one.

While comparing the volumes of numerous compounds in this manner Schroeder was struck by the fact that the oxygen in quartz would have exactly the same volume as the silicon associated with it, on the supposition that the silicon retains the volume that belongs to it in the free state. Finding similar relations in other compounds, he conceived the idea that the molecular volumes of the constituents might have a common measure of which they are all multiples. To this common measure he gives the name of stere. A few examples will illustrate his meaning:

Volume KI = 54·0	KCl = 37·8
NaI = 43·2	NaCl = 27·0
K – Na = 10·8	K – Na = 10·8 = 2 × 5·4
Volume NaI = 43·2	NaCl = 27·0
LiI = 37·8	LiCl = 21·6
Na – Li = 5·4	Na – Li = 5·4 = 1 × 5·4
Volume RbI = 70·2	RbCl = 54·0
KI = 54·0	KCl = 37·8
Rb – K = 16·2	Rb – K = 16·2 = 3 × 5·4.

Again, twice the volume of LiCl (2 × 21·6) is equal to the volume of NaI (43·2); twice NaCl (2 × 27·0) = KI (54·0), etc. Hence 1 volume I = 2 volumes Cl, 1 volume Na = 2 volumes Li, and 1 volume K = 2 volumes Na. We have found, then, that these substances, as well as their differences, have a common measure; and this is what Schroeder means by the expression that they have the stere 5·4.

But this is not all. Comparing still further, we get the following differences of volume:

RbI = 70·2	KI = 54·0	NaI = 43·2	LiI = 37·8
RbCl = 54·0	KCl = 37·8	NaCl = 27·0	LiCl = 21·6
I – Cl = 16·2	I – Cl = 16·2	I – Cl = 16·2	I – Cl = 16·2 = 3 × 5·4

In other words, iodine and chlorine have the same stere as the metals with which they are in each case associated. From these and many analogous examples Schroeder has quite recently generalized the proposition: "In every compound a definite volumic measure or stere predominates and causes all the components to subordinate themselves to it."

As many isomorphous bodies, such as KCl and NaCl, magnesite and calcite, potassium sulphate, selenate and chromate, have the same stere, it was natural to connect the latter with the crystalline form. Further extensive research has shown, however, that the stere does not depend directly upon the form; that there are isomorphous bodies with unlike, and heteromorphous bodies with like steres. It was found that the stere of a compound is determined entirely by that of one of its elements, which impresses its own stere on all the rest. The fact that isomorphous bodies so often have equal steres is explained by the reason that their controlling elements are also isosteric. Thus the rhombohedric carbonates of magnesia, manganese, and lime, are isosteric because Mg, Mn, and Ca have the same stere. From these observations Schroeder deduces the following law, which he calls the steric law: "In every compound the stere of one of the components predominates, in consequence of the forces active during crystallization, and impresses itself upon all the others." For example, the stere of silver (Ag) is 5·14, one half the volume 10·28, calculated from its density and equivalent. AgCl has a volume of 25·70 or 5 × 5·14; AgI = 41·1, or 8 × 5·14; AgBr = 30·84, or 6 × 5·14; Ag_2O = 30·8, or 6 × 5·14; $C_2H_3O_2Ag$ = 51·4, or 10 × 5·14. All these volumes are exact multiples of the silver stere, and consequently the other elements associated with silver must also have assumed volumes divisible by 5·14, as the law requires.

The steres of all the elements hitherto determined lie between the narrow limits of 5·0 and 6·1. Thus carbon has a stere of 5·11, which it impresses on a series of organic bodies; phosphorus and arsenic cause most of their compounds to assume the stere 5·3, etc.

In Liebig's *Annalen* for 1874, and more recently in the report of the session of the Munich Academy of Sciences, December 1, 1877, Schroeder shows the applicability of his law to five important groups:

1. Silicon, quartz, sillimanite, disthene. Stere, 5·65.
2. Aluminum, corundum, chrysoberyl, diospore, andalusite. Stere, 5·14.
3. Magnesium, periclase, spinelle, olivine, diopside, humite, and garnets. Stere, 5·52.
4. Oxides and silicates of manganese. Stere, 5·52.
5. Sulphides and arsenides of iron, cobalt, nickel, copper, zinc, and lead.

Those who desire more detailed information on these points are referred to the above memoirs, and also to Liebig's *Annalen* for 1878, and to the Berlin *Chem. Gesell.* for May, 1878.

A very important corollary follows from Schroeder's law. If bodies combine only in whole volumes or steres, we can determine the molecular constitution of solids, because their molecules must contain a sufficient number of atoms to bring out the volume of each constituent as an entire multiple of the controlling stere. Thus the volume of silicon determined from its density was found to be 11·3, and its stere is consequently 5·65. To express the fact that the silicon molecule occupies two steres, Schroeder writes Si_1^2, the upper right hand exponent representing the number of steres, and the lower the number of atoms. Now the volume of quartz, to which allusion has been made before, is just double that of silicon; consequently it contains four steres, two of which belong to oxygen, and its molecular formula is written $\overline{Si_1^2}\ O_2^2$, with a line over Si to show that the compound is controlled or dominated by the silicon stere. In his calculations Schroeder marks the steres with a line drawn above, and the volumes with a line drawn below the figures; thus, $\overline{Si_1^2}\ O_2^2 = 4 \times \overline{5·65} = \underline{22·6}$. Take another example:

Corundum $\overline{Al_2^2}\ O_3^3 = 5 \times \overline{5·14} = \underline{25·7}$. This means that in corundum, as in most oxides, each oxygen atom occupies one stere; that aluminum is present with one half its metallic volume, $\frac{10·28}{2} = 5·14$; that the aluminum stere 5·14 impresses itself upon all the atoms present; and that the observed volume of corundum, 25·7, is made up of the equal volumes of five such atoms, two of aluminum and three of oxygen.

But this is not all. If the atomic weights are taken in grammes, the volumes will be expressed in cubic centimeters; thus $\overline{Ag_1^2} = 2 \times \overline{5·14} = \underline{10·28}$ means that one atom of silver or 108 grammes occupies a space of 10·28 cubic centimeters, or of two silver steres, each equal to 5·14 c.c.

A few examples will suffice to show the manner of arriving at the molecular formulas of compounds.

The observed volume of chloride of silver is 25·7, as has been stated before. This is equal to five silver steres (5 × 5·14 = 25·7). As two of these belong to the silver present, we have left three for the chlorine, and we write $\overline{Ag_2^2}\ Cl_3^3 = 5 \times \overline{5·14} = \underline{25·7}$.

The observed volume of iodide of silver is 41·12, or eight times the silver stere. Subtracting two steres for Ag, there remain six for the iodine, and we have $Ag_2^2\ I_6^6 = 8 \times \overline{5·14} = \underline{41·12}$.

The observed volume of bromide of silver is 30·84, or 6 × 5·14. Our formula is, therefore, $Ag_2^2\ Br_4^4 = 6 \times \overline{5·14} = \underline{30·84}$.

The volumic constitution of the iodides and chlorides of the alkaline metals is determined from the data already given:

$K_1^4\ I_1^4 = 10 \times \overline{5·4} = \underline{54·0}$	$K_1^4\ Cl_1^3 = 7 \times \overline{5·4} = \underline{37·8}$
$Na_1^2\ I_1^4 = 8 \times \overline{5·4} = \underline{43·2}$	$Na_1^2\ Cl_1^3 = 5 \times \overline{5·4} = \underline{27·0}$
$Li_1^1\ I_1^4 = 7 \times \overline{5·4} = \underline{37·8}$	$Li_1^1\ Cl_1^3 = 4 \times \overline{5·4} = \underline{21·6}$

Rubidium was found to contain three steres more than potassium; we have, therefore:

$Rb_1^7\ I_1^4 = 13 \times \overline{5·4} = \underline{70·2}$	$Rb_1^7\ Cl_1^3 = 10 \times \overline{5·4} = \underline{54·6}$

Again, rubidium was found to have double the volume of ammonium, and we must, therefore, write $Am_2^7\ Cl_2^6 = 13 \times \overline{5·4} = \underline{70·2}$, or twice the observed volume 35·1. The bromides have been calculated in the same way.

The difference in the densities and volumes of the two varieties of cinnabar is explained as follows: Amorphous black cinnabar is $\overline{Hg_2^2}\ S_2^2 = 11 \times \overline{5·52} = \underline{60·72}$, or twice the observed volume 30·36; while red rhombohedric cinnabar is $Hg_2^2\ S_2^2 = 11 \times \overline{5·30} = \underline{58·30}$, or twice the observed volume 29·10. In the black variety the mercury stere predominates, while the red is ruled by the sulphur stere.

Schroeder has the modesty to call his steric law simply a hypothesis, but he believes that it will force its way into general acceptance; and he concludes his memoir with the following general statements. Bodies combine only in whole volumes having whole steres, just as they have only whole atoms. Simple volumic relations are perceived in gases at equal temperatures and pressures, in liquids at temperatures producing an equal tension of their vapors, and in solids when the steres of their controlling elements are ascertained.

C. F. K.

Formation of Coal.

E. Fremy holds that there are several kinds of isomeric cellulose, constituting the skeleton of plants. Coal is not an organized substance. The vegetal impressions presented by coal are produced as in shales or other mineral matters. The chief substances contained in the cells of plants under the double influence of heat and pressure produce bodies having a great analogy to coal. The pigments, the resins, and the fats of leaves, if submitted to heat and pressure, yield compounds which approximate to bitumens. The vegetable matter which gave rise to coal has undergone, first, the peaty fermentation, the coal being then formed by a secondary transformation.

H. W. WILEY finds that one part of uranine in one million parts of water is readily detected by means of the spectroscope.

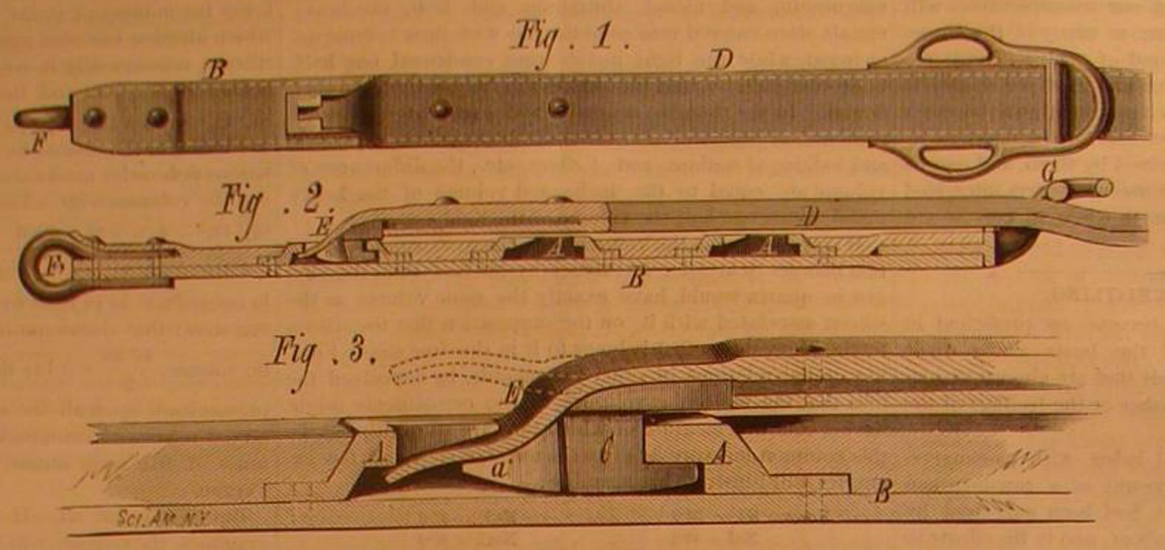
AN IMPROVED TUG COUPLING.

The annexed engraving represents an improved tug coupling recently patented by Mr. P. B. Hirsch, of 374 Blake street, Denver, Col. It is applicable to both light and heavy harness, and is easily coupled or uncoupled without twisting or turning the trace.

The metal boxes, A, are firmly embedded and riveted in the cockeye portion, B, of the coupling, and are slotted and recessed to receive the hooked metal tongue, C, secured to the trace portion, D, of the coupling. The shank of the tongue, C, is firmly riveted in the part, B, and turns downward and inward, forming a strong hook. When the tongue is inserted in one of the boxes, A, and pulled so that the hook enters the recess in the box the adjustment is complete. The flexible leather tongue, E, is then thrust into the wider part of the slot in the box, over the spur, *a'*, to prevent the accidental disengagement of the hook.

The inventor claims important advantages in regard to strength, convenience, and durability, and appearance over the ordinary forms of coupling.

Further information may be obtained by addressing the inventor as above.



HIRSCH'S TUG COUPLING.

A NEW WATER METER.

It is a well known fact that three fourths ofthe water supplied to consumers in all cities is wasted through carelessness, leaky pipes, bad plumbing, and open faucets. The unsuccessful efforts of city authorities have shown that the waste cannot be regulated and the difficulties obviated except by the use of water meters. By their use the supply would be diminished, the water taxes reduced, and each consumer would pay only for what he used—not for what his neighbor wasted. The trouble has been in the past that meters could not be made so cheap that their use could be made general. A meter must be mechanically perfect; a perfect register; certain and positive in its motion; without a dead center and a disposition to stop. A machine of such peculiar and delicate essentials is not easily obtained at a small expense.

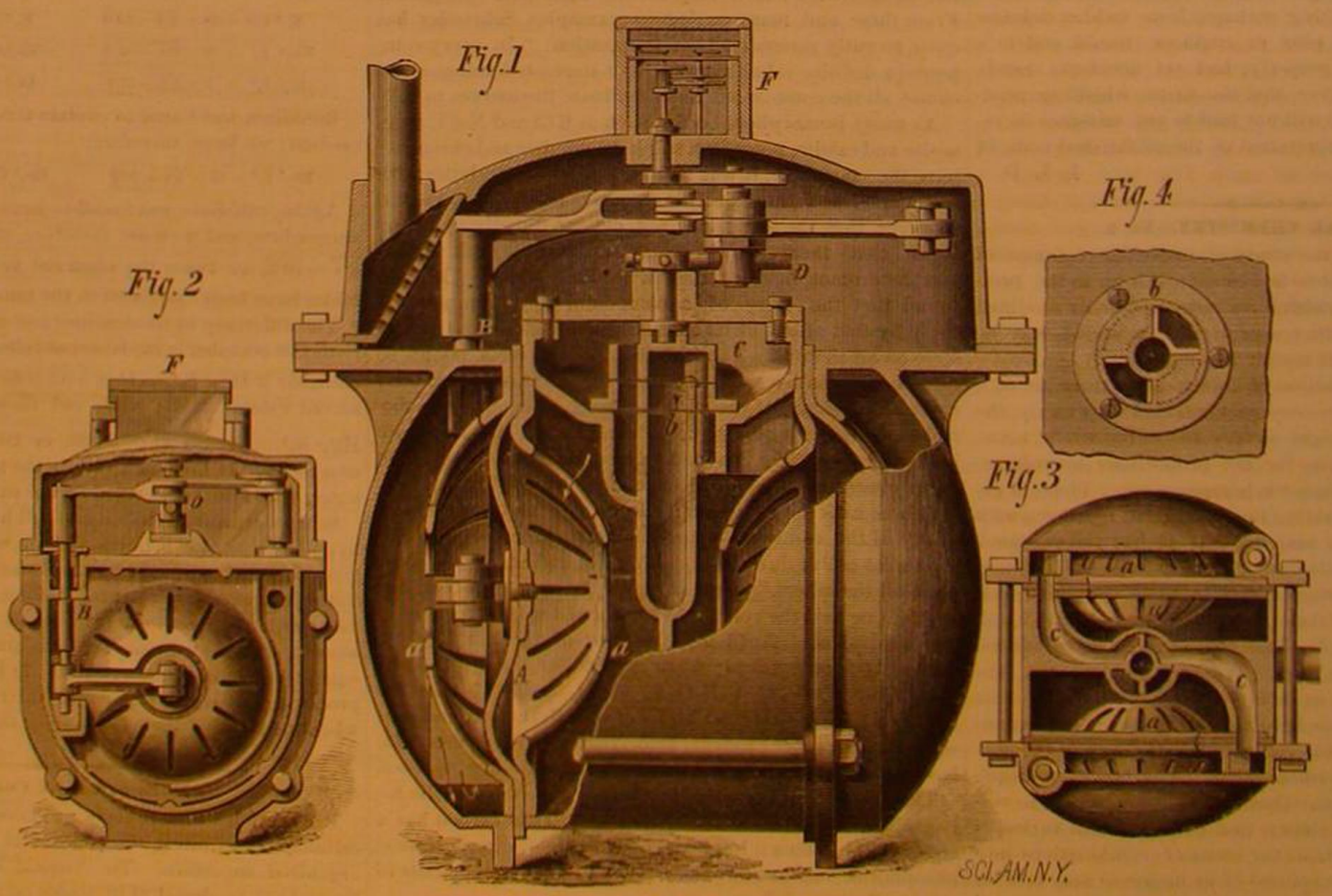
Mr. W. B. Mounteney, of the People's Gaslight and Coke Company, of Chicago, Ill., has after four years of thought and work invented a meter which he has named "The Mounteney Diaphragm Meter," and for which he claims all the excellences which such a machine should possess. It is said that the registering dial hand moved as regularly under the lightest as under the fullest pressure, and that a cubic foot of water is as accurately measured when drawn by drops as when drawn through a five eighths pipe with full pressure. The machine is noiseless and frictionless, and simple and durable in its construction, and as it is made of unfinished castings it can be made cheap.

The general form of the apparatus is shown in Fig. 1 which is a side elevation partly in section; the other figures represent details not clearly shown in Fig. 1.

The upper part of the meter chamber receives the water from the supply pipe, and contains the levers that actuate the registering mechanism and the rotary valve, C. The lower portion of the meter is divided into four compartments by a central rigid partition and the two flexible diaphragms, A. The latter are placed between concave metallic diaphragms, *a*, which are slotted to insure the easy detachment of the rubber diaphragm, and to agitate the water so as to prevent the accumulation of sediment. The rubber diaphragms are connected with the arms of the rock shafts, B, and the latter extend into the upper or receiving chamber through a simple and very effective stuffing box, and are provided with arms which are connected by links with a crank on the shaft of the valve, C. The registering mechanism at the top of the casing receives its motion from the crank on the valve shaft, and accurately records the oscillations of the diaphragms, and consequently indicates the amount of water consumed. The entrance and eduction of water to all of the compartments is controlled by the rotary valve, C, which is operated by the diaphragms through the medium of the shafts and levers already described. The water under pressure is alternately conducted to and allowed to flow from opposite sides of the pair of diaphragms, so that both diaphragms are made to traverse alternately backward and forward as the chambers are alternately filled with a measured quantity of water, which will be accurately indicated by the index and dial of the registering apparatus.

It will be noticed that this meter contains no pistons or other parts that are liable to corrode, and stick or get out of repair.

Further information may be obtained from Mr. William B. Mounteney, 39 and 41 So. Halsted street, Chicago, Ill.



MOUNTENEY'S DIAPHRAGM METER.

New French Torpedo Vessel.

The Compagnie des Forges at Chantiers de la Méditerranée have just supplied to the arsenal at Toulon a torpedo boat, whose length is 110 feet and width only 10 feet, the draught of water not exceeding 38 inches. The speed attained by this vessel at the official trials is stated to have averaged 19 knots per hour. In the front of the vessel is a chamber furnished with a tube to receive a Whitehead torpedo of the largest dimensions. When it is desired to launch the projectile the front of the vessel is opened by special mechanism, and the torpedo is projected into the water, either by means of a jet of steam or compressed air. As soon as the Whitehead torpedo has left the projecting tube it is propelled automatically by means of the motor contained within it, and pursues its course toward the object of attack at a speed exceeding 20 knots an hour.

Threatened Failure of the European Silk Crop.

The London *Saturday Review* reports that serious fears are entertained of a failure in the European silk crop. The countries which grow silk are Italy, France, and Spain, in Europe; and in Asia, China, Japan, India, Asia Minor, and Syria; to which has lately been added America. The American production, however, is so small that it may be left out of account. Asia Minor and Syria were once producers on a very large scale, but have long ceased to be so, and the Spanish crop has also become insignificant. Even France is rapidly falling off in her cultivation of the silkworm. Practically, therefore, manufacturers now depend for their supply on Italy and the far East. In Europe, we may say roughly, the Italian crop exceeds the French, upon an average, nearly four times, while the French exceeds the Spanish in a still greater proportion. We may further illustrate the important position occupied by Italy in this industry by saying that, while a good Italian crop is expected to yield about 80,000 bales, the average import from China to Europe falls short of that amount by about 15,000 bales. A failure of the Italian crop means, therefore, in effect, a failure of the European supply. Now, it is said that not only in Italy, but in France and Spain also, the intense frosts of the spring have fatally injured the cocoon. The badness of the weather, moreover, has so checked vegetation that there are not sufficient leaves for the worms, among which there is, in consequence, very great mortality. And, in addition to all this, it is feared that if heat now sets in the damage will become irremediable, as the leaves of the mulberry will be dried up altogether.

To a large extent the excitement that prevails is founded upon mere apprehension, and it is possible that matters may not turn out nearly as badly as is feared. Much may happen before harvest. But it is not to be forgotten that the injury done by the severe frost on the night of April 14, 1876, was never repaired. During the two months which followed that disaster reports were in circulation similar to those now current, but they were set down to the designs of speculators. At the end of June, however, they were found to be correct, and a sudden and extraordinary rise of price was the result. Persons interested in the trade remember all this, and are resolved not to be caught a second time. There has, therefore, been a great deal of speculative buying, and in consequence a sharp upward movement of the market during the past fortnight. Yet it does not necessarily follow that the experience of three years ago is about to be repeated.

In the trade itself the accepted estimate is that one third of the Italian crop is irreparably damaged.

From Lyons the reports are equally unfavorable. If this estimate proves correct, the European supply will fall short by, at the least, 30,000 bales. In other words, the average annual import from China would need to be increased fifty per cent to make up for the loss in Europe.

Of course we say this merely by way of illustration. The silks of India and Japan are more like those of Europe than the Chinese, and they would naturally be drawn upon more largely by European manufacturers. All these countries would therefore contribute their quotas; yet, even so, it is not to be expected that they would be able to furnish anything like the full amount. The harvest in the far East is already completed, and is said to be abundant in quantity and excellent in quality. But the cultivation was adjusted to meet an average demand. The European failure was not, and could

not have been foreseen, and consequently means do not exist of supplying this year in full measure the European deficiency, supposing it to occur. Assuming, therefore, that there is not an extraordinary falling off in the consumption, there must be a very great rise in the price of raw material.

In New York the prices of silk goods have lately been advanced.

Coal on the Pacific Coast.

The San Francisco *Journal of Commerce* reports a prospect of an abundant supply of high grade bituminous coal from Washington Territory. Among the latest beds discovered are the Carbon Mines, on Carbon River, Pierce County, 1½ to 3 miles southwest of the Northern Pacific Railroad at Wilkinson Station. They consist of five claims of 160 acres each, on which twelve coal veins have been opened. All of these can be worked by a cross cut of less than 600 feet. The coal beds, as far as they have been exposed, extend 2½ miles in length and have a thickness of 115⅝ feet.

The quantity of coal that can be moved without pumping is estimated at 26,000,000 tons. At the present rate of consumption in California this would last over forty-seven years. The coal is of all grades, from the semi-anthracite to the richest bituminous, and will supply qualities for steam, grate, domestic, forge, gas, and smelting purposes. These coals are all free from sulphur, and make from 64 to 75 per cent of splendid coke for smelting purposes. The cost of mining and delivering in San Francisco will be $4.50 to $5 per ton, so that selling at $6 per ton a very handsome profit will be made. An assay made by Henry G. Hanks, gives the following as the composition of this coal:

	Per cent.
Fixed carbon	57·9
Volatile combustible matter	35·0
Ash	5·8
Water	1·3
Total	100·0

"This shows," the *Journal of Commerce* remarks, "that they are equal in quality to any coals ever sold in San Francisco, and they may by and by be expected to lead the market. The thickness of the veins now open to view is 115⅝ feet, as against 85 feet for that of all the other veins yet opened on the Pacific Coast.

The Way to Wealth.

The Rev. Dr. R. D. Hitchcock, who is not only a prominent theologian, but a profound thinker, says: "Suppose no muscle is put into the land; no sweat moistens it; it goes back into its original wildness, and that which formerly supported one hundred civilized men, affords support for one savage. The value which land possesses has developed by labor. Have you considered how short-lived labor is? Crops last no more than a year. Railways, so long as you stop work upon them, go to pieces rapidly and cease to be valuable. Houses have to be made over constantly. St. Peter's Church, at Rome, one of the most solid of structures, is repaired annually at a cost of $30,000. [The Reverend Doctor might have added, mechanics actually live in houses erected on the top of St. Peter's, that they may watch for any defect and attend to any leak in the roof.—EDS.] A great part of the wealth of the world is only 12 months old; when men stop working it passes away. Suppose you earn $1.25 a day and spend the same, at the end of the year you are no better off than at the beginning. You have only lived. Suppose you spend $1, or, better still, 85 cents; then you have become a capitalist. Capital is wages saved, and every man can become a capitalist. I began to preach at $550 a year; I've been there, and know what it is. My rule was then, and has been ever since, to live within my income. So it would have been, no matter what my business. Spend less than you earn; then you will acquire capital, and your capital will be as good as that of any other man."

Seeds of Camellia Japonica.

The seeds, after being freed from their oil by pressure, are exhausted with alcohol, the alcoholic solution precipitated by lead acetate, and the yellow precipitate thus produced decomposed by sulphureted hydrogen; on evaporation, a bluish-white powder of bitter taste is obtained, which the author calls "camellin." This substance is almost insoluble in water, and, when boiled with sulphuric acid, reduces alkaline copper solutions; it appears by other reactions to resemble digitalin, and has the molecular formula $C_{32}H_{44}O_{12}$. Boiled with dilute sulphuric acid it yields only a small amount of sugar, showing that it is decomposed only with great difficulty or else that other substances are produced. The alcoholic filtrate, after separation of the precipitate produced by lead acetate, leaves, when evaporated, a residue of a yellow color and bitter taste, which contains sugar and tannin, and perhaps another glucoside. The Japanese consider the seeds to be a poison, and the oil was formerly used to oil the swords of Japanese warriors.

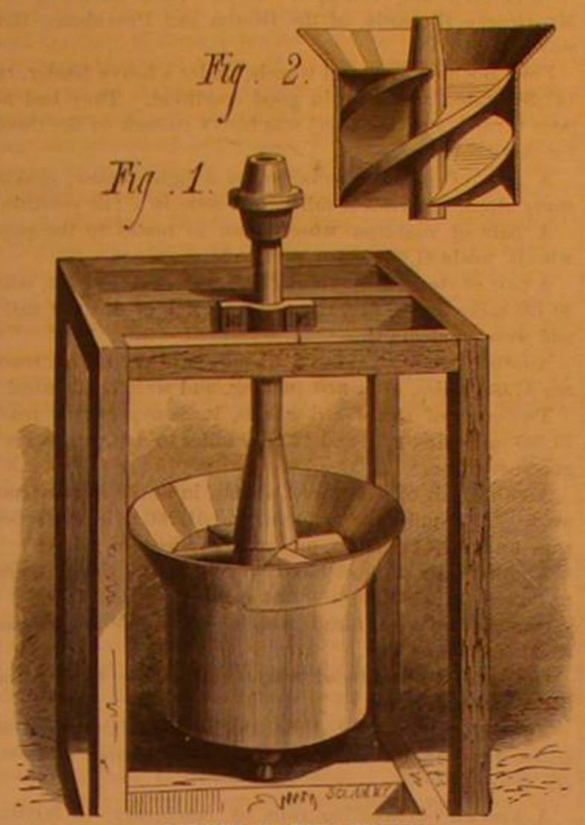
Fluorescence.

J. L. Soret has already pointed out the beautiful violet fluorescence of solutions of cerium sulphate and chloride elicited only by the extreme ultra violet rays of the induction spark, the solar rays not being sufficiently refrangible for its production. He has since found that the solutions of many salts of the earthy metals possess analogous properties. He enumerates lanthanum chloride, didymium chloride and sulphate; terbium, yttrium, erbium, ytterbium chlorides; philippium chloride; thorium sulphate; zirconium sulphate and chloride; aluminum and glucinium chlorides.

IMPROVED WATER WHEEL.

The engraving given herewith represents an improved water wheel recently patented by Mr. Albert B. Couch, of Newnan, Ga. It is designed to run perpendicularly or horizontally, or at any desired angle, and it has the advantage of being very simple and inexpensive.

The wheel consists of a spiral or screw of any desired pitch, mounted upon the shaft, and inclosed by a casing which revolves with it. The upper portion of the casing is flared, forming a funnel for receiving the water, which is delivered to the wheel in quantities just sufficient to fill the funnel without overflowing it. Figure 2 shows the internal construction.

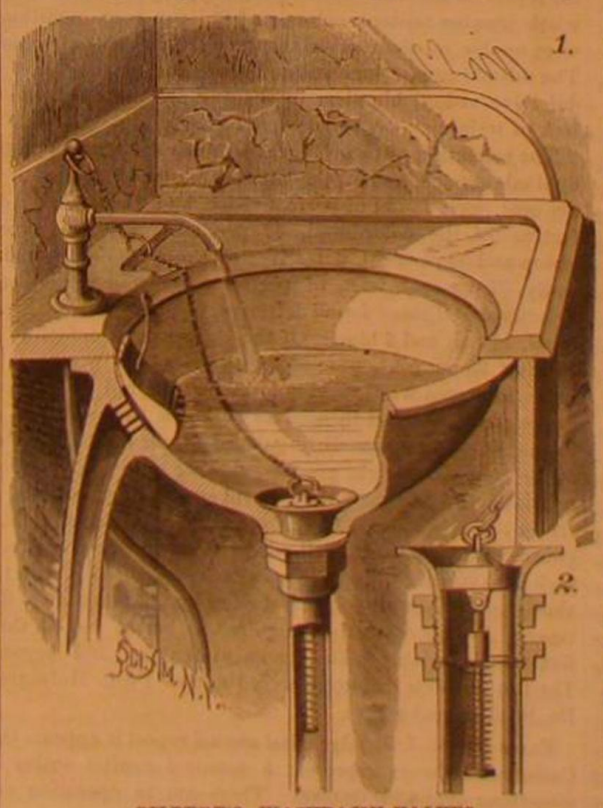


COUCH'S WATER WHEEL.

Motion is taken from the wheel by a belt which runs on the outside of the casing, or by attaching a cog wheel. The inventor claims that he realizes a percentage of power which will compare well with the best wheels in market.

IMPROVED WASHBASIN VALVES.

The plumbing of a house consists, practically, of two pipes—one connected with the water supply and the other with the sewer. Great care is taken to have the water pipes tight, so that there shall be no leakage, while comparatively little attention is paid to the drain pipes, which, in many cases, are pouring into the dwelling a flood of sewer gas.



GILBERT'S WASHBASIN VALVES.

The common water trap, when full of water, is the only device that will close a sewer pipe perfectly airtight; but the water trap is liable to be siphoned out by the rush of water through other waste pipes, permitting the entrance of gas, and when it remains full it becomes saturated with sewer gas, and is almost as pernicious as the sewer itself. In other contrivances an obstruction of the thickness of a piece of paper will allow the gas to enter. The principal thing to be accomplished is to prevent siphoning, and thus to admit of the use of the best form of trap. This is accomplished by the devices shown in the accompanying engraving, in which Fig. 1 represents a washbasin having a side broken to show the improvements in place. Fig. 2 is a vertical section of the escape valve, which is provided with a jointed stem, and a spring for holding it to its seat. The valve is opened by means of the chain, and as soon as the chain is released it closes automatically. When it is desired to hold it open for any purpose the extra ring in the chain is slipped over the top of the faucet. The joint in the valve stem permits of tipping the valve so that any obstruction in the pipe may be readily removed. The float valve, which covers the overflow, rises when the water in the basin exceeds a certain limit and allows it to escape, but when the water is below the overflow the valve closes the overflow openings, so that no air can enter the waste pipe. This being the case there can be no siphoning, and the water required to seal the S traps will remain and prevent the gas from passing, and the basin valves will prevent any emanations from the water in the trap from entering the room.

We are informed that these valves can be applied to basins already in use, and that basins are made having the valves attached.

Further information may be obtained from Mr. James McQuiston, 102 West 14th street, New York city.

RECENT AMERICAN PATENTS.

An improved life preserver and swimming plate or paddle, consisting of a disk or plate made of cork, having a mitten attached to it, and provided with a strap and buckle for securing it to the wrist, has been patented by Mr. Charles Primbs, of United States Army.

Mr. Joseph Truax, of Mount Gilead, O., has patented an improved bee-hive, having honey-boxes with loose comb guides that insure the formation of a straight comb, which may be easily removed without cutting or breaking the box.

An improved device for holding up the thills of wagons, sleighs, and other vehicles, to keep them out of the way and prevent them from being broken, has been patented by Messrs. George H. Pitcher and Leonard Young, of Lewiston, Me. It consists of a forked arm rising from and extending over the yoke, having its branches curved and made elastic for the reception of the thills.

Mr. Michael P. Low, of New York, N. Y., has patented a cheap and effective mode of fastening mica to the doors of stoves, ranges, and furnaces. The invention consists in casting on the inner side of the door, above and below the openings, lugs of peculiar form for holding the mica.

An improved ballast-log for vessels has been patented by Mr. Cesare Leparelli, of New York, N. Y. It is formed of a heavy and lighter upper part, and is designed to furnish an improved means of ballasting vessels when in port and empty.

A wardrobe hook, having at the upper part a tenon and a lip or flange for receiving a shelf, has been patented by Mr. Lewis F. Ward, of Marathon, N. Y., the object being to adapt the ordinary wardrobe-hooks for use as brackets or supports for shelves.

An improved machine for shaving the sides and edges of hoops has been patented by Messrs. A. J. Philpott & G. W. Horton, of Owensborough, Ky. The invention consists in two pairs of upright knives and a pair of horizontal knives, between which the hoop is drawn by a wheel and sweep.

An improved lamp attachment for preventing combustible dust from entering the flame, has been patented by Mr. Louis W. Peck, of Minneapolis, Minn. The device consists of a tube or box having a diaphragm or partition that causes the deposit of the dust before it reaches the flame.

An improved knocking-over bit for knitting machines, which consists in a slitted and mortised frame for holding the bits, which are of novel form, and are provided with a yielding support, has been patented by Mr. W. D. Ormsby, of Waltham, Mass.

Small Vessels for War.

A letter of Hobart Pasha to Mr. Brassey, M.P., is published in the London *Times*, reiterating his opinion that small vessels are best for fighting purposes. He says: "What we want are small, heavily-armed, fast vessels, that can, as it were, 'hop round their enemy like a cooper round a cask,' hitting him on every vulnerable point, shelling his decks at long range, and worrying him to death. Of course, the small vessels would be liable to a hard knock now and then; but you cannot go to war in kid gloves. As to bombarding forts, rely on it, in these days of 35 tons in masked batteries, or batteries cased with 30 inches of iron, the idea is obsolete—no sane man would think of such a thing. Fleets' guns can only be used against land defenses in making a diversion while landing troops. Remember, also, the immense cost of losing by torpedoes or otherwise, one of the new monsters such as Italy has built."

Palmetto Fiber for Paper.

The Fernandina (Fla.) *Mirror* reports that the machinery, lately brought to that place by Professor Loomis, for the preparation of palmetto fiber is working satisfactorily, and that the experiment is an assured success. The stalks of the scrub palmetto are used. It is said that the fiber is likely to prove useful for cordage, paper, tubs, pails, flour barrels, boats, powder kegs, and no end of other articles of general use. A portion of the fiber shipped to paper mills is intended for the manufacture of a high grade paper to be used by the Canadian Government in the printing of bank notes. Ultimately, it is said, the various grades of paper fiber will be made into pulp in Florida.

RECENT MECHANICAL INVENTIONS.

Mr. Ludwig Marx, of West Chester, Pa., has patented an improvement in barber's chairs. The back is slotted and pivoted in the frame and hinged to the bottom, the latter being arranged to slide upon rollers. A screw is provided for moving the seat back and forth.

An improved paper pulp screen, patented by Mr. John S. Warren, of Gardiner, Me., consists of a hollow screen box arranged to revolve in a tank, and containing a hollow shaft, upon which there are conical sleeves which agitate the pulp and keep the screen free.

Mr. George Hoag, of New York city, has invented an improved combined scale and coin tester. It may be used for weighing letters and other mail matter, and for testing the weight, size, and thickness of gold and silver coins. The scale pan is slotted to accommodate coins of different sizes, and two extra beams are provided, one for gold and the other for silver coin.

A bit for boring out rifles, to render them smooth and of a uniform caliber, has been patented by Mr. J. O. Martin, of Oak Level, Va. The invention consists in a bit of cylindrical shape formed at the end of the bit rod. The cutters are made by grooving the bit rod at an angle of forty-five degrees to the length of the rod. The cutters thus formed are intersected by grooves cut parallel with the axis of the rod.

An improved momentum brake for spinning mules has been patented by Mr. Jeremiah D. Stanwood, of East Killingly, Conn. It consists in a novel combination of mechanism applied to the Mason mule, which prevents the yarn from drawing out of the rolls by the standing twist, and makes it equal to that spun upon spinning frames by dispensing with twist motion and regulators.

Mr. William M. Dunn, of Graysville, Ga., has devised an improved lumber gauge for saw mills. It consists of a guide in which is placed a bar with an arm projecting from it, and carrying a roller which touches the log, and a pointer extending over a scale on the guide.

An improvement in lithographic printing machines has been patented by Mr. Joseph Krayer, of Johannisberg-on-the-Rhine, Wiesbaden, Germany. It consists in a novel combination of mechanism which cannot be described without illustrations.

An improvement in lock works for clock movements has been patented by Mr. George B. Owen, of Winsted, Conn. It consists in providing the striking cam with a clutch adjustment, so that when the minute hand is turned forward, a pin on the shaft clutches the cam and turns it against the wire lever that actuates the pawl controlling the striking wheel; but when the hand is turned back any distance less than an hour the shaft is disengaged from the cam.

Mr. John Heald, of Chorley, England, has patented an improved machine for grinding and doughing India rubber. It consists of an agitator and rollers having adjustable bearings, and a hollow roller adapted to receive either steam or water, this roller being provided with a clearing knife.

An improved stamp canceler, patented by Mr. Ernest W. Brenner, of Fort Totten, Dakota Territory, has a rotary cutter for defacing the stamp as the marking or printing device is brought into operation. The cutter is mounted upon a spirally grooved rod, which is turned by the descent of the printing stamp. The printing stamp has a novel automatic inker.

Mr. Charles Seymour, of Defiance, Ohio, has patented an improved device for balancing cylinders and cutter heads. The invention consists mainly in a frame provided with centers for holding the cylinder or cutter head. This frame is supported in gimbals or upon a universal joint, so that when the cylinder is rotated the throw due to inequalities of weight or form is made manifest, and furnishes sufficient data for the correction of the difficulty.

RAILWAY NOTES.

IN his report on the railway exhibits at the Paris Exhibition, Assistant Commissioner Anderson says, that as there is no part of the world where railroads have been such an important agency in material development as has been the case in the United States, so it is gratifying to observe that nowhere else has there been greater progress in the art of railway construction, or in the business of railway administration and management. Of the 185,000 miles of completed railways in the world in 1878, nearly one-half were in the United States. Having reference to territorial areas, this preponderance is very great, but as compared with populations, it is enormous. In 1878 there were 15,000 miles of completed railway in France. The gross receipts were $162,847,105. The average receipts per mile were $13,132. They employ 183,000 persons, or an average of 12 6-10ths per mile. The mean velocity of passenger trains an hour is 32 miles. In Great Britain there were 17,000 miles of road open in 1877, at an average cost complete of $174,000 per mile. The net earnings for 18 years have exceeded 4 26-100 per centum per annum upon the whole amount of capital invested. The rate of speed on English railways is greater than on any other railroads in the world, averaging for passenger trains 40 miles an hour, with a maximum of 70 an hour on best trains. The gauge of the trunk lines of Europe is 4 feet 8½ inches between the rails. The narrow gauge, as generally adopted in Europe, is 39 371-1000 inches. The cost of these roads is $29,000 a mile. In England narrow gauge roads have been reduced to 2 feet 11½ inches.

THE preparations for changing the gauge of the St. Louis, Iron Mountain and Southern Railway, which had been in progress for the past two months, culminated Friday night, June 27. At daybreak Saturday over 3,000 men began the work of shifting the rails, and long before night the entire line, extending from St. Louis to Texarkana—nearly 700 miles—had been changed from five feet to the standard gauge of four feet eight and one-half inches. The locomotives and cars had also been altered to correspond, and traffic under the new order of things will proceed without break or hindrance.

THE committee on the best form and material for locomotive wheels and axles, in their report to the American Rail Master Mechanics' Association, at their recent annual convention in Cincinnati, submitted the following mileages of steel-faced and steel-tired wheels. Their authority was Mr. George Richards, of the Boston and Providence Railway:

Four Bochum cast-steel wheels, under a heavy tender, ran 142,260 miles, and were in good condition. They had not been turned, and the wheel was heavy enough on the thread for three turnings.

A pair of paper wheels, under a light tender, making many stops, ran 125,941 miles, and were in a fair condition.

A pair of cast-iron wheels, run as mates to the paper wheels, made 91,062 miles, and were worn out.

A pair of steel-faced wheels, in heavy engine truck, made 50,123 miles on the first run, and a total of 121,929 miles, and were condemned.

Another pair of steel-faced wheels, in heavy engine truck, ran 47,034 miles, after first turning, and were condemned.

Two pairs of steel-faced wheels, in heavy engine truck, 79,905 miles first run, and 129,587 miles to date, and were in good condition.

Another pair of steel-faced wheels, in heavy engine truck, made 71,852 miles the first run, and 41,266 miles the second run; total, 113,118 miles, and were condemned.

Another pair of steel-faced wheels, under heavy tender, made only 31,372 miles the first run.

One pair of steel-faced wheels, in engine truck, made 38,932 miles first run.

One pair of steel-faced wheels, in engine truck, made 64,750 miles first run.

The association adopted the standard car-axle which was adopted by the Master Car-Builders' Association at Boston six years ago.

A SYSTEM of handling rails by machinery, to facilitate track-laying, has been used successfully on the Central Pacific and other railroads. A train of flat cars is provided with a system of adjustable ways, by means of which rails and ties are brought forward in a continuous stream and delivered to the trackmen on the part of the road bed where they are to be laid. It is claimed that this method greatly expedites the laying of track, besides saving the cost of teaming and the injury to the road bed by hauling heavy wagons over it, all teams being dispensed with, and more than half the men usually employed.

Dr. P. D. KEYSER, of the Will's Eye Hospital, Philadelphia, has examined for color-blindness the employes of several railways centering at Philadelphia. According to his report to the State Medical Society, 3½ per cent. of the whole number mistook colors, and 8½ per cent. additional were unable to distinguish accurately the shades of colors. The mistaking of colors was doubtless due in large part to defective vision; blunders in shading are probably due to lack of training.

The refraction of the eyes was carefully examined with the ophthalmoscope, and of the number under examination 79 per cent. were found of perfect vision and 21 per cent. defective; of the color-blind, 47 per cent. were of perfect vision and 53 per cent. defective; of those who only shaded badly, 77 per cent. were of perfect vision and 23 per cent. defective. Of those found defective, 50 per cent. were green blind, 44 red, and 6 blue. Of the 8½ per cent. defective in shading, 95 per cent. were so in greens and 5 per cent. in red. Two men who could not distinguish red from green on test, had educated themselves to know that red was an intense color, and thus distinguished bright red signals, but at the same time bright greens and other bright colors were red to them. For these they would stop their trains, and so err on the safe side. On the other hand, dark reds, dark greens, and browns were all one to them, thus making them useless as signals. Another peculiarity in one case was the ability to distinguish bright red close by, but not at a distance. A color correctly recognized as bright red at three feet was invariably called green at ten feet and beyond. The test methods employed were those of Prof. Holmgren, Dr. Stilling, and others.

FROM Mr. C. J. Brydge's last annual report it appears that Canadian railways represent a nominal capital outlay of something over $360,000,000. There are in operation and under construction 7,905 miles of road. The total train mileage is given at 19,669,447 miles. The number of passengers carried was 6,443,924. The tonnage of freight handled during the year was 7,883,472. The operating expenses for the year amounted to $16,100,102, against $16,290,091 in the preceding year; while the receipts increased from $18,742,053 to $20,520,078. There were 97 persons killed last year, against 111 the year previous; and 361 injured, against 317.

THERE are now considerably more than 300 miles of railway in operation in South Australia; during the present year a large addition to this mileage is anticipated, and many new lines are projected, such as the Port Augusta and Government Gums, and the Mount Gambia and Rivoli Vale Railways, while an important project for carrying a trunk line right across the Australian continent has been favorably received. To build such a line would take some twelve or fourteen years, but when once constructed it would have an extraordinary influence in developing the internal resources of South Australia, and Australia generally.

THE Illinois Railroad Commissioners have obtained returns from twenty-six railway companies, which show that the "life" of a locomotive engine varied on these railways from eight years to twenty-four, and that the general average duration was fifteen and a quarter years. Passenger cars endure from eight to twenty years—the average being fifteen and three quarter years; the average life of stock cars being ten years, and that of freight cars eleven and a half years; and railway bridges, of wood, endure from five to twenty years. As to the life of rails, the statistics seem to indicate that those of iron last from three to twelve years—the mean being seven; while steel rails are credited with from nine to twenty years' service—an average of fourteen years is obtained from the returns.

THE excursion car City of Worcester, devised by Mr. Jerome Marble, of Worcester, Mass., has proved to be a profitable as well as novel experiment. The car is divided into three parts, the ends for about ten feet being devoted to kitchen and pantry at one end, and to closets for clothing, lavatories, etc., at the other. The central portion has 12 double berths built after the Pullman pattern, and is fitted with tables, easy chairs, etc. The party carries a small library, an upright piano, and many of the usual accompaniments of a fine drawing room; while suspended from the bottom of the car are bunkers for provisions, fuel, hunting and fishing appliances, etc. The charge of railway companies for hauling this car is simply the regular first class fare for twelve persons. The inventor says that the cost of a trip of over 4,000 miles travel and seven weeks' duration, for a party of a dozen or more, was but a little over $200 each, this sum including all expenses. Deducting the charges of the railway companies, the expenses of the party living in the car were 57 cents a day each. In this way the disagreeables of ordinary traveling were avoided and the cost was materially reduced.

Preservative Wrapping and Packing Paper.

Mr. John F. Rodgers, of Philadelphia, claims to have discovered a preservative wrapping and packing paper for protecting cloths, furs, etc., from mildew and the ravages of moths and other insects. The patent bears date January 9, 1878. The paper used is made from woolen and cotton rags and manila rope or manila paper. This paper is saturated with a mixture of seventy parts, by measure, of the oil remaining from the distillation of coal tar naphtha by live steam with five parts crude carbolic acid, containing at least fifty per cent of phenols, twenty parts of thin coal tar heated to about 160° Fah., and five parts of refined petroleum.

After saturating the paper it is passed through squeezers and over hot rollers for the purpose of drying. When cool it is cut into sheets as desired, and the drying completed in the atmosphere. The paper thus treated is used for packing woolen clothing, cloth, furs, carpets, and all material likely to be injured by moths, mice, or virmin, and will also to a great extent, he states, prevent cotton material from mildew.

Free Labor in the South.

In an official report on Southern labor it is asserted that the number of acres of cotton cultivated had increased between 1871 and 1878 from about 7,500,000 acres to more than 12,000,000 acres. Between 1869 and 1878 there was an increase of more than 3,000,000 in the number of cattle and swine. It is estimated by Representative Whitthorne that more than $200,000,000 worth of Southern labor products enter into the purchase of merchandise and manufactured goods of New England, New York, New Jersey, and Pennsylvania. The gross earnings of the railroads of Southern States are placed at $42,927,594 per annum, and it is held that all the principal cities and towns of the South have increased decidedly in population, and that there is a constant and general growth of manufacturing establishments.

Malleable Nickel and Cobalt.

Th. Fleitmann has succeeded in obtaining the metals nickel and cobalt in malleable condition by fusing them with a very small quantity of metallic magnesium. He suspected that the absorption of carbon monoxide by the metals might be the cause of their want of malleability, and introduced the magnesium for the purpose of destroying the gas, as this metal is known to decompose the oxides of carbon. The success was very surprising. An addition of ⅛ per cent. of metallic magnesium changes the structure of the metals entirely. They can now be easily welded when hot. Nickel is malleable even when cold, while cobalt becomes extremely hard when cold, so that it will probably be applicable for cutting instruments.

At the same time the cast metals are very compact, and are almost as solid and tough as cast steel, so that the metallic parts of harness and similar objects may be made from them.

Both metals take a very high polish, and resist the action of the atmosphere very well. The author has also succeeded in welding malleable nickel and cobalt together with steel and iron, so that the pieces of iron and steel that are coated on one or both sides with nickel or cobalt may be beaten out to the thinnest plates without any separation of the metals.

THE GEYSERS OF THE AZORES.

We crossed a stretch of the plateau, and suddenly looked down on the other side of it into an immense, deep, nearly circular crater, beautifully green.

Its undulating bottom was dotted over with white houses among gardens and corn fields, and in the distance was seen a small column of steam hovering over the hot springs. We drove down a steep incline for at least a couple of miles, and at last reached the village of Furnas. The road hence to the hot springs led across a small stream fed by them, deeply stained red, and smelling strongly of sulphureted hydrogen. Thence the path went up a little valley, cut out in the low ridge of very fine light whitish ashes which separates the main Furnas valley from that part of it in which the Furnas lake is situated. It is a beautiful tiny glen, with dark evergreen foliage on its steep banks, and on the swamp borders of its narrow bed were masses of the brilliant green leaves of the eatable arum (*Caladium esculentum*), one of the staple foods of the Polynesians, their "taro." The "taro" is cultivated all over the islands, but thrives here, especially in the warm mineral water.

The Furnas lake is about three miles in circumference. There are two groups of boiling springs, the one at the margin of the lake, the other close to the town of Furnas. The boiling springs near the lake are scattered over an area of about 40 yards square, covered with a grayish clayey deposit; a geyser or hot spring formation being composed of matter deposited by the hot water. No doubt the present hot springs are the dwindled remains of former fully developed geysers.

The principal spring consists of a basin about 12 feet in diameter, full, up to within 2 feet of the brim, of a bluish water, which, in the center, is in constant and most violent ebullition, the water being thrown up a foot in height as it boils forth. A constant column of steam rises from the basin.

Near by is a sort of fissure, from which issue, at short irregular intervals, jets or splashes of boiling water mingled with steam and sulphureted hydrogen in abundance.

This spring makes a gurgling, churning sort of noise; the large basin, a sort of roar. In the sides of the fissure grow, in the area splashed by the hot water, some green lowly organized algæ (*Batryococcus*) which form a thick crust upon the rock surface. Similar growths of lowly organized plants in the water of hot springs have been observed in various parts of the world. At a couple of feet distant from this hot spring rushes up a perfectly cold iron spring with a considerable stream of water.

All around are small openings, from which sulphureted hydrogen and other gases issue with a fizzing noise, and coat the openings with bright yellow crystals of sulphur. The ground around is hot, too hot in many places for the hand to rest upon, and it is somewhat dangerous to approach the pools of hot water at all closely, since the hard crust on the surface may give way, and one may be let fall into the boiling mud.

Just above these hot springs is a beautiful mountain stream, which forms little cascades as it tumbles down to the lake valley from the fern-clad moor above.

At the town of Furnas is an inn kept for families who come in the season to drink the waters and bathe. There is a free bath house, built by the government, with marble baths and hot and cold mineral water laid on to each.

The whereabouts of the springs near the town are marked by clouds of steam. The spirngs are scattered over a larger area than at the lake springs, and the gray geyser formation is piled into irregular hillocks around them, instead of presenting a nearly flat surface, as at the other springs.

Here the principal spring is like that at the lake, but the amount of hot steam rushing up is much greater, and the noise is almost deafening. The water is thrown up about two or three feet in a constant hot fountain. Close by are sulphur springs with hot water issuing in violent intermittent splashes; and there is also one deep chasm, from the depths of which boiling hot blue mud is jerked out in similar splashes. The mud hardens on the sides of the cavity into a crust made up of successive laminæ. The natives use the natural hot water to heat sticks or planks, in order to bend them. They also sometimes dig holes in the mud and set their kettles in them to boil. As at the other springs, there are cold springs issuing from the ground close to the boiling ones. One spring has its water charged with carbonic acid and effervescing.

All the springs empty into one small stream, which then runs down to the sea, with a complex mixture of mineral flavors in its water, and retains its heat for several miles.

In the shores of the lake there are large extents of geyser deposit, forming strata 40 to 50 feet in thickness, and evidently resulting from hot springs, now worked out, but with a few small discharge pipes of heated gas remaining active here and there.

Near the seaward end of the lake is a hole, where, as in the Grotto del Cave, an animal, when put into it, becomes stupefied by inhaling the carbonic acid gas discharged.

I made an excursion from Ponta Delgada to the Caldeira des Sette Cidades, or Caldron of the Seven Cities. It is a marvelous hollow of enormous size, with two lakes at its bottom and a number of villages in it. One slowly climbs the mountains from the sea and suddenly looks down from the crater edge upon lakes 1,500 feet below. On the flat bottom of the crater, which is covered with verdure and cultivated fields, are several small secondary craters, the whole reminding one of a crater in the moon. One of these small tracers has been so cut up by deep water courses that between them only a series of sharp radiating ridges is left standing, and the crater has thus a very fantastic appearance.—*H. N. Moseley, Notes by a Naturalist.*

The Quality of American Cotton Goods.

An assertion made in a Rhode Island newspaper, to the effect that the best cotton goods sold in that State were of English and French manufacture, naturally stirred up considerable feeling in certain quarters.

The true state of affairs seems to have been correctly described by a representative of one of our largest manufacturers of cotton goods, who frankly admitted to a *Tribune* reporter that the French manufacture a finer quality of cotton goods than we do, but these are principally lawns and light gauzy fabrics, for which a few people pay high prices. Only a small quantity of them comes here, he said, and it is not unfair to say that nine tenths of all the lawns sold in this country are of American manufacture. "Our mills are greatly improved, and the quality of fabrics turned out is far superior to that of last year. We are now making superior lawns, percales and gauze goods nearly equal to the French in fineness and far more serviceable. The very best cotton goods sold in Rhode Island may possibly be French and English, but this is not true of other States. The manufactories of New York, Massachusetts, and Connecticut make splendid cotton fabrics. The same quality of goods as that manufactured in France could be made here, but it would not pay, as these goods are purchased by only a few persons who are willing to pay 35 cents a yard for fabrics which are really not worth over 15 cents. England is not making any finer goods than America, and as a rule English goods are not so fine as American. The body of English goods is made equal to ours in weight frequently by the use of clay instead of cotton. England is even imitating our trade marks for cotton fabrics to be sent to China, and one American house has been compelled to copyright its labels in England to prevent this. A greater quantity of very fine goods for home trade is being manufactured now than ever before, and several large factories are working from 5 A.M. to 10 P.M., on fine lawns to take the place of foreign goods. There have been recently more orders to American manufactories for British trade than ever before."

Another prominent New York firm, admitting the superior fineness of certain foreign goods, said: "American cotton dress goods have greatly improved in quality, and they are taking the place of foreign cotton and worsted goods. This is especially true of the manufactures of Pennsylvania, Rhode Island, Massachusetts, and Connecticut. Within three years over 10,000 looms have been altered, greatly improving piques and light goods for spring and summer wear. There are over thirty different kinds of fine cotton goods now in market which were not manufactured in this country four years ago."

Of like effect was the testimony of a Rhode Island manufacturer, who said, relative to the fineness of American products: "There is a steady improvement going on in American cotton goods. One mill in Rhode Island is now making Victoria and bishop lawns and jaconets that are equal to anything made abroad, and British manufacturers have frankly admitted that they will destroy their American trade. Certain mills in New England are turning out percales equal to the finest foreign fabrics that formerly sold largely in our market, and at a much lower price."

The New Ocean Pier at Long Branch.

The great iron tubular pier at Long Branch is rapidly approaching completion. At the end of the pier, as far as completed, 660 feet, to which some 200 feet are to be added, there is a depth of fifteen feet at dead low water, and when the two hundred additional feet are added the depth will be twenty-two feet at dead low water. The iron spiles supporting the pier are tubular, they being, for the first 150 feet, six inches in diameter, and the remainder are eight and ten inches until nearly the end is reached, when they are twelve inches in diameter They are driven into the sand to the depth of from 14 to 17 feet. Every 20 feet from the commencement of the pier are lamp posts, each with two lamps, and at the top of each post will be a small streamer. Ash wood is exclusively used in the wood work of the structure. The pier is 25 feet in width in some places and 50 feet wide in others. The approach, not included in the total given length of 660 feet, is 94 feet long. On either side of the approach to the pier, running 250 feet each way, is a handsome pavilion, 25 feet wide, of a very pretty design. This pavilion will be fitted up with promenades, restaurants, balconies, etc. Below this are being constructed 600 bathing rooms, all supplied with gas and running water. The bathing grounds are on either side of the pier and are shaded by it. When the season is over it is proposed, says the Philadelphia *Ledger*, to remove the flooring of the pier, so that the waves can break over the iron work without doing any damage.

Coney Island Pier.

A new and splendid iron pier has lately been constructed at Coney Island, the celebrated sea shore resort, near New York City. Although the pier stands directly out in the ocean, the largest passenger boats have no difficulty in landing. On the 27th of June the first landing was made, by the steamer Grand Republic, from Bridgeport, Conn., with 4,000 passengers. At about 500 feet from the pier she slowed up, and was made fast in two minutes from the time of touching. There was a considerable swell at the time, but owing to the fender piles surrounding the pier head, there was no concussion. The band on board played, flags were waved, and the cheers from the throng on the pier were answered by cheers from the boat. The Grand Republic was received by Capt. Griffin, the pier superintendent, and his officers, and Messrs. Maclay & Davies, the constructing engineers of the work. The pier is of iron, and its construction has been remarkably rapid. The first pile was driven on April 22, and although a few finishing touches, that will require an additional two weeks, are yet to be applied, the work is practically finished for landing purposes.

There are two decks, or stories, and landings are made on the lower one, which is lined on each side with bathing houses, from which steps project into the water. On ascending by stairs to the upper deck it is found to be roofed, and bordered with restaurants, pavilions, and offices yet uncompleted. The pier is 1,000 feet long and 50 wide, with enlargements at the approach, center, and head of 120, 83, and 100 feet respectively. The upper story is 24 feet above high water, and the lower 12 feet. The pier at Scarborough, England, is of the same length, but less than half the width. The Douglas pier at the Isle of Man is also as long, but only 17 feet wide, and the celebrated Westward Ho pier is only half the length and width of the Coney Island pier. The pier stands on 260 piles, all sunk to a depth of 15 to 20 feet into the sand, and well braced. The deck floors are of Georgia pine, and the structures on the top have towers, gables, etc., giving them a picturesque appearance. The structure will be illuminated with both gas and electric lights. The depth of water at the outer end is 20 feet at high tide and 15 at low tide. The cost of the work has been over $200,000.

The Exportation of Machine Made Joinery.

The Baltimore *Sun* describes a new American enterprise in the exportation of machine made doors, window sashes, window blinds, and similar articles of joinery. The first shipment to England of this sort of goods took place in 1877, and although it was confined to doors for the cheaper class of houses, it at once met with a demand that justified the expectations of the shippers. A few window sashes and blinds were also sent; but they were chiefly intended for the British provinces, as Venetian blinds are not used in England. This new trade is, however, only in its infancy. For the first time, in 1877, some 19,000 doors and 6,284 pairs of sashes and blinds were shipped from New York to England, the greater part of which went thence to Australia and New Zealand. Since then California has supplied machine made joinery to Australia, sending there 27,000 doors last month as against some 5,000 sent direct from New York. But the transfer of the Australian demand for machine made doors to California, and its consequent loss to the Eastern States, has been compensated for by an increase in the British demand for local use. The shipments of doors to England and Scotland in 1878 were about 45,000, as against 2,800 in 1877. Up to June of the present year these shipments show a slight increase. It is a trade that is evidently capable of great extension, for all the pine lumber used in England is brought from Norway and the United States. It is a trade, too, that affects the English workman in two ways. For many years past there has been a large annual demand upon England from Australia and other British dependencies where wood of the proper kind is scarce for the doors of warehouses and private dwellings, and to economize the cost of the doors so exported they were made up into packing boxes, four doors placed longitudinally forming each box, the two ends being doors for small closets. As all the doors were hand made, the trade of making them gave employment to quite a large number of English workmen, and the diversion of this trade to California, coupled with the demand that has sprung up in England itself for the machine doors of the Eastern States, must cause a good deal of anxiety among English joiners and carpenters, in the present depressed condition of the labor market there.

A Successful Inventor and Manufacturer.

Sir Henry Bessemer has had an experience that few inventors are allowed to have, in living to see the world-wide results of his invention, and to realize the economy in resources which has been made possible by its use. The sewing machine and electric telegraph have been labor saving in their effect to an enormous extent, but with these it would have been difficult for their originators when alive to estimate the monetary value to mankind of the discoveries. With the making of steel the case, however, is different, for the saving can be figured down to a nicety on every ton made, and the annual product of the various civilized countries is pretty accurately known. From data thus collected it is estimated that in labor and material the world is a gainer to the amount of $100,000,000 a year by using the Bessemer process in converting ore into steel. Or considered in another way, the advantage of a low-priced enduring material, such as Bessemer steel, when compared with iron, has been made a matter of calculation, as far as railroad tracks are concerned, with the following astonishing results: Mr. Price Williams, who is an expert in matters of this kind, has stated that by substituting steel for iron a saving in expenditure will be made during the life of one set of steel rails on all the existing lines in Great Britain of not less than $850,000,000. In view of these facts, says the New York *Sun*, if Sir Henry has obtained in royalties the sum of $5,250,000, most persons will concede he has got no more than he deserves.

NEW PROPELLING APPARATUS.

The two views given in the engraving represent an ingenious and convenient arrangement of machinery for driving a boat by foot power. The hull of the boat is of the usual construction, having a long and tapering propeller screw, whose shaft extends forward and receives its motion from a transverse shaft placed amidships and having foot cranks arranged diametrically opposite. In front of the shaft there is a frame which supports both the steering apparatus and the seat of the operator.

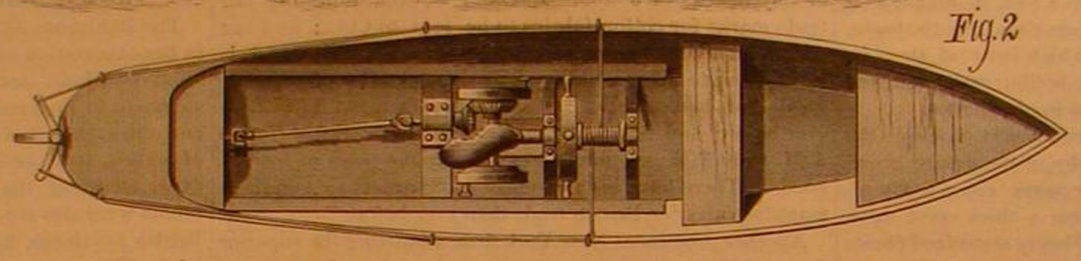
The propeller shaft is made in sections so that it may be lengthened or shortened; and the propelling and steering machinery is fixed to a single frame that may be moved backward or forward, as the loading of the boat may require.

The tiller ropes extend along the gunwale through suitable guides and are attached to the tiller. The rudder is partly supported by the screw shaft.

This invention was recently patented by Mr. A. E. Tangen, of Bismarck, Dakota Ter.

Fig. 1.

Fig. 2



TANGEN'S PROPELLING APPARATUS.

Alum not Allowed in English Bread.

George Allen, baker, of Walsall, was summoned at the instance of Mr. C. W. Stephens, sanitary inspector, for selling an article of food not compounded of the ingredients demanded, and also for selling bread containing alum, so as to be injurious to health. The inspector stated that he purchased a two-lb. loaf at the shop of defendant, and forwarded it to Mr. E. W. T. Jones, the borough analyst, whose certificate of analysis he produced. The certificate showed that the loaf was adulterated with alum in the proportion of 36 grains to the four-lb. loaf, and that such adulteration would tend to render the bread indigestible. Dr. J. Maclachlar, medical officer of health, gave it as his opinion that the quantity of alum stated would be likely to make bread injurious to health. Addressing the bench for the defense, Mr. Nanson said he did not dispute that there was alum in the loaf, but he urged that none was put in by the defendant or at his establishment, and that the flour was used just as it came from the miller. The bench, after hearing the defendant, considered the case proved, and imposed a fine of £5 and costs on the first summons, the other being withdrawn. The fine and costs amounted to £7 14s.

NEW MILLING ATTACHMENT FOR LATHES.

The invention illustrated herewith is intended to supply the wants of machinists who are unable or unwilling to purchase a milling machine and yet appreciate the great saving of labor, files, etc., effected even by the occasional use of such a machine.

This device can be easily applied to any lathe, can be removed or put in position in a fraction of a minute, and will, it is claimed, work with the smoothness and solidity of the best milling machine. It consists, essentially, of a rectangular frame swinging between the lathe centers and carrying a cutter arbor. The position of this cutter frame is adjusted and its stability secured by means of the U shaped clamping plate, which carries a tangent screw, and is itself clamped to the lathe bed in front of the head stock.

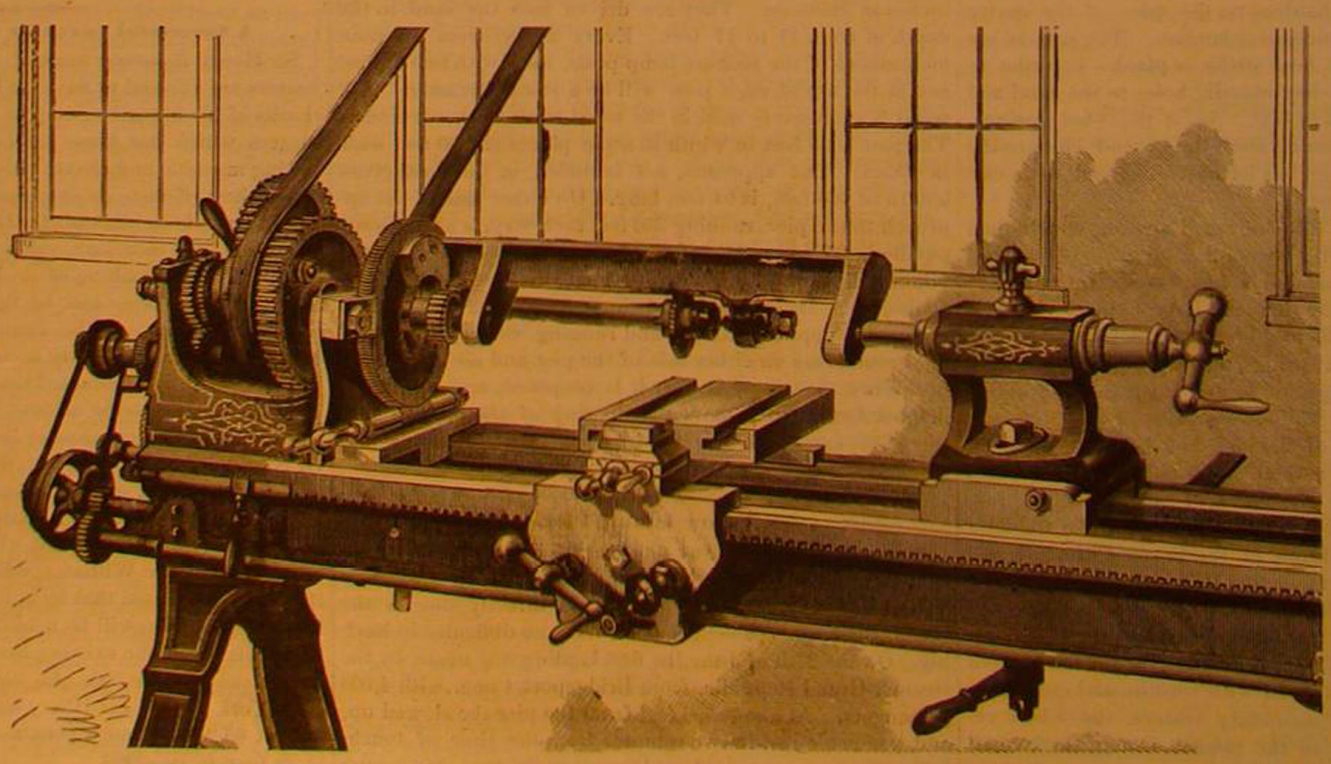
The cutter arbor runs between steel center points, the right hand point being adjustable and secured by a jam nut. It is driven by a gear which is secured to a small face plate screwed upon the lathe mandrel. The front side of this gear carries the running center of the lathe, which bears against the projection of the cutter frame. The position of the cutter frame, and consequently the height of the cutter, is adjusted by the tangent screw engaging the edge of the annular worm wheel plate which forms a part of the cutter frame. This plate, and with it the cutter frame, may be held in any position by the clamping nut which appears in front, and also by a similar nut on the opposite side, which does not show in the engraving. The cutter frame is therefore rigidly secured to the lathe bed at three points in a horizontal plane, and as the running center of the lathe occupies a central position there is no leverage or undue strain upon it.

The friction being upon hardened steel centers the machine runs easily at high speeds, and the solidity of the frame allows the taking of a heavy and smooth cut.

By relaxing a nut beneath the lathe bed and sliding back the tail stock, both clamp plate and cutter frame are released and may be lifted off together.

The bedplate runs on the cross slide of the lathe carriage, and is linked to the tool head so as to traverse with it by means of the cross feed screw. Its longitudinal motion is of course that of the lathe carriage. This bedplate is made in sizes to suit different carriages, and is fitted with centers for fluting taps, facing nuts, etc., and is provided with a vise; it will carry any planer or milling machine vise or chuck of suitable size. It need not be removed when the lathe is performing its ordinary work as it is not in the way, serves to protect the slide from dirt and chips, and is often of use in boring cylinders and similar work. An ordinary parallel vise, mounted on a bar or shank fitting in the tool post, may be used to hold work, thus dispensing with the bedplate altogether. This arrangement, though less desirable, will do good service, and may in some cases be preferred.

Further information may be obtained from Mr. William Main, Piermont, Rockland county, N. Y.



MAIN'S MILLING ATTACHMENT FOR LATHES.

Dr. Reimann advises those engaged in cotton dyeing to discontinue the use of tartar emetic. It does not fix the aniline colors themselves, but merely fastens the tannin, and as antimony can be dispensed with there is no reason why health should be endangered.

Antiquities from Chiriqui.

At a meeting of the New York Academy of Sciences, June 2, representative specimens were exhibited of a large collection of flint implements, golden frogs, potteries, and the like, obtained by Mr. McNeill, from ancient graves in Central America. These objects are for the most part now in the possession of Mr. J. S. Lamson, of this city, who described, from Mr. McNeill's notes, the manner of their occurrence in the graves about the slopes of Chiriqui mountain.

The graves cover many acres (even many square miles) at the base of Chiriqui, near the coast, lying for the most part beneath many feet of alluvial deposit. No external sign marks the place of one of these tombs, but the natives find them readily by sounding the soft earth with long iron rods, which vibrate when they come in contact with flat stones with which they are covered. Some of them are oblong in shape, like modern graves, but by far the greater part are nearly circular. The walls are all of sea-worn stones, of a kind not at present existing in the neighborhood, and the flat slabs that cover them have been brought obviously from a great distance, as no such material exists in the vicinity. It has not been discovered that these tombs are arranged with any regard to special order, but there is some sort of evidence that the larger ones have been reopened for the reception of bodies from time to time, down to a date of comparative recency.

The implements exhumed consist, in the first instance, of knives and rude weapons of stone, together with polishing stones, obviously used to smooth the surface of the pottery. The latter shows a great many interesting forms, most common of which is the jar, very pointed at the bottom, with an extremely narrow neck, and not very inclining lips. They vary in proportions from jars having a capacity of less than a pint to those capable of holding two quarts. The ruder specimens rest upon tripods, while the more highly ornamented have no legs and must have been somewhat inconvenient vessels to handle. The coarser pottery is not decorated in colors. The top is bordered with an ornamented design cut in or incised so as to resemble the modern stamp, and there are some attempts at figure work, the principal animals being the frog, the owl's face, according to some, cougar's according to other critics, and the monkey; although Prof. Putnam, of the Peabody Museum, thinks that these so-called monkeys are rude representations of the human form.

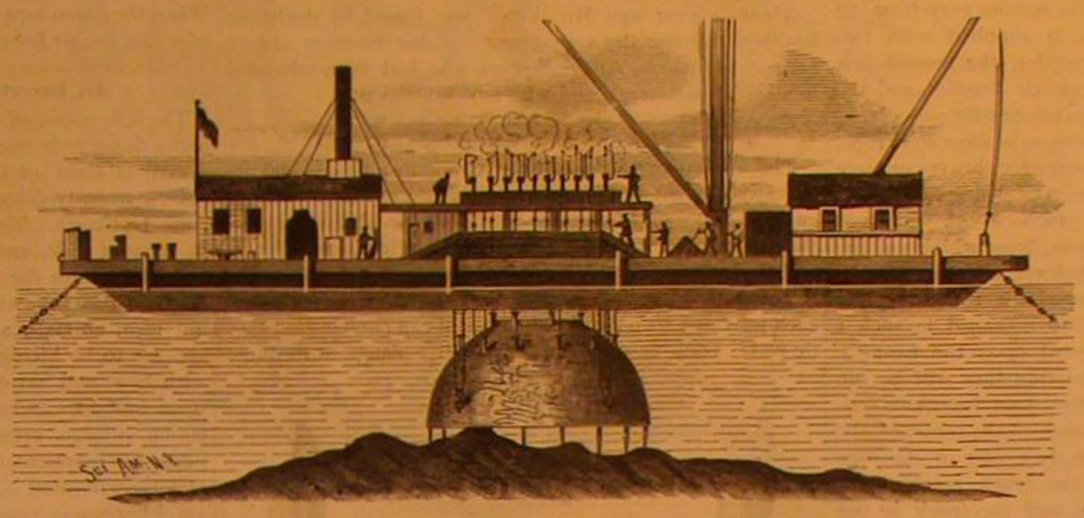
The collection has also some very curious representations of birds, which are ornamented with red stripes upon a black ground. The latter are hollow within and perforated at the tail, at the bill, and beneath the wings, so as to be used as whistles to imitate the notes of birds, and to produce different musical notes by closing one or another of the apertures with the fingers. Their use, unless to attract birds by imitating their notes, is doubtful. The legs of the tripods are heavy, pod-shaped, and hollow, containing within several balls of pottery and furnished with a slit like old-fashioned sleigh bells. Their sound when shaken is similar to that of a rattle-box; but it is scarcely credible that they were used for that purpose, although there are several pottery rattle-boxes in the collection. Professor Putnam, who had given the collection a careful examination, entered upon a very elaborate comparison of these remains with the Mexican, Peruvian, and those of the mound-builders, who, it appears, had a similar trick of hollowing out the legs of their tripods and furnishing them with movable balls. According to Professor Putnam, these remains are found as far south as Bogota, and while they have some affinity for the Mexican and Peruvian potteries, they are both less graceful in design and

less elaborate in decoration. He finds the frog a form common to them all, and so the cougar's or tiger's face. But the Mexicans usually sculptured a face or figure, head downward, upon the external aspect of each leg of the tripod, a feature seldom or never seen in this ruder work. They also ornamented their jars with hieroglyphic inscriptions (which have never been deciphered, by the way), and the latter have no place in the collection of Mr. Lamson, with a single doubtful exception. Professor Putnam did not attempt to assign any special age to these remains.

THE UNITED STATES DRILLING SCOW, EAST RIVER.

[*Continued from first page.*]

and steadying the drills while at work had proved inadequate. At this stage of the undertaking the management of the East River Improvement was intrusted to Major-General John Newton, U. S. Engineer, whose first work was to devise means for meeting the difficulties which had defeated his predecessors. The result was the drilling scow, the construction and working of which is illustrated by the accompanying engravings.

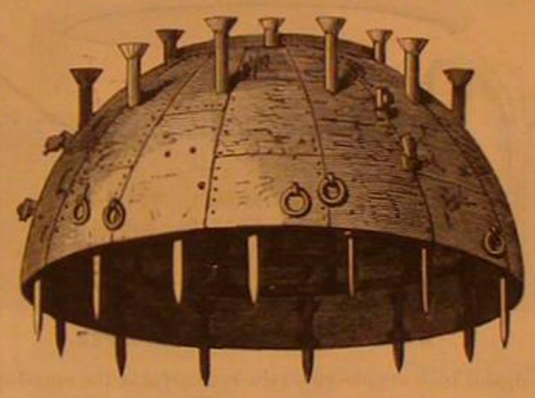


SCOW AND DOME IN POSITION.

The scow is at once a boat, a machine shop, and a fortification. Its great size, massive structure, and overhanging guard, faced with iron, were necessary for the protection of its works against collision. At first such nominal accidents were of frequent occurrence. In a little while it was demonstrated that the colliding vessels were sure to get the worst of the encounter, and since then the pilots have given the scow as wide a berth as possible. Still strictly unavoidable collisions are of almost daily occurrence, owing to the necessary position of the scow while at work, the narrowness of the channel, and the severity of the tides.

In the center of the scow is a well hole 32 feet in diameter, in which is hung a hemispherical dome of boiler plate on an iron frame. This dome, or caisson, is 30 feet in diameter, open at top and bottom, and carries a number of strong iron tubes for the protection of the drill bars. It is also furnished with a dozen stout legs, so arranged that they can be let go all at once, when one edge of the dome touches the reef to be operated on. The legs are held by self-acting cams, so that, when extended to fit the uneven surface of the reef the dome is to stand on, they are securely locked, and thus support the dome in an upright position. The hemispherical shape was chosen for the dome on account of its superior stability under the action of the fierce currents. By converting the transverse pressure of the moving masses of water into a radial pressure downward, the dome is sure to stand firm.

The dome, as shown in the cross section, is attached to the scow by chains connecting with the hoisting engines, by which it is raised and lowered. The drill engines are carried by the stout framework inclosing the well, and are so mounted that they can be placed directly over such drill tubes as may offer the best positions for drilling. Within the dome is another ingenious device, by which a drill tube can be brought directly over any point on the bottom within the 15 foot circle of the upper opening of the dome. It is rarely possible and never necessary to drill as many holes as there are drill tubes provided; the larger number—20 are in the outer circle of the dome, and an unlimited number possible in the inner circle—being furnished to make it easy to locate the drill holes to the best advantage. The drills and drill rods are together about 10 feet long, and weigh between six and seven hundred pounds each. The cutting edges of the drills are in the form of a cross, and are 5½ inches in length. Originally the drill holes were 3½ inches in diameter, but the speed of cutting was found to increase with the enlargement of the bits, and now the larger size is used exclusively. The cutting is done by the impact of the falling drill bar, which drops from two to three feet. The drill rods are connected with the piston rods of the drilling engines by ropes, a flexible coupling being necessary on account of the liability of the scow to slight movements caused by shifting currents and frequent collisions, while the dome is fixed. The length of the rope is regulated by a feed gear, to suit the changing level of the scow due to the rise and fall of the tides. The operations of the scow are grandly simple. With the dome swung by the chains the scow is anchored over the rock to be operated on, head to the tide, by stout chains fore and aft, and side anchors to insure steadiness. The anchor chains are strong enough to withstand not only the stress of the tides, but also the shock of colliding vessels. The site of the blast has already been fixed by the divers, and the scow, when in place, lies so that the dome is directly over the spot selected. Then the dome is lowered, and as soon as it touches bottom the legs are let go and the dome is unhooked from the scow. The diver next selects the most suitable points for drilling, and the drill tubes are brought into position, if within the upper circle of the dome; if not, the nearest available tubes are selected. The drilling engines are then placed, the drill rods are inserted, and the work is set going. The average penetration of the drills during a shift of 8 hours is from 7 to 10 feet, according to the nature of the rock. The average penetration for each hole ranges from 8 to 12 feet. One sharpening of the drill bit usually suffices for a hole.



THE DOME.

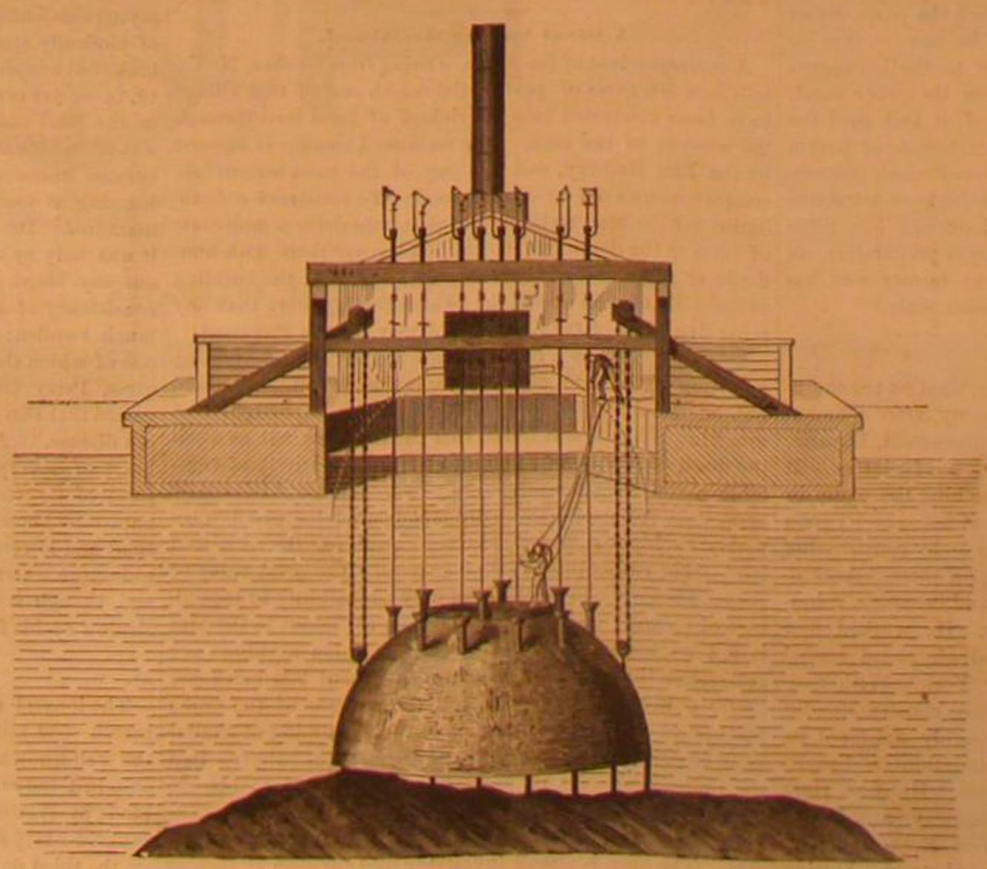
The drilling completed, the diver descends and stops the holes with wooden plugs to keep them from filling with sand and mud, connects the plugs by cords, and the last one by a line to the surface. Then the chains are hooked to the dome, the dome is raised clear of the bottom, and the scow is swung out of position or taken to some other reef.

The charges, inclosed in tin cases about 10 feet long and 5 inches, tapering to 4 inches, in diameter, are conveyed to the site of the blast on a small scow. Guided by the main line of the stoppers the diver, at slack water, descends to the first hole; the charge is passed down to him and inserted; then he proceeds to the next in order, and so on until all the drill holes are charged. In each cartridge is an exploding fuse, from which a fine wire leads to the exploding battery on the scow. When all the charges are down the diver returns to the scow, which is withdrawn to the proper distance and the blast is fired. The visible effect of the blast is the elevation of the water over the reef like a huge dome, which instantly bursts, sending up a huge tower of foam, water, and rock fragments from 50 to 200 feet in height. The appearance varies, of course, with the depth of water, the number of charges, and the amount of explosive used. The prevailing type under favorable conditions is that figured by our artist.

As many as twenty-one holes have been simultaneously fired on Diamond Reef, with a total charge of eleven hundred and forty pounds of nitro-glycerine. During recent operations the location of the dome has been determined by sextant observations, and its separate position and the position of each drill hole have been carefully laid out on a special plan of the reef. At first, the object being to remove with the greatest dispatch the more prominent points of the reef, no attempt was made to secure a uniform removal of the rock. Latterly the work has been conducted by face blasting, with a view to the most complete and economical breaking up of the reef and to facilitate the removal of the rock, which is raised by grappling.

The scow has been used for the removal of the rocks and reefs known as Diamond Reef at the mouth of East River, between Governor's Island and the Battery; Coenties Reef, six hundred yards northeastward, in East River; Pot Rock and the Frying Pan, in Hell Gate; Way's Reef, Shell Drake, and a rock opposite 125th street, Harlem River.

During the past three years, though idle much of the time for lack of appropriations, a considerable portion of Diamond Reef has been reduced to the twenty-six foot level at low water; Way's Reef has been reduced from seventeen to twenty-six feet; Coenties Reef from fifteen to twenty-five feet; and the Harlem River Rock from nine to fourteen feet. Considerable work has also been done on Pot Rock and the Frying Pan.



CROSS SECTION OF SCOW, SHOWING THE WELL HOLE.

MISCELLANEOUS INVENTIONS.

An improved window shade hanging, patented by Mr. Joseph Hemkeler, of Lowell, Mo., consists in combining with the curtain roller a second roll hung in loops of flat belts that are attached at one end to the window frame and connect the flanged spools on the ends of the rolls.

An insulator for telegraph wires, formed of a piece of glass perforated longitudinally, and a screw adapted to the perforation and having a round head provided with a square mortise for securing a key or screwdriver for driving the screw home, and having at each end a rubber ring, has been patented by Mr. J. H. Bloomfield, of Concordia, Entre Rios, Argentine Republic.

Mr. John Sherreff, of Dedham, Mass., has patented an improved mail box, provided with rawhide bunters or protectors. Its body is composed of stout paper board or vulcanized paper or fiber.

An improved article of hard rubber manufacture, formed of strips or sheets of metal foil and caoutchouc, has been patented by Messrs. Daniel F. Connell, of Brooklyn, and Edward Fagan, of New York, N. Y. The strips or shreds are distributed through the rubber to give it increased weight and density.

Mr. Prince H. Foster, of Babylon, N. Y., has patented an improved sanitary mask to be worn in sick rooms and in other places where persons may be exposed to infected or malarial air. It consists of a mask made of rubber or other suitable material, and secured air-tight to the head of the wearer by an elastic band. It is provided with valves and filters at the nose and mouth, and has transparent eye plates or windows.

Wire Rope Transportation at the Reading Iron Works.

The *Iron Age* describes a system of wire rope transportation at the Reading Iron Works, which is expected to do away with much expensive handling and carting, and will offer a good example of a system which is rapidly gaining ground in Europe, and has been repeatedly used with success both in Eastern and Western States, although not to that large extent which its advantages warrant. At the Reading Works there will be three lines of transportation, the first of which will be 1,000 feet in length. It will be used exclusively for conveying pipes manufactured in the establishment to a siding along the Reading Railroad, 90 feet in length, where the pipes will be loaded upon cars. The second line will be 800 feet in length, and will be used for the transportation of anthracite coal, while the third line will be 300 feet in length, and will carry soft coal and pea coal to the rolling mill. The trestles vary from 20 to 45 feet in height. The first line is supplied with two terminal and eight intermediate trestles, the second line with two terminal and four intermediate trestles, and the third line with two terminal and one intermediate trestle.

The main line will be equipped with an endless steel rope, 1¼ inches in diameter, which will run over sheaves or large wheels located upon the trestles, the rope fitting firmly into grooves in the circumference of each wheel. Grooved trucks will be fastened upon the chain, from which will be suspended hangers to support whatever articles may be transported. As this line will be used for carrying pipes almost exclusively, two trucks will be arranged in such a manner as to carry the pipes suspended upon the hangers. When the trucks reach the railroad siding they will be run from the endless rope upon the siding by an ingenious contrivance. From the center of the track to the center of the wheel the gauge is the same as from the center of the rope to the center of the wheel. Upon the truck reaching the siding, the rope shoots at an angle, and the truck is run upon the railroad tracks with its freight. The moment the wheel strikes the rail, the rope slips down and leaves the truck standing upon the rail. The truck is then disengaged from the rope and unloaded. While one line of loaded trucks is being conveyed from the pipe mill to the siding, a line of empty ones is being returned.

The operations of the other lines for carrying coal from the railroad sidings and dumping places to the pipe and rolling mills are of a similar character. The large sheaves, or wheels, are 8 feet in diameter, and the small sheaves are 2 and 3 feet in diameter. The coal will be carried in buckets suspended from trucks fastened to chains. The power used in operating the endless ropes will be transmitted from a stationary engine by the line of shafting in the flue-cutting department of the pipe mill.

Poison for Rats and Mice.

Carbonate of baryta has been found to be a most efficient poison for rats and similar vermin. Indeed, at a special series of trials by the Zootechnical Institute, in connection with the Royal Agricultural College, at Proskaw, this substance was found to be more efficacious than any other. It occurs as a heavy white powder, devoid of taste or smell. In the Proskaw experiments it was mixed with four times its weight of barley meal, and pellets of the paste were introduced into the holes of the rats, house mice, and field mice. A small quantity proves fatal. It appears to cause immediate and complete paralysis of the hind extremities, so that it may be assumed that mice eating of it in their holes will die within them, and so not prove destructive in their turn to domesticated animals that might otherwise devour the carcasses. It was found in practice that neither fowls nor pigeons would touch the paste, either in its soft state or when hardened by the sun; so that its employment is probably free from danger to the occupants of the poultry yards. Some rabbits, on the other hand, that got access to the paste ate heartily of it and paid the penalty with their lives. Next to the carbonate of baryta paste the ordinary phosphorus paste proved most destructive, and this, it was found by experiment, is more attractive to the mice in a soft form than when hardened into pills. But it is considerably dearer than the baryta preparation, an important factor in the calculations of the farmer who has to wage war against rodents on an extensive scale.

Albert Weber.

Albert Weber, the piano manufacturer, died on the morning of June 25th, at his residence in this city, after a lingering illness. Mr. Weber was born in Heiligenstadt, Bavaria, in 1829, and came to this country a youth of sixteen. It was his intention to make a living by teaching the piano or by obtaining a position as an organist, but his sagacity soon taught him that there was more to be made by constructing musical instruments than by playing upon them. Accordingly, he abandoned his earlier notions and became a voluntary apprentice to a piano manufacturer. He worked first with Van Winckle, of Port Chester, and afterward served an apprenticeship with Holder, of New York. With assiduity he devoted himself to the art of piano construction for about six years, in which time he thoroughly mastered its details and intricacies, and then, being ambitious and aspiring, set up in business on his own account. His first store was a little music shop on West Broadway, near White street. Later, he moved further up West Broadway, and opened a store near the corner of Lispenard street. During these years his business continued to increase, and in 1864 he moved to more extensive premises at the corner of Broome and Crosby streets. About this date he began to be known to the musicians of this city; teachers and players flocked to his store, and his pianos came rapidly into favor. In a few years he was well known in professional circles, and in 1869 his business had assumed such proportions as to render another step up town both expedient and necessary. In that year, therefore, he moved to the extensive warerooms on Fifth avenue, which have since been occupied by the firm. Here his business reached splendid proportions.

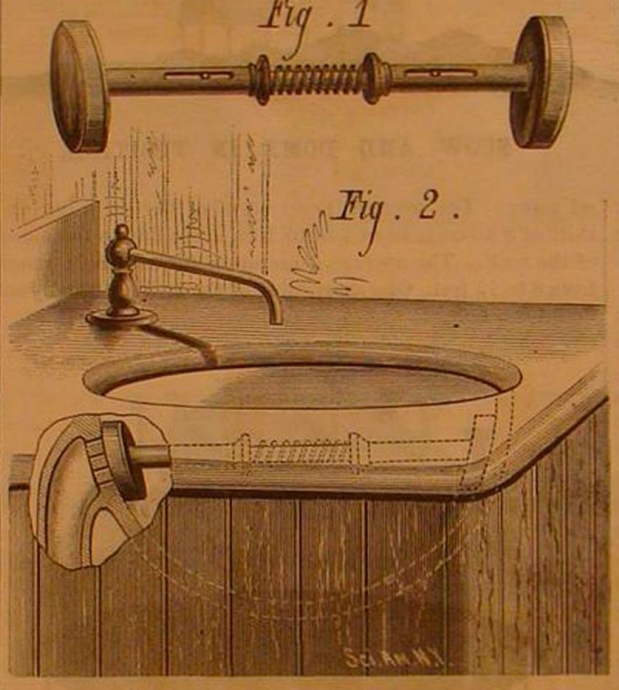
While he was in Broome street he built, in 1868, the manufactory in Seventh avenue, which, in 1876, was enlarged to a frontage of 262 feet on Seventeenth street, and of 204 feet on the avenue. About 400 men are regularly employed, and the yearly product is now between 1,800 and 2,000 instruments. Mr. Weber gave his personal supervision to the manufacture of 14,500 pianos.

About a year ago Mr. Weber was forced by declining health to transfer the management of the business almost entirely to his son, Albert Weber, who had been educated in all its departments, and who now inherits it.

NEW SEWER GAS STOPPER.

The accompanying engraving represents a simple and apparently efficient device for preventing the entrance of sewer gas into a house through the overflow pipe of a washbasin. Its construction will be understood by referring to Fig. 1, and the manner of applying it is shown in Fig. 2.

The stopper consists of two longitudinally slotted tubes, each provided with a curved elliptical cap carrying an elastic pad. Each tube is provided with a flange at its inner



WEMPLE'S SEWER GAS STOPPER.

end, and both are placed on the rod carrying the spiral spring that forces the two tubes apart. The stopper is applied to the basin by pressing the two tubes toward each other, placing one pad over the overflow holes, and then allowing the device to expand by the pressure of the spring. These stoppers are made of different lengths to suit basins of various sizes.

Further information may be obtained from the inventor, Mr. Christopher Y. Wemple, Nos. 2 to 10 Worth street, New York city.

A Great Swamp Reclaimed.

A correspondent of the *Times*, writing from Goshen, N. Y., tells how 500 acres of pestilential marsh east of that village have been converted into the richest of farm land through the wisdom of one man. The reclaimed swamp is crossed by the Erie Railway, and was one of the most serious obstacles encountered by its engineers. To construct a foundation for the road bed it was necessary to drive a multitude of piles to the depth of 100 feet, and cover them with hundreds of thousands of loads of stone and dirt; the building of one mile of road across the swamp costing more than any other five miles of the road from Jersey City to Piermont.

Twenty years ago a farmer conceived the idea of draining a portion of the tract and making it tillable soil. By ditching, he reclaimed 60 acres. The first acre he bought cost him $1. When it was found that the draining left as a soil the finest of black muck, composed almost entirely of vegetable mould, the price advanced to $17 an acre. After the 60 acres were reclaimed, the price still further increased, until to-day as high as $1,000 has been paid for the reclaimed land. The ruling price is $500 an acre. The great value of the land is owing to its extraordinary adaptability to the culture of onions. A crop of 800 bushels of onions to the acre is not uncommon, and the Greycourt onion meadows are celebrated throughout the country. About 300 acres are under cultivation this year, and the success of the onion business in the meadows has led to the reclaiming of similar lands in other parts of the country, until it is believed that the onion crop of Orange county will amount to 500,000 bushels this year. The average price received by onion raisers is $1 a bushel. The average yield is 300 bushels to the acre. The crop is almost invariably sold for cash as soon as it is ready for market, and as it matures early in the season, the farmer is allowed abundant time to keep his land in the condition necessary to its productiveness.

There are 17,000 acres of swamp land in the Wallkill Valley, which will eventually be converted into this muck soil, which is the best in the world for vegetable raising. The land, after draining, is tilled with the slightest labor. Onion seed is sown by a hand drill, and the greatest labor is in keeping down the weeds after the plant begins to grow. This work is done by boys and girls. Hundreds of these may be seen in the growing season on their hands and knees between the onion rows, pulling up the weeds that the rich soil calls rapidly into existence. The weeding requires skill and care, as the soil is so loose that there is constant danger of tearing up the young and tender plants by their roots, or removing their covering of earth. The red onion is the variety grown most successfully, as the dark muck gives the white onion a dirty hue, which injures its marketable value. When the onion tops are at the height of their growth, their odor fills the air for great distances around.

An Inscribed Cavern in Wisconsin.

The *Chronicle*, of La Crosse, Wis., of June 15, prints half a dozen rude engravings, said to be exact tracings (reduced) of some of the pictures on the walls of a small cavern recently discovered in Barre township, some miles from La Crosse. The cave is described as thirty feet long by thirteen wide, and at its largest dimensions about eight feet high above the sand, which is from three to six feet deep. Upon the walls are very rude carvings representing men, animals, arms, implements, and something that appears to be hieroglyphics. One picture represents a man with bow and arrow, shooting at an animal. There are three buffaloes and one rabbit represented; three animals which, if large, must have been hippopotami; one that appears to represent the mastodon, and one moose, quite plainly delineated. There are eight representations of what are either canoes, much carved, or, which they more resemble, hammocks. One sketch of a man is quite plain. He wears a kind of chaplet, or crown, and was probably chief of his tribe or clan. There are many fragments of pictures where the rock has decomposed. It is coarse, soft, white sandstone. On one side there is a space about two feet high and two and one half feet into the wall, that has in time decomposed and fallen out. Above are the upper fragments of pictures and below the lower, showing that they were made when the rock was entire. From the depth to which the decomposition had reached in a dry and dark cavern, they must have been quite ancient.

These carvings, as copied by the *Chronicle*, are such as are commonly made by savages the world over. The alleged mastodon looks more like a hog, while the hippopotamus might be any square muzzled animal. The *Chronicle* says: "Every one who has visited the spot so far has come away convinced that the cave far ante-dates anything short of the ancient cave dwellers, and it needs only a sight of the interior of the room to convince the most hardened skeptic that there is no possibility of humbug." Among the visitors named are Dr. H. G. Miller, who, it is said, has made careful studies of the remains of the mound builders; and Hon. Hugh Cameron, who is described as a well informed geologist. The latter pronounced the discovery as a very important one. This, we take it, will depend entirely on the correctness of the conjecture that some of the animals represented are the prehistoric creatures named.

New Diseases.

Professor Winckel, the Director of the Royal Lying-in Institution at Dresden, has reported to the Congress of Children's Doctors, lately held in Berlin, observations upon a mysterious children's disease, which he had an opportunity of clinically studying in his own institution. An epidemic broke out toward the end of March. Of 23 children attacked, 19, or 82 per cent, died, and the average duration of illness in the fatal cases was 32 hours. The illness began with a sort of sudden stupefaction of the children. The respiration became hoarse, accompanied with groaning and occasional foaming at the mouth. The change in the blood was remarkable. Dr. Winckel made incisions in some cases, but it was only by using pressure that he was able to squeeze out any blood. It was a thick, brown-black fluid, of the consistency of a sirup. The body became flaccid, the liver much swollen; presently convulsions supervened, during one of which the child expired. The President of the Congress, Privy Councilor Dr. Gerhardt, of Würzburg, suggested that this new disorder should be designated "Winckel's disease." Another disease has become apparent in the heart of a very crowded portion of London. It is a new form of Cyprus fever, and a diagnosis of a recent malignant case shows the patient to be suffering from hallucinations and lowered vitality. The faculty ascribe the disease to impure water, and have given it the name of detephobia, and, though it is seldom fatal, the sufferer remains but a shadow of his former self.

Weston's Walk.

The longest distance ever made in a six days' walking match—550 miles—was accomplished by Edward Weston, the well known pedestrian, in the contest for the championship in London, June 16–21. The best previous record was made by Weston's opponent, Brown, in April last, when he covered 542½ miles. In the last contest Brown broke down on the third day, and made, in all, only 453 miles. Weston's daily records were respectively 123, 97, 93, 77, 83, 77 miles.

PLOWING BY ELECTRICITY.

Experiments have just been made at Sermaize (Marne), France, with a new system of mechanical plowing, the invention of MM. Chrétien & Félix, two engineers of the above place, who are already favorably known to the industrial world.

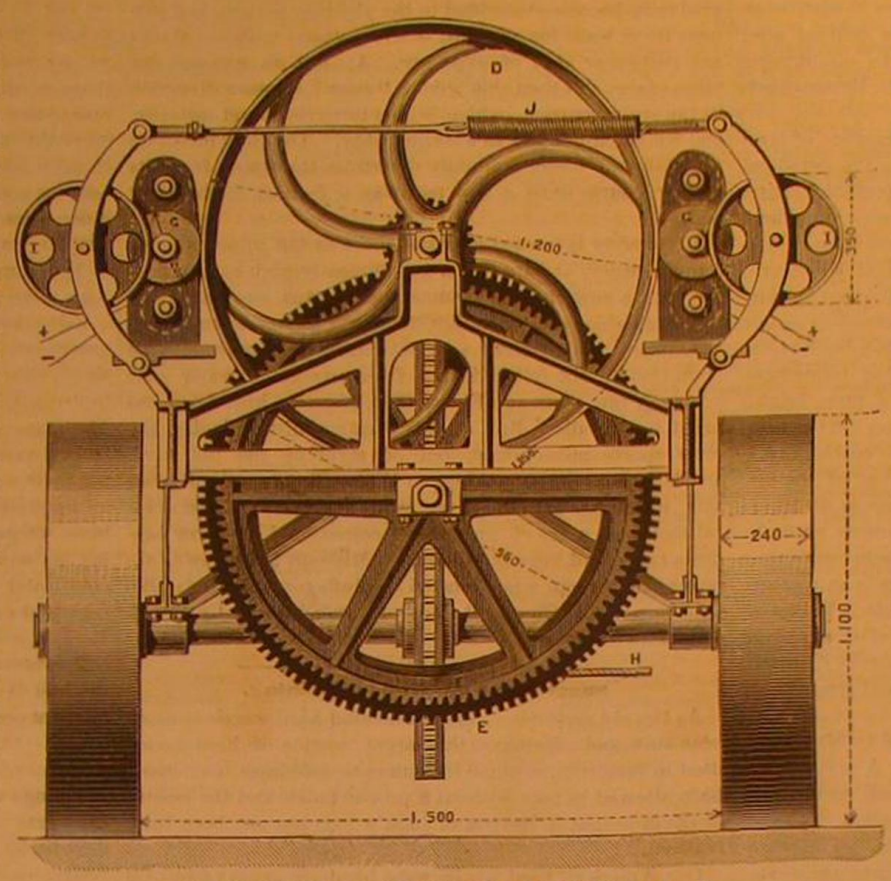
Tillage by mechanical power, as practiced at present in England, the United States, and some parts of France, is based on the use of locomotive steam engines placed on a headland and actuating drums over which passes an endless steel rope serving to carry the plow back and forth over the field. These machines are very high priced; it costs a great deal to manage them and keep them in repair. Special care has to be exercised to make them work well; they are difficult to manage in the fields, especially in rainy weather; and, finally, they require a considerable supply of water. The work, however, is better done; and the deep tillage of the soil that mechanical plowing alone can effect, multiplies the nutritive surfaces of the arable layer and gives a mean increase of 30 per cent. in crops. But in spite of all its advantages, steam plowing has made little headway in France, both on account of the parceling out of the lands among numerous proprietors, and the inconveniences that we have just enumerated.

With a view to the more general adoption of mechanical power on farms, the engineers mentioned above have devised an arrangement by which motive power in a certain fixed position may be employed to do the work of several adjacent farms through the medium of electricity as an agent of transmission. They have for this purpose adopted the Gramme dynamo-electric machine for the generation of electricity, and similar machines as the electro-dynamic agent for reconversion of the electricity, conveyed to any required distance by cables, into motive power.

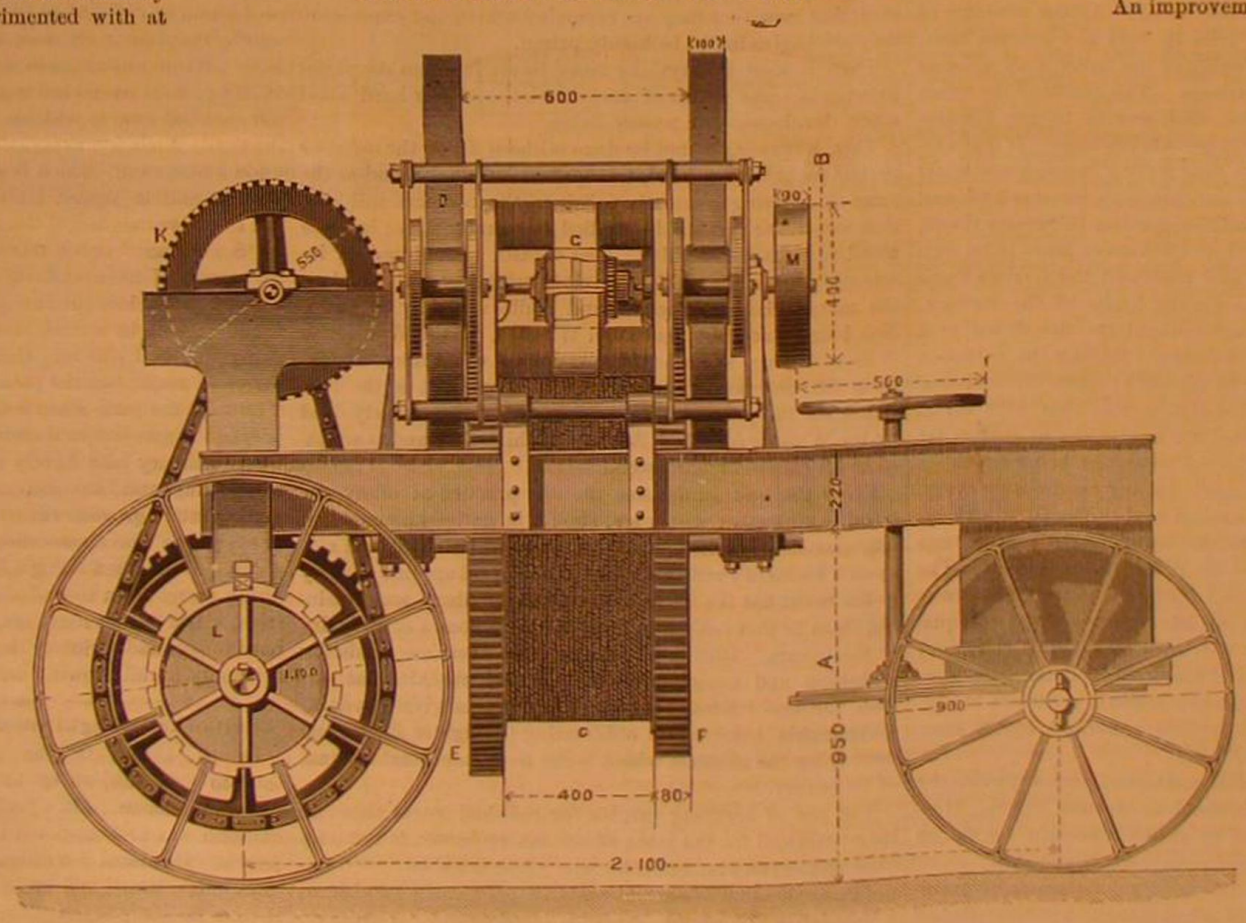
Two forms of these machines have already been established and experimented with at Sermaize—one of them designed for unloading beet boats, and the other for plowing. The former was in operation all of last winter, and its use was found to effect a saving of about 40 per cent over manual labor. Besides this, the beets were unloaded very much quicker (a matter of capital importance in the sugar-making industry) and without the aid of special workmen, who cannot always be depended upon. Within the past few weeks the power has been transmitted to some neighboring fields, which have been plowed by a balance plow and the windlasses which we illustrate herewith. Each of these consists of a carriage of wrought iron, the two side frame pieces being of I section, mounted on four iron wheels. Two Gramme electro-dynamic machines, G G, are mounted on a hinged frame attached to the side frames. These machines are connected together at their upper parts by means of a simple connecting rod and a pair of India rubber rings (the arrangement of friction wheel, I, and the spiral spring, J, was removed after trial, as not giving sufficient rigidity, though the friction was very small), which hold the pulleys on the end of the Gramme machine spindles, against the pulleys, D D. The small pulleys in the Gramme machines are covered with gutta percha. The hauling drum, C, receives the movement of the pulleys, D, by means of the pinions, E or F, which give the slow or fast speed respectively. Upon the end of the spindle carrying the pulleys, D, is fixed a bevel pinion gearing with the bevel wheel, K, upon the shaft carrying which is a pitch pinion, over which and the wheel, L, runs a pitch chain, by which the headland movement of the windlass is obtained. The steering of the windlass is effected by the hand wheel, as shown in front. For working, the hind wheels are fixed upon the axle by a set screw, which is loosened for traveling. The rope, H, is of steel, half an inch diameter and 1·3 miles in length, as used at Sermaize. The electric cables are carried on posts, as for telegraphic purposes. They consist of wires each 0·04 inch in diameter, giving a total sectional area of about 0·33 inch. In the experiments the windlasses, constituted as above, were placed at a distance of 664 feet apart, and by means of commutators the electricity was alternately passed through the one and the other pair of machines as the plow crossed and recrossed the field. An engine in the sugar factory already mentioned, and situated 1,300 feet from the field, gave motion to the dynamo-electric machines which supplied the electricity, about eight horse power being employed. When in light ground two furrows have been made, but in heavy ground only one, the power transmitted to the plow being but that of three to four horses. The designers will, however, soon have machinery ready which will enable them to use a four furrow plow.

The gramme machines at the works were driven at 1,600 revolutions per minute, while those on the windlasses made 800 per minute. The pulleys, D, made 133 revolutions per minute, and the hauling drums 14 and 27 under the slow and fast speeds respectively, the corresponding speeds of the plow being 164 and 266 feet per minute. The furrows were 10·8 inches wide and 7·87 inches deep. Making two furrows, about 24 square yards were plowed per minute. It was found that about 50 per cent of the work of the fixed engine was realized on the field, and that the efficiency of the electro-dynamic apparatus is from 30 to 60 per cent, according to the distance of transmission.

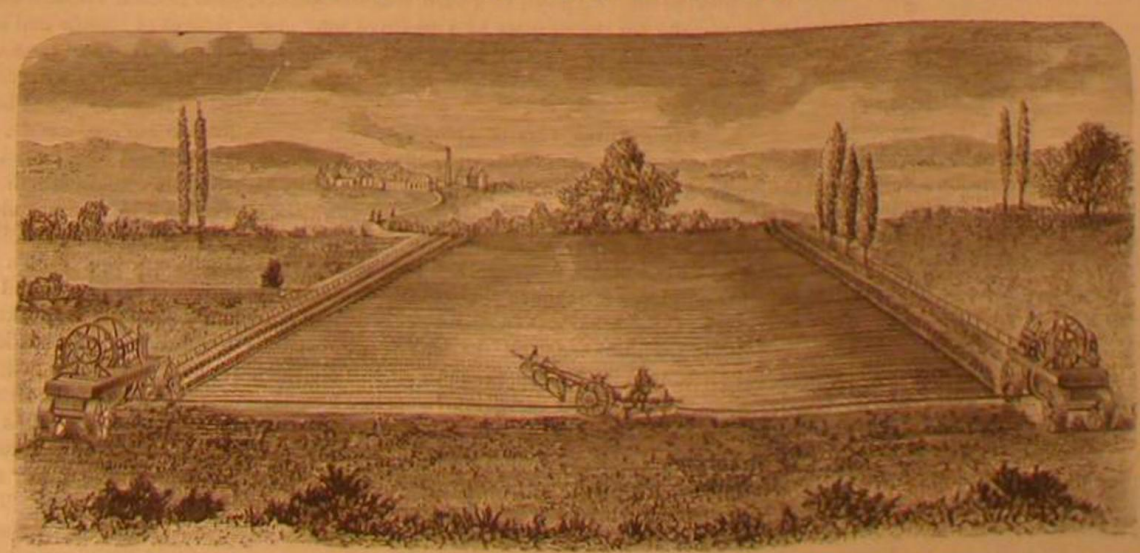
It is urged that the apparatus will provide in France the means of supplanting much hand labor, which is somewhat scarce, and that by its means many falls of water not now used may be usefully employed for generating power for transmission. Our illustrations are copied from those which have appeared in the *Revue Industrielle*.



TRANSVERSE SECTION ON LINE A B.



APPARATUS FOR PLOWING BY ELECTRICITY.



PLOWING BY ELECTRICITY AT SERMAIZE, FRANCE.

NEW AGRICULTURAL INVENTIONS.

An improvement in check row corn planters, consisting chiefly in the peculiar arrangement of devices for imparting motion from the drive shaft to the feed slides, and in a contrivance for throwing the slide-operating mechanism into and out of gear, has been patented by Mr. Charles G. Everet, of Belfontaine, O.

Mr. Aaron F. French, of Denison, Iowa, has patented an improved harrow, having its tooth bars connected by tubes threaded externally to receive the nuts by which the bars are held in place, and threaded internally to receive the hooks and eyes that connect the different sections of the harrow.

A new machine for planting corn in hills at a uniform distance apart has been patented by Mr. Theodore F. Tanner, of Jefferson City, Mo. It consists of a frame, carrying seed boxes, mounted on wheels, and provided with valves and slides that are opened at regular intervals by connections from the driving wheels of the apparatus.

An improved fertilizer distributer has been patented by Mr. William Hodges, of Okolona, Miss. The machine is provided with a hopper having hinged ends that are connected with a shaft or roller so that they may be drawn inward to aid in the discharge of the fertilizer.

Messrs. Arthur C. and Reuben W. Sriver, of New Baltimore, O., have patented an improved harvester reel and dropper, the principal features of which consist in novel means for regulating the vertical adjustment of the reel above the cutter bar, and in a device for intermittently discharging the cut grain.

Petroleum as a Steam-Maker.

To-day there are 7,000,000 barrels, of 40 gallons each, of crude petroleum above ground in the oil regions. This vast accumulation of heat and light producing material is going a begging at 64 cents per barrel. Every hour adds to this ocean of oil; in spite of the enormous consumption the stock accumulates. Every new use to which petroleum is applied possesses interest to producers, and the day that shall see crude oil take the place of coal as a steam producer will be a glad day for mankind in general and oil men in particular. That such a day is not very far distant seems evident after an inspection of the working, recently, of an oil burning device tested on a river steamer at the Monongahela wharf.

A representative of the *Telegraph*, with a number of river men and steamboat owners, was present upon the occasion, and the object of this article is to briefly set forth the claims to public attention possessed by the device under consideration. The invention is the property of the American Hydro-Carbon Gas Company—John Campbell, General Manager—and embraces simple but vital principles of construction, wherein atmospheric air and steam are combined in proper proportions with oil, and injected into the firebox beneath the boilers in the form of spray. The latter being immediately converted into inflammable gas becomes a pure, bright, powerful flame, devoid of smoke and producing intense heat.

To accomplish this result extremely simple machinery is used. A small hole is drilled into the iron front of the firebox, and into this passes a tube which branches as it leaves this point into two pipes. One of these connects with the boiler itself, and the other with the receptacle containing crude oil. At the juncture of these pipes there is an aperture for the admission of outer, or atmospheric air. Valves of peculiar construction regulate the quantity of steam or oil admitted to the furnace. This is all the machinery required, but its operation is wonderfully complete and remarkably successful.

The little steamer Billy Collins was selected by Mr. Campbell for the test and was fired up at 9 A.M. A preliminary blaze of wood under the boiler raised the small quantity of steam necessary to start the burner into operation. The oil valve was opened a trifle, the steam valve ditto. The petroleum trickled into the feed pipe, was caught up by the steam, and both plunged into the depths of the firebox, a mass of many-tongued, roaring, brilliant flame. As the pressure of steam increased, this flame grew in fury and intense heat, roaring through the entire length of the boiler with a sound like the coming of a thunderstorm. The needle of the steam gauge climbed rapidly up the dial, and in twenty minutes the safety valve blew off at 120 pounds pressure. It was a remarkable sight. Here was a boat puffing through the water with no sign of smoke from her chimneys, no speck of soot in flues or firebox, no fireman, no opening of furnace doors, no dirt, no coal going in, and no clinkers or ashes to be seen anywhere. A turn of the hand regulated the terrible flame that seemed trying to overpower the limits of the furnace, and another turn of the hand brought the fire down to a quiet little flame, a foot or two long. During the forenoon occupied by the test, about 20 gallons of crude oil were consumed, and Mr. Campbell's estimate was, that with oil at one dollar per barrel, this fuel was equivalent to coal at six cents, in heat producing value, other things being equal.

But other things are not equal, by any means, and everything is in favor of oil as against coal. The labor and expense of "firing up" is dispensed with, and the engineer can regulate the flame as he does the steam in his engines. The danger from sparks and flying cinders is entirely done away with. The space occupied by oil, as compared to an equal value of coal, is very much less, and this much is gained for cargo. Further, the wear and tear upon boilers, grate bars, etc., is infinitely less, and, it seems scarcely necessary to add, the comfort of passengers is greatly enhanced by the absolute freedom from dirt of all kinds.

To the western boatman this method of steam producing is full of interest. "Coal is coal" on western rivers. Here is a fuel that seems provided by nature especially for use on craft where every atom of carrying space is valuable.

To ocean going steamers this device must prove of extraordinary interest. A tank of oil situated at a remote end of the ship would hold fuel sufficient for a double trip, and supplant the great coal bunkers with their attendant dirt. Space prevents even a glance at the possibilities of this burner on the ocean.

To railroad men this burner is full of promise also. A locomotive boiler, with its many tubes, would be pierced in every part with this wonderful oil flame, and the benefits arising from the entire absence of sparks, cinders, and smoke are simply incalculable. In fact the "hydrocarbon" folks have got a "big thing," and upon their success in introducing their device to the public, and in overcoming popular prejudices, depends not a little the future of the oil trade.—*Pittsburg Telegraph.*

The Missouri River.

To be appreciated Missouri River must be seen and heard during the April or June rise, when its waters are red and thick with the powdered soil they have brought from the mountains and stolen from the farms in the valleys. Then it pours and swirls and eddies along with a treacherous sound between a chuckle and a half suppressed whisper, that repels while it fascinates the listener. It made millions of acres of rich black deposits, on which it still holds a mortgage, the foreclosure of which no man can foresee. Hundreds of farmers, after clearing away the heavy timber and raising fine crops year after year, on their eighty or more acres of deep, inexhaustible river bottom, have seen their entire possessions swept away in a few days by a sudden and unexpected "change of channel" during an April or June "rise." These changes of channel have different causes. Sometimes a giant cottonwood tree that has been uprooted where the river has risen upon the forest above, is borne down by the current and lodged in the mud, where it will gradually become embedded in the yielding bottom, and perhaps lie in wait for months, or even years, without giving any particular sign of existence. At last an unusual rise takes place, and then this hidden "snag" creates a diversion in the strong current, which begins to circle round the spot, and which culminates in a boiling eddy. The eddy increases in depth and force, gradually diverting the water from its former course until a new pathway is formed in the river bed.

If the eddy is located near the shore at the upper edge of a promontory, and the water is sufficiently high to overflow the flats, a new channel is sometimes carved straight across some valuable farm or timber strip, and a river town, where steamboats took freight and passengers last year, may be from two to six miles distant from navigable water next year. A few years ago Forest City, Mo., was kissed day and night by the dirty lips of this Western flirt. To-day the river sports miles away, out of sight of the old love, and is whispering soft things to White Cloud on the Kansas side, which has gained a river, while the State has lost several thousand acres of productive cotton land that now supports cattle and hogs in Missouri. Missouri River towns are never safe, except when located on bluffs, or table lands, like Omaha, White Cloud, St. Joseph, and Kansas City.—*St. Paul Pioneer Press.*

Suggestions on Wood Finishing.

As the old methods of finely finishing hard woods have all been slow and expensive, the larger portion of hard woods used in furniture, musical instruments, buildings, etc., have been allowed to pass without a proper finish, and the beauty of effect sought in the use of such woods has not been fully realized.

Our American hard woods were formerly so very plentiful and cheap that their true merits were not properly appreciated; but now that they are becoming scarce and expensive, they are beginning to be highly prized.

There is scarcely anything more beautiful than the variegated colors and grains of many varieties of our hard wood when developed by a proper finish.

This, however, cannot be done without filling the softer or porous parts with a hard, transparent substance, and at the same time giving a smooth polish to the compact solid, so that when the varnish is applied it cannot strike into the wood and change its color. The varnish should merely lie smoothly upon the surface, giving brilliancy and effect to the natural beauty of color and endless variety of grain. Not long since Mr. Nathaniel Wheeler, of the Wheeler & Wilson Sewing Machine Co., patented a wood filler, which, from the testimony of those who have used it, is the best article for the purpose yet produced. It is extensively used by the Wheeler & Wilson Sewing Machine Co., and is adapted to all classes of hard wood work.

From the best authorities the old practice of oiling the wood is altogether wrong and should be entirely abandoned. Any one at all skilled in the art of wood-finishing will see, upon a moment's reflection, that a coat of oil applied directly to the wood has the effect of swelling the fibers, and retaining them in that condition until the oil becomes entirely dry or disappears. During all this time the fibers are gradually shrinking, and consequently moving and checking the varnish. Oil also "burns" the wood, and in time gives it a dark, disagreeable color, quite obliterating the lighter shades and destroying the contrast which is the most important element of its beauty.

The use of scraping varnish for polished work, although long practiced for the want of something better, is not only slow and expensive, but otherwise objectionable.

The application of several coats of poor rosin varnish, as a foundation for durable work, is inconsistent. A little reflection should satisfy any one that such a filler cannot possibly be as good as one composed of a hard, tough substance, prepared especially for the purpose by a person of long practical experience, which thoroughly unites with the fibers of the wood.

Lime Juice versus Alcohol.

There are visible signs of no uncertain kind that alcohol, as a beverage, is not likely in the future to have quite its own way, even in the metropolis. Coffee taverns and coffee tavern companies are being established now at a rapid rate, and, as far as we can judge, have worked very successfully. But before these places were much thought of—that is, about two years ago—those who looked about them might have observed in the windows and at the bars of most public houses, eating houses, and ginshops, more or less conspicuous advertisements of several varieties of so called lime juice beverages. We have at the present moment before us examples of several of this kind, and there is no doubt that, particularly during the warmer months (though these, by the way, are now few and far between), lime juice and its components constitute among the metropolitan public an exceeding popular drink.

Most people have had, or think they have had, at one time of life, some variety of cutaneous affection, which often takes the convenient synonym of scurvy. And as the latter disease was not many years since much written and talked about in connection with the mercantile marine, and still more, two years ago, in connection with the Royal Navy, we cannot be much surprised at the success of those who endeavor, for commercial purposes, to promote the sale of such drinks. It seems, however, that they do not meet with the unqualified approval of publicans, or rather of distillers and brewers. The former are now absolutely compelled to keep them, to sell them, and to advertise them. But, if we are correctly informed, the poor man's friend, in the shape of the licensed victualer, deprecates the imbibition of lime juice in any form whatever. He sells it because the inevitable law of commerce—that is, supply and demand—compels him to do so. But he will tell the individual who asks for a glass that it promotes acidity of the stomach, that it deranges the kidneys, congests the liver, corrodes the intestinal canal, and so on, and then the customer is told that he had much better keep to the old glass of "bitters" or "gin," etc.

Being tolerably certain that the reports as to this sort of gossip are substantially correct, we counsel the public to turn a deaf ear to such elaborate and ignorant nonsense, and to drink their lime juice whenever and wherever they list. There are with this as with other liquids pure and adulterated varieties, and as to this matter they must, of course, use their own judgment. But they may be assured that, as a rule, lime juice is, particularly during the summer, a far more wholesome drink than any form of alcohol, and that, say, an ounce or two of the pure juice in a tumbler of really cold water, sweetened to taste, is about the pleasantest beverage that can be taken when the thermometer is over 65° or 70° Fah. We commend this drink to the attention of the coffee tavern companies, but recommend them to procure the best West India lime juice, as more wholesome than any mixture containing other ingredients.—*Lancet.*

The Stinging Tree.

Though the tropical scrubs of Queensland are very luxuriant and beautiful, they are not without their dangerous drawbacks, for there is one plant growing in them that is really deadly in its effects—that is to say, deadly in the same way that one would apply the term to fire; as, if a certain proportion of one's body is burnt by the stinging tree, death will be the result. It would be as safe to pass through fires as to fall into one of these trees. They are found growing from two to three inches high to ten and fifteen feet; in the old ones the stem is whitish, and red berries usually grow on the top. It emits a peculiar disagreeable smell, but it is best known by its leaf, which is nearly round, having a point on the top, and is jagged all round the edge, like the nettle. All the leaves are large—some larger than a saucer.

"Sometimes," says a traveler, "while shooting turkeys in the scrubs I have entirely forgotten the stinging tree till warned of its close proximity by its smell, and I have then found myself in a little forest of them. I was only once stung, and that was very lightly. Its effects are curious. It leaves no mark, but the pain is maddening, and for months afterward the part, when touched, is tender in rainy weather, or when it gets wet in washing, etc. I have seen a man who treats ordinary pain lightly roll on the ground in agony after being stung; and I have known a horse so completely mad after getting into a grove of the trees that he rushed open-mouthed at every one who approached him, and had to be shot in the scrub. Dogs when stung will rush about, whining piteously, biting pieces from the affected part." The small stinging trees, a few inches high, are as dangerous as any, being so hard to see, and seriously imperiling one's ankles. The scrub is usually found growing among palm trees.

Caution to Draughtsmen.—Arsenic in Water Colors.

Dr. H. Fleck, in the *Chemiker Zeitung*, calls attention to this subject by the sudden death of a mechanical draughtsman. On a *post mortem* examination the cause of death was first supposed to be oxalate, and then a narcotic poison. Chemical investigation showed that the liver, kidneys, lungs, heart, and brain were impregnated with arsenic, though the œsophagus contained not a trace, and the stomach with its contents gave a barely perceptible arsenical mirror. The general circumstances of the case excluding the suspicions of suicide and malicious poisoning, it was found that the deceased had been in the habit when drawing of placing the pencil filled with color between his lips in order to point it. The water colors he had used were analyzed, and while Indian ink, gamboge, carmine, blue, red eosin ink, and neutral tint were found perfectly free from arsenic, a sample of sepia contained 3·08 per cent of arsenious acid, terra di Sienna 3·14, and a reddish brown color, the name of which was indistinct, 3·15. Burnt Sienna, Vandyck brown, bister, bladder green, brown ocher, Indian red, umber, raw and burnt, were also found arseniferous. Most of these colors are essentially iron lakes. Hence it appears that the mere presence of ferric oxide, except in a hydrated state and accompanied by free magnesia in quantity sufficient to neutralize the acids of the stomach, does not act as an antidote to arsenious acid. This case seems likewise to prove that arsenic taken in minute doses can accumulate in the system until it can be readily recognized in all organs, and can exert a dangerous action. This result seems to prove that the impunity with which the peasants of Styria consume small doses of arsenic must depend upon circumstances not yet fully understood.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

NEW BOOKS AND PUBLICATIONS.

LEFFEL'S WATERWHEEL BOOK. Springfield, Ohio: James Leffel & Co. 1879–1880.

The James Leffel turbine water wheel may fairly be accounted one of the great prime movers of American mechanical industry, there being over 8,000 of them in successful use, giving nearly 500,000 horse power. One recently built for a mining company runs under a head of 300 feet, the highest head thus far utilized in this country. The descriptive book in hand is a new and improved edition, handsomely printed and full of information of use to owners of water powers of every description.

ILLUSTRATED MANUAL OF THE BOOKWALTER ENGINE. Springfield: James Leffel & Co.

The manual of the Bookwalter Engine is more pronouncedly a descriptive price list. It is [worth consulting by any one contemplating the purchase of a small portable engine and boiler.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) S. T. C. asks (1) for directions for making a good ice box. A. Make the box and cover with hollow walls, which may be simply filled with air. The cover should fit well, and the box should be lined throughout with zinc. 2. Which makes the best of the following: Three thicknesses of good board or two thicknesses of board filled in with charcoal? A. The latter.

(2) L. & H. asks: Is it possible to well metallize by galvanoplasty, a large piece of clay or terra cotta work, such as a bust, natural size, or a group or statuette, and if so please let us know if there is a more efficient way to prepare it than the use of plumbago? A. It is difficult to impart a uniformly adherent coating of metal on such ware. A good method is to coat the ware with a varnish composed of shellac 6 parts, borax 1 part, boiling water q. s. to form a thick sirup. When this is nearly dry it is thickly and uniformly coated with a metallic bronze powder and thoroughly dried to about 110° Fah., before suspending in the "striking" bath. It is essential that the first film be thrown on expeditiously. After plating the articles may be placed for a short time in water heated to about 200° Fah.

(3) G. A. H. asks: 1. Will the gravity battery keep best on an open or on a closed circuit? A. The closed circuit is best. 2. Will tin on one side of the copper spirals make any difference? A. There should be no tin on the copper. You may remove the tin by heating the copper red hot and plunging it into water.

(4) H. H. C. asks: 1. Can two or more of the electric machines described in No. 161, SCIENTIFIC AMERICAN SUPPLEMENT, be worked together to advantage by foot power? A. No, it is not an easy matter to drive a single one. 2. Should the wires of the first connect with the magnet of the second? A. The wires might be connected in this way, but it would be better to make a single machine of double the size.

(5) C. B. B. asks: 1. How can I polish fancy woods? A. Take rather thick alcoholic shellac varnish 2 parts, boiled linseed oil 1 part, shake well together before using. Apply with a rubber and rub briskly until the varnish is hard and *bright*. 2. Could not a boat only large enough to carry one person be run by clockwork, and if not, why? A. Yes, but it would economize power by applying it directly to the propelling mechanism. 3. I intend making a barometer; how can I make the scale and have it correct? A. The barometer scale is simply a scale of inches, divided into tenths.

(6) H. R. M. asks the process by which the gloss is produced upon photographs, and whether the same process can be employed with what is termed heliotypes or artotypes, as published in some of the illustrated papers of New York, and if not, explain the means employed; also please state the ifference betweeu the two latter named terms. How can arto or heliotypes be mounted on cardboard suitable for albums? A. For albumen prints the warmed burnishing press used by photographers is all that is required, we believe. A rather weak solution of white wax in absolute alcohol is sometimes used as well for artotype or heliotype as for ordinary solar prints. It is simply sponged over the mounted print, which is then passed through the warm burnishing press, by which the fine gloss is imparted. Solution of bleached shellac in alcohol (1 to 10) is also occasionally used. Good starch paste is very generally used for mounting. For a description of heliotype processes consult Vogel's "Chemistry of Light and Photography." The artotype process so-called was patented by Johann B. Obernette, of Munich, in 1878 (208'14). It consists in forming first on a transparent or non-transparent plate a coating or film of albumen and soluble glass, and adding to this the sensitive film. The first coating is composed of: albumen 7 parts, soluble glass 3, water 8. The second or sensitizing bath is composed of: gelatine 50 grammes, fish glue (isinglass) 50, ammonium bichromate 15, water 1 liter. Filter for use.

(7) O. E. P. writes: In your issue of June 21, "Notes and Queries," (30), D. J. W. asks for a receipt for blue writing ink. I make it by dissolving the common preparation sold in every grocery, known as "Sawyer's washing blue," in clear water. It dissolves instantly, does not give much trouble by thickening, and never fades. Any desired shade may be had by varying the quantity of water. I have used it for measure lines on mechanical drawings made 10 years ago, and it is as bright now as when put on.

(8) O. A. R. asks: 1. Has there ever been an invention made to work two telegraph instruments at once on the same line? A. Yes, and it is common to transmit four messages simultaneously over a single wire. 2. How can I take the rust off the brass of an instrument? A. You should remove it with fine emery paper or crocus cloth or paper. 3. How many jars will it take to run telegraph line with a loop of 1,800 feet wire—900 each way, size of wire No. 18, soft iron? A. It depends altogether on the resistance of your instruments. No. 18 wire is too small; use No. 10.

(9) C. A. V. asks if gutta percha and India rubber can be dissolved and mixed by boiling together in any liquid. A. Caoutchouc and gutta percha are both quite soluble in naphtha, benzole, and carbon disulphide. The latter, when mixed with about six per cent of absolute alcohol, is one of the best solvents. The solution is performed in the cold (best in the open air), as it would not be safe or economical to heat these volatile and inflammable liquids. Exposed to the air the solutions soon evaporate, leaving the gums in their original condition.

(10) B. M. asks how many Tom Thumb batteries, made in the manner described on page 101 of the SCIENTIFIC AMERICAN Reference Book, would it take to raise ½ inch of No. 40 platinum wire to a red heat. A. About forty.

(11) W. W. B. asks: What can I use to remove rust from small watch pinions that will not cause the pinion to rust after applying? A. Soften with oil and apply a little emery flour.

(12) S. T. asks (1) if water becomes purified by freezing. A. Water is purified from most contaminating substances by crystallizing (freezing). 2. Will it purify itself by running a few miles? A. It depends very much upon the nature of the soil or bed; over a gravelly bed, usually yes.

(13) W. J. R. writes: In your answer to query No. 36, to "Student," page 380, current volume, June 14, you say his engine 8x12 in. is "badly proportioned" to produce the power estimated by him, namely "100 lb. pressure, 100 revolutions—24·5 horse power." Will you please state why? A. Because of the loss at every stroke by the clearance and waste spaces.

(14) B. P. C. writes: I am running an engine of about 6 horse power, 8 inches stroke, driving wheel 30 inches, makes 200 revolutions per minute, belted to a 48 inch wheel on shaft which makes 130 revolutions per minute. Am about to change to an engine of 12 horse power, 12 inches stroke, with driving wheel of 48 inches. What size wheel do I want on shaft, and what number of revolutions of engine, to produce the same result, namely, 130 revolutions of shaft? A. If you run your new engine 130 revolutions per minute you need not change your wheel; as you have equal diameter on both shafts, the driven shaft will run same speed as the engine.

(15) "Medicus" asks: When water and other bodies are freezing, heat is given out, and when water or the same bodies are thawing, cold is given out. Some of our elementary text books upon natural philosophy teach this. Is it true, and what is the *modus operandi*? A. Condensation is accompanied by an elimination of heat; liquefaction by an absorption of heat (from surrounding bodies). Consult Professor Tyndall's "Heat as a Mode of Motion."

(16) W. M. writes: In nearly all works referring to the computation of indicated horse power of steam engines from indicator cards of the same, the rule for finding the mean effective pressure during any stroke of piston assumes that the back pressure during that stroke is shown on the same card as shows the initial pressure. Should not the pressure on the opposite side of piston be obtained for the opposite card, and the mean effective pressure computed therefrom? A. Yes.

(17) W. H. M. asks: 1. Is it necessary to level an engine (portable) both ways, across and parallel with the valve seat? A. No, the necessity for leveling is that the heating surfaces of the boiler may be properly covered. 2. In lining up a cylinder of a portable engine, where the slides are attached to the front cylinder head, how would you line it up—line the slides or the other parts first? A. Line everything by the center line of the cylinder in one direction, and by center of shaft in the other. 3. Would it be necessary to have front cover upon the cylinder and then stretch line? A. No.

(18) J. G. writes: F proposes to put a windmill wheel on an ordinary hand car and gear it from said wheel, and contends it will propel the car against the wind, size of wheel optional. Opposition say no. Please decide. A. F is right, if he uses properly proportioned gearing, but the speed will be low.

(19) G. A. D. asks for the process of making lime water. A. Agitate an ounce of pure caustic lime in a pint bottle nearly filled with water, and after the lime has subsided decant the clear supernatant liquid. It must be kept in well stoppered bottles.

(20) J. R. L. asks: What is the best way to get water up a hill 28 feet rise and 60 feet distant? If suction pump, what size? We want water to supply steam engine on top of hill. A. You can use a pump driven by your steam engine, or if you have a sufficient reservoir on top of the hill, a pump driven by a windmill. Size of pump depends upon the quantity of water you wish to raise.

(21) J. D. M. asks how to test water to ascertain if there is lead in it. A. Evaporate a sample of the water nearly to dryness, and mix the remainder with a small quantity of sulphureted hydrogen water (hydrosulphuric acid). The formation of a precipitate or of a dark precipitate or cloud indicates lead. 2. To find out whether there is any decaying substance in my well? A. Treat one sample of the water with a cold saturated solution of tannic acid, another with enough dilute solution of potassium permanganate to produce a faint color; if a slight gelatinous precipitate forms in the first, even after 24 hours' standing, or if the latter quickly loses the color imparted by the permanganate, the water should not be used.

(22) A. M. writes: It is stated that in a boiler (with all the flues and crown sheet covered with water) where the fire is direct and intense the water assumes a spheroidal form and is not in contact with the plates at all. It is said that the master mechanic of some Eastern railroad had proved it by inserting a small pipe in the smoke arch end of a locomotive until it reached the flue sheet of the fire box, and nothing issued but blue steam, and he got no water until he drew it away from the flue sheet for half an inch, and in another case a pipe was introduced through the top of return flue boiler until within three eighths of an inch of the bottom sheet, and upon opening the cock a small quantity of water (that had stood in the pipe) came forth and then nothing but steam, nor did he get any more water until he removed the lower end of the pipe three quarters of an inch from the bottom of the boiler. It does not look likely. What is your opinion on the matter? A. This is a point that must be determined by the temperature of the fire and the conducting power of the metal. That the water can be driven from the metal surface has been frequently shown, but it does not occur under the ordinary conditions of a steam boiler, except when so badly designed that there is no proper circulation. In a locomotive boiler too small for its work and forced by a sharp jet the repulsion may occur.

(23) F. W. B. asks: 1. Would an engine 3x1½ (three by one and a half) inches be large enough to run a boat fifteen feet long by thirty inches in width? How large a boiler would it require? A. Yes, at a moderate speed. 2. Would a boiler made of No. 17 copper, with 4 2-inch flues, made on the vertical plan, furnish sufficient steam? A. No. 3. Which is preferable for running on creeks and other shallow places, a screw or paddle wheel? A. For so small boats a screw running partly out of water.

(24) F. T. asks: Should any kind of oil be used on belts for elevators or driving machinery: if so, what kind? A. Neat's foot oil.

(25) G. O. L. D. writes: I have some soft rubber and "gold rags," containing gold leaf. By what process can I get the gold out of the rubber and rags? A. Incinerate on a hot iron plate, mix with about 2-3 its weight of a mixture of equal parts salt and carbonate of soda, and submit to a white heat in a Hessian crucible for about twenty minutes, adding a small quantity of niter occasionally; cool in the crucible—the button will be found at the bottom.

(26) T. H. K. writes that he has discovered that smoking coffee will cure consumption. [The active alkaloid (caffeine) in coffee suffers more or less complete decomposition under the circumstances, but the products yielded have little or no therapeutic value in this connection, as far as known. Smoking coffee berries will not cure pulmonary consumption, though it would doubtless prove a comparatively harmless if not pleasant substitute for tobacco.]

(27) C. H. M. asks: Why are not electro-magnetic machines used instead of galvanic batteries for telegraphing purposes? Can they not be so used? A. They are largely used for private lines.

(28) E. K. asks how to coat whitening and give it a gold color so that it can be burnished and leave some parts matt or dead gold color? A. Coat with gold size, and when this is nearly dry, apply gold leaf or a suitable bronze powder.

(29) E. H. asks for a recipe for removing the gloss imparted to fine diagonal cloths after they are slightly worn. A. The glossiness cannot be permanently removed, since it is due to the loss of the nap. It may be temporarily remedied by the use of a little ammonia water.

(30) W. H. asks: What is the process of making solid emery wheels, and if there is more than one process, and if they are patented? A. Many of the best wheels are cemented with vulcanized rubber, borax, or zinc chloride (or oxychloride), and barium carbonate; other materials, such as feldspar and clay, alkaline silicates, litharge and japan, shellac, and other resinous and gummy matters, albumen and lime, etc.

(31) G. A. W. writes: I am working at electrosilver and gold plating, and as it has been some years since I worked at it, my memory has failed me in some things. 1. My solutions (silver) striking and plating are composed of the following: namely, striking to 1 gallon of water, ¾ ounce silver (chloride), 1 lb. cyanide potassium (fused), 4 ounces of sal soda. Plating to 1 gallon water, 1 ounce silver, ¾ lb. of cyanide potassium, 4 ounces of sal soda, and a little white caustic potash in each. Now I would like to know if these are all the necessary ingredients; if not, please enlighten me. A. Yes, the soda and potash are not essential. 2. If bisulphide carbon will make silver solution plate bright, will it answer for gold; if not, what will, and how used? How are the various colors obtained? A. No. See article on page 2540, No. 160, of SCIENTIFIC AMERICAN SUPPLEMENT. 3 What preparation is used for coating work to be sectio..a. or spot gilt, and how prepared and removed? I have been using asphaltum, but in removing it with turpentine it has a tendency to stain the work and will not work well in the solution either hot or cold. A. Asphaltum varnish or paraffine. 4. I am using Smee's batteries for plating. I see some account of carbon sheets being substituted for the platinized silver: are they immersed in the same liquid (diluted SO_4), if so are they cheaper and less trouble? A. Yes. 5. What acids, and the proportions, used to dissolve platinum, and can a sheet of silver be coated by being merely passed through the hot solution? How is the best and most permanent way of platinizing silver sheets? A. Hydrochloric acid, 3 parts; nitric acid, 1 part; heat to about 160° Fah. Attach the clean plate to the zinc pole of a weak battery and immerse in the cold solution somewhat diluted. 6. In my Bunsen batteries I use nitric acid in the porous cups with the carbons, am I right? A. Yes. Solution of potassium bichromate and moderately strong sulphuric acid solution may be advantageously substituted.

(32) H. F. G. asks: 1. What is the weight of a bushel of bituminous coal? A. 76 to 80 lb. 2. How much water will a bushel of such coal evaporate burned in an ordinary locomotive furnace? A. Ordinarily from 6 to 7½ lb. per pound of coal.

(33) E. J. O. asks: What will remove coal tar from hair cloth, such as chair bottoms, without injuring it? A. Naphtha, benzole, or carbon disulphide. Use a stiff brush if necessary.

(34) A. U. L. asks: 1. Would the rail of a railroad track make a good conductor for a telephone for reasonable distances? A. No. 2. Must the wires leading into the house be insulated? A. Yes. 3. What kind of a battery is the best, say for a distance of three or four miles, and how many cells of same? A. No battery is requisite. 4. I have recently seen such articles as glass and porcelain cemented together so as to sustain a weight of several hundred pounds, by a cement sold under the name of stratina, or London cement. Can you tell what its composition is? It seems to be very effective. A. Dissolve glue in warm strong acetic acid to form a sirupy solution.

(35) H. H. W. asks (1) if brick is ever used in covering locomotive boilers? A. No. 2. If not, please give the name of some cheap covering that would do. A. Asbestos covering; a mixture of clay and cow hair; or hair felt, or even old carpets or blankets.

(36) W. H. W. asks: Will sound travel faster in a dense than in a rare atmosphere, and why? A. The velocity of sound is not materially affected by the density of the air. Its intensity is diminished by increased atmospheric density. It has been determined that the velocity of sound decreases with the temperature about 1·1 feet for every degree.

(37) G. C. asks: 1. Please give me a rule for compounding gear for a lathe.

A. $\frac{T\,S}{t'\,t}\,I = N$; $\frac{t\,t'}{I\,T} = S$. T representing the number of teeth in traverse screw wheel; S, number in stud wheel gearing in mandrel; t, number in wheel upon mandrel, and t', number in gearing upon stud pinion, gearing in T; I, number of threads per inch upon traverse screw; N, number to be cut. 2. Please tell me how to make a cheap telephone. A. See full directions for making telephones in SUPPLEMENT, 142.

(38) J. H. W. asks: Can you inform me why a hazel switch will turn in the hands of some persons, who claim to be able to discover water or mineral by this means? A great many declare that it will not turn. I used to think so myself until I tried it last summer, and found that there were certain places in which the rod would turn in spite of me. I held it so tight that the bark peeled off. I cannot account for it myself, and have been laughed at for asserting that there is some truth in the claims of men who call themselves diviners until I am tired of it. Have never seen the matter explained. A. The rod is moved by the voluntary or involuntary muscular action of the hands of the operator, and not by any mysterious external influence, as many suppose.

(39) C. C. A. asks how to make a compound with which to insulate wire. A. Shellac varnish will do very well, providing the wire is wound before the varnish becomes thoroughly dry.

(40) J. A. W. writes: I would inquire through your paper of the M.Ds. if a connection between the aorta and pulmonary artery where they cross is common. I found in examining the heart of a calf that was sold in market for veal a phenomenon of this kind; if it occurred in one instance might it not in another, and what would be the physical results of such a case? The opening was as large as the carotid artery; no appearance of any valves, but the tissue was very thick and firm.

(41) Y. & O. ask: 1. How ought a cheap ice house to be built on top of ground? A. See SUPPLEMENTS 55, 59, and 116. 2. How can I construct a lightning rod which will answer all the purposes, and cost less than those sold by dealers? A. See p. 348, (10), current volume of the SCIENTIFIC AMERICAN.

(42) W. B. W. writes: Seeing an article in SCIENTIFIC AMERICAN by Dr. Rollin R. Grigg, of Buffalo, N. Y., I ask for information ("The Cause of Consumption"): What will heal the mucous membranes and the stopping of the waste of albumen? A. The author of the article referred to has kindly given us the following: There is no one medicine that can cure all cases of irritated and abraded mucous membranes and stop the waste of albumen. A variety of remedies is required to do this, in the different cases, and the treatment must be governed to a great extent by the peculiarities of constitution, and by the condition and the symptoms of each patient at the time the case is taken in hand. Furthermore, this is a diseased condition, where every case should be under the care of an educated, judicious physician, as much as severe cases of typhoid fever, diphtheria, or any of the other most intricate diseases. I will say, however, for the encouragement of all, on this now almost hopeless subject, that there is a series of most reliable physiological facts bearing directly upon the curability of all cases in the first stages, and which shows that of all tissues the mucous membranes are the most quickly and easily healed of any by proper treatment.

(43) E. W. C. writes: The screws in our cheese presses are 1¾ of an inch in diameter. From the center of the screw to the end of the lever it is 2 feet and 5 inches. Five turns of the screw move it 1 inch. How many pounds pressure will 150 pounds weight applied to the end of the lever produce? What is the rule for finding it? A. Theoretically, 136,800 pounds, but there should be a large deduction for friction. The weight (150 pounds) × distance moved through (76 feet = 912 inches) divided by distance through which the screw moves (1 inch) $\frac{150 \times 912}{1} = 136{,}800$ pounds.

(44) H. H. asks: 1. Would it be possible or practical to run a small light boat, say 2½ feet wide, 12 feet long, with a spring motor similar to those used for small toys? A. Yes, but the power required to wind up the springs had better be applied direct to oars. 2. Could an electric engine be used instead of the above, how would the cost compare with steam engine? A. Yes. The cost of the electric engine would be greater than that of a steam engine, and the cost of running it would be about fifty times as much.

(45) J. T. asks (1) how saw blades are tempered. A. They are usually heated in a reverberatory furnace and hardened and tempered in oil. 2. Can temper be taken out by heating a saw in the fire? A. Yes, but the saw will be ruined. 3. Where an iron mandrel runs in wooden bearings, what kind of wood is best for bearings? A. Hard birch or maple. 4. Which is best, pine or hickory? A. Hickory.

(46) O. L. P. asks: Will it require more power to work an elevator perpendicularly than it will to operate a similar one on an inclined plane at 45 degrees? If so, what is the rule to find difference of power required? A. The power will be the same, not taking friction into consideration.

(47) V. A. N. asks for the size of steam ports in a cylinder 2 by 3 inches. Is 3-16 by 1¼ inch too large? A. 3-16 by 1 inch is sufficient.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

J. N. J.—The sample of ore is quite rich in copper (copper glance) and contains also traces of silver. A chemical analysis or assay will be necessary to ascertain the proportions of these and the value of the ore. The property is valuable.—H. J. P.—1. A serpentine rock—it contains no copper. 2. Talcose slate.—C. H. M.—It is quartzite.

COMMUNICATIONS RECEIVED.

On Boiler Explosions. By S. P.
On the Collared Peccary. By J. R. G.
On the Movement of Light in Space. By A. S.
On Theory of Creation. By W. P. T.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

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June 10, 1879,

AND EACH BEARING THAT DATE.

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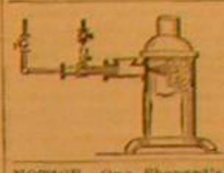

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