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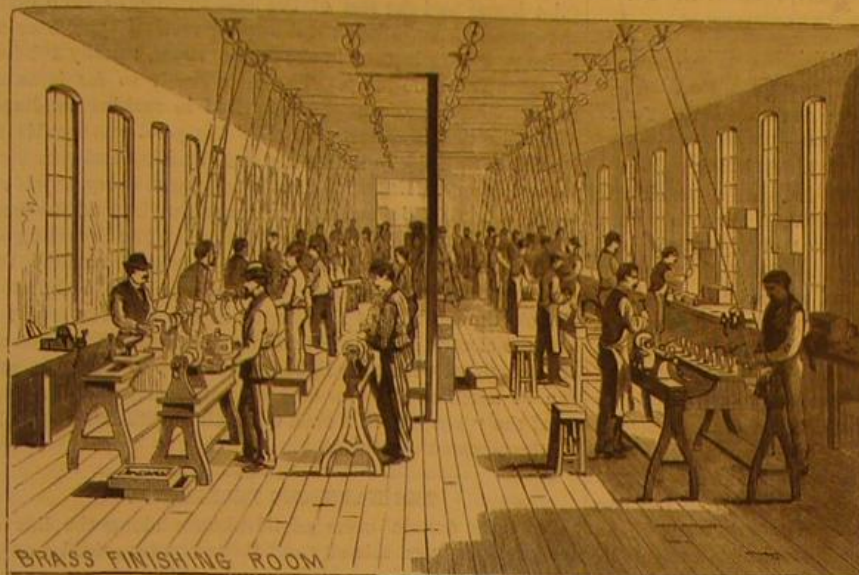
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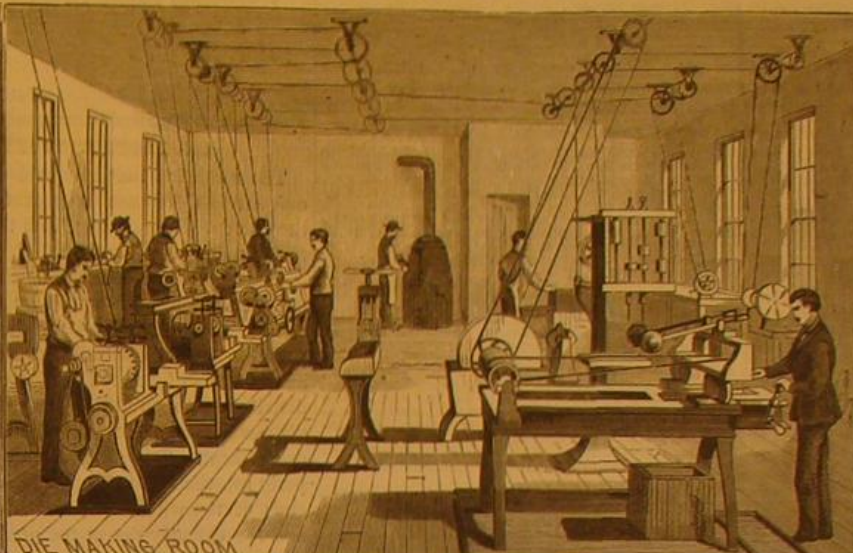
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NEW YORK, DECEMBER 11, 1880.

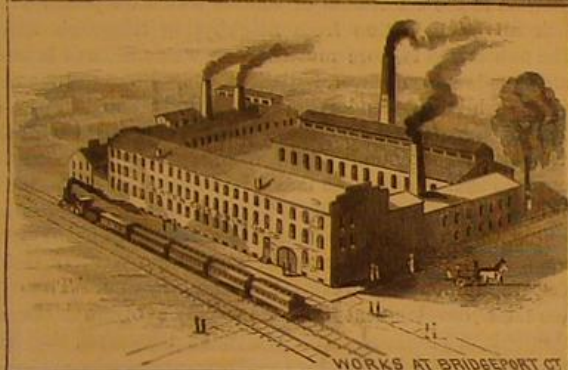
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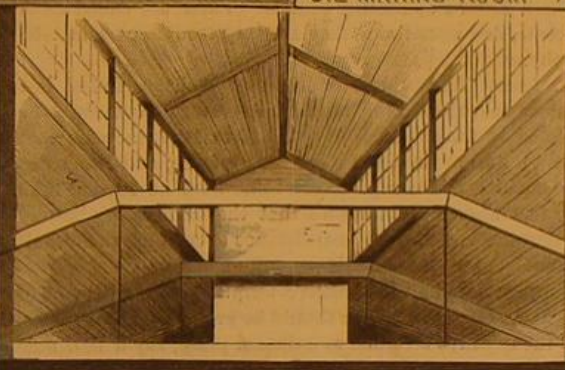
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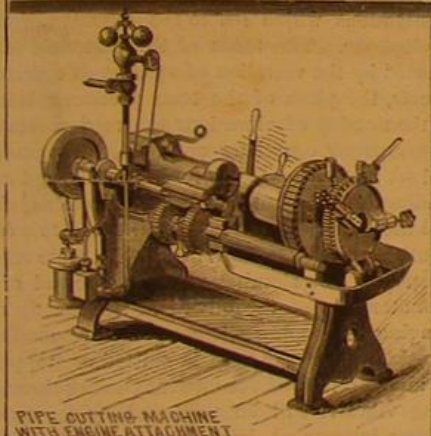
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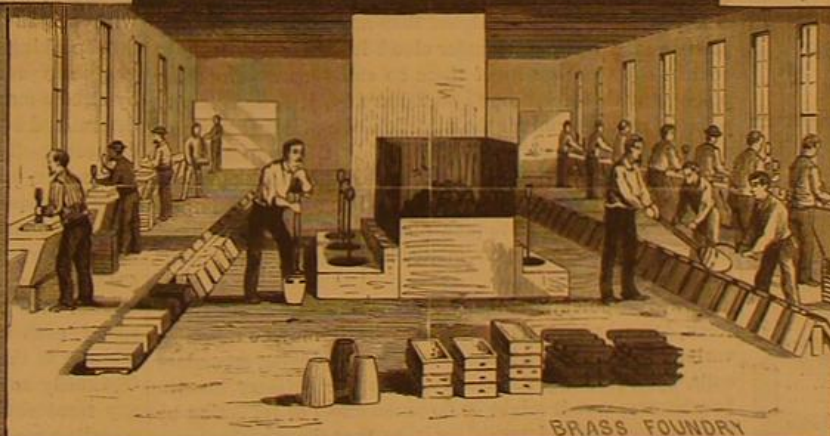
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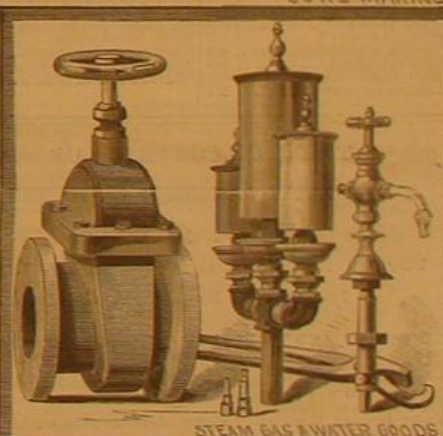
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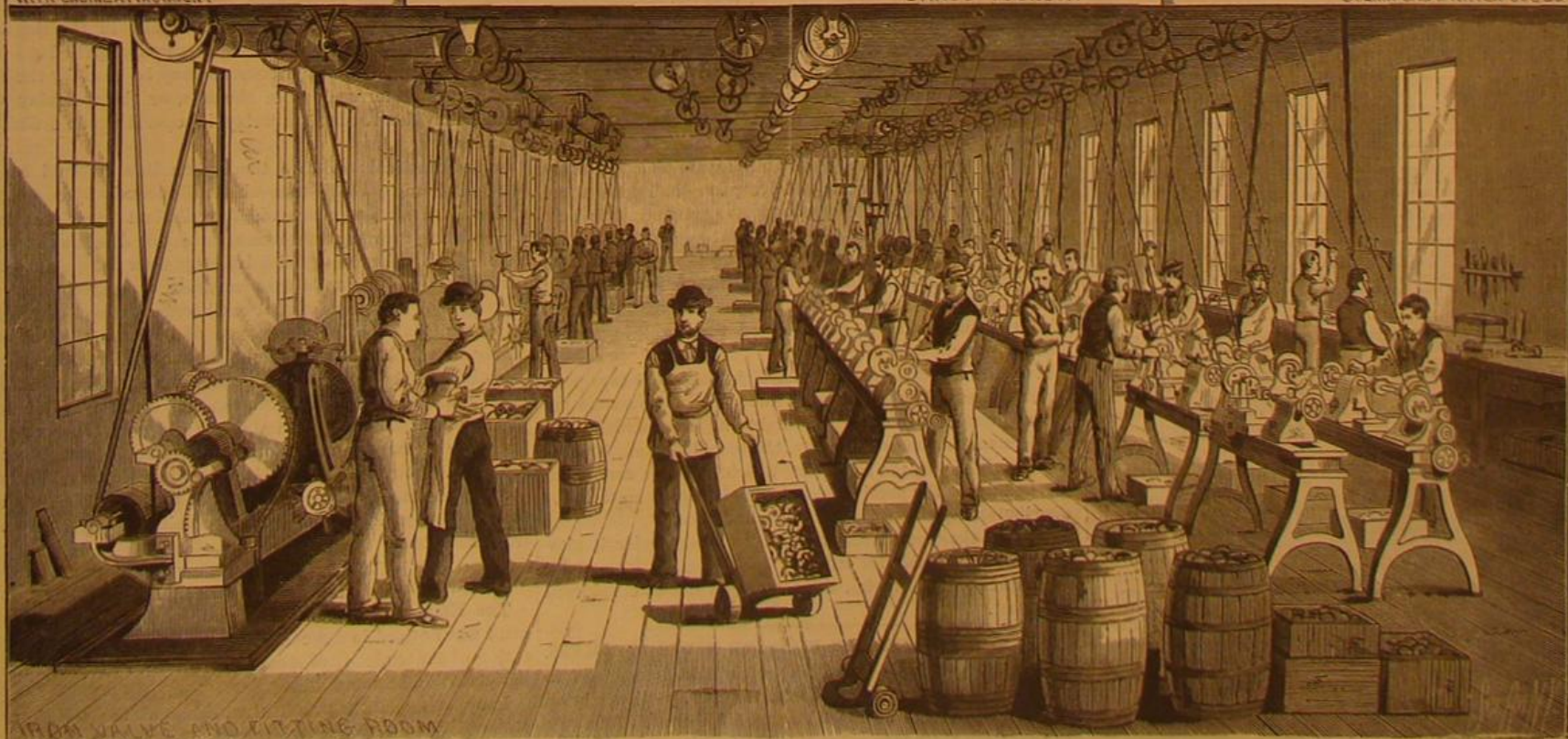
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Scientific American.

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ON PROTECTION FROM LIGHTNING.

The condition that determines the direction of an electric
current is difference in potential between the two points,
the current always being from the point of higher potential
to the point of lower potential.

Upon the surface of the earth and within it electricity is
constantly being generated by various means: by the fric-
tion of the wind upon it, by running water, by heat at the
junction of two dissimilar substances, by magnetic disturb-
ances, and so forth. The electricity so generated is quickly
distributed to points of lower potential, and the whole is
ultimately metamorphosed into that molecular vibration
called heat. Let an ordinary magneto-telephone be pro-
perly attached to a wire a hundred feet long, and the two
ends of the wire be stuck into the earth almost anywhere,
and the ear may detect the presence of electric currents by
the well known sputtering sounds. These are called earth
currents, and sometimes they are very troublesome in tele-
graphy.

Professor Trowbridge, of Harvard College, found last
summer that the ticking of the observatory clock could be
detected at the distance of a mile from the line wire that
goes to Boston furnishing the time service, and this when
the terminals of the experimental line were no further than
fifty feet apart. This shows that the observatory battery
charges the earth for a great distance every time the circuit
is completed by the seconds pendulum.

Suppose now that the positive terminal of a battery or of
a dynamo-electric machine should be grounded at any place,
and the negative terminal at a distant place, say a half mile
or more away, the developed electricity would charge the
first place to a potential higher than any other neighboring
place, and a charged thunder cloud immediately overhead
could not discharge itself there so easily as at any other
place at a distance, for, as stated at first, it is difference of
potential that determines the direction of an electric current,
and the difference of potential is less in this supposed case
than elsewhere. If the potential could be raised as high as
that developed in the cloud, it would be absolutely impos-
sible for any discharge to take place between the cloud and
the earth at that place, no matter how near they might be
together.

Now, the potential of any ordinary battery is relatively
weak, but whatever its source may be, it may be raised in
various ways: by providing points, by employing secondary
coils, by increasing the resistance in the primary circuit.
In whatever way it might be done the effect of induction by
the cloud would be lessened by it so that the reaction upon
the charged cloud would be either to necessitate the dis-
charge at some other place where there was a greater differ-
ence in potential, or else to delay it until the potential had
been raised still higher, which would only make it still
easier to strike elsewhere. The evidence gathered from
places where lightning has struck seems to indicate that the
conditions which determine the stroke are comparatively
trivial. For instance, a comparatively low limb upon a tree
may be struck instead of the topmost part, and it is here
argued that the charging of the earth at a given place with
positive electricity may be a sufficient guard against light-
ning stroke, while at the negative end of the circuit it
would be more likely to strike than elsewhere. This end
of the circuit could be so arranged that lightning could
harm nothing.

It is also taken for granted that lightning is always posi-
tive, and that all appearances of the so-called up stroke are
optical delusions. The source of lightning in a thunder cloud
appears to be always the same, the so-called latent heat of
the watery vapor, the energy of which must be accounted
for, and where the precipitation is rapid there is no time for
distribution by convection or by conduction.

Perhaps the cost of such a method would render it alto-
gether impracticable for ordinary buildings, but for powder
magazines, oil tanks, etc., the cost might not be considered
too great.

THE ELECTRIC LIGHT ON WESTERN RIVER STEAMERS.

From present indications the electric light is destined to
play an important part in inland navigation, particularly on
the tortuous rivers of the West and Northwest. As a rule
the Western river men are very slow to adopt new ideas in
their profession, but within the past few months the electric

light has been affixed to some of the finest steamers on the
Mississippi and Ohio.

The first boat to adopt the light was the Reuben R.
Springer, plying between Cincinnati and New Orleans, and
to-day the list includes the S. H. Parisot, the Natchez, the
C. P. Chouteau, and Golden Crown, on the Mississippi;
the Scotia, on the Ohio; and the towboats Iron Age and
Iron Duke, plying between Pittsburg and St. Louis; also
the towboat Harry Brown, described some time since in
these columns, and engaged in coal towing between Pitts-
burg and New Orleans. Other steamers will shortly be
fitted with the new light. In most cases a single light is
used, of 1,500 or 2,000 candle power, and located at the
forward end of the cabin deck. The carbons are placed in
a movable lamp, similar to a locomotive "headlight," whose
reflector projects the rays to the point desired, keeping the
pilot house and the rest of the boat in shadow. To drive
the generator an independent engine, vertical type, 8 or 10
horse power, is located in the engine room, usually 200 feet
or more from the lamp. The main result so far is noted
in the reduction of the time required in making landings.
With the old cresset or "torch" the pilot was unable to
land at the precise point desired, and backing and relanding
was necessary. But with the electric light every object on
shore is clearly defined in the darkest night, and the boat
touches the shore just where desired. The handling of
freight is also facilitated greatly. In actual running, the
Western pilot as yet refuses to tolerate the light, and prefers
the old time guides of hills and other landmarks. In fog
also the electric light is pronounced useless. When steam-
ers are fitted with two lights, the second is portable, and
can be taken on shore or moved to any portion of the boat
or of the "tow" of coal craft surrounding the steamer. In
all these cases the Brush light is used.

THE HARMONIC TELEGRAPH.

Recently certain users of telephones along the line of
telegraph between this city and Boston have noticed a novel
addition to the assortment of sounds which telephone wires
pick up by induction from neighboring telegraph wires.
The new sound is more musical than welcome, and is obvi-
ously made up of several distinct tones singing together,
while each is independently interrupted by rapid breaks or
short spaces of silence. These breaks correspond with the
"dot and dash" sounds of the ordinary telegraphic instru-
ment, so that the message may be spelled out by the inter-
ruptions of the singing tone. Tracing these sounds to their
source, they are found to be due to a relatively new system
of multiplex telegraphy now on trial on the Western Union
Telegraph line between New York and Boston. The sys-
tem is a development of Elisha Gray's original electro-
harmonic or electro-acoustic multiplex telegraph, the early
history of which is familiar to all who are at all acquainted
with the investigations which led to the invention of the
first speaking telephone. The tones of the harmonic tele-
graph are produced by the vibration of steel reeds operated
by electro-magnets, the pitch of the tone produced being
determined by the number of vibrations the reed makes in
a second. The current operating one reed, when passed
over a line, will set in motion at the further end a reed
exactly corresponding to the first in rate of vibration, and
cause it to yield the same note, while a reed tuned to a dif-
ferent note is entirely unaffected. When two or more reeds
are sounding separately or simultaneously at one end of a
circuit, their counterparts at the other end will exactly re-
spond, each singing or keeping silent as its corresponding
vibrator at the other end of the wire is started or stopped.
Obviously any interruptions of the current passing through
any transmitting vibrator will be produced by its corre-
sponding receiving instrument, but not by any other in the
series, causing clearly recognizable breaks in the singing
tone emitted by the vibrator. The message spelled out by
such interruptions of the current may be read by the re-
ceiver in the interruptions of the tone, or the receiving vi-
brator may be used as a relay in operating an ordinary
sounder.

In the practical work, on the Boston line referred to, it
has been found possible to send simultaneously by one wire,
and analyze at the other end, four distinct tones, thereby
transmitting four separate messages in one direction at one
time. This offers a signal advantage over the quadruplex
system, which transmits two separate messages simulta-
neously each way, but cannot send four messages one way.
In cases of extraordinary pressure of business the full ca-
pacity of the harmonic system may be utilized in either
direction. It is hoped that the harmonic system will ulti-
mately make possible the simultaneous sending of four or
five messages both ways on a single wire; in other words,
four tone messages and one ordinary Morse message in each
direction, or ten in all. In this way all the tones of the oc-
tave will be made use of, and that is the probable limit of
the system, unless it be found possible to operate with
fractional tones.

RESPONSIBILITY OF EMPLOYERS IN GERMANY.

The Employers Liability Bill before the British Parlia-
ment was noticed in a recent issue of this paper as an indi-
cation of the tendency of modern law to throw especial safe-
guards around human life.

It appears that the practical working of the "Enforced
Responsibility Law" in Germany, designed to make em-
ployers amenable for injuries received by those at work
for them, has not proved altogether satisfactory. At any

rate, Mr. Baare, Prussian Counselor of Commerce (and president of the celebrated Bochum Iron Works Company), has been called on by the government for suggestions as to its amendment, and has recommended a new law.

The old law, passed in 1871, makes railway companies responsible for injuries received by their employees in all cases in which the injury cannot be proved to be chargeable to "acts of God" or the personal carelessness of the party injured. The proprietors of mines, quarries, factories, and the like, on the contrary, are made responsible only when the injury is caused by the carelessness of the proprietor or his representatives. This restriction is held by Mr. Baare to be unjust, and he accordingly proposes a law under which any person in the service of another shall have the right to claim damages for injuries received in such service under any circumstances. The maximum damages to be paid to a laborer are fixed at \$125 a year, or two-thirds of the usual yearly wages of a laborer. Men of higher grade, in case of injury, are entitled to two-thirds their usual yearly income.

These payments, however, do not come out of the employer's pocket. They are to be met from the funds of an insurance company, under the control of the German Empire, but supported by premiums paid annually by the employers, employees, and the community as a whole.

This arrangement, if carried out, would bring the laboring classes into close dependence upon the government, and Chancellor Bismarck is credited with the expectation that it would go far to check socialistic agitation. To an outsider the plan seems in no way calculated to increase the manliness or thrift of the laboring class of Germany.

THE CORUNDUM MINES, MACON COUNTY, N. C.

These mines are situated on the Sugar Fork River, a tributary of the Tennessee, nine miles from Franklin. They are owned and worked by the Hampden Emery Company, of Chester, Mass. A considerable part of the ore is roasted for the purpose of more easily separating the corundum from the accompanying rock. When sufficiently burned, the ore is conveyed to the stamps, crushed, and carried by a stream of water into troughs to be washed. A portion of the ore is then jigged, the corundum settling on the bottom; the lighter stuff, rising to the top, is skimmed off. The richer ores are cleaned by simple washing. From the jigs the corundum is placed on a drainer, and when sufficiently drained is taken to the loft, spread, dried, and sacked. The corundum is then hauled sixty miles to Mt. Airy, a station on the Charlotte and Atlanta Railroad.

The first mine reached is an open cut. It is situated on a steep hill side, about one hundred feet above the mill. The vein, though quite irregular, appears to have a width of from three to four feet.

The corundum in this vein is inclosed in that variety of chlorite called ripidolite and jeffersite, associated with tremolite and spinel. The corundum occurs in both cleavage and crystalline form, the crystals often having perfect terminations, while many are transparent and constitute the true Oriental sapphire, ruby, emerald, topaz, etc. Among such gems have been found an emerald weighing 30½ carats, and a ruby weighing 10 carats.

Two or three hundred yards south, and apparently on the same vein, is another opening of about one hundred feet in length, from which about a one hundred tons of ore have been taken. Lying on the east side and running parallel with this vein is a continuous vein of beautiful light gray corundum in crystals, from the size of a goosequill to that of the finest cambric needle.

The corundum taken from this vein is so entirely free from foreign matter that it requires very little manipulation to prepare it for use.

At the top of the hill, and two or three hundred feet above the former is still another open cut, twelve feet wide and fourteen deep. In portions of this vein are found large bipyramidal crystals similar to those from the Carnatics in the East Indies. This vein appears to have regular walling made up of tremolite, and carries corundum, spinel, and nearly all the varieties of chlorite. Southwest of this and probably on the same vein as the last, is another mine which has been more extensively worked than any of the others. The vein is sixteen feet wide, and is uncovered for a distance of ten rods. The rock is so far decomposed that it can with difficulty be mined with a pick.

A tunnel is run in the center of this vein to a distance of twenty feet; connected with this tunnel at the farther end is a shaft eighteen feet in depth. This tunnel and shaft was originally made for the purpose of drying the walls of the vein before removal. It is now used as an oven for drying and roasting the ore. The varieties of chlorite associated with the corundum contains water of crystallization and exfoliates when heated, rendering it more easy to separate from the corundum. Since the first opening of this mine more than six hundred tons have been taken out, two hundred tons of this since April 1, 1880.

HOT JOURNALS.

One of the most important cares of an engineer is to see to it that the various bearings of the machinery in his charge are smooth, of uniform surface, and rightly adjusted. This apparently simple duty frequently requires the exercise of his best judgment; it is not only necessary that the journal box surfaces be close to the journal, but it is frequently just as necessary that the journal boxes be prevented from accidentally approaching closer to the journal.

In a steam engine under full head of steam the play of one-sixty-fourth part of an inch between the crank pin boxes and the crank pin may be sufficient to jar the whole engine; and yet, if the engineer in endeavoring to take up this lost motion, should accidentally overtighten the crank pin boxes, the chances are that a broken crank pin or pitman, and a knocked out cylinder head, will serve as an illustration of the union which is apt to take place between the crank pin and its boxes under such circumstances. Many an apparently unaccountable break in a revolving shaft has occurred from a defective bearing. Heavy shafting, carefully lined in hangers secured to the workshop ceiling, may for months run without any sign of heating; but a pile of iron castings, or other heavy weight, unequally disposed on the floor overhead, may cause just sufficient deflection to expose the revolving shaft to one of the most destructive strains, and cause one or more of the hanger bearings to heat. In machinery the wearing away of one of the parts may subject another part to destructive strain, and it generally requires the exercise of experience and judgment in the construction and handling of the machinery, in order to prevent the harm. Many tons of coal have been wasted and much wear and tear of belts and machinery caused by inattention to these defects. In steam engines especially the adjustment of the journal boxes requires close attention. The expansion of the journal by heat, the quality of the lubricant used, the condition of the bearing surfaces and the amount of pressure they will be subjected to, exclusive of dust, speed of revolution, etc., should be taken into account. In all metal there is more or less elasticity, and when one box of a journal is by means of its screw bolts drawn to the right position in regard to its journal, it should also bear solidly on the other box, in order to maintain the adjustment of the boxes to the journal; if this precaution is neglected, when the shaft is revolving the elasticity of the screw bolts appears to act to cause an approach of the boxes, thereby squeezing out the oil from between the bearing surfaces and causing them to heat or grind. It appears that the continuous motion in one direction of one metal in close contact with another, tends to produce a still closer contact and finally a union of the metal surfaces; the lubricating oil, by preventing direct contact of the metal surfaces, opposes this tendency, and the use of liners or equivalent means to prevent the improper approach of the journal boxes, aids the oil in insulating itself between the bearing surfaces. It is surprising to watch the effect of a few minutes' grinding of a journal in its bearing. We have seen a twenty-horse engine, under full pressure of steam, brought almost to a standstill by the sudden grinding of one of the bearings of a shaft about two inches in diameter. It appeared that the shaft would have twisted off sooner than revolve in the defective bearing.

WORLD'S FAIR IN 1883.

The matter having been pretty conclusively settled that we are to have a world's fair in the city of New York or in its immediate vicinity in 1883, the next important thing to be settled is the location for holding it.

A committee has this matter in charge, and at its weekly meetings they have placed before them various suggestions as to available space to be had for the purpose, and propositions as to terms for its occupancy.

The city of Brooklyn claims to have facilities superior to New York for the requirements of the Exhibition, and in some respects its claim seems to be well based. The Prospect Park Commissioners have generously consented, we understand, to allow the Exhibition to be held within the limits of the park, which our Commissioners very properly refuse to permit in Central Park, New York.

The following from the *Daily Bulletin*, of this city, echoes the opinion of many of the leading citizens of both New York and Brooklyn:

"If we are really to have another World's Fair," says the editor of the *Bulletin*, "it seems to us Prospect Park, Brooklyn, all things considered, would be the best site that could possibly be selected. True, the charter restricts the choice to some location on Manhattan Island; but if everything is satisfactory in other respects, it is presumed there would be no difficulty in having that instrument modified accordingly. The tender of the park is certainly a very generous one on the part of our sister city, and its numerous advantages are apparent. It would preserve our Central Park from invasion, and place at the disposal of the Commission 'ample room and range enough' for every purpose of the Exhibition without costing them a dollar; and this, too, with excellent sewage and other sanitary arrangements complete. With abundant railroad facilities for the transportation of merchandise and visitors, good roadways and carriage drives, and one of the finest boulevards in the world, we do not see what other locality can begin to compete with it. The Fair, there, would also attract the vast multitude that in the course of the summer go to and from the near-by watering places on the sea shore; and that of itself is a basis of financial success, it seems to us, which ought not to be overlooked."

Beet Sugar Making in Delaware.

The new sugar mill of the Delaware Sugar Company, at Riverside, a short distance above Wilmington, has begun work. Last year the entire product of sugar beets in Delaware amounted to about 300 tons, but this season the company expect to obtain from three to four thousand tons of better beets than last year, the cultivation having been better understood. The beets already delivered are testing

from 8 to 14 per cent of saccharine matter, and the company are paying from \$3.50 to \$7 per ton for them, and are working up about 50 tons a day. If they obtain the quantity of beets calculated upon, the product, under the new and improved process now in use in the new mill, will be about 550,000 pounds of raw sugar, 200,000 pounds of molasses, and 1,700 tons of pulp, which is now selling at the factory to farmers at \$1 per ton. It is stated that some of the beets were allowed to remain in the ground too late in the season, and thereby were somewhat deteriorated for producing sugar. This, with other defects in the cultivation, will, it is said, be remedied the next season.

AN INVENTION WANTED.

In carrying out their laudable and highly promising efforts to introduce silk production as a domestic industry in this country, the Women's Silk Culture Association of the United States have discovered the need of a suitable hand reel for home use, and appeal to the inventive readers of the *SCIENTIFIC AMERICAN* to supply the need.

The economical production of cocoons is no longer a problem in this country. The worms thrive almost everywhere, and in every community are women and children who have plenty of unoccupied time which can be utilized easily and pleasantly in the production of cocoons. But silk manufacturers furnish no market for cocoons; they want reeled silk. The unwinding of the cocoons may be done in special establishments erected for the purpose; and were the silk growers sufficiently numerous to supply the requisite cocoons, such "filatures" would no doubt be provided, and so furnish a market for the cocoons raised.

As yet, however, the silk growers are too few and too scattered to support such establishments. Accordingly, it becomes necessary in the domestication of the silk industry to provide a simple hand reel with which those who raise the cocoons can also unwind them. The reel should be simple in construction, small and inexpensive; preferably of metal, as less liable than wood to be affected by atmospheric changes; and capable of turning off a warp answering the requirements of marketable silk.

Obviously a reel to meet the present demand will make for itself a much wider demand; since many who are now prevented from engaging in silk production by their inability to meet the demands of the trade for reeled silk, would doubtless engage in the work if the proper reel were provided. Our silk manufacturers are now, in the infancy of the business in this country, using \$10,000,000 worth of raw silk a year. The association believe that the agriculturists of the United States will ultimately produce, may, must produce this amount of raw silk, and more. They report that the industry is exciting a warm interest in all parts of the country, and that from every State in the Union there comes a plea for the establishment of just such a home industry. The office of the association is at 1328 Chestnut street, Philadelphia. Intending inventors should communicate with Mrs. John Lucas, President.

Death of "One of Nature's Gluttons."

The readers of the *SCIENTIFIC AMERICAN* will regret to hear of the death of the frog Rana Pipen, whose portrait appeared in this paper of February 7. He was found by Mr. Dan. Beard, November 17, dead in the glass globe that has been his home for nearly two years. The immediate cause of his death is supposed to be indigestion caused by the combined effects of supping upon two-thirds of a white perch and resting all night under the steam heater. His loss will be mourned by a large circle of friends.

RANA PIPEN'S MENU.

May, 14, one dozen "June bugs."
 " 15, one full grown live mouse.
 " 19, one leopard frog, one-third smaller than Rana.
 " 24, large piece of meat.
 June 2, 9 A.M., one full grown live mouse.
 " 2, 1 P.M., " " "
 " 5, one large piece of meat.
 July 18, one live mouse, full grown.
 " 20, one young alligator.
 " 27, one live mouse, full grown.
 " 29, " " "
 August 9, " " "
 September 17, one large brown bat.
 " 20, one craw fish.
 " 21, two "
 " 23, one "
 " 25, one live mouse, full grown.
 " 27, " " "
 October 8, " " "
 November 15, white perch.
 " 17, dead.

Convergent Squint.

Dr. C. A. Bucklin, in an article in the *Medical Record*, on the cause and treatment of squint, expresses the opinion that every squinting eye that is not due to paralysis of a muscle can be straightened. In convergent squint the use of one eye is usually lost; consequently its earliest symptoms should receive prompt attention. Dr. Bucklin has had the advantage of examining over two hundred cases of squint, and illustrates his text with a few of the more interesting ones to show the success that has attended the treatment which he therein recommends, that of tenotomy, or division of the tendon of the abnormally shortened muscle.

AMATEUR MECHANICS.

HINTS ON MODEL MAKING.

It is a simple matter for an experienced instrument maker or machinist to produce a fine model with turned shafts, cut gearing, true pulleys, and smooth working cams, but it is quite another thing for an inventor, without tools or materials, to embody his ideas in a working model even though he may have a mechanical taste.

It is fair to suppose that every mechanical inventor in these days of cheap machinery possesses some sort of a lathe, as these indispensable machines are now made for prices within the reach of almost any one.

It is quite evident, from an inspection of the models of the Patent Office, that most inventors who undertake to make their own models expend a great deal of labor without corresponding results. In the matter of gearing, for instance, one will whittle his wheels in wood, another will borrow his gearing from some defunct clock, while still another will purchase ready-made wheels from one of our well-known firms making a business of furnishing parts of models.

Of the three methods of obtaining the gearing the latter is undoubtedly the best, as all that is necessary to be done, in case of the cast gear wheels, is to bore them and file up the teeth, and as the cut gear wheels are generally bored, the shaft may be fitted without further work on the wheels. It is, however, seldom absolutely necessary to use toothed gearing, as rotary motion may be readily transferred by suitable friction wheels or by grooved or sprocket wheels and a round belt.

Figs. 1 and 2 show a form of friction gearing which is both simple and effective. The larger wheel is simply a disk of sheet brass having rounded edges, and boss spun or soldered on, and a smaller wheel consists of two swaged disks of steel having their convex faces separated by a metal washer a little thinner than the large wheel. These three members are secured to a common boss by spinning the end of the boss partly over one of the disks, as shown in the sectional view, Fig. 2. This form of friction gearing is noiseless and runs strong enough for the requirements of almost any model.

Figs. 3 and 4 show a form of sprocket wheel which is readily made and is almost as positive in its action as gearing. In this case the two wheels are alike; they consist of disks of sheet metal nicked to a uniform depth from the edge, and the arms thus formed are bent alternately in opposite directions, forming a groove for receiving the round belt used in transferring motion from one wheel to the other. It is evident that a belt cannot slip on a wheel of this construction.

Fig. 5 shows a form of friction gearing for transferring motion at right angles, and for imparting a variable speed to a shaft from another shaft running at a uniform rate. The large wheel in this instance is merely a plane disk of metal mounted in the manner already described. The smaller wheel is a grooved metal pulley surrounded by an elastic rubber ring. This is pressed with more or less force against the metallic disk, and its speed may be varied by moving it toward or away from the axis of the disk.

As to the matter of irregular motion usually imparted by cams, it is difficult to make a cam in the ordinary way with the milling machine, and there appears no very simple way of cutting them from solid castings. There is, however, a simple way of building them up from readily obtained materials.

Fig. 6 shows a cam consisting of a cylinder of brass or a short section of brass tubing provided with two heads and mounted on a shaft. The cam groove is laid out on this surface, and two parallel pieces of square brass wire are soldered to the surface of the cylinder, or fastened by means of screws. They are placed uniformly distant throughout the entire circumference of the cylinder.

Fig. 7 shows a cam built up in the same way on the face of a disk.

As to shafts, the model maker may save himself much labor and expense by using Stubb's steel for small shafts, and cold rolled iron for larger ones. Either the steel or iron may be bought in one and three foot lengths.

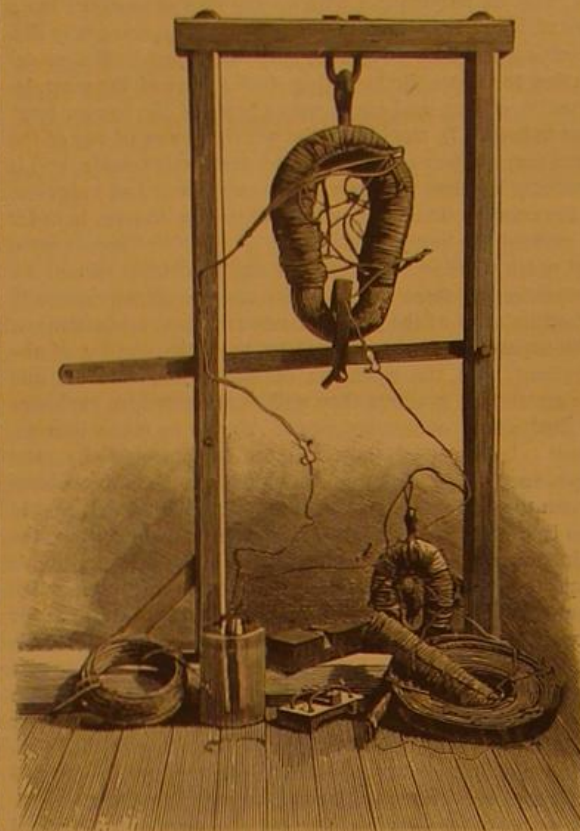
Almost anything in the way of parts of models may be purchased ready for use, so that all the inventor need do is to combine them and mount them on a suitable frame; but even so simple a matter as a wooden frame for a model sometimes proves troublesome.

The small tenons and mortises are difficult to make, and the frame to be strong enough to bear handling must be made so heavy as to be entirely out of proportion. A simple and easy method of securing the joints of small frames is to clamp the parts in the position they are to occupy in relation to each other, and then drill, with a sharp twist drill, two holes through one piece from side to side and into the end of the abutting piece, then inserting two hard wood pins, having previously coated them with glue. This makes a joint far stronger than the mortise and tenon, and it is very quickly done.

M.

PROFESSOR HENRY'S BIG MAGNET.

In the course of his pioneer work in the investigation of electro-magnetic action, William Sturgeon, of London, discovered in 1825 that soft iron could be rendered temporarily magnetic by surrounding it with a coil of conducting wire connected with a battery. As the result of this discovery he made the first step toward the construction of an electro-magnet. He bent a piece of iron wire into the form of a horseshoe, insulated it by a coating of varnish, and then



PROFESSOR HENRY'S BIG MAGNET.

wound it with copper wire spirally, the spirals being widely separated, so that the current would be compelled to pass round and round the iron core. When the current was on the wire the core was found to be magnetic; when off, the core was not magnetic.

Professor Henry took up the discovery at this point and carried it an important step further. He wound the copper wire with insulating silk, making it possible to cover the core of the magnet with a much greater length of wire in closely wound coils, and also to lay on coil above coil. The compound helix so made developed great power, the same battery yielding with it a hundred times as much magnetic

Henry was called to the chair of Natural Philosophy in the College of New Jersey, at Princeton. Here he made two larger magnets for use in his investigations. One weighing 59½ pounds, and capable of sustaining 2,063 pounds, is now in the cabinet of Yale College. The other, made in 1833, weighed 100 pounds, and could support 3,500 pounds. It was many years before any magnet approaching this in power was constructed.

Through the courtesy of Mr. R. H. Rose, photographer at Princeton, and by permission of Professor Schanck, of the College of New Jersey, we are enabled to present an exact likeness of this historic instrument, as hung in the frame by which the inventor tested its strength. The magnet is deposited in the hall of the School of Science, one of the college buildings erected by the munificence of the late John C. Green. The coil at the right of the engraving represents the original silk-covered ribbon coil used by Professor Henry in his experiments on induction. The wire and battery at the left are modern, to show by contrast the improvement since made in the means for electrical investigation.

In the middle of the foreground is one of the pole-changers made and used by the professor. He was accustomed to delight himself and his classes with this by changing the polarity of the big magnet so quickly that a twenty-eight pound armature could not fall off, but was freed and reattracted to its place with a sharp snap.

Dr. C. O. Crosby.

A characteristically American inventor, Dr. C. O. Crosby, died in Brooklyn, November 15.

Dr. Crosby was born in Simsbury, Conn., and for a number of years practiced dentistry in New Haven. His natural bent was rather for invention, to which he early gave his attention. In connection with Henry Kellogg, of New Haven, he invented a machine for making ruffles and another for making pointed tape trimming, creating thereby a new industry from which he acquired a considerable fortune. Later he invented a machine for making fish hooks, a marvel of ingenuity; and afterwards a machine for making needles. These two formed the basis of a large business still carried on in New Haven. A machine for making pins was another of his notable inventions. Others were, a machine for making shoes, a machine for making tatting, and a machine for making cigarettes; all giving evidence of his wonderful versatility and inventive genius.

From the inquiries conducted by Prof. Hermann Cohn, of Breslau, since 1865, it appears that short-sightedness is rarely or never born with those subject to it, and is almost always the result of strains sustained by the eye during study in early youth. Myopia, as it is called, is seldom found among pupils of village schools, and its frequency increases in proportion to the demand made upon the eye in higher schools and in colleges. A better construction of school desks, an improved typography of text books, and a sufficient lighting of class rooms, are the remedies proposed to abate this malady.

One Hundred Bushels of Shelled Corn to the Acre.

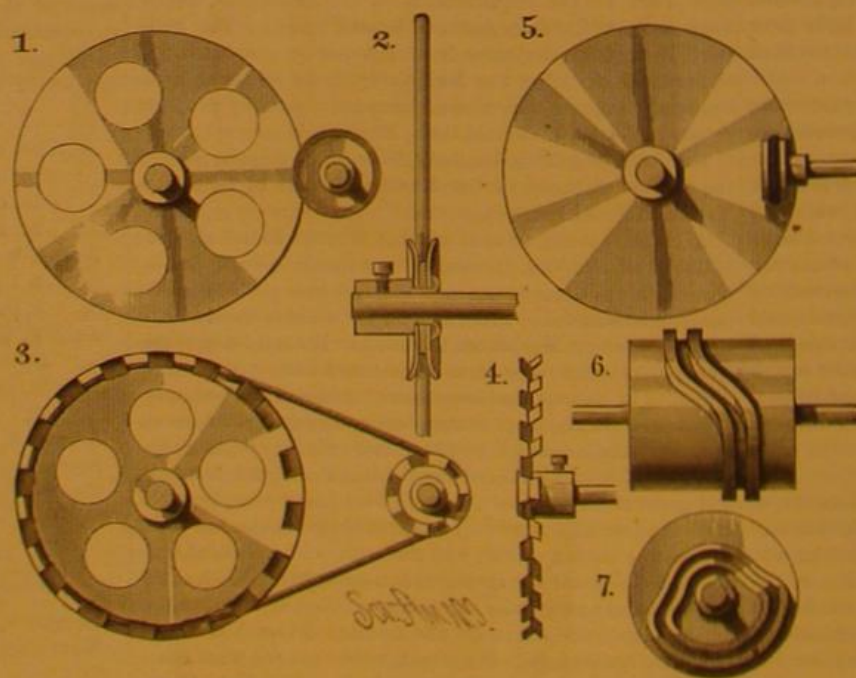
Mr. Nathan G. Pierce tells the *American Cultivator* how he raises 100 bushels of shelled corn to the acre, having accomplished that feat for the second time this year. He uses for seed an eight-rowed corn which he has improved by careful selection, and believes it to be a good variety to raise in that locality, or, in fact, anywhere between Virginia and the Canada line, or east of the Alleghany Mountains.

The ground selected for planting was a good piece of gravelly loam. It was well plowed last spring, about the first of May, harrowed, treated to a broadcast application of 900 pounds fertilizer to the acre; again harrowed faithfully, rendering the land fine and mellow; rows marked three feet apart, a small amount of fertilizer scattered to each row. May 10th, three kernels of corn planted in each hill, two feet apart in the rows; cultivated and hoed four times, allowing no weeds to grow; passed through the entire piece, cutting each hill down to two stalks; every sucker in each hill cut throughout the field.

During the entire period of growth through the season the field was closely watched, every weed pulled and every ear of smut cut out. At the proper time, after the corn had become hard, it was cut, bound in bundles, and stooked. When dry it was drawn into the barn, where, with the assistance of a hired man, the corn was husked, weighed as husked, and found to yield 110 bushels of

shelled corn to the acre, allowing seventy-five pounds of ears to equal one bushel of shelled corn.

When, says the *Polyt. Notizblatt*, a few drops of ether or alcohol are let fall upon a paper equally moistened with cadmium and iodide starch solution, and the volatile liquids are set on fire, the paper will be found, after their evaporation, to be turned blue, owing to the formation of ozone.



TRANSMITTING AND CONVERTING MOTION.

power as could be obtained with Sturgeon's arrangement. The first magnet on this principle was used by Professor Henry in 1828. It consisted of an iron bar two inches square and twenty inches long, bent, of course, into the form of a U or horseshoe, and wound with 549 feet of insulated copper wire in nine coils. The keeper weighed seven pounds, the core twenty-one pounds, and its lifting power was 750 pounds.

This magnet was used at Albany. In 1832 Professor

IMPROVED CAR COUPLING.

We give an engraving of a novel car coupling, which is automatic in its action, and is almost as simple as the common link and draw bar. It seems well adapted to freight cars, and may be used with advantage on passenger cars. The link or coupler consists of a bar of iron having in each end mortises, in which are pivoted the arms of drop bolts, which extend through a mortise in the middle of the bar. These bolts have large square heads fitted to corresponding recesses in the draw head. The lower part of the bolt drops into a slot in the lower part of the draw head.

In the operation of coupling the cars the pivoted arm of the bolt acts as a guide to the link, and at the same time raises the bolt so that it enters the end of the draw head readily. When the link has entered the draw head far enough the hinged pin drops into its place and the coupling is secure.

To release the coupling, the hinged pin is raised by means of a short lever on the inner end of a rock shaft, which extends to the side of the car. Here the rock shaft is provided with a hand lever, by means of which the coupling may be operated. The hand lever is provided with a ratchet arrangement by which the uncoupling lever may be held in position to prevent the coupling from acting.

Fig. 1 shows the draw head in section, and gives the position of the link and of the uncoupling lever. Fig. 2 is a perspective view of the link detached from the draw head.

It will be noticed that no springs or parts liable to get out of repair are used in this coupling. The inventor provides a pin with a square head, which may be used in this draw head in connection with an ordinary link.

We are informed that this coupling is in practical use on one of our principal railroads, and that it is indorsed by eminent railway engineers.

The invention has been patented by Mr. J. C. Cope. Dr. Fred Verneti, of Montgomery City, Mo., is agent.

Test of the Mississippi Outlet.

The Dominion line steamer Montreal, bound for Liverpool, passed the jetties November 17, with the largest cargo ever taken from New Orleans. It consisted of 6,669 bales of cotton, 42,658 bushels of corn, and 2,000 packages of miscellaneous cargo, the total being equivalent in bulk to 9,565 bales of cotton.

NEW REFERENCE INDEX.

The engraving shows a reference index for dictionaries, directories, catalogues, Bibles, blank books, and all other books of reference.

With this index applied to a dictionary, directory, or any book alphabetically arranged, the initial letters of the entire alphabet are constantly visible, so that, whether the book is lying on either side or open at any page, the student can turn to any letter by a single motion.

As shown in the engraving notches are cut in the edges of the leaves so as to expose a small portion of the page on which each letter begins. On the surface thus exposed is pasted a facing of thin leather bearing the initial letter. The notches from A to M are cut toward the front, and from N to Z toward the back cover, thus forming two series. Now, when the book is lying on either side, the letters in the upper series, being closed downward, are hid, and when open at any place except between M and N, a portion of either one or the other series is hid. To obviate this difficulty and make the index perfect, each letter of the first series is duplicated on the margin of the front cover and on the margin of each leaf through to the notch containing the same letter. The letters on the leather facings or "pasters" in the notches are called primaries, and the marginal letters on the covers and leaves secondaries; and as will be readily seen, each secondary is directly opposite its corresponding primary. The primaries of the second series are duplicated in the same manner by secondaries on the back cover and leaves. If the book is lying with front cover up, and it is desired to turn to any word beginning with C, pass the finger under that letter on the cover into the notch under it, and the book is opened instantly to the position of the open volume in the cut. Here the primaries from D to M are still hid, but the corresponding secondaries are seen on the margin, each indicating that the notch directly under it contains the same letter, and the book is opened to any of them in the same manner as it was to C. Suppose now that the book is lying open in the position shown in the cut, and it is desired to open it to any of the exposed primaries, place the thumb on the primary, then grasping the adjacent cover or leaves with the fingers, and the book is instantly opened to that letter.

In indexing Bibles, pasters bearing abbreviations of the books are employed, and only the primary feature is applied, since so many notches are necessary that the secondary fea-

ture is impracticable. The notches are colored with any desirable color, and the pasters commonly used are of black leather, with the letter or abbreviation in gold, so that the index proves an ornamentation rather than a blemish to the book. It is the only index ever devised that applies to the class of books above mentioned. It saves one half the

corn starch, cracked wheat, or any dry substance that it may be desired to have in packages of uniform weight. They are made of different sizes, according to the work to be done, so that they will weigh from one pound to twenty bushels at a time. The twenty bushel scale will weigh at the rate of three thousand bushels an hour. The weighing is effected pound for pound, according to the weights shown on the scale beam, so that it is absolutely impossible for the machine to make a mistake, and it can only be operated by delivering the exact weight which it has been adjusted to give. At the Institute Fair it has been running for the purpose of showing its operation with cup elevators, which deliver the grain in a continuous stream into the scale; each time the receptacle in the scale has received the required weight, the grain is quickly tipped out, and the filling again commences, but as the grain is tipped out an automatic register records the fact, so that the work done for any particular length of time may always be known by a glance at the register. The machine is so simple in its details that it cannot possibly get out of order with any ordinary use, and it cannot make a mistake in giving exact weight and a true count.

In the same section in which the automatic scale is shown may also be seen the pneumatic grain elevator patented by Mr. J. B. Stoner. This is worked by an exhaust, and, while it dries, cools, and cleans the grain, does away with all shoveling, saving four-fifths of the cost of that item, and will reduce the cost of annual insurance one per cent, from the fact that no machinery need be located in the warehouse, so there can be no fire from friction. It will also largely reduce the cost of warehouse building, as, with this system, no heavy framework is needed to bear heavy machinery.

For particulars in regard to both the above inventions apply to or address E. L. Hayes, 243 Broadway, New York. These inventions have also been patented in Canada, England, France, Germany, and Belgium.

RECENT INVENTIONS.

Mr. Alonzo J. Simmons, of Pana, Ill., has patented a novel mechanical movement for converting a rotary into a rectilinear reciprocating motion; and it consists in the combination of a shaft carrying a pinion with a peculiarly formed sliding block contained in a housing within which the block slides. This block is formed with an oblong groove and an elongated or elliptical gear on one side, with which the pinion engages, and with a straight groove on the other, which receives the tongue of another sliding block, which is connected to the object to be reciprocated, whereby a rotation of the shaft gives to the first sliding block a four motioned sliding action, and this in turn transmits a rectilinear sliding action to the second block.

An improved steam cooker, which is simple and in which any kind of food can be cooked thoroughly and rapidly, has been patented by Elizabeth Gallaher, of Bradford, Pa.

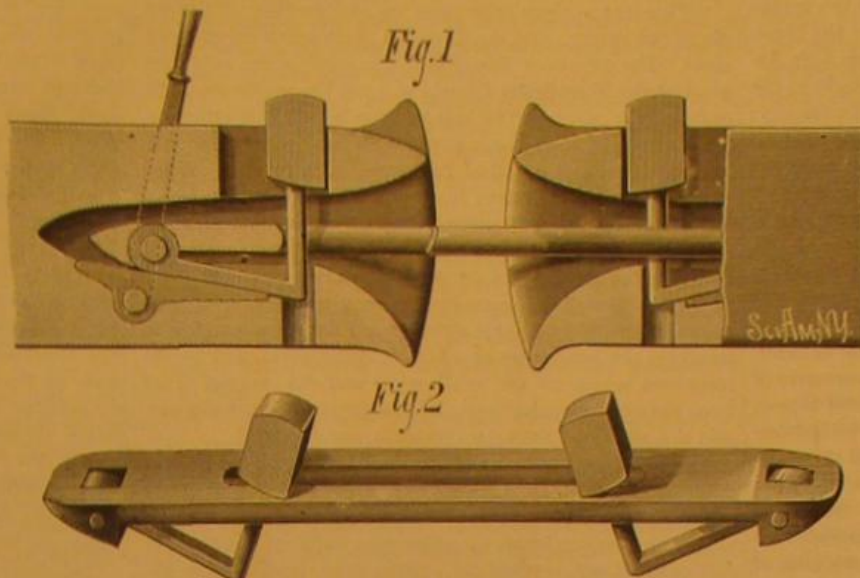
An improved polishing machine has been patented by Mr. Mervin R. Chase, of Warren, R. I. The object of this invention is to feed the polishing powder to and distribute it upon the polishing surfaces, to render the polishing surfaces by their construction and the peculiarly prepared polishing powder used upon them thoroughly pliable, pressing the polishing powder evenly upon all parts of the surfaces to be polished. The machine consists of two disks of yielding material having radial grooves in their adjacent faces. The polishing powder, which consists of polishing material and sawdust of cork is introduced through the center of the disks by means of a hollow shaft. The knives or other objects to be polished are introduced between the two disks.

Mr. William C. Marr, of Onawa, Ia., has patented an improved revolving scraper mounted upon wheels, which is so constructed that it may be operated and controlled by a person riding upon it or walking in its rear.

A glass ball trap with an automatically revolving arm and throwing spring has been patented by Messrs. James Kerstetter and John Fagley, of Kribb's Farm, Pa. The invention consists of a clockwork arrangement by which the arm and throwing spring are constantly revolved.

Mr. Edward Clark, of Brooklyn, N. Y., has patented an apparatus for recovering the sulphuric acid from the sludge acid from oil refineries in such a manner as to prevent any unpleasant or unhealthy odor from escaping, and at the same time obtain a sulphuric acid sufficiently pure for use in manufacturing superphosphates and analogous uses.

Mr. Carl Bush, of New York city, has patented an improved clay digger which consists in a blade or land side of a plow provided with a flange at the bottom edge and detachable mould board at the rear edge, to which blade a beam and a handle united at their lower ends are attached in such a manner as to form a runner which passes over the surface of the ground while the other parts cut into the ground.



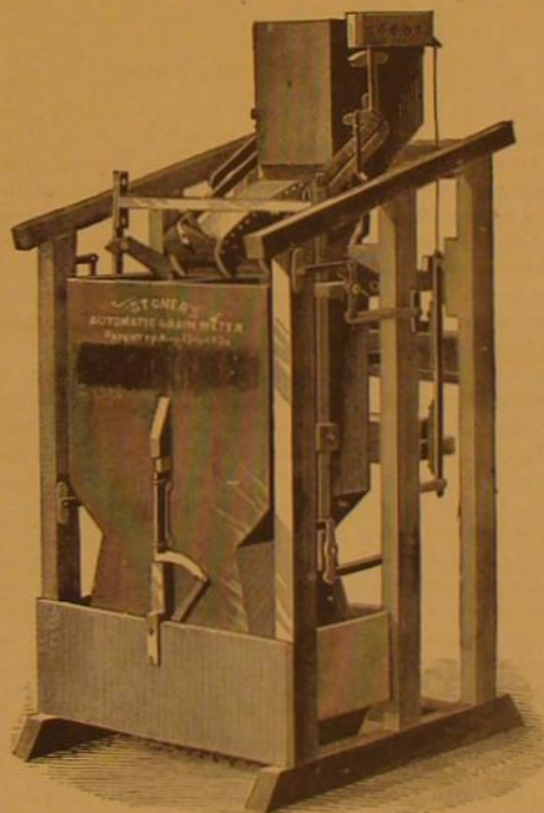
COPE'S CAR COUPLING.

time now used in thumbing books of reference, and will outlast the binding even of a leather-bound volume.

All communications in regard to this invention should be addressed to C. H. Denison's Index Office, 28 Bond street, New York City.

THE STONER AUTOMATIC SCALE.

Among the ingenious devices which have been attracting public attention at the American Institute Fair this year, the Stoner automatic scale, an illustration of which is here



THE STONER AUTOMATIC SCALE.

given, deserves especial attention. It is made under two patents granted to J. B. Stoner, August 12, 1878, and June 1, 1880. These scales are intended for use in warehouses, mills, and stores, or for putting up packages of flour, spice,



C. H. DENISON'S REFERENCE INDEX.

Meeting of Civil Engineers.

The 28th annual meeting of the American Society of Civil Engineers, adjourned from November 3, was resumed in this city, November 17.

The day's programme embraced the reading and discussion of the annual report of the secretary, John Bogart; a lunch at the office of the Engineer of the New York and Brooklyn Bridge, followed by an inspection of the plans of the bridge and the superstructure; a visit to the buildings of the Western Union Telegraph Company and the Equitable Life Assurance Company; an exhibition of the electric light in the last named building; a ride in a tugboat around the Battery; a visit to the Erie Railroad elevator in Jersey City; a visit to the Hudson River Tunnel, and an evening meeting at the house, in Twentieth street.

The society lost by death during the year nine members: as follows: Thomas A. Emmet, John C. Thompson, I. M. St. John, Max Hyarlsberg, George W. Edge, Thomas S. Hardel, James A. Hayward, William H. Greenwood, and Arthur L. Ford.

At the evening meeting Mr. Craes, from a special committee appointed to collect data concerning the measurement of the flow of streams in times of freshets, made a brief report, in which he stated that the committee had received but few responses to their inquiries. Mr. O. Chanute said the problem presented to the engineer was how to increase the rainfall over that country known as the American Desert, in which the soil is abundantly rich to produce cereals, but where they could not now be grown on account of a lack of sufficient rainfall. Mr. Craes read an interesting paper prepared by Frederick S. Odell on the sewerage system of Memphis.

THE NATIONAL ACADEMY OF SCIENCES.

The fall meeting of the National Academy of Sciences closed on Friday, November 19.

Thursday's session began with the reading of two papers by Prof. S. P. Langley, "On the Thermal Balance" and "On the Measurement of Radiant Energy." In the first, Prof. Langley described at length the new instrument for measuring radiant energy, first made public some months ago. After nearly a year's experimenting he was able to present to the Academy a practically perfect instrument. In using the thermal balance a relatively powerful battery is employed, and the feeble radiant energy acts, not by its own weak force, as in the thermopile, but by controlling this great battery power, just as a weak human hand might control enormously greater power than its own when laid on the throttle valve of a steam engine. The thermal balance consists essentially of two series of delicate strips of excessively thin steel, platinum, or palladium, through which two equal currents pass. These opposite currents meet in a galvanometer, whose needle, pushed in opposite ways by two equally powerful forces, remains motionless. Warming one of the sets of strips by an almost inconceivably small amount would, it was shown, diminish the flow of electricity through the strips so warmed and alter the index. As little change as a fifty-thousandth part of a Fahrenheit degree could be thus detected, and what was important, the instrument was not only far more sensitive than the thermopile, but far more prompt and very precise.

Important applications of the new instrument in determining the distribution of heat in the solar spectrum were described in Prof. Langley's second paper. As is well known, in the spectrum formed by a prism the rays are unequally distributed, and part of the heat is absorbed by the material composing the prism, so that the distribution of heat in the spectrum affords no true test of the heating power of the differently colored rays.

In the pure spectrum of the reflecting grating, on the other hand, the rays are so dispersed as to make it practically impossible, with the instruments hitherto at command, to exactly measure their energy. For many years Dr. John W. Draper has held that the alleged threefold character of the solar beam as commonly taught, and supposed to be proved by the curves of heat, light, and actinic energy in the prismatic spectrum, was not true, the two halves of the spectrum divided by the ray of medium wave length being equal in energy. The complete experimental demonstration of Dr. Draper's position has been made possible by the thermal balance.

The exact conclusion of the research undertaken by him must, Prof. Langley said, be deferred. It was now clear, however, that the curves representing the distribution of heat and light in the spectrum were substantially coincident, and the statements of eminent European authorities, who had taken too little account of American men of science, as represented by such names as those of Rutherford and Draper, must be modified.

Prof. Elias Loomis, of Yale, followed with a report of his investigations respecting the "causes which determine the progressive movement of storms," the principal results of the investigation being as follows:

(1.) The lowest latitude in which a cyclone center has been formed near the West India Islands is 10°, and the lowest latitude in the neighborhood of Southern Asia is 6°. Violent squalls and fresh gales of wind have, however, been encountered directly under the equator. (2.) The ordinary course of tropical hurricanes is toward the west-northwest. In a few cases they seem to have advanced toward a point a little south of west, and in a few cases their course has been almost exactly toward the north. (3.) Tropical hurricanes are invariably accompanied by a violent fall of rain. This rainfall is never less than 5 inches in 24 hours for a

portion of the track, and frequently it exceeds 10 inches in 24 hours. (4.) Tropical storms are generally preceded by a northerly wind, and after the passage of the low center the wind generally veers to the southeast at stations near the center, and the southerly wind, which follows the low center, is generally stronger than the northerly wind which preceded it.

"This fact appears to suggest the explanation of the origin of the cyclone and the direction of its progressive movement. The prevalent direction of the wind in the neighborhood of the West India Islands is from the northeast. Occasionally a strong wind sets in from a southerly quarter. The interference of these winds with each other gives rise to a gyration, and a fall of rain sometimes results. When rain commences the latent heat which is liberated causes an inflow of wind from all quarters, by which the rainfall is increased; and since the winds are deflected by the rotation of the earth, an area of low pressure is produced and the force of the winds will be maintained as long as the rainfall continues. The effect of this strong wind from the south is to transport the low center in a northerly direction, and by the combined action of the south wind and the normal wind from the northeast the center of low pressure is usually carried in a direction between the north and the west."

An important improvement in the Sprengel air pump was described by Prof. O. N. Rood, of Columbia College. After cutting off certain sources of leakage into the apparatus by means of mercury traps, he obtained a vacuum of one-sixty millionth of an atmosphere. Still finer results were obtained after the adoption of devices for withdrawing the moisture contained in the mercury used. In conclusion, Prof. Rood said that he had obtained vacua as high as the ninety-four-millionth of an atmosphere in some of his experiments, and in one had gone as high as one one-hundred-and-ten-millionth. There was no reason why higher results even than these should not be obtained, as it was merely a question of making the pump perfectly tight and excluding moisture. Prof. Crookes, of London, who has experimented in this direction, has reported his highest result as one-twenty-millionth of an atmosphere, and in France a distinguished experimentalist had recorded a vacuum of one-seventeen-millionth.

Prof. John S. Newberry, of Columbia School of Mines, read two papers, one on the "Antimony Mines of Southern Utah," the other on "Deposits of Crystalline Ores in Utah." Prof. Newberry regards Utah as one of the great mineral regions in the United States, and her mines of iron, coal, and antimony, to say nothing of the precious metals, as at no very remote date to attract an immense influx of population. He has prepared maps and a geological description of the iron, coal, and antimony deposits of the region south of Salt Lake, which were employed in illustrating his memoirs on these subjects, and are among the first accurate contributions to the geological knowledge of a tract of country whose mineral resources entitle it to rank as a profitable field for mining enterprise and capital.

The aggregate of iron in Utah he described as such as to throw into the shade all other known deposits in this country. He had seen enough lying loose during his short tour in the southern section of that Territory to keep all the foundries in the United States in operation for a hundred years. One of the most striking iron deposits upon which his eye had ever rested consisted of a group of hills, from 1,000 to 2,000 feet high, which were penetrated to a great depth with parallel veins of iron ore. As one crosses the valley of which these eminences formed a local boundary, they are identifiable from a distance of five or six miles as masses of metal. The type of metal was the magnetite, whose inky blackness of color gave the range the appearance of mountains of coal. One of these hills rose to a greater height than the rest, and in this the iron axis was disposed in strata as exactly parallel to each other as lines could be drawn upon the blackboard. While the prevalent ore in this region was magnetite, it was, nevertheless, interspersed with abundant masses of hematite; and there were many points where the two were intimately intermixed and blended. As one journeyed from point to point in this region the surface was found to be strewn with boulders and broken masses of iron. He remembered such a mass about twelve or fifteen miles south of Iron City, which was 1,000 feet long by 500 broad and 200 feet high—a vast castellated crag of black magnetite.

Anywhere one might pick up vast masses of natural lodestone. The variety of structure was also surprising. Here was a mass as solid as cast iron; near by was a mass that was soft, decomposed, and stained blood-red. Within six to ten miles of this vast deposit of iron was an abundance of the best of coal to work it, so that one could stand on the brink of an iron hill and look down upon coal enough to convert it.

The first paper of the last day was a brief but important one by Prof. Henry Draper, on the "Photographing of the Nebulae in Orion." After distributing copies of photographs taken by him, Prof. Draper said: The gaseous nebulae are bodies of interest because they may be regarded as representing an early stage in the genesis of stellar or solar systems. Matter appears to exist in them in a simple form, as indicated by their simple spectrum of three or four lines. It is desirable, therefore, to ascertain what changes occur in the nebulae, and determine, if possible, the laws regulating their internal movements. Drawings by hand have been made of some of the nebulae, and especially of the nebula in Orion, for upwards of 200 years. But drawings

are open to the objection that fancy or bias may distort the picture, and it is therefore difficult to depend on the result, and to compare the drawing of one man with that of another. To apply photography to depicting the nebulae is difficult, because these bodies are very faint, and, of course, owing to the earth's motion and other causes they seem not to be at rest. They require a large telescope of special construction, and it must be driven by clock-work with the greatest precision. All such difficulties as those arising from refraction, flexure of the telescope tube, slip of loose bearings, atmospheric tremor, wind, irregularities of clock-work, foggy or yellow state of the air, have to be encountered. The photographic exposure needed is only an hour, and a slip or movement of a very small fraction of an inch is easily seen in the photograph when it is subjected to a magnifier.

In taking the photographs Prof. Draper used a triple achromatic objective of 11 inches aperture made by Clark & Sons, according to the plan of Mr. Rutherford, for correcting the rays especially for photography. This telescope was mounted on an equatorial stand and driven by a clock made by Prof. Draper. The photographic plates were bromo-gelatin and about eight times as sensitive as the wet collodion formerly employed. Having described the photographs, Prof. Draper remarked that a series of photographs taken at different seasons and in different years would make it possible to determine with some precision what changes, if any, are taking place in the nebulae.

Prof. George F. Baker read a paper on "Condensers of High Potentiality," in which he described their construction and use. In measuring the insulation resistance of an underground cable about a year ago, a mica condenser, made by Elliot Brothers, of London, was used; the condenser was perforated by a potential of less than 200 volts. Correspondence with the makers showed that higher potential than 100 volts was never used on condensers in England. That potential produced no current through three and one-half miles of the cable insulation on a Thomson galvanometer of 5,011 ohms resistance; and even 1,000 cells (of 700 volts electromotive force) gave a deflection of only 35 scale divisions. Hence a condenser was constructed, insulated with the exceptionally high insulating material of the cable. This was found to stand the electromotive force of the 1,000 cells without difficulty. This insulating material, essentially a mixture of beeswax and rosin, therefore, has the first requirement—low specific inductive capacity—in a high degree. Paraffine, used to adulterate the beeswax, prevented high insulation; this was obtained only by using pure beeswax.

Desiring to use a condenser, upon the secondary wire of an induction coil giving a ten to fifteen inch spark, for the purpose of spectrum photography, Dr. Henry Draper suggested trial of one of the above condensers upon this circuit. This was constructed accordingly by R. P. Manly, of Philadelphia, and contained about 800 feet of tin plate, insulated by sheets of blotting paper soaked in the cable composition. On trial it was found to work admirably. Using the alternating current of a Gramme machine upon the coil, 2,400 sparks, three inches in length, were obtained from the condenser, with a noise resembling the fusillade of musketry. The potential here must be many thousands of volts; and the perfect action of the condenser shows the insulation to possess the second requirement.

There is no doubt that this form of condenser will replace entirely the Leyden jar for charges of high potential. It is compact and always clean; and it has the decided advantage that in case of its perforation it may be repaired by warming the composition. The perforations are filled up by the semi-melted mass. The production of such a condenser seems to furnish a new and ready method for determining the electromotive force of magnetic machines—a method more convenient than most of the methods now in use.

A paper on the "Ellipticity of the Earth," by C. S. Peirce, was presented by request of the Superintendent of the Coast Survey, and read by Prof. Langley. Prof. Peirce's observations have extended over a series of years, and have been conducted with appliances of extreme delicacy. Some of his conclusions are at variance with accepted doctrines. He finds, for example, that the correction hitherto made for the attraction of elevations is without actual foundation in fact. An island in the ocean, instead of making necessary a correction for its elevation above the general level, is without such influence as has previously been supposed on the vibration of the pendulum, and the same principle applies to elevations of other descriptions.

Lieutenant-Commander Sigsbee's gravitating trap for collecting organisms at different depths was described by Prof. Agassiz, who also reviewed the more important results determined by its use. It was found that to the depth of 50 fathoms the same organisms were taken as at the surface. The next 50 fathoms contained the same types, but the genera were less numerous. They counted 17 genera of pelagic organisms upon the immediate surface in one of these investigations, but only 5 of them were brought up when the trap was let down to a depth of 100 fathoms. Prof. Agassiz concluded with a high compliment to the ingenuity of Commander Sigsbee, whose invention had surmounted so many of the difficulties connected with the study of submarine biology.

He believed that the bodies of pelagic organisms brought up from great depth where the carcasses of animals that had perished of age or accident upon the surface, and had slowly settled to the bottom to furnish food for its liv-

ing hosts. It required from three to four days for a dead tunica to sink to the depth of 1,000 fathoms.

The closing paper was by Prof. O. C. Marsh, "On the Brain and Spinal Cord of Some Extinct Reptiles." Referring to his previous paper on the same subject, and to the brain development previously enounced by him, Prof. Marsh called attention to the singular brain or brains of a gigantic reptilian of the jurassic formation which he had recently examined. This immense animal, though 30 feet in length, possessed a brain scarcely as large as that of an ordinary dog, as judged from the capacity of the brain cavity. But the most remarkable feature of its nervous system was an immense enlargement of the spinal cord in the sacral region, where the bone was so excavated as to form an immense vaulted receptacle, several times larger than the brain cavity. The sacrum consisted of four vertebrae, which were well ossified and of great solidity, and within this was contained, during the life of the animal, a posterior brain—if he might use the term—which was eight times as large as the encephalon. The point was of very curious interest, not only as a fact of fossil anatomy, but in respect to the physiological inferences that might be drawn from it, into which he did not propose to enter. It was so remarkable, indeed, that he took occasion to examine other examples of the same species before accepting it as a general fact of extensive application. Upon recurring to some younger specimens of the same gigantic saurian, he was enabled to verify the existence of the cavity in every instance, and to prove that sacral enlargement of the cord in extinct reptilians was an extraordinary fact. If it had appeared in a single instance, it must, of course, have been regarded as a phenomenon due to injury or disease; but in all cases since his attention was attracted to the point by this enormous creature he had found the posterior cavity in extinct reptiles.

There was nothing analogous to this sacral enlargement, Prof. Marsh continued, in existing vertebrates. The auriphax had absolutely no brain—that is, no cerebral enlargement of the cord at the anterior extremity, but there was no enlargement of the spinal cavity at the sacrum which answered to what he had observed in extinct species. He would not take the time of his colleagues by drawing any conclusions from the facts he had stated. Prof. Rood inquired if the sacral enlargement was in such a position as to furnish a point of origin for the nerves of the leg. Prof. Marsh replied that such was the case, and that the creature had very powerful hind legs. But the fore legs were equally strong, and there was no corresponding enlargement.

AMERICAN INDUSTRIES.—No. 62.

THE MANUFACTURE OF STEAM, GAS, AND WATER FITTINGS, TOOLS, ETC.

The vast quantities and almost infinite variety of goods now required in this department, apart from the plain piping and other staple articles, render it especially appropriate that the making of these more difficult parts should constitute a branch of business by itself. The manufacture of cocks, valves, couplings, stops, etc., covers an almost endless assortment of varying patterns, and these, with the fittings and collateral articles, require an extensive variety of especially contrived tools and appliances, as well as the most skillful workmanship. Our illustrations on the first page of this paper represent the more important details of this branch of industry, as carried on at the extensive establishment of the Eaton, Cole & Burnham Company, at Bridgeport, Conn., where are made almost every description of steam, gas, and water goods, in cast, wrought, and malleable iron, as well as in brass, copper, and the related alloys.

The die making department is shown in one of the views at the top of the page. Here are made every description of screw threading taps and dies, with stocks adjustable or otherwise; also gas pipe reamers, drills, cutters, etc. A considerable proportion of the work done here is in the preparation of the working apparatus necessary in the other branches of the manufacture; but this is also the starting point for the making of a full line of tools for the use of gas, water, and steam fitters. The stocks and dies made are adapted to cutting threads on pipe of from $\frac{1}{4}$ inch to 3 inches diameter, the dies being made either right or left, and fitted to work with a variety of different kinds of stocks.

The pipe cutter shown in one of the views, with engine attachment, is also furnished without such attachment, and of different sizes, to be used with either steam or hand power. The hand machine will cut and thread pipes of $\frac{1}{8}$ inch to 2 inches inclusive, while the largest size machine will cut and thread pipes of $2\frac{1}{2}$ to 6 inches diameter.

In the core making, which is shown in one of the sketches, only the most skillful hands can be employed in many of the specialties here produced. Cores are of sand or loam, sometimes also having a little straw or horse dung, and they are so moulded that they may be used as a part of the pattern, and in many cases to enable the pattern to be cast in a two part flask, where a three or four part one would otherwise be required. The core boxes used are of wood and metal, and for many of the goods, have to be made particularly for the work; the long cores are generally strengthened by wires or rods, but they will never bear much handling, and are carefully removed from the boxes and thoroughly dried in an oven for this purpose before using. When but little sand or loam is used in the core the latter is well burned, which consumes the small particles of straw, making them more porous, in consequence of which the castings are sounder, because the cores thus made allow of the free

escape of air. In making cores for long pipes a twisted straw rope is first wound around an iron bar; this is then covered with a mixture of loam and horse dung, which is swept into cylindrical form by being revolved against the edge of a board, on which are cut the patterns of any interior rings or changes in size which are to be made in the pipe for each length of a core. This gives a straw core, through which the gases generated by the liquid metal may freely escape. In some cases, also, when the designs are complicated, the cores themselves are made in halves and placed together after being dried.

The core making is, of course, directly dependent on the pattern department, but the latter, as well as the iron foundry and forge shop, which are necessarily leading departments of the business, are not shown in detail in our illustrations.

The brass foundry, which forms the center view on the first page, is a capacious, well lighted, and well ventilated building. The variety of valves, cocks, and fittings cast here includes almost everything known to the trade in this department, and yet a great proportion of the work, though only in small pieces, is such as requires the greatest care and skill.

It is of prime importance in this work that the quality of the brass should be especially adapted to the uses for which the goods are designed, and in this particular the long experience and great variety of goods made by this company have been of great value. It is evident, for instance, that for engine work, and in many of the uses for which brass is required in steam fittings, a much tougher article is called for than in cases where the pressure would be greatly lighter or the wear far less severe. The ordinary commercial brass consists of two parts by weight of copper and one of zinc, though the proportions vary according to the experience of founders and the work in hand. A small percentage of lead is sometimes used, and this diminishes the ductility and increases the hardness, so that it can with greater facility be worked on the lathe. A tough brass for engine work is composed of twenty parts of copper to three of zinc and three of tin; while for heavy bearings a brass is made of thirty-two parts of copper to one of zinc and five of tin. Zinc, which is a good deal cheaper than the other elements, melts more quickly, and, if care be not taken, will burn off more or less before the metal is ready to pour.

The different components of the alloy which it is proposed to make are put together by weight in the crucibles, the furnaces in which the latter are placed are shown in the center. At the sides are the workmen preparing the moulds, and between them and the furnaces are the flasks containing the moulds into which the melted metal is to be poured. The most of the copper used comes from the Lake Superior region, which furnishes the best quality, and many of the alloys made here have stood the test of the severest use in proof of their adaptation to the purposes designed.

The brass finishing room, shown in one of the views, is fitted up with a great variety of improved machinery. There is a great deal of lathe work here, and there are many machines especially adapted for rapid finishing on goods of which the company make large quantities. Here the gauges and gauge cocks are fitted up, and the different styles of lubricators, valves, bibbs, nozzles, and couplings put together. The cutting of V-shaped and square screw threads and threads of varying pitch is also done here, and the assortment of tools with which the shop is provided for this purpose is so large that any demand for an article in common use can immediately be filled, if, indeed, it be not already made up in stock.

The iron valve and fitting room shown in the view at the bottom of the page illustrates the department in which the finishing work on all iron goods is performed. Here the double and single section radiators are set up, and the machine work generally is completed on all goods in either malleable, cast, or wrought iron.

In hydraulic and double extra strong pipe, in wrought iron pipes of many sizes, and in boiler flues, etc., the work done in this establishment covers every variety of goods in which thoroughly good workmanship, a high degree of skill, and the best of materials are indispensable requisites. A bare enumeration of the different articles produced makes an extended catalogue. It includes everything required by the gas-fitter—pipe tongs, vises, and proving pumps, fixtures and fittings; in the goods for steam work are patterns of feed-water heaters, gauges, steam traps, oil cups, and lubricators; in plumbers' tools and materials are the modern heating appliances, traps, water fixtures, etc., plain and plated; besides hose couplings, caps, pipes, and nozzles for fire department, mill, and factory use. It would, of course, be impossible that so extensive a line of goods could be produced except in an establishment which had grown into the business by the natural enlargement of its trade, but the company have kept pace with the growing demands by successive enlargements of the works at Bridgeport through many years, until now they have one of the largest and most completely fitted up factories in this line of industry in the world.

The New York office and warehouse of the company is at No. 58 John street.

The Atmosphere of Celestial Bodies.

M. José J. Landeur communicates an interesting paper to *Les Mondes* on the atmosphere of celestial bodies. Whereas previous investigations have given about 250 miles as the furthest result for the height of the earth's atmosphere, M. Landeur places it at not less than 22,000 miles. He cor-

roborates his calculation by showing that the height at which meteoric matter becomes incandescent on approaching the earth is far beyond the distance heretofore assigned to it, and therefore there must be an atmosphere at that greater distance to produce the incandescence. He also accounts for the spectrum of the aurora borealis, showing a marked coincidence with that of the zodiacal light by the theory that since the earth travels in the zodiacal nebula from September to May, the rarefied atmosphere beyond the earth's heavy envelope of air must absorb some of the constituent elements of the zodiacal nebula, and thus these elements make their presence apparent in the spectrum of the aurora, which phenomenon occurs in this rarefied outer envelope.

M. Landeur believes also that the difference between the observed acceleration of the moon's mean movement and that obtained by calculation on any of the previously advanced hypotheses, which is very marked, may be wholly explained by the resistance of this nebula in the moon's movement.

The Sense of Colors.

At the recent meeting of the French Association for the Advancement of Science, M. Charpentier, of Nancy, read a paper in which he propounded the somewhat novel theory that the sense of light and that of colors are independent. Since white light is the sum total of the various colors, it has been commonly thought that the sensation of white light was simply the sum total of the sensations of its constituent colors. On the ground that the sensitiveness of the eye for white light may be increased—as, for instance, by the previous absence of all light—without the sensitiveness for color being increased, he urges that there is a color-sense as distinct from that of light as is the sense of touch from the sense of heat.

Correspondence.

Shower of Angular Hailstones.

To the Editor of the Scientific American:

On the 1st of December, 1878, at 9:30 P.M., a remarkable hailstorm passed over Thymbra Farm, on the Plains of Troy, Asia Minor. A gale was blowing at the time from the southward, when a sudden massing of dark clouds fly-



ing in various concentric directions was observed. As the clouds passed over the farm there was a heavy discharge of hailstones, for the space of about five minutes, which whitened the ground with an icy covering. The hailstones were above the average size. The remarkable feature, however, was the extraordinary shapes these stones presented, some of which were round or irregular with angular projections, others flattened with but two of these points. Shapeless masses of ice also fell. The stones were whiter at the core than on the external portion. To account for this phenomenon, it may be suggested that the upper portion of the cloud was suddenly converted to snow, which, falling and gyrating in the lower, formed the nucleus around which the vapor was condensed and frozen; while a rotatory motion gave the round form to the body, or added to the spherical nucleus of the snow, the angular portions of the crystals increased in size. The delicate arrangement of the original hexagonal crystals of the snow was destroyed, which explains the various shapes and irregular number of angles in the hailstones. The drawing is made from a sketch taken at the time, which represents the natural size of the hailstones. Violent gusts of wind, but no electrical discharge, accompanied the fall. FRANK CALVERT.

U. S. C. A., Dardanelles.

MECHANICAL INVENTIONS.

An improved coffee pulper and separator has been patented by Mr. Edwin L. Henington, of Santaren, Para, Brazil. The object of this invention is to furnish simple and convenient machines for expeditiously removing and separating the pulp from the berries or kernels of the coffee fruit.

An improved car coupling has been patented by Mr. James Court, of Harrisburg, Pa. This invention consists in improved means for supporting the coupling devices of a car, and in combining the parts that do the coupling with and uncoupling from the link.

Mr. Franklin H. Lummus, of Brooklyn, N. Y., has patented a cotton condenser, which may discharge the dirt accumulated in the pocket provided for it by being raised out at the bottom.

Mr. William Tucker, of East Toledo, Ohio, has patented

an improvement in that form of coupling in which the bumper is formed with a hooked head and provided with a hinged jaw that engages with the hooked head of the adjoining car.

An improved tool for cutting plate iron has been patented by Mr. William T. Bennett, of Petersburg, Ill. This invention is more particularly intended for cutting pieces from steam boilers in order to insert patches, but it may be used for various other purposes. It consists in a cutting blade and a handle or lever and its fulcrum, and the combination and arrangement thereof with relation to each other, so that by operating the handle the blade will cut or saw the metal.

NEW MACHINE FOR WASHING BOTTLES.

The engraving shows a simple machine for washing bottles, lamp chimneys, tumblers, and other similar vessels. It consists of a shaft revolved by a small water wheel propelled by a jet of water from the faucet on the water pipe.

The brush, which is inserted in the bottle or other vessel to be cleaned, may be of any suitable size or form; the illustration shows three wire arms springing outwardly and carrying chains which are thrown against the inner surface of the vessel by centrifugal force.

These chains loosen any adhering matter and agitate the soap and water so that the bottle is rapidly and thoroughly cleansed.

This invention was recently patented by Mr. M. Cody, of Boston, Mass.

Bleaching Gutta Percha.

Dissolve the gutta percha in twenty times its weight of boiling benzole, add to the solution plaster of very good quality, and agitate the mixture from time to time. By reposing for two days the plaster is deposited and carries down with it all the impurities of the gutta percha insoluble in benzole. The clear liquid decanted is introduced by small portions at a time into twice its volume of alcohol of 90 per cent, agitating continually. During this operation the gutta percha is precipitated in the state of a pasty mass, perfectly white. The desiccation of the gutta percha thus purified requires several weeks' exposure to the air, but may be accelerated by trituration in a mortar, which liberate moistures which it tends to retain.—*Journal de Pharmacy.*

IMPROVEMENT IN FEEDING AND WATERING LIVE STOCK ON CARS.

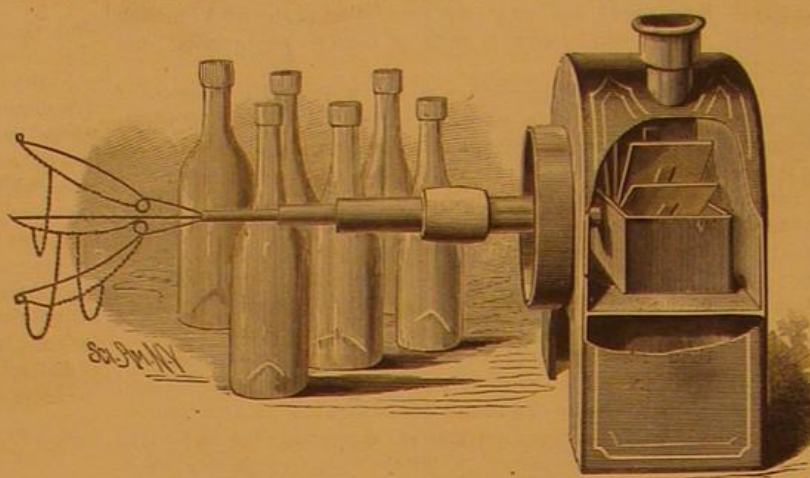
The cruel and barbarous treatment to which animals in transit from the West to Eastern markets are frequently subjected is an old and long-standing abuse. It has been clearly stated and denounced for years as shameful, inhuman, and uneconomical, but up to the present time there has been no substantial improvement in the means and methods provided over those of twenty years ago, when the business was begun.

So important has this question become that the American Humane Association has offered a premium of \$5,000 for the best device for, and most practicable improvement in, cattle cars.

From the best information at hand the estimated loss on cattle in transit equals 6 per cent, and about 9 per cent on sheep and swine, the greater portion of which loss is chargeable to improper treatment *en route*. The saving of one half of this percentage would amount to an enormous profit to

the cattle interest, and would mean as well better and cheaper meat both in this country and in Europe. Of the cattle that live, many, by reason of starvation and cruelties inflicted while in transit, and after, lose nearly a hundred pounds weight from the sweetest and best part of the meat, and come out of the cars full of fever, or with bruises, sores, and ulcers, and these, together with smaller animals, to which the loss and suffering are proportionately great, are all sold in our market for food.

If there were no other side to this question than that which pertains to the "profit and loss account" of the business ledger, we might be content to leave the subject here, letting those whose economical interests are involved discover the remedy. Such, however, is not the case, for it has become well settled through our Boards of Health at the commercial centers, societies of social science, and veterinary experts, that a large portion of the meats offered for sale in our markets is diseased and unfit for consump-



MACHINE FOR WASHING BOTTLES.

tion, which condition is very largely attributable to the improper and unnatural treatment of live stock during the time of shipment from the West to the East. We can, therefore, only hope for healthy meats for consumption, as a general rule, when live stock are cared for in transit as they should be.

From these facts it appears that cruelty to animals in transportation avenges itself upon the consumer, and that we shall never be secure against disease from eating poisonous meats until animals are properly fed and watered and thus brought in good health to the shambles. This can readily be done without materially adding to the expense of transportation, and with increased profit to all concerned, by adopting the cheap, effectual, and practical method shown in the engraving, which are devices recently perfected by Mr. A. D. Tingley, of this city, and are now owned by the Union Live Stock Feeding Company, of 27 Union Square, and are indorsed by the "Farmers' Club" and Mr. Henry Bergh, of this city. The Feeding Company are negotiating with the trunk railroad lines of this country for the early erection and operation of these feeding stations.

There is, therefore, an urgent need for the introduction of some plan by which the needless suffering of these dumb creatures in transit may be lessened. It has been fully demonstrated by actual tests that, by feeding and watering live stock regularly every twelve hours between St. Louis or Chicago and New York, 50 pounds and upward in shrink-

age was saved to each head of cattle, and the condition of the meat materially improved. The following is a moderate estimate of saving to the shipper with eight feeding and watering stations between St. Louis and New York:

Allowing 16 cattle to each car, and a saving in shrinkage of 50 lb. per head, or 800 lb. per car, worth 8 cents per lb., we have a total saving to the shipper on each car load.....	\$64.00
Deduct cost of feeding and watering at 20 cents per head at each station.....	\$25.60
Net saving to the shipper on each car load.....	\$38.40

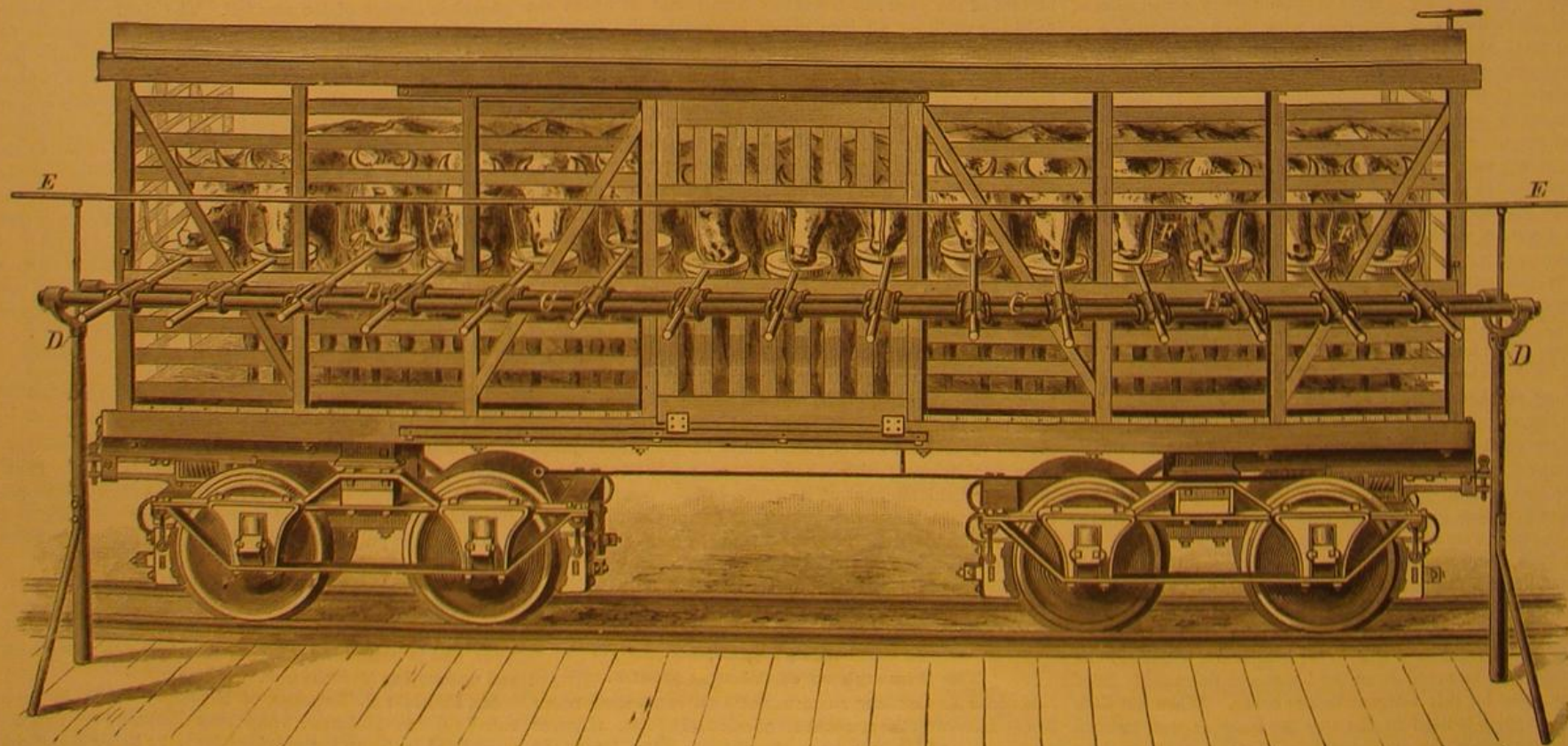
By official reports there were received and shipped at the two cities of St. Louis and Chicago alone, during the year 1879, 14,024,172 head of live stock, and the adoption and use of these devices would save millions of dollars annually to this industry, and at the small charge of five cents per head for the devices which effect this large saving, would bring the Union Live Stock Company an annual net income of over \$700,000, besides the great beneficial results to beef consumers. It is a simple device for feeding and watering, entirely separate from the cars, and is erected about twelve hours' run apart, at suitable stopping places along the track on both sides of the car. Its construction and use will appear from the following description, reference being had to letters in the engraving.

A represents a series of feed boxes, with handles which slide back and forth in socket, B, and allow the feed boxes to be pushed in and out of the car as desired. The sockets or supports, B, of the feed boxes (through which the handles slide) slide sideways on the rods, C, giving a lateral movement to the feed boxes to avoid posts and braces when the boxes are pushed into the car. D is a joint or hinge in the upright posts, which gives a slight rocking motion to the horizontal part of the framework, allowing the feed boxes to be slightly raised or lowered. E is the main water pipe, and F represents small leaders from the main water pipe to each separate feed box. It is designed to build a row of these on both sides of the track, and thus get at the heads of the stock, wherever they are. The only alteration required to be made in the stock cars now in use is to loosen one board on each side of the car, head high, and support it on hinges and hooks, so that it may, by lowering, provide an opening for the feed boxes.

This arrangement not only provides in a simple and inexpensive manner for the comfort of the stock, but permits of their transportation with greater dispatch, since it avoids the labor and delay of unloading.

Unfit for Human Food.

At the regular session of the Health Board yesterday, Dr. Ewing, executive officer of the Night Medical Service, reported that during the month of October thirty-eight persons had been treated by twenty-five physicians. Assistant Sanitary Superintendent Dr. Jones informs the Commissioners that on the 11th inst. he visited two slaughter houses on First avenue and seized several quarters of beef which was unfit to eat. In closing his communication Dr. Jones stated that he understood that the cattle were weak and sickly before being killed, and that the butchers were in the habit of selling the meat to Bologna sausage makers for two or three cents a pound. A committee of the leading cattle slaughterers in this city asked the Board to appoint a veterinary surgeon as an inspector of cattle and slaughter houses.—*New York Daily Herald*, Nov. 17.



LIVE STOCK FEEDING AND WATERING APPARATUS FOR RAILWAY CARS.

BORN BLIND AND DEAF.

BY DANIEL C. BEARD.

Australia seems to be a spot set aside by nature for experiments in curious forms of animal life. By some means, in the far distant past, a representative of that singular order, the marsupials, reached North America, where it is still to be found in abundance, a source of wonder to the ignorant and a puzzle to men of science. It was not until 1848 that the mysteries and fables shrouding the birth of this animal were swept away by Bachman and some of his friends, who, by diligent work and patient experiment, set aside forever the wild theories of such men as Valentine, Marcgrave, Piso, Beverly, Pennant, and others, who held that the young of this creature grow upon the mammae as the fruit does upon a stalk!

The *Didelphis virginianus*, in other words, the common opossum, is described by scientists as follows: "Head long and conical, muzzle pointed, ears large and membranous, rounded, and almost naked, tongue aculeated, internal toe of hind foot opposable to fingers," etc. Equally good and far less technical is the description given by a small street Arab as he gazed at one of these animals in the writer's possession: "Oh, looky, Billy," said he, "see that big rat; hit's got a pig's head, a coon's body, monkey's feet, and a rat's tail." The accuracy of the last description may be tested by reference to the accompanying engraving showing the parts in detail.

According to "Wood," fifteen days elapse, and the young opossum comes into this world, a diminutive, helpless babe, weighing not more than three or four grains, blind, naked, and deaf. It cannot even open its mouth, its jaws being sealed together, a small orifice only left at the muzzle, through which it receives its nourishment. One would think it was ill adapted to buffet with the rough world, but Nature, ever kind to her creatures, has ready prepared a soft cradle for its reception, where it is placed by its mother. The opossum, like its cousin the kangaroo, is a pouched animal; within the pouch are the mammae; to one of these the young opossum fastens itself almost immediately after being placed in the pouch. The growth of this

babe is surprisingly rapid, increasing from three and three-quarter grains to thirty grains in a week. In four weeks' time its funny head may be seen cautiously peering out at the great wide world; and at the end of the fifth week the little fellow is able to leave its snug quarters and venture out. Not being over-confident of its ability to take care of itself it grasps with its prehensile tail the tail of its mother.

Next to the rabbit the Virginia opossum is one of the most prolific of animals, often appearing with a dozen or more in its pouch, while other older ones cluster upon its back, firmly anchored there by their tails.

You have but to spend a short time upon some Southern

said that these animals are readily domesticated, soon becoming very tame and gentle, which is probably true. But the one I have, possibly through disappointment at the loss of her family, has a very ugly temper. She occupies the house formerly the home of the pygmy musk deer, an illustration and description of which was published in this paper in April, 1879. Whenever I approach the house she retreats to the furthest corner, and there, with distended jaws, defies further molestation.

Removal of Grease Spots.

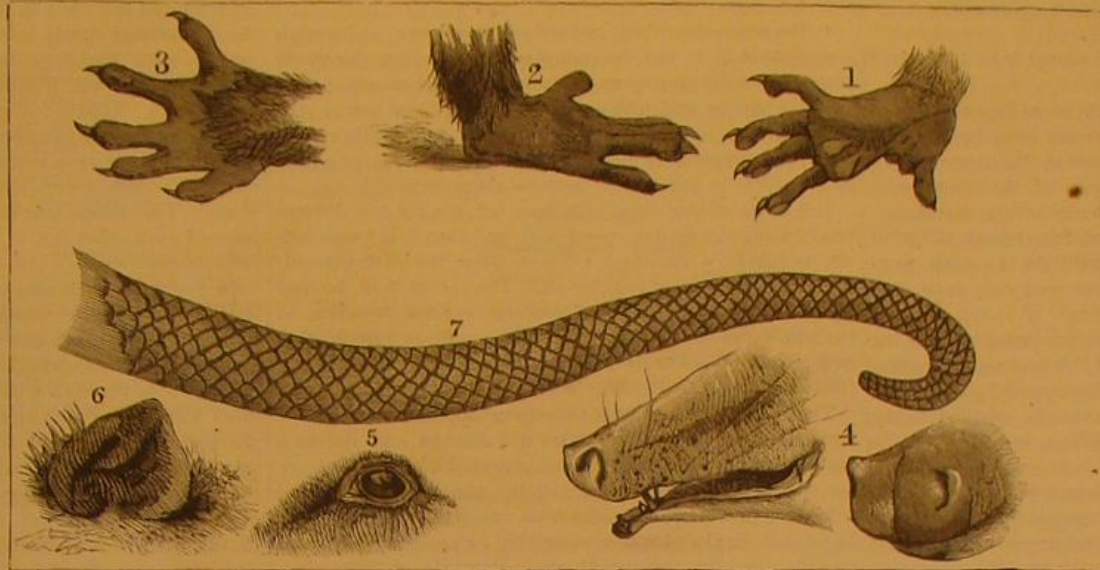
Fatty oils have a greater surface tension than oil of turpentine, benzole, or ether. Hence, if a grease spot on a piece of cloth be moistened on the reverse side with one of these solvents, the tension on the greasy side is larger, and therefore the mixture of benzole and fat or grease will tend to move towards the main grease spot. If we were to moisten the center of this spot with benzole, we should not remove it, but drive the grease upon the clean portion of the cloth. It is, therefore, necessary to distribute the benzole first over a circle surrounding the grease spot, to approach the latter gradually, at the same time having blotting paper in contact with the spot to absorb the fat immediately.

Another method, namely, to apply a hot iron on one side, while blotting paper is

applied to the other, depends upon the fact that the surface tension of a substance diminishes with a rise of temperature. If, therefore, the temperature at different portions or sides of the cloth is different, the fat acquires a tendency to move from the hotter parts towards the cooler.—*The Pharmacist*.

Chicago's Manufacturing Industries.

The recent census of the manufacturing industries of Chicago discloses evidence of a phenomenal rate of progress during the last ten years. The footings show 3,752 establishments, \$80,692,102 capital, 113,507 persons employed, \$37,615,381 wages paid, and \$253,405,695 in value of the articles manufactured. This is nearly three times the annual product in 1870. The leading industry is meat



OPOSSUM.—1 Bottom of hind foot.—2. Top of hind foot.—3. Top of fore foot.—4. Side and front of snout.—5. Eye.—6. Ear.—7. Prehensile tail.

plantation to learn the charms of a 'possum hunt, and if you can overcome your scruples enough to taste the meat after it is prepared by one of the sable hunters, you will pronounce it good.

Though this marsupial sometimes makes raids upon hens' nests, and occasionally upon the hens themselves, the good it accomplishes in exterminating other more mischievous animals doubly repays for a few stolen eggs and an occasional chicken. One that Bachman kept in a stable chased or devoured every rat upon the place.

Through the kindness of my friend Mr. John Walker, of Flushing, I secured a large female opossum from Charleston, S. C. When caught she had three young ones in her pouch, but when the Charleston steamer arrived at this port I was disappointed to find the young ones missing. It is



OPOSSUM.—*Didelphis Virginianus*.

packing: 72 establishments, with \$8,464,000 capital, employ 12,891 persons, and put up \$81,570,000 in value of meats. The iron and steel manufactures reach about \$25,000,000. The rolling mill products are valued at \$15,673,624, not including the Bessemer Steel Works, the values for which are merged in a general item. The manufacture of clothing foots up \$17,423,607; sash, doors, etc., \$8,981,281; bridges and railroad stock, \$8,030,398; furniture, \$7,188,278; tanning and currying, \$5,637,000; alcohol and rectifying, \$5,021,220; lard oil, \$6,508,800.

DECISIONS RELATING TO PATENTS.

United States Circuit Court—District of Vermont.

HOLLY vs. VERGENNES MACHINE COMPANY.

Wheeler, J.:

1. The meaning of the claims in a patent is to be derived from the specification.

2. Two devices are substantially the same in the sense of the law of patents when they perform the same functions in substantially the same way to accomplish the same result, and, except when form is of the essence of the invention, it should not be regarded in the question of infringement.

3. In determining the matter of infringement attention should be paid to such portions as really do the work, so as not to give undue importance to parts used only as a convenient mode of construction.

4. The patentee is entitled to the exclusive use of the whole of his patented invention, and if it is of a combination of numerous parts, including in it other new and useful combinations of less of the parts, he seems to be entitled to the exclusive use of these lesser combinations, as well as to the exclusive use of the whole.

This suit is brought upon reissued letters patent, No. 5,132, dated November 5, 1872, for a new system of waterworks for supplying cities and towns with water, and original letters patent, No. 94,747, dated September 14, 1869, for a new safety valve for street water pipes, both granted to the plaintiff. The defenses are that the plaintiff is not the original and first inventor of the inventions described in the patents, and that the defendants do not infringe. The cause was heard at last term on pleadings, proofs, and arguments of counsel.

Before the plaintiff's invention water to supply cities and towns was, when the supply was located high enough, drawn into a reservoir, and from thence into a main pipe, from which others ramified through all parts of the city or town and into dwellings and other places to spigots, from which it could be drawn as wanted for use. In level places, where there was still an elevation for a reservoir, it was forced by pumps into a reservoir, and when there was no such elevation it was forced into a stand pipe of the necessary size and height or into mains connecting with such a stand pipe, and the pressure of the water in the reservoirs or stand-pipes would regulate the flow to the spigots and hydrants. Where it had to be supplied by pumps the irregularity in the amount drawn at the spigots and hydrants would not admit of a uniform supply to the mains, and if pumps were employed for furnishing such a supply the incompressibility of water is such that when the drawing ceased the pipes would burst or the pumps or machinery be broken.

The plaintiff's inventions obviated these difficulties by providing pumping machinery which increasing pressure of water in the mains would slacken and decreasing pressure would hasten, and guarding against sudden shocks from the quick closing of hydrants by the use of an air chamber connecting with the mains, and preventing the danger of continued pressure from that source while the machinery was slackening by a peculiarly arranged relief valve applied to the mains, so that the water could be pumped directly into the mains and drawn therefrom by the spigots and hydrants at pleasure with safety to the works without any stand-pipe or reservoir. None of the systems set up as anticipations had these contrivances combined in this manner.

The London waterworks, constructed by Peter Maurice in 1583, as described by Thomas Ewbank in "Hydraulics and Mechanics," the system of waterworks described in the English patent to Joseph Bramah, dated October 31, 1812; and the London bridge waterworks, described by William Mathews in "Hydraulics, 1835," had pumps forcing water directly into mains to be carried to inhabitants; but neither of them had any contrivances for slackening the quantity forced as any pressure increased from diminishing the quantity drawn, as described; neither does it appear from the descriptions given but that the water flowed through by a constant flow, and was caught as wanted for use. Birkinbine's system at the State Lunatic Hospital at Harrisburg, Pennsylvania, had connection with a reservoir at the top of the building. Linsley's system at Burlington, Vermont, had connection with a reservoir above the city. Birkinbine had no means for regulating the quantity pumped by the severity of the pressure in the mains, and Linsley had none for lessening the quantity as the pressure increased. His system was nearer like the plaintiff's than any other was, but his lacked some of the essential features of the plaintiff's. His had means for slackening the pumping machinery when the pressure in the mains decreased, to prevent the machinery from running away if the pressure should be removed by bursting or other casualty; but this is quite different from regulating the supply according to the pressure. He had pipes leading each way from the main carrying the water up to the reservoir, and as to those pipes the water was pumped directly into them without going to the reservoir; but as they

were connected by the main with the reservoir the pressure in them would be regulated by the pressure from the reservoir, and would not in any manner regulate the quantity pumped according to their requirements. Birkinbine had a safety valve on the main for the same purposes as the plaintiff's relief valve; but his valve was held by dead weights, while the plaintiff's is steadied by a dash pot. None of these things show that the plaintiff was not the original and first inventor of the inventions described in both patents.

This is in accordance with the decision of Drummond and Gresham, J. J., in *Holly vs. Union City* (14 O. G., 5), so far as that decision goes, which only involves the reissued patent. This suit rests upon the first claim to that patent, which is for—

"The above-described method of supplying a city with water—that is to say, by pumping directly into the water mains when the apparatus for that purpose is supplied with contrivances by which the pressure within those mains may be preserved in a great degree uniform, sufficiently so for practical purposes, or increased or diminished at pleasure, substantially as and for the purpose above shown."

It is objected that this claim does not specify any devices constituting the system mentioned, and that it is too indefinite to furnish a foundation for a claim for infringement; but this objection cannot prevail. The patent is to be read altogether for the purpose of ascertaining the meaning of the whole and of every part. Consequently the specification may be referred to for ascertaining the meaning of the claims. (*Bates vs. Coe*, 15 O. G., 337; *Brooks vs. Fish*, 15 Haw., 215.)

The specification describes pumping apparatus which the increase of pressure in the mains will slacken and decrease will hasten. It describes mains connected with an air chamber and a relief valve for easing the shock of sudden and continued pressure, and mains from which the water is drawn as wanted, or closed mains, operating by pumping the water directly into the mains without a reservoir or stand-pipe. The claim of the system as and for the purposes above shown is a claim for this combination of these various contrivances, operating together in this manner for this purpose. It is for these devices so combined and arranged, and not for any abstract principle or method apart from the devices themselves. The claim appears to be valid when so construed. (*Holly vs. Union City*, 14 O. G., 5.)

The plaintiff's pumping apparatus is arranged so that the increase of pressure in the mains will lessen the amount of water being pumped into them by forcing the water against a piston, the motion of which, operating through complicated devices, shuts off the motive power and slackens the pumps. This is the pumping apparatus supplied with contrivances by which the pressure within the mains may be preserved in a great degree uniform which is mentioned in this first claim, and that part of the patented invention covered by this claim is the combination of this apparatus with the mains, the air chamber, the relief valve, the pipes, and the spigots.

The answer and the evidence show that the defendants have put in waterworks for cities and towns, or participated in putting them in, which have the pumping apparatus described in letters patent No. 154,468, dated August 25, 1864, issued to John P. Flanders, one of the defendants, for an improvement in pumps, stated in the specification to relate more particularly to pumping engines adapted to the delivery of large volumes of water, as in town or city supply where no stand-pipe or reservoir is employed, and in the description referring only to such engines as pump directly into the mains. In this pumping apparatus the increasing pressure of the water in the mains decreases the amount of water pumped in by acting upon a valve, which opens and closes a duct leading from one end of the pump cylinder to the other around past the piston, so that when the pressure opens the valve the water is pumped from one side of the piston to the other and not forced along, and when the pressure is diminished by the opening of the spigots and drawing water the valve closes and the water is forced along again to take the place of that drawn off. This is a pumping apparatus supplied with contrivances by which the pressure within the mains may be preserved in a great degree uniform, as mentioned in this claim of this original patent of the plaintiff. The combination and arrangement are the same in defendants' works as in the plaintiff's, unless there is a substantial difference in these pumping engines, and the rest of the combination is the same, whether there is a difference here or not.

Two questions arise here: One is whether these pumping engines are substantially the same in this arrangement, and the other is whether the rest of the arrangement is a part of the plaintiff's patented invention if they are not. If they are, the defendants have taken the whole of the invention covered by this claim. If they are not, and the rest of the combination without them is covered by the patent, then the defendants have taken so much of the patented invention. In this matter of regulating the flow of water in such pipes according to the wants of consumers, without the aid of the force of gravitation furnished by reservoirs and stand-pipes, the plaintiff precedes Flanders and has produced something which underlies all that Flanders has produced, and if it includes what Flanders has produced, he has a monopoly of it. (*Railway Co. vs. Sayles*, 97 U. S., 554.) And these pumping machines are substantially the same in the sense of the law of patents when they perform the same function in substantially the same way to accomplish the same result, and except where form is of the essence of the invention it should not be regarded in questions of this kind, and it is not of the essence of this invention. Attention should be

paid to such portions as really do the work, so as not to give undue importance to parts used only as a convenient mode of construction. (*Machine Co. vs. Murphy*, 97 U. S., 120.)

Here the pressure in the mains does the work of lessening the flow. In the plaintiff's machine it does it by pressing against a valve and slackening the machinery propelling the water. In the defendants' machine it does it by pressing against a valve and lessening the effect of the machinery upon the water. The means are the same, the result the same, and the mode is different only in form. (*Foster vs. Moore*, 1 Curtis' C. C., 279.) If this was not so, the arrangement of the mains, air chamber, relief valve, and pipes was new, and a material part of the invention, which would be covered and included in this claim of the patent, and which the defendants would have no right to take and use in connection with Flanders' invention. (*Sellers vs. Dickinson*, 6 E. L. and Eq., 514, 5 Exch., 312; *Lister vs. Leather*, 8 Ell. and Backb., 1,004.)

Flanders' pumping apparatus is the equivalent of the plaintiff's in making up a system of waterworks with these other parts, although it may not be the same thing for other purposes. The question now is not whether they are the equivalents of each other for all purposes, but is whether they are for this purpose.

In *Sellers vs. Dickinson* the patent was for machinery, consisting, among other things, of a clutch box operating automatically to cut off the power from a loom whenever the shuttle became entangled, combined with other mechanical contrivances through which the momentum of the sley was made to move a brake against the flywheel to take up the momentum of the parts and prevent sudden shock from the stoppage. The clutch box was old, but its combination with the brake was new. The defendant's contrivance for accomplishing the same object, and for which he had obtained a patent, dispensed with a clutch box and had different contrivances from the plaintiff's for applying the momentum of the sley to the brake. It was argued that the patent was for a combination, and that there could be no infringement unless the whole combination of the same elements was used. This argument was overruled. Pollock, C. B., saying that if a portion of a patent for a new arrangement of machinery is in itself new and useful, and another person, for the purpose of producing the same effect, uses that portion of the arrangement and substitutes for the other matters combined with it another mechanical equivalent, that would be an infringement, and the plaintiff there had judgment. The defendants here use the pressure in the mains for the same purpose that the plaintiff does, and thereby complete the arrangement of the plaintiff's patent, the same as the defendant there used the momentum of the sley for the same purpose that the plaintiff there did, thereby completing the combination of that patent. These views do not differ from the decision in *Prouty vs. Ruggles* (16 Pet., 336) and like cases, where it is held that a patent for a combination of several parts to accomplish a part is not infringed by a combination of less of the same parts alone, or with other substantially different, to produce the same result. That case was put expressly upon the ground that neither any of the parts nor any portion of the combination less than the whole was new.

The patentee is entitled to the exclusive use of the whole of his patented invention, and if it is of a combination of numerous parts, including in it other new and useful combinations of less of the parts, he seems to be entitled to the exclusive use of these lesser combinations, as well as to the exclusive use of the whole. (*Sharp vs. Tift*, 17 O. G., 1,282.)

The pumping apparatus of Flanders may be an improvement upon that of the plaintiff, and properly patentable as such, so as to entitle him to the exclusive use of those particular devices, but that would give him no right to use his devices to infringe the plaintiff's patent with, although this fact may be of importance in determining the amount of profits or damages due to such infringement.

The other patent is for a dash-pot combined with a safety valve upon water pipes subjected to great pressure, to steady the motions of the valve in opening and closing. The dash-pot is an old and well known contrivance for steadying motion, but it had never been combined with such valves before. The defendants use a dash-pot in the same combination, but they claim they do not infringe because their dash-pot is different from the plaintiff's. The plaintiff's is closed at the top and receives water, in which the loose piston works, at the bottom from the main on which it is placed. The defendants' is open at the top and receives water there, and is closed at the bottom. Their operation in steadying motion is alike. The pressure of the water in the main may communicate some motion to the piston in the plaintiff's dash-pot which it cannot do to that of the defendants'; but that is not noticed in the patent. The dash-pots each accomplish the same result by the same means in substantially the same way. The combination is the same, and the use of theirs by the defendants infringes the patent of the plaintiff's. (*Machine Company vs. Murphy*, 97 U. S., 120.)

It has been urged in argument that the defendants only make and sell the Flanders pump, and that they do not infringe the plaintiff's patents, although their purchasers may have infringed by putting them into systems of waterworks. If all they did was to make and sell these pumps merely, probably they would not infringe by that alone; but the answer and proofs go beyond this. Flanders, in his testimony as to what works they have put up, does not limit what they did to making and selling the pumps merely. The effect of the whole clearly is, they participated and concurred

in putting in the whole by furnishing the pumps for that purpose, and this is sufficient to make them liable as infringers. (*Boeker vs. Dones*, 15 O. G., 510.)

Let a decree be entered that the first claim of the reissued patent and the other patent are valid; that the defendants have infringed both, and for an injunction and an account, with costs.

U. S. Circuit Court—Northern District of Illinois.

THE NATIONAL CAR BRAKE SHOE COMPANY vs. THE LAKE SHORE AND MICHIGAN SOUTHERN RAILWAY COMPANY, SAME vs. THE ILLINOIS CENTRAL RAILROAD COMPANY. —PATENT SHOE FOR CAR BRAKES. PATENT OF OCTOBER 6, 1863.

Drummond, J.:

1. Effect must be given to the whole of the description contained in the specification and drawings of a patent. Hence, if it can be ascertained that a patentee intended to divide his invention into two parts, and to describe and claim them as separate improvements, the patent must be construed according to his intention, so as to give full effect to each part of the invention.

2. Where a patent claims, first, a combination of two parts so arranged that one can have a "lateral rocking motion" on the other, and, secondly, a combination of the same parts with two additional elements, "the whole being constructed and arranged substantially as specified," but not in terms referring to the rocking motion, the second claim is infringed by the use of its combination of mechanism, although the arrangement is such as not to permit any rocking motion.

Patent sustained.

The Cracking of Paint.

What is the cause of paint cracking? You may ask a dozen painters that question, and each will have a different answer. One will say, it has got too much oil in it; another, there is too much japan in it; again not enough oil in it; others, that your paint dries too quick; and so we might go on and fill pages with the answers that you would receive from different painters, for each will have a different answer. The general conclusion of observant painters is that the cracking of paint is caused more by the use of oil and hurried work than anything else.

A great many painters persist in mixing their paints to have them very elastic all the way through, thinking they will have a tough elastic surface that will give like rubber to the swelling and shrinking of the wood, without cracking, and would scarcely break apart if the panel were split in two. Well, we will admit they could get a very elastic coat, and providing it remained that way and never dry hard, it would be just the thing; but the paint is bound to dry hard some time, and any material will contract in drying. The elastic body of paint will continue to dry and contract, until its elasticity gets to its utmost limits, when it will give way and spread open in big cracks, looking the same as house painter's paint when it cracks.

To paint a job up with elastic coats of paint, it should go through a very long process, longer than anybody would want to give, the way painting is hurried now. The different coats should be put on very thin, and each allowed to dry thoroughly before another is put on. Putting on a number of heavy coats of any kind of paint or rough stuff as fast as you can, or before the under coat is dried through, will cause cracking of the worst kind, either before or after varnishing.

Paint too often is supposed to be dry, when really it is not half dry. It formerly took six months or more to get a job ready for finishing on the elastic principle, and then you would want good drying weather; but now you must paint a job through and through in a month, or even a shorter time, and the job supposed to last the same.

The quick process or flat coating can also be hurried so that it will crack, and crack badly too. Our ideas of obviating the cracking of paint are these: let every part of the wood be thoroughly primed with good fresh priming; prime inside and out, or use slush on the inside, which is just as good as priming, so that the water cannot act on the wood. Let the priming get perfectly dry, then mix every coat of lead, so that it will dry hard. Mix the filling with japan and varnish, so that this may dry firm and hard; use no oil in it. Have every coat dead color; do not have them with a gloss color, which is very deceiving, appearing dry, but when the subsequent coats are put on, they go into what is known as color cracks, caused by the under coats not being hard.

Do not apply the coats too heavy; have them as thin as possible to answer your purpose, and let each get thoroughly dry before putting on another. Place enough coats on to fill the grain of the wood, making a perfect surface. Then you will have on a body of paint firmly bound together, and thoroughly dry. When paint is thoroughly dry, it can shrink no more, as it only shrinks when in the process of drying, and if it does not shrink, it cannot crack; also in this kind of a body of paint, there is no moisture or oil to sweat out and destroy the luster of the varnish.

Painting of this description will not crack until the joints of the wood begin to give way, admitting water and damp atmosphere, which swells the wood along the edges of the joints, causing the paint to crack from the swelling and shrinking of the wood. Varnish may crack on top of the best painting ever done, and the underneath or foundation

be solid. We have seen where the varnish on jobs was cracked terribly, but in taking the varnish off by the use of spirits of ammonia, found the filling as sound as it was possible to be.

If the paint is not well protected by varnish, it will perish in time, sooner or later, owing to how well it is protected. A job to be kept in good order should not be allowed to go for two or three years without having anything done to it; we have seen men who would complain because the painting did not last as long as the carriage, thinking, we supposed, that the one painting was enough. Once a year is enough to have a carriage varnished to be kept in order, though no rule is laid down, except when it commences to look as if it wanted varnishing, have it done; don't wait until it wants burning off before attending to it.

Nowadays, painters will paint jobs in two weeks, and wonder at the cracks. The blame is generally laid on the material, or on anything else handy and suitable, but the real cause is, finishing the job in two weeks, requiring the coats to dry as hard as possible, and trust to luck for results. —*Carriage Monthly*.

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although merely approximate, they are sufficiently accurate to enable the observer to recognize the planets.

M. M.

POSITIONS OF PLANETS FOR DECEMBER, 1880.

Mercury.

Mercury can be seen only in the morning. On December 1 Mercury rises at 5h. 47m. A.M. On December 31 Mercury rises at 6h. 34m. A.M.

Mercury is at its greatest elongation west of the sun on the 12th.

Mercury passes Mars on December 23.

Venus.

Venus will be brilliant in the southwest all through December, setting later and later. On December 31 it sets about 8 P.M.

The moon passes north and east of Venus December 4.

Mars.

On December 1 Mars rises at 6h. 16m. A.M. On December 31 Mars rises at 6h. 15m. A.M.

Mars and Mercury are in conjunction on December 23. According to the "Nautical Almanac" Mercury is 1° north of Mars at 8 A.M.

Jupiter.

Although Jupiter is long past its perihelion, it is still the great light of the evening skies, coming to the meridian early in the evening, and at a good altitude for amateur observers in this latitude. Its altitude is about 51° to 52° through the month of December.

On December 1 Jupiter rises at 1h. 44m. A.M. On the 31st at 11h. 48m. A.M.

Saturn.

Saturn can be known by its position in regard to Jupiter. It follows Jupiter at a distance of 12½° on December 1, and 10° on the 31st.

Saturn is nearly 4° north of Jupiter in declination on December 1, and 3° north of Jupiter on the 31st.

Saturn rises at 2h. 20m. P.M. December 1; at 6h. 20m. P.M. December 31.

Saturn is stationary among the stars December 24.

Uranus.

Uranus rises at 11h. 49m. P.M. December 1; at 9h. 51m. P.M. December 31.

Uranus comes to the meridian at 6h. 14m. A.M. on December 1; at 4h. 16m. on the 31st, for this meridian.

PHENOMENA OF JUPITER'S SATELLITES.

December 1.—A little before 9 satellite I. enters on a transit.

December 2.—About 9:15 satellite I. reappears from eclipse.

December 3.—About 8:15 satellite II. completes a transit.

December 5.—Just before 8:15 satellite III. reappears from occultation.

December 8.—At 10 satellite I. is very near Jupiter, being about to make a transit.

December 9.—Between 8 and 2 satellite I. is missing in occultation.

December 10.—About 8:15 satellite II. enters on a transit.

December 12.—At 8 satellite II. is very near the planet, having just reappeared from eclipse.

About 9:15 satellite III. is occulted.

December 16.—About 9:45 satellite I. is occulted.

December 17.—A little after 9 satellite I. reappears after transit.

December 18.—At 8 satellite I. is very near Jupiter, having just appeared after eclipse.

December 19.—Satellite II. is missing in eclipse between 8 and 10.

December 24.—About 8:45 satellite I. enters on a transit.

December 25.—A little after 8:30 satellite I. reappears from eclipse.

December 26.—Between 8 and 10 satellite II. is missing in occultation.

December 30.—A little before 10 satellite III. reappears after transit.

A. K. FITZGERALD.

Decomposition of the Elements.

It has been known for some time, says the *Photographic News*, that simple relations exist between the spectra of the elements in a natural group, consisting in the homologous relations of the lines of the spectra. Similar relations are also found in the spectra of compounds. For example, cyanogen gives a peculiar spectrum, the more refrangible half of which is comparable to the carbon spectrum, and the less refrangible half to the nitrogen spectrum of the first order, and they are respectively homologous with these spectra; similar relations are observed with carbon monoxide.

As now the spectrum of cyanogen is homologous in one half with the spectrum of carbon, and in the other half with the spectrum of nitrogen, because it contains both these substances, in like manner similar cases might be inferred in the homologous relations of the spectra of certain elements.

Dr. Ciamician, of Vienna, carried this out exhaustively in the Academy of Sciences. He thinks the cause of the homologous relations of the spectra of the elements could be explained by the assumption that the elements are compound, and gives the following surprising explanations.

1. The spectra of the elements carbon, boron, beryllium, and magnesium are perfectly homologous with one another. These four elements consist, therefore, of the same material, which exists in different grades of condensation, which finds expression in the displacement of the homologous lines. The atomic weights of carbon (12) and boron are, in fact, near one another; the atomic weight of magnesium is double that of carbon (24). Ciamician calls these groups "Carbonoids."

2. The spectra of silicon and aluminum are homologous with one another, and the more refrangible side corresponds with the spectrum of carbon, the less refrangible with that of oxygen. Silicon consists, therefore, of carbon and oxygen, corresponding to $12+16=28$ (atomic weight of silicon).

Aluminum contains the carbon in the form of boron and oxygen, as its atomic weight ($11+16=27$) indicates.

3. The elements of the alkaline earth metals have spectra, the more refrangible part of which corresponds with the spectrum of magnesium, and the less refrangible part with the spectra of the elements of the oxygen series. Therefore calcium, strontium, and barium consist of carbon in the form of magnesium, and oxygen in the condensation forms of sulphur, selenium, and tellurium, corresponding to the atomic weights: $\text{Ca}=24+16$, $\text{Sr}=24+16$, $\text{Ba}=24+7+16$.

4. The elements of the oxygen group all consist of the same material, which is found in different stages of condensation; which finds expression in the displacement of the homologous lines, and in certain other peculiarities in the formation of the homologous groups of lines in the spectrum. The atomic weights of the elements of the series are: $\text{O}=16$, $\text{S}=16+16$, $\text{Se}=16+4+16$, $\text{Te}=16+7+16$.

5. The halogens all consist of fluorine and oxygen in different forms of condensation; the atomic weights of the elements of this group— $\text{Cl}=19+16$, $\text{Br}=19+4+16$, $\text{I}=19+7+16$ —express these relations. In this series, as is known, the composition of single members has been conjectured for a considerable time, and they have been thought likewise to consist of fluorine and oxygen.

6. The spectra of the nitrogen group are homologous in the less refrangible part with the nitrogen spectrum, in the more refrangible part with the spectra of the elements of the oxygen group. The elements of the nitrogen group consist accordingly of nitrogen and oxygen in different grades of condensation, which agrees with the atomic weights: $\text{N}=14$, $\text{P}=14+16$, $\text{As}=14+4+16$, $\text{Sb}=14+7+16$.

If one relies on this hypothesis, then the remarkable relations of the atomic weights of the elements to one another appear perfectly intelligible. We have then, in the so-called elements of inorganic chemistry, really to do with homologous series, which can quite be compared with the homologous series of organic compounds, which has besides been already conjectured by different authors.

We see, further, that with increasing condensation of the material the metallic character is always more clearly marked; the higher members of a series have always more metallic properties.

It is probable that the present fundamental substance can be collectively referred to the typical elements—hydrogen, carbon, nitrogen, oxygen, and fluorine; it is not, however, implied that these are to be considered as the final components of the material.

The Load of a Freight Car.

A rapid increase has been going on during recent years in the amount of freight regarded as the maximum load of a car. Formerly 20,000 pounds was the limit; now, according to the Western Weighing Association, the average of the different classes of freight, as determined by the weights of 50,000 cars weighed during a period of six weeks, was from 23,750 for machinery to 29,925 for ore, the maximum in nearly all cases exceeding 30,000 pounds. Certain classes of freight reached, respectively, as high as 35,000, 37,750, 39,300, 39,600, and even, in the case of ore, to the enormous weight of 48,500 pounds, or more than 24 tons. The superintendent of the association is satisfied that the various articles of freight enumerated, 23 in number, will average fully 27,000 pounds per car, and the whole will not average less than 25,000 pounds per car. The fact that such loads can be safely carried now is due to the vastly improved condition of tracks as well as to the heavier construction of the car.

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. The publishers of this paper guarantee to advertise a circulation of not less than 50,000 copies every weekly issue.

Chard's Extra Heavy Machinery Oil.
Chard's Anti-Corrosive Cylinder Oil.
Chard's Patent Lubricene and Gear Grease.
R. J. Chard, Sole Proprietor, 6 Burling Slip, New York.

Bracket Woods.—Wm. E. Uptegrove, Saw Mills, 463 East 10th St., New York, offers to the trade a choice stock of these woods. Send for price list.

OFFICE CITY WATER WORKS, CINC., O., April 15, 1880.
I take pleasure in stating that of all the coverings now in use at City Water Works, embracing 15,000 square feet of various kinds, the H. W. Johns Asbestos Air Chamber Covering is by far the best, not only in efficiency, but also in durability and lightness.

(Signed) THOMAS H. RYON, Assist.-Engineer in charge.
H. W. Johns Mfg. Co., 87 Maiden Lane, New York, sole manufacturers.

Astronomical Telescopes, first quality & low prices. Eye Pieces, Micrometers, etc. W. T. Gregg, 75 Fulton St., N. Y. Money to Invest in Manufacture; Box 1084, Batavia, N. Y.

Wanted.—A man competent to take charge of the Metal Working Department of a large Manufacturing. He must be energetic, quick, and inventive, as well as practically familiar with the best methods of press and die work, particularly in brass. Answer, stating qualifications in detail, as well as name and references, which will be received in confidence. R. S. & Co., Box 723, N. Y.

Wanted.—A few good Wood Turners wanted to work on Gauge and Waymoth Lathes. One competent to superintend shop. Good wages and steady employment. Winter & Ball, cor. Grove and 18th Sts., Jersey City, N. J.

Wanted.—Metal Pattern Makers accustomed to small work. Ad. St. Louis Malleable Iron Co., St. Louis, Mo. Engines. Geo. F. Shedd, Waltham, Mass.

The Mackinnon Pen or Fluid Pencil. The commercial pen of the age. The only successful reservoir pen in the market. The only pen in the world with a diamond circle around the point. The only reservoir pen supplied with a gravitating valve; others substitute a spring, which soon gets out of order. The only pen accompanied by a written guarantee from the manufacturers. The only pen that will stand the test of time. A history of the Mackinnon Pen; its uses, prices, etc., free. Mackinnon Pen Co., 200 Broadway, New York.

Wiley & Russell Mfg. Co. See adv., p. 333.

Among the numerous Mowing Machines now in use, none ranks so high as the Eureka. It does perfect work and gives universal satisfaction. Farmers in want of a mowing machine will consult their best interests by sending for illustrated circular, to Eureka Mower Company, Towanda, Pa.

Brass & Copper in sheets, wire & blanks. See ad., p. 364.

Wanted.—A Man as Superintendent and Foreman of Machine and Foundry (N. Y. State). Manufacturing a specialty. Good business and mechanical ability required. Giving antecedents, references, and salary desired. Address Iron, P. O. Box 253, New York City.

Diamond Planers. J. Dickinson, 64 Nassau St., N. Y. The Inventors Institute, Cooper Union Building, New York. Sales of patent rights negotiated and inventions exhibited for subscribers. Send for circular.

Fragrant Vanity Fair Tobacco and Cigarettes. 7 First Prize Medals—Vienna, 1873; Philadelphia, 1876; Paris, 1878; Sydney, 1879—awarded Wm. S. Kimball & Co., Rochester, N. Y.

Superior Malleable Castings at moderate rates of Richard P. Pim, Wilmington, Del.

Wood-Working Machinery of Improved Design and Workmanship. Cordesman, Egan & Co., Cincinnati, O.

The E. Stebbins Manufacturing Co. (Brightwood, P. O.), Springfield, Mass., are prepared to furnish all kinds of Brass and Composition Castings at short notice; also Babbitt Metal. The quality of the work is what has given this foundry its high reputation. All work guaranteed.

The "1890" Lace Cutter by mail for 50 cts.; discount to the trade. Sterling Elliott, 222 Dover St., Boston, Mass.

The Tools, Fixtures, and Patterns of the Taunton Foundry and Machine Company for sale, by the George Place Machinery Agency, 121 Chambers St., New York.

Improved Rock Drills and Air Compressors. Illustrated catalogues and information gladly furnished. Address Ingersoll Rock Drill Co., 1 1/2 Park Place, N. Y.

Eagle Anvils, 10 cents per pound. Fully warranted.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co., Box 421, Pottsville, Pa. See p. 349.

Packing once tried always used. Phoenix Packing from 1-15 up in spools or on coils. Phoenix Packing Company, 126 Liberty St., N. Y.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs., H. Lloyd, Son & Co., Pittsburg, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, Limited, Erie, Pa.

Skinner & Wood, Erie, Pa. Portable and Stationary Engines, are full of orders, and withdraw their illustrated advertisement. Send for their new circulars.

Power, Foot, and Hand Presses for Metal Workers. Lowest prices. Peerless Punch & Shear Co., 53 Day St., N. Y.

Recipes and Information on all Industrial Processes. Park Benjamin's Expert Office, 50 Astor House, N. Y.

For the best Slave, Barrel, Keg, and Hoghead Machinery, address H. A. Crossier, Cleveland, Ohio.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 40 John St., N. Y. For Mill Mach'y & Mill Fitting, see illus. adv. p. 349.

The Brown Automatic Cut-off Engine; unequalled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Pittsburg, Mass.

Gun Powder Pile Drivers. Thos. Shaw, 915 Ridge Avenue, Philadelphia, Pa.

Light and Fine Machinery to order. Foot Lathe catalogue for stamp. Chase & Woodman, Newark, N. J.

For Separators, Farm & Vertical Engines, see adv. p. 349.

For Patent Shapers and Planers, see illus. adv. p. 349.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr. & Bros., 331 Jefferson St., Philadelphia, Pa.

Slave, Barrel, Keg, and Hoghead Machinery a specialty, by E. & H. Holmes, Buffalo, N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Voccom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 348.

National Institute of Steam and Mechanical Engineering, Bridgeport, Conn. Blast Furnace Construction and Management. The metallurgy of iron and steel. Practical Instruction in Steam Engineering, and a good situation when competent. Send for pamphlet.

Peck's Patent Drop Press. See adv., page 333.

Reed's Sectional Covering for steam surfaces; any one can apply it; can be removed and replaced without injury. J. A. Locke, Agt., 32 Cortlandt St., N. Y.

Downer's Cleaning and Polishing Oil for bright metals, is the oldest and best in the market. Highly recommended by the New York, Boston, and other Fire Departments throughout the country. For quickness of cleaning and luster produced it has no equal. Sample five gallon can be sent C. O. D. for \$5. A. H. Downer, 17 Peck Slip, New York.

Blake "Lion and Eagle" Imp'd Crusher. See p. 333.

Presses, Dies, and Tools for working Sheet Metal, etc. Fruit & other can elevators. Bliss & Williams, B'klyn, N. Y.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's ad., p. 349.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Condit, Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Sheet Metal Presses, Ferracute Co., Bridgeton, N. J. Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

Saw Mill Machinery. Stearns Mfg. Co. See p. 333.

Portable Railroads. Sugar Mills. Horizontal & Beam Steam Engines. Atlantic Steam Engine Wks., B'klyn, N. Y.

Apply to J. H. Blaisdell for all kinds of Wood and Iron-Working Machinery. 107 Liberty St., New York. Send for illustrated catalogue.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 15,000 Crank Shafts, and 10,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

For Superior Steam Heat. Appar., see adv., page 364.

Gear Wheels for Models (list free); experimental and model work, dies and punches, metal cutting, manufacturing, etc. D. Gilbert & Son, 213 Chester St., Phila., Pa.

The best Truss ever used. Send for descriptive circular to N. Y. Elastic Truss Co., 63 Broadway, New York.

Houston's Four-Sided Moulder. See adv., page 366.

A profitable business for a person with a small capital. Buy a Stereopticon or Magic Lantern, and an interesting assortment of views. Travel, and give public exhibitions. For particulars, send stamp for 116 page catalogue, to McAllister, Mfg. Optician, 40 Nassau St., N. Y. New Economizer Portable Engine. See illus. adv. p. 366.

Rollstone Mac. Co.'s Wood Working Mach'y ad., p. 366.

For Shafts, Pulleys, or Hangers, call and see stock kept at 79 Liberty St., N. Y. Wm. Sellers & Co.

Wm. Sellers & Co., Phila., have introduced a new injector, worked by a single motion of a lever.

Ore Breaker, Crusher, and Pulverizer. Smaller sizes run by horse power. See p. 365. Totten & Co., Pittsburg.

Vacuum Cylinder Oils. See adv., page 365.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Solomon's Parallel Vise, Taylor Stiles & Co., Riegelsville, N. J.

H. A. Lee's Moulding Machines, Worcester, Mass. Comb'd Punch & Shears; Universal Lathe Chucks. Lambertville Iron Works, Lambertville, N. J. See ad. p. 283.

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. If not then published, they may conclude that, for good reasons, the Editor declines 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) A. R. writes: I wish to make an electro-magnet capable of sustaining from 100 pounds to 125 pounds weight. A. To form the core bend a piece of soft, round iron, one inch in diameter and two feet long. Into the form of the letter U; on each of its arms slip a spool or coil of insulated wire, three inches in diameter and about eight inches long, formed by winding No. 16 copper wire, cotton insulation, on a mandrel or shaft of round iron, one inch in diameter and one foot long, wrapped with four layers of foolscap paper. As each layer of insulated wire is wound on the mandrel it should be brushed over with hot glue, and when the spool is thus wound, and the glue between each layer of wire is thoroughly dry, then the mandrel is knocked out of the spool. Wind each spool in the same direction, and when the spools are slipped on the

core, connect the inside end of one spool of wire with the inside end of the other spool of wire; this will leave two ends of wire, which are to be connected with the poles of a battery of six Bunsen cells.

(2) H. asks: How can nickel be stripped from a piece of Britannia ware without injuring the surface of the latter? A. Nickel cannot readily be stripped from such an alloy cleanly. You may try a bath composed of a strong hot solution of an alkaline nitrate acidified with oil of vitriol. Dip, and rinse well in water; repeat if necessary.

(3) M. C. asks: What is the best steel for magnets? A. That will depend somewhat on the style of magnet that is to be made. For permanent horseshoe magnets, the German spring steel is generally preferred. 2. To what degree should it be tempered? A. Leave it hard, especially at the ends.

(4) E. B. S. asks: How can I put up a sand battery? A. Make a water-tight box of about 1 cubic foot capacity, out of sheet lead one-sixteenth of an inch thick, and nearly fill it with clean white sand moistened with a solution of sulphate of copper. The lead box forms the positive pole of the battery, and a plate of zinc buried in the sand forms the negative pole.

(5) C. B. W. asks: 1. What should be the focal length of a 2 1/2 inch objective for an astronomical telescope? A. From 36 to 44 inches. 2. How can I construct an astronomical eyepiece? A. See SUPPLEMENT, No. 252, for full instructions for constructing small telescopes.

(6) W. R. A. asks: How can I refill the porous cells of a Leclanche battery? A. Hold the top of the porous cup in a gas flame until the pitch with which it is sealed is softened, then draw out the carbon plate, and refill the cup with granulated black oxide of manganese and coarsely powdered gas coke, in about the proportion of five parts of the oxide of manganese to one of gas coke.

(7) McK. & Co. ask (1) how to make a waterproof paste to stick silk on silk. A. Macerate virgin rubber (caoutchouc) cut into finest shavings with about ten times its weight of pure benzene in an open-mouthed bottle set in hot water (away from fire); shake occasionally and add more benzene, if necessary, until a perfect solution is obtained. The cement should not be used in excess—in such quantity as to delay its drying. 2. Where can I buy diamond cutting tools and machinery? Where can I get a young man as jeweler and diamond cutter and setter? A. An advertisement in Business and Personal column would no doubt procure the information you require.

(8) W. E. H. asks: Can you describe a simple inexpensive way to prepare oxygen for inhalation? Also plan for inhaling instrument such as may be made by any handy workman? If so, you may enable many rural physicians to test the efficacy of oxygen in catarrh and in pulmonary affections. A. Mix pure crystallized potassium chlorate with about one-quarter its weight of pure black oxide of manganese, and heat the mixture in a copper retort, with large delivery tube, until the gas begins to come over. Conduct the gas through a large empty bottle (to avoid accident by back pressure), then through a strong solution of iron sulphate (copperas), and then through an iron tube several feet in length, filled loosely with fresh quicklime in granular lumps (free from dust). Collect in a rubber bag. An ordinary mouth piece answers well enough if the air from the lungs is expelled through the nostrils, or so as not to contaminate the contents of the bag. The heat should be continued under the retort with caution to avoid too rapid a disengagement of the oxygen until no more gas comes over.

(9) C. H. C. asks: Does the area of the base or bottom of a cistern have anything to do with the pressure of the contents on the sides of the same, or, in other words, does not the pressure on the sides of a cistern depend entirely on the depth of the contents and not on the cubical contents of the same? A. The pressure per square foot depends entirely on the depth of the water.

(10) C. W. Y. writes: We have a quantity of silver and of gold solution, made the usual way with cyanide of potassium. 1. Is there a cheap way of precipitating the metals so that we can use them? A. Precipitate the silver solution with excess of caustic soda or carbonate of soda; wash, dry, and heat the silver cyanide mixed with borax glass nearly to whiteness in a small blacklead crucible. Make the gold bath distinctly acid by adding sulphuric acid (out of doors to avoid inhaling the poisonous gas given off), then add an excess of sulphate of iron in strong aqueous solution to precipitate the gold. Collect the precipitate gold on a filter, wash with hot water, and fuse in a small crucible with borax glass as in the case of silver. 2. Is there some way that we can prepare the solution to apply with a sponge like the ordinary washes for cheap plating? A. We know of no way of using the bath as suggested. 3. How can we make a cheap battery so as to use our solution, provided it cannot be precipitated without too much expense? The solution is so rich that any bright clean metal will be plated over in a few minutes. A. See Nos. 157, 158, and 159, SCIENTIFIC AMERICAN SUPPLEMENT, for descriptions of batteries.

(11) C. U. F. asks for the best preparation of whitewash that will stand the storms and time (for outside of buildings). A. For brickwork exposed to damp take one half peck well burned quicklime, fresh from the kiln, slake with hot water, enough to reduce it to a paste, and pass it through a fine sieve; add a gallon of clean white salt which has been dissolved in a small quantity of boiling water, and a thin smooth paste, also hot, made from 1 lb. fine rice flour; also 1/4 lb. best white glue, made in the water bath. Mix together, stir well, add 1/2 lb. best Spanish whiting in 5 quarts boiling water, stir, cover over to retain heat and exclude dust, and let it stand a week. Heat to boiling, stir, and apply hot. The above proportions will cover 40 square yards. 2. Also the best way to refine elder for family use? A. See pp. 394 (7) and (15), Vol. 39, and 299 (24) and 28 (46), Vol. 38, SCIENTIFIC AMERICAN.

(12) J. W. McF. asks: 1. Of what is the wax composed that is used by electro-platers for building

up card stands, etc., when the top has an uneven edge, so that when gold plating the inside, the solution will cover the whole surface? A. Resin, 3 oz.; beeswax, 2 oz.; sweet oil, q. s. to soften. Heat together in a small dish, stir with a stick, pour into cold water, and work it well with the hands. Should it get brittle more oil must be incorporated. 2. I have a scarf pin that is made of oxidized silver. Can you inform me how it is done? A. Dip the clean silver into aqueous solution of an alkaline sulphide, or expose it while moist to the action of sulphureted hydrogen.

(13) G. A. L. asks: How can the mottled coating seen on new gun barrels be reproduced, or what ingredients are required to make a preparation suitable for browning them, and which will be harmless to the iron? A. 1. Mix powdered chloride of antimony into a thin creamy paste with olive oil, adding a few drops of nitric acid. Warm the metal, cover its surface uniformly with this paste, and let it stand until properly browned. 2. Nitric acid, 1/4 oz.; spirit of niter, 1/2 oz.; spirit of wine, 1 oz.; sulphate of copper, 2 oz.; tincture chloride of iron, 1 oz.; water, 40 oz. 3. Sulphate of copper, 1 oz.; water, 20 oz.; spirit of niter, 1 oz. The blue vitriol is dissolved in the hot water, and the solution cooled before the other ingredients are added. The browning and marking is effected with the burnisher and scratch brush, the polishing with a piece of smooth hard wood. Lacquer with thin alcoholic shellac and use the wood polisher again. The metal in the first place must be chemically clean.

(14) A. C. L. asks: Will you please inform me what kind of cement is used in cementing rubber rolls as used in clothes wringers, and how applied? A. See answer to McK. & Co. on this page.

(15) A. F. B. asks: Can you give me a formula for a composition that will serve as a substitute for vulcanized rubber? I wish to make some dishes for photographic purposes. A. You can use wooden or paper mache vessels coated with a film of gutta percha dissolved in warm benzole. We know of no satisfactory substitute for rubber.

(16) J. H. T. writes: It is claimed that fruit or vegetables of any kind if heated and put into air tight jars or cans will keep without working or spoiling, but I find that green corn is an exception; if there be other exceptions I do not know of them. Can you tell me why green corn is an exception? Also how it is that it ferments when sealed up in airtight cans? I am told that if I put two ounces tartaric acid to every sixteen quarts of corn while cooking and then seal it up it will keep and not ferment. Why is it so? A. The secret lies in thoroughly curing the corn—it requires much longer heating than most vegetables. The natural milk is not removed and tartaric acid is not used. Pack each can as full as possible, seal, and place at once in the boiling water; after it has boiled long enough tap a blow hole, and as soon as the air and steam are out seal again with a drop of solder.

(17) "Cavalry Man" asks: Can you give in your paper a receipt for putting a dark blue color to steel? The arms we use are of a dark blue color when we first receive them, but this soon wears off, and I would like to know some method of restoring it. It is only a surface coat, and muriatic acid washes it off so that if you try to impart a blue with muriatic acid it first washes off the color already on and thus necessitates bluing the whole barrel instead of only the spot devoid of color. A. The original color is due to the film of oxide formed on tempering the metal. It cannot well be repaired when injured without reheating the whole piece. A good, though easily injured imitation, for cloaking a worn spot is a very thin alcoholic solution of shellac, colored to suit with a trace of aniline blue-purple.

(18) W. E. J. asks: 1. Will two currents, one positive and one negative, traveling over the same wire and in the same direction, neutralize each other? A. Yes. 2. Is there any way by which two magnets may be arranged so as to be acted on independently over one wire? A. Yes. See Duplex and Quadruplex Telegraphy in "Prescott's Electricity and the Electric Telegraph."

(19) S. B. M. asks (1) how to make impression paper different colors. A. We refer you to SCIENTIFIC AMERICAN, Vol. 40, page 187 (22). 2. How to ebony wood. A. See SCIENTIFIC AMERICAN, Vol. 40, page 91 (18). 3. The proper position of eccentric from the crank pin on an engine. A. It should be set ahead of the crank pin; but how much will depend upon the valve and valve gear; it should be sufficient to give one-sixteenth to three sixteenth inch opening of valve when the crank pin is on the center, depending upon the rise and velocity of the piston.

(20) G. H. E. asks: 1. Do polarized armatures lose their magnetism soon? A. With fair usage, no. 2. Is their use to be commended as to practical efficiency? A. Yes; they are largely used in telegraphy and in telephone calls.

(21) C. W. B. asks: 1. Which is better for the drive wheel of a foot power scroll saw, an iron or wooden wheel? A. Iron is best, but wood answers a good purpose. 2. Is it better to have a tight balance wheel on the shaft that drives the saw? A. Yes.

(22) A. L. E. asks how to find the circumference of a circle, the diameter being given. A. Multiply the diameter by 3.1416.

(23) G. B. C. asks (1) for an amateur telegraph line, one-half mile in length, five stations; what size of wire? A. No. 12 galvanized iron wire will answer. 2. How many Leclanche cells? A. Five to each station. 3. How much and what size of insulated wire on each pair of spools of sounders. A. Use 8 or 10 layers of No. 24 silk covered copper wire, taking care to have nearly the same amount of wire in each magnet.

(24) G. H. asks how to blue wire such as used in manufacturing hair pins, also fish hooks, etc. A. Dip them in a lacquer composed of a good quality of alcoholic shellac varnish to which has been added a little aniline blue.

(35) J. W. H. asks: Will a saw that is run by water power run any stronger at night than in the day? A. No. 2. Will pure steam from the upper part of a steam boiler when let out scald, if no water comes with the steam? A. If of sufficiently high pressure it will not scald near the outlet.

(36) H. R. asks: How are Bourdon springs for pressure gauges manufactured? A. The tube is, we believe, first drawn with a cylindrical section, like other drawn brass tubes, then given the proper section by either rollers or drawing through another die.

(37) W. S. asks: 1. How can I melt copper, brass, and zinc, and what kind of furnace and heat will I need if I melt copper and zinc together to make brass? How many parts must I have and what kind of flux, or is there any need of flux? For melting, will I have to take an iron ladle or crucible? A. You can melt the metals referred to in a common coal fire. You will require a crucible for copper and brass, but zinc may be melted in an iron ladle. Common brass is composed of copper 3 parts, zinc 1 part. Fine yellow brass, copper 2 parts, zinc 1 part. Melt the copper, then add the zinc. Stir the alloy with a dry wooden rod. A little borax may be used as a flux. 2. On making moulds, what kind of mixture must I take to work nicely and cast well? A. Fine moulding sand is the best for general use.

(38) W. T. K. asks (1) how to connect three steam whistles so that they will all go off at once? A. Have one common steam valve to the 3 whistles. 2. What power is in a cylinder $1\frac{1}{2}$ inch bore and $1\frac{1}{4}$ stroke, at 600 revolutions a minute? A. For rules for calculating horse power of engines, see SUPPLEMENT, No. 253.

(39) J. K. asks: 1. What will prevent a grindstone wearing off in one place more than in another? I have one about 30 inches in diameter, and there is one place that is soft in it and I can't keep it round. A. It is an inherent defect in the stone. We know of no remedy. 2. What power am I using. The pulley I get my power from is 14 inches in diameter, and it makes 250 revolutions per minute with a 2-inch belt. A. About $2\frac{1}{2}$ horse power; possibly $2\frac{3}{4}$, if the belt is run very tight.

(30) D. C. M. asks: 1. How can I measure the power of a telescope or field glass? A. The magnifying power of a telescope is found by dividing the focal length of the objective by the focal length of the eyepiece. 2. How should I proceed to make a sunglass for a telescope? A. Place a piece of very dark glass over the eyepiece. See SUPPLEMENT 252 for directions for making telescopes. 3. Which is the best for an observatory, a mercurial or an aneroid barometer? A. Mercurial. 4. Where can I procure dynamite cartridges for extracting stumps, and what will be the probable cost? A. Address manufacturers who advertise in our columns. 5. Where can I get a copy of the "Nautical Almanac"? A. From industrial publishers whose advertisements may be found in another column. 6. Who shall I apply to to become a volunteer observer for the U. S. Signal Service? A. Apply to the chief of the Signal Service Bureau at Washington, D. C.

(31) K. E. B. asks: 1. Could I obtain power enough from a $\frac{1}{2}$ inch hydrant to run an electric machine five times the size of the cut on first page of SUPPLEMENT, No. 161? Water has good pressure from Worthington engines. A. It depends entirely on the pressure and the size of the pipe leading to the half inch aperture. With a pressure of 40 pounds per square inch you could do it. If you intend making a machine of the size named you should follow Siemens' latest machine, or imitate some of the more recent machines of prominent makers. 2. How does electricity pass from the cores of the magnets to the wire, the wire being insulated on an electric machine? A. It does not pass from the cores of the magnets to the wires. It is evident you do not understand the principle upon which the dynamo-electric machine operates. You should consult some elementary work on physics. 3. Why must the machine given in No. 161 SUPPLEMENT be set on a brass plate? I see other machines rest on iron or wood. A. Any non-magnetic material will do. Iron cannot be used, as it would close the poles of the magnet. 4. Suppose an electric machine will run ten lamps, and I only use one, will my light be any larger from the one than it would when all ten were in use? A. Yes. 5. I understand that electricity does not burn passing through the carbons of a lamp. If so, why should the number of lamps to a machine have a limit? A. Every lamp adds to the resistance of the circuit, and there is a limit to the resistance the machine is capable of overcoming.

(32) J. N. W. asks: Do any of the stars twinkle except the fixed stars? A. All stars twinkle. This phenomenon is due to the constantly varying density of the atmosphere.

(33) R. M. asks how steel watch chains and other small steel articles are polished. A. By tumbling in a wooden cylinder containing leather scraps and crocus.

(34) C. A. C. asks: 1. How many feet of No. 16 and No. 36 copper wire are required to produce one ohm resistance? A. Of No. 16, American gauge, about 222 feet. Of No. 36, about $2\frac{1}{2}$ feet. 2. What weight ought an electro-magnet to lift if composed of two spools with cores $1\frac{1}{2}$ x 3 inches, wrapped with twelve layers of No. 16 cotton-covered copper wire, with ten cells of gravity battery? A. It ought to lift 50 pounds or more. You would get a better effect by making the cores much longer, say 8 inches, and winding the same amount of wire so as to form a coil 5 inches long on the outer end of each core.

(35) J. A. asks: 1. Will you please answer in your next issue of the SCIENTIFIC AMERICAN how can water backs which are full of lime be cleared out? A. There is no practical means, except mechanical means, chipping or the like, that can be of any service. 2. Is any essential part of the locomotive patented? A. Many of the modern appliances to locomotives are patented, but the main parts of the locomotive are old, and may be made without infringing patents.

(36) P. C. N., C. G., W. V., C. W. T., and others ask: 1. For a plain description of how to proceed in order to charge a straight bar of steel with sufficient magnetism to give it the power of lifting four times its own weight. Also, how to proceed with horse-shoe and other forms. 2. The name of the best brand of steel to use (Jesse's, chrome, or black diamond), and why it is the best. How to temper. 3. Is there any gain in allowing the bar to remain under the influence of the current for a long time, or does it receive the full charge instantaneously? In fact, we would like some information on this subject that we can rely upon. A. 1. The quickest and best way to magnetize steel bars is to place them centrally in a suitable coil, and then connect the helix with the wires from a dynamo-electric machine or powerful battery for a few seconds, remembering to break the current before removing the magnet from the coil. If the source of the current is a dynamo machine, the coil should be about $2\frac{1}{2}$ inches long and should consist of 10 or 12 layers of No. 12 magnet wire. If a battery is used, a coil $1\frac{1}{2}$ inches long, composed of 14 or 16 layers of No. 16 magnet wire, will be the best. The internal diameter of the coil should be only large enough to admit the bars easily. A battery of six Grenet elements, each having an effective zinc surface of 30 square inches connected in series, will do the work very well on small magnets; such, for instance, as are used in telephones. Where a number of magnets are to be made at one time the bars may be passed in a continuous line through the coil, always keeping three bars in contact end to end, adding one above the coil before taking one off below. In this manner sixty bar magnets have been strongly charged in ten minutes. Horse-shoe magnets cannot be charged so readily. There are two or three ways of charging them. One way is to place them in contact with the poles of a very strong electro-magnet, removing them after breaking the current; another method is to place each limb of the magnet in a coil adapted to the current to be used, and still another method is to employ a single coil, inserting one pole of the magnet into the coil in one direction, thus breaking the current, and inserting the other pole into the coil from the opposite direction. It is well to remember that the magnet will be very much impaired if the current is not broken before removing it from the coil. The secret of success in charging magnets is to have a strong current. It is impossible to make magnets satisfactorily without this all-important requisite. 2. As to the quality of steel best adapted to this purpose, machinery steel hardened and not tempered springs admirably. For horse-shoe magnets German spring steel is the best. Tool steel answers well if hardened and drawn to a straw color. 3. The steel receives its maximum charge almost instantly. It is useless to allow it to remain under the influence of the magnetizing current more than a few seconds.

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

A. D. L.—A fair variety of potter's clay.—P. M. C.—An argillaceous lime carbonate.—W. T.—The clay contains a large percentage of alkalies and a little lime phosphate.—C. McG.—It is tourmaline.—H. S.—Zinc sulphide.—G. C. R.—A fair quality of potter's clay.—J. T. C.—Carbonate of lime. Some of the stone would probably make a fair cement.—F. D. H.—Tourmaline.—G. N. H.—Titaniferous iron oxide.

COMMUNICATIONS RECEIVED.

On Swift's Comet. By W. R. B.
Features of No. 9. By W. B. W.
On Scientific Discussion. By C. R.

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INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were
Granted in the Week Ending
November 9, 1880.

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 27 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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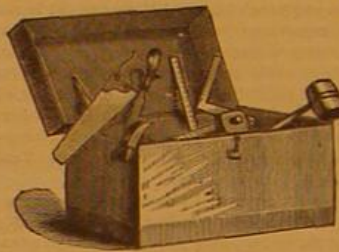
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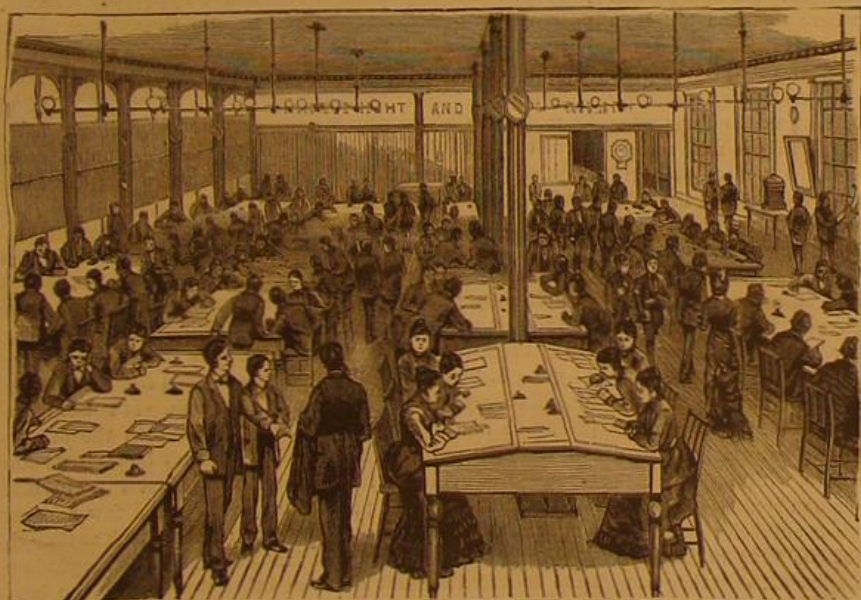
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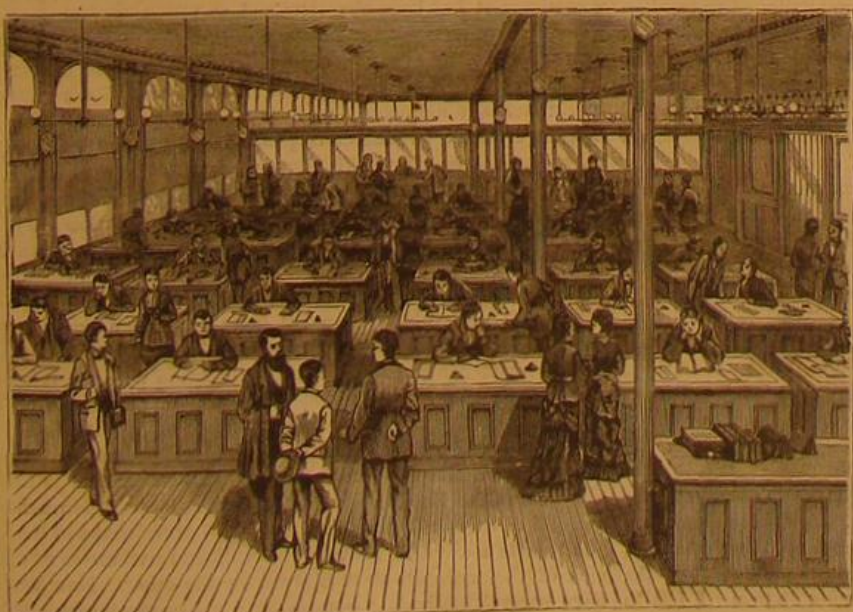
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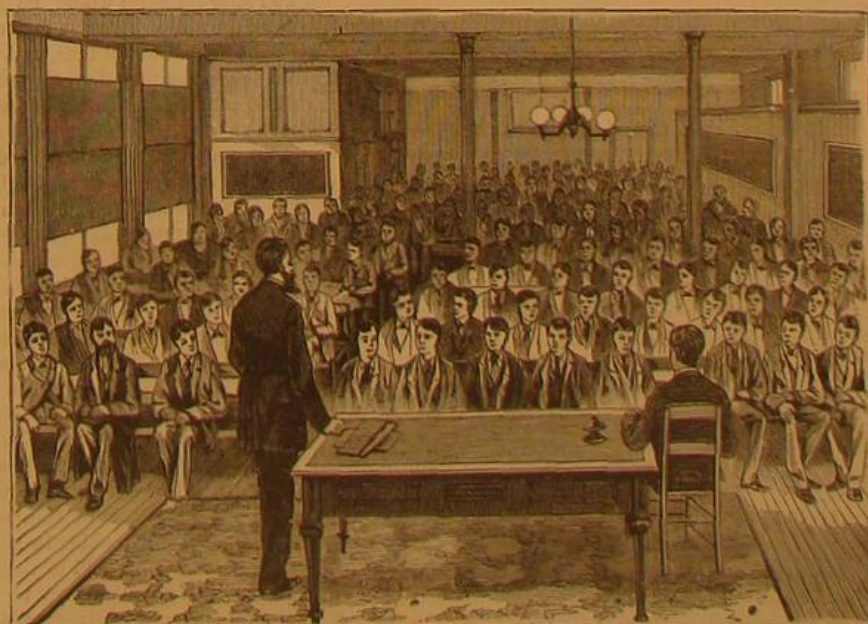
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FIRES—CAUSES AND PREVENTION.

It is estimated that the total annual losses of insured property by fire, throughout the world, average nearly two hundred million dollars. Add to this the annual destruction of uninsured property, and we should probably have a total amounting to quite double these figures. How great the loss, how severe the tax upon the productive industry of mankind, this enormous yearly destruction amounts to, will come home to the minds of most readers more directly if we call attention to the fact that it just about equals the value of our total wheat crop during a year of good yield. And it is a direct tax upon productive industry everywhere, because, although here and there a nominal loser, fully insured, has only made what is sometimes called "a good sale" to the companies holding his risk, this is only a way of apportioning the loss whereby the community at large become the sufferers. Thus it is that we find all ably-managed insurance companies earnestly endeavoring to make it plain to the public how fires should be guarded against, or most effectually localized and controlled when once started.

During the fall, or from "lighting up" time till about New Year's day, more fires occur ordinarily than in any other portion of the year. This fact points to some of the most general causes of conflagrations—as in the lighting and heating of houses, factories, etc., where this had not been necessary during the summer months. It is also found that after the first of the year the number of fires is greatly diminished, the lighting and heating arrangements having been subjected to a period of trial during which their most obvious defects would be remedied. While it may readily be conceded that the utmost care of the owner of property could not totally prevent great average losses from fire—for the greater the holdings the more must the proprietor trust to the oversight of others—it is evident that the above facts indicate the necessity of more strenuous precautions at this season. Gas pipes and fittings should then be tested; furnace flues and settings looked to; stove, heater, and grate fixtures and connections examined—and in all these particulars the scrutiny should be most closely directed to parts ordinarily covered up or out of sight, so that any defect or weakness from long disuse may be exposed. When to the above causes of fires we have added the extremely fruitful one found in the extensive use of coal oil within a few years past, we have indicated the most common sources of conflagrations of known origin. An English authority gives the percentages of different causes of 30,000 fires in London, from 1833 to 1865, as follows: Candles, 11.07; curtains, 9.71; flues, 7.80; gas, 7.65; sparks, 4.47; stoves, 1.67; children playing, 1.59; matches, 1.41; smoking tobacco, 1.40; other known causes, 19.40; unknown causes, 32.88. The foregoing figures do not give the percentage of incendiary fires, and later statistics would, no doubt, show vastly more fires from the use of kerosene than are here attributed to candles.

The prevention of fires, and the best means of minimizing the loss when they do occur, are topics which cover a wide field, and a collection of the literature on the subject would make a very respectable library. As the question presents itself to-day, it may well be doubted whether the general practice of large property holders of insuring all their possessions does not tend to lessen the constant vigilance which is the most essential requisite in preventing fires. Thousands of merchants never mean to keep a dollar's worth of goods in store or warehouse that is not fully covered by insurance, and they make this cost a regular charge upon their business as peremptorily as they do the wages paid the hands in their employ. But few manufacturers can so completely cover their risks by insurance, yet a large portion of them do so as far as they are able. It does not follow but that the larger portion of both merchants and manufacturers exercise what the law will fully decide is "due vigilance" in the care of the property so insured, but it is evident that in most cases the thoughtfulness is much less complete—the care wonderfully lacking in personal supervision—as compared with what would be the case were each one his own insurer. Of course, this in no way casts a doubt upon the general policy of business men being amply insured, but in fact shows the greater necessity why they should be so, that they may not suffer from the carelessness of a neighbor; it also points to the necessity of continually increasing care and thoroughness of inspection on the part of the insurance companies. These agencies, in fact, must compel the insured

to keep up to the mark in the introduction of every improvement to ward off fires or diminish their destructiveness.

The progress made in this department during recent years has been great. The almost universal use of steam has been attended by the fitting up of factories with force pumps, hose, and all the appliances of a modern fire brigade; dangerous rooms are metal sheathed, and machinery likely to cause fire is surrounded by stationary pipes from which jets of water may be turned on instantaneously from the outside; stores and warehouses have standing pipes from which every floor may be flooded with water under pressure, and the elevators, those most dangerous flues for rapidly spreading a fire, are either bricked in entirely or supposed to be closed at every floor. The latter point, however, is sometimes forgotten, as sea captains forget to keep the divisions of their vessels having watertight compartments separate from one another; the open elevator enlarges a small fire as rapidly as the open compartment allows the vessel to sink.

With the best of appliances, however, discipline and drill on the part of the hands, in all factories, is of prime importance. It is always in the first stages of a fire that thoroughly efficient action is necessary, and here it is worth a thousand-fold more than can be any efforts after a fire is once thoroughly started. Long immunity is apt to beget a feeling of security, and the carelessness resulting from overconfidence has been the means of destroying many valuable factories which were amply provided with every facility for their own preservation. The teachers in some of the public schools of New York and Brooklyn, during the past year, set an example which some of our millowners might profitably follow. There have been cases when, from a sudden alarm of fire, children have been crushed in their crowding to get out of the building. The teachers, in the instances referred to, marched their children out, under discipline, as if there had been a fire. Let owners of factories try some such plan as this, by which workmen may be called upon to cope with an imaginary fire, and many of them will, we venture to say, find means of improving their present system or appliances for protection, elaborate as they may at present think them to be.

WHAT IS LIGHT?

If on opening a text book on geology one should find stated the view concerning the creation and age of the earth that was held a hundred years ago, and this view gravely put forward as a possible or alternative hypothesis with the current one deducible from the nebula theory, one would be excused for smiling while he turned to the title page to see who in the name of geology should write such stuff. Nevertheless this is precisely similar to what one will find in most treatises on physics for schools and colleges if he turns to the subject of light. For instance, I quote from a book edited by an eminent man of science in England, the book bearing the date 1873.

"There are two theories of light; one the *emissive* theory; the other, the *vibratory* theory;" just as if the emissive or corpuscular theory was not mathematically untenable sixty years ago, and experimentally demonstrated to be false more than forty years ago. Unless one were treating of the history of the science of optics there is no reason why the latter theory should be mentioned any more than the old theory of the formation of the earth. It is not to be presumed that any one whose opinion is worth the asking still thinks it possible that the old view may be the true one because the evidence is demonstrable against it, yet while the undulatory theory prevails there are not a few persons well instructed otherwise who still write and speak as though light has some sort of independent existence as distinguished from so-called radiant heat; in other words, that the heat and light we receive from the sun are specifically different.

A brief survey of our present knowledge of this form of energy will help to show how far wrong the common conception of light is. For fifteen years it has been common to hear heat spoken of as a mode of molecular motion, and sometimes it has been characterized as *vibratory*, and most persons have received the impression that the vibratory motion was an actual change of position of the molecular in space instead of a *change of form*. Make a ring of wire five or six inches in diameter, and, holding it between the thumb and finger at the twisted ends, pluck it with a finger of the other hand; the ring will vibrate, have three nodes, and will give a good idea of the character of the vibration that constitutes what we call heat. This vibratory motion may have a greater or less amplitude, and the energy of the vibration will be as the square of that amplitude. But the vibrating molecule gives up its energy of vibration to the surrounding ether; that is to say, it loses amplitude precisely as a vibrating tuning fork will lose it. The ether transmits the energy it has received in every direction with the velocity of 186,000 miles per second, whether the amplitude be great or small, and whether the number of vibrations be many or few. It is quite immaterial. The *form* of this energy which the ether transmits is *undulatory*; that is to say, not unlike that of the wave upon a loose rope when one end of it is shaken by the hand. As every shake of the hand starts a wave in the rope, so will every vibration of a part of the molecule start a wave in the ether. Now we have several methods for measuring the wave lengths in ether, and we also know the velocity of movement. Let v = velocity, l = wave length, and n = number of vibrations per second, then $n = \frac{v}{l}$, and by calculation the value of n varies within wide limits, say from 1×10^{14} to 20×10^{14} . But all

vibrating bodies are capable of vibrating in several periods, the longest period being called the *fundamental*, and the remainder, which stand in some simple ratios to the fundamental, are called *harmonics*. Each of these will give to the ether its own particular vibratory movement, so that a single molecule may be constantly giving out rays of many wave lengths precisely as a sounding bell gives out sounds of various pitches at one and the same time.

Again, when these undulations in the ether fall upon other molecules the latter may reflect them away or they may absorb them, in which case the absorbing molecules are themselves made to vibrate with increased amplitude, and we say they have been heated. Some molecules, such as carbon, appear to be capable of stopping undulations of all wave lengths and to be heated by them; others are only affected by undulations of particular wave lengths, or of wave lengths between special limits. In this case it is a species of sympathetic vibration. The distinction between the molecular vibrations, and the undulations in ether that result from them, must be kept in mind, as must also the effect of the undulations that fall upon other molecules. To one the name *heat* is applied, to the other the name of *radiant energy* is given; and it matters not whether the undulations be long or short, the same molecule may give out both.

Now let a prism be placed in the path of such rays of different wave length from a single molecule, and what is called the dispersive action of the prism will separate the rays in the order of their wave lengths, the longer waves being less refracted than the shorter ones; but the energy of any one of these will depend upon the *amplitude of undulation*, which in turn will depend upon the amplitude of vibration of the part of the molecule that originated it, but in general the longer waves have greater amplitude, though not necessarily so. Consequently, if a thermopile be so placed as to receive these various rays, and their energy be measured by its absorption on the face of the pile, each one would be found to heat it, the longer waves more than the shorter ones, simply because the amplitude is greater, but for no other reason, for it is possible, and in certain cases is the fact, that a short wave has as much or more energy than a longer one. If the eye should take the place of the thermopile it would be found that some of these rays did not affect it at all, while some would produce the sensation of light. This would be the case with any waves having a wave length between the limits of, say, 1-37,000 of an inch and 1-60,000 of an inch; any shorter waves will not produce the sensation of light. If instead of the eye a piece of paper washed in a solution of the chloride of silver should be placed where the dispersed rays should fall upon it, it would be found that only the shorter waves would affect it at all, and among these shorter ones would be some of those rays which the eye could not perceive at all.

It was formerly inferred from these facts that the heat rays, the light rays, and the chemical rays were different in quality; and some of the late books treating upon this very subject represent a solar spectrum as being made up of a heat spectrum, a light spectrum, and an actinic or chemical spectrum, and the idea has often been made to do duty as an analogy in trinitarian theology; nevertheless it is utterly wrong and misleading. There is no such thing as an actinic spectrum; that is, there are no such rays as special chemical rays; any given ray will do chemical work if it falls upon the proper kind of matter. For instance, while it is true that for such salts of silver as the chloride, the bromide, etc., the shorter waves are most efficient; by employing salts of iron one may get photographic effects with wave lengths much too long for any eye to perceive. Capt. Abney has photographed the whole solar spectrum from one end to the other, which is sufficient evidence that there are no special chemical rays. As to the eye itself, certain of the wave lengths are competent to produce the sensation we call light, but the same ray will heat the face of a thermopile or produce photographic effects if permitted to act upon the proper material, so there is no more propriety in calling it a light ray than in calling it a heat ray or an actinic ray. What the ray will do depends solely upon what kind of matter it falls upon, and all three of these names, *light*, *heat*, and *actinism*, are names of effects of radiant energy. The retina of the eye is itself demonstrably a photographic plate having a substance called purpurine secreted by appropriate glands spread over it in place of the silver salts of common photography. This substance purpurine is rapidly decomposed by radiant energy of certain wave lengths, becoming bleached, but the decomposition is attended by certain molecular movements; the ends of the optic nerves, which are also spread over the retina, are shaken by the disrupting molecules, and the disturbance is the origin of what we call the sensation of light. But the sensation is generally a compound one, and when all wave lengths which are competent to affect the retina are present, the compound effect we call white or whiteness. When some of the rays are absent, as, for instance, the longer ones, the optical effect is one we call green or greenness; and the special physiological mechanism for producing the sensation may be either three special sets of nerves, capable of sympathetic vibration to waves of about 1-39,000, 1-45,000, and 1-55,000 of an inch in length, as Helmholtz has suggested, or, as seems to the writer more probable, the substance purpurine is a highly complex organic substance made up of molecules of different sizes and requiring wave lengths of different orders to decompose them, so that a part of the substance may be quite disintegrated, while other molecules may be quite entire throughout the visual space. This will account for most of the

chromatic effects of vision, for complementary colors, and for color blindness, by supposing that the purpurine is not normally constituted. This is in accordance with experimental photography, for it has been found that the long waves will act only upon heavier molecules. It is true vision may be good when there is no purpurine, but there is no doubt but that this substance is secreted in the eye, and that it is photographic in its properties, and so far must be taken as an element in any theory of vision; but the chief point here considered is that objectively light does not exist independent of the eye, that light is a physiological phenomenon, and to speak of it otherwise is to confound a cause with an effect. It is, hence, incorrect to speak of the velocity of light; it has no velocity. It is *radiant energy* that has the velocity of 186,000 miles a second. It is incorrect to say we receive heat from the sun. What we do receive is *radiant energy*, which is here transformed into heat. This is not hypercritical, but is in accordance with the knowledge we have to-day. The old nomenclature we use, but without definite meaning; the latter is left to be inferred from the connection or context. If a man should attach to the water main in a city a properly constructed waterwheel, the latter will rotate; but it would not be proper to say that he received rotation from the reservoir. What he received was water with a certain pressure; in other words, a certain form of energy, which he transforms into rotation by the appropriate means; but by substituting other means he can make the same water pressure maintain a vibratory motion, as with the hydraulic ram valve, or let it waste itself by open flow, in which case it becomes ultimately molecular vibration that is heat. The analogy holds strictly. The trouble all comes from neglecting to distinguish between different forms of energy—energy in matter and energy in the ether.

GLASS SPINNING AND WEAVING.

Quite recently a Pittsburg glass firm has succeeded, to a notable degree, in producing glass threads of sufficient fineness and elasticity to permit of their being woven into fabrics of novel character and quality. Their success is such as to warrant the assumption that garments of pure glass, glistening and imperishable, are among the possibilities of the near future. The spinning of glass threads of extreme fineness is not a new process, but, as carried on at present by the firm in question—Messrs. Atterbury & Co.—possesses considerable interest. From a quality of glass similar to that from which table ware is made, rods of glass averaging half an inch in diameter are drawn to any desired length and of various colors. These rods are then so placed that the flame of two gas burners is blown against that end of the rod pointed toward the large "spinning" wheel. The latter is 8½ feet in diameter, and turns at the rate of 300 revolutions per minute. The flames, having played upon the end of the glass cylinder until a melting heat is attained, a thread of glass is drawn from the rod and affixed to the periphery of the wheel, whose face is about 12 inches wide. Motion is then communicated, and the crystal thread is drawn from between the gas jets and wrapped upon the wheel at the rate of about 7,500 feet per minute. A higher speed results in a finer filament of glass, and *vice versa*. During its passage from the flame to the wheel, a distance of five or six feet, the thread has become cooled, and yet its elasticity is preserved to a notable degree. The next step in the process consists in the removal of the layers of threads from the wheel. This is easily accomplished, and after being cut to the desired lengths, the filaments are woven in a loom somewhat similar to that used in weaving silken goods. Until within the past few weeks only the wool of the fabric was of glass, but at present both warp and woof are in crystal. Samples of this cloth have been forwarded to New York and to Chicago, and the manufacturers claim to be able to duplicate in colors, texture, etc., any garments sent them. A tablecloth of glass recently completed shines with a satiny, opalescent luster by day, and under gaslight shows remarkable beauty. Imitation plumes, in opal, ruby, pale green, and other hues, are also constructed of these threads, and are wonderfully pretty. The chief obstacle yet to surmount seems to lie in the manipulation of these threads, which are so fine that a bunch containing 250 is not so thick as an average sized knitting needle, and which do not possess the tractability of threads of silk or cotton.

[The foregoing information is furnished by a correspondent in Pittsburg. A sample of the goods mentioned, a tablecloth of glass, is now on exhibition in this city.]

The weaving of such heavy fabrics of glass for ornamental purposes and for curiosities is no new thing; nor, in our estimation, does comparative success in such experiments warrant the enthusiastic claims of the Pittsburg manufacturers touching the adaptability of glass for wearing apparel. Unless it is in their power to change the nature of glass absolutely and radically, it does not seem possible for them so to overcome the ultimate brittleness of the separate fibers as to make the fabric fit to be brought in contact with the skin. The woven stuff may be relatively tough and flexible; but unless the entire fabric can be made of one unbreakable fiber the touch of the free ends, be they never so fine, must be anything but pleasant or beneficial. If one can judge by the finest filaments of glass spun hitherto. Besides, in weaving and wearing the goods, a certain amount of fiber dust must be produced as in the case of all other textile material. When the softest of vegetable fibers are employed the air charged with their fragments is hurtful to the lungs; still more injurious must be the spicules of spun glass.

However, although the manufacturers are likely to be disappointed in their expectation of finding in glass a cheap and available substitute for linen, cotton, and silk in dress goods, it is quite possible that a wide range of useful application may be found for their new fabric.]

REMARKABLE ERUPTION OF MAUNA LOA.

Late advices from the Sandwich Islands describe the eruption of Mauna Loa, which began Nov. 5, as one of the grandest ever witnessed. The opening was about six miles from the summit of the mountain, and already two great streams of lava had been poured out; one of them, from one to two yards wide and twenty feet deep, had reached a distance of thirty miles. Terrible explosions accompany the flow of the lava stream, which for a time threatened the town of Hilo; at last reports the flow seemed to be turning in another direction.

Mauna Loa, "long or high mountain," occupies a large portion of the central and southern part of the island of Hawaii, and reaches an elevation of 13,760 feet. It has been built up by lavas thrown out in a highly fluid state, and flowing long distances before cooling; as a consequence the slopes of the mountain are very gentle, averaging, according to Prof. Dana, not more than six and a half degrees. Its craters are numerous, and usually occur near the summit and on the sides, new ones opening frequently, and furnishing, as in the latest instance, magnificent lava streams. The terminal crater is circular, 8,000 feet in diameter, and in 1864 was about 1,000 feet deep. In 1859 an enormous lava fountain spouted from this crater for four or five days, throwing a column of white hot fluid lava about 200 feet in diameter to the height of two or three hundred feet. The lava stream ran 50 miles to the sea in eight days. Other great eruptions have occurred in 1832, 1840, 1843, 1852, 1855, 1868 and 1873. The lava streams poured out in 1840, 1859, and 1868, flowed to the sea, adding considerably to the area of the island. Those of 1843 and 1857 are estimated to have poured out respectively 17,000,000,000 and 38,000,000,000 cubic feet of lava. In 1868 the lava stream forced its way under ground a distance of twenty miles, and burst forth from a fissure two miles long, throwing up enormous columns of crimson lava and red hot rock to the height of five or six hundred feet.

On the eastern part of Mauna Loa, 16 miles from the summit crater, is Kilauea, the largest continuously active crater in the world. It is eight miles in circumference, and 1,000 feet deep. Its eruptions are generally independent of those of Mauna Loa.

NEW AIR ENGINE.

A valuable improvement in compressed air engines has recently been patented in this country and in Europe by Col. F. E. B. Beaumont, of the Royal Engineers, and we learn from accounts given in the London and provincial papers that it has proved highly efficient and satisfactory.

The engine possesses some peculiar features which render it very economical in the use of compressed air. It has two cylinders, one being much larger than the other. Into the smaller of these cylinders the compressed air is taken directly from the reservoir, and after doing its work there it is discharged into the larger cylinder, where it is further expanded, being finally discharged into the open air.

The admission of air to the smaller cylinder is regulated by an adjustable cut-off apparatus, which admits of maintaining a uniform power under a variable pressure. When the reservoir at first starting contains air at a very high pressure, the cut-off is adjusted so that the small cylinder receives a very small charge of air at each stroke; when the pressure in the reservoir diminishes the cut-off is delayed so that a larger quantity of air is admitted to the small cylinder; and when the pressure in the reservoir is so far reduced that the pressure on the smaller piston gives very little power, the supply passages are kept open so that the air acts directly on the piston of the larger cylinder. This arrangement is also available when the air pressure is high and great power is required for a short time, as, for example, in starting a locomotive.

It is, perhaps, needless to mention the advantages a motor of this kind possesses over the steam locomotive. The absence of smoke and noise renders it particularly desirable for tunnels, elevated roads, and, in fact, for any city railroad.

Further information in regard to this important invention may be obtained by addressing Mr. R. Ten Broeck, at the Windsor Hotel, New York.

Telegraph Wires Underground.

Philadelphia newspapers report that the American Union Telegraph Company are about to try in that city the experiment of putting their wires underground. The plan works well enough in European cities, and there would seem to be no reason why it should not succeed here, save the indisposition of the companies to bear the first cost of making the change. For some months the Western Union Telegraph Company has had the matter under consideration, but will probably wait until pressed by a rival company before it undertakes the more serious task of taking down its forest of poles and sinking the wires which contribute so much to the prevailing ugliness of our streets. Sooner or later the poles and wires must come down; and it is altogether probable that the change will be beneficial to the companies in the long run, owing to the smaller cost of maintaining a subterranean system. It will certainly be an advantage to the community.

IMPROVED SAFETY NUT.

That a safety nut so simple and so obviously efficient as the one shown in the annexed engraving should be among the recent inventions in this line instead of being among the first, is a curious example of the manner in which inventors often overlook the simplest means of accomplishing an end. The principle on which this nut operates will be understood by reference to the engraving. Two nuts are represented on each bolt, simply for the purpose of showing the difference between the nut when loose and when screwed down. In practice only one nut is required to each bolt.

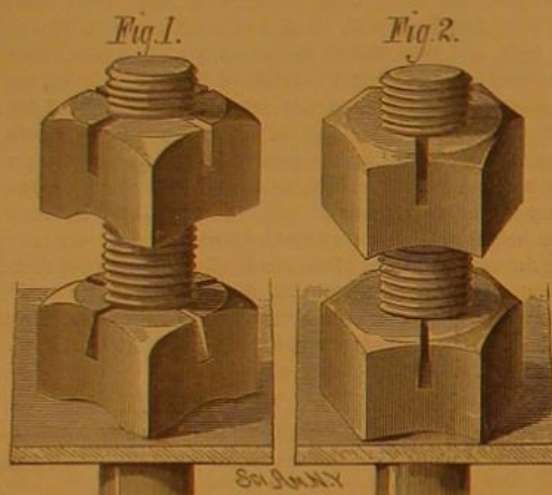
The square nut shown in Fig. 1 is concave on its under side, so that it touches its bearings only at the corners and in the outer face of the nut there are two slots at right angles to each other. When this nut is screwed home the outer portion is contracted so as to clamp the bolt tightly.

The hexagonal nut shown in Fig. 2 has but a single transverse slot, and the nut is made concave on the under surface, so that when the nut is screwed home it will contract the outer portion and so clamp the bolt.

This nut may be removed and replaced by means of the wrench, but it will not become accidentally loosened, and the bolt to which it is applied will always remain tight, as the nut possesses a certain amount of elasticity. The action of this nut is such as to prevent stripping the threads of either bolt or nut.

As only one nut is used with each bolt, and as no washer or other extra appliance is required, it is obvious that a great saving is effected by this invention.

We are informed that several of the leading railroads have adopted this nut, and use it on the tracks, engines, cars, and machinery. The Atwood Safety Nut Company manufacture this article in a variety of forms.



THE ATWOOD SAFETY NUT.

Further information may be obtained by addressing J. W. Labaree, Secretary and Treasurer, Room 2, Agawam Bank Building, Springfield, Mass.

Petroleum Prospects.

The total oil production of the Pennsylvania oil regions for the month of October was 2,094,608 barrels. The conditions in the producing field are gradually giving warrant for permanently higher prices of crude. The confidence of the trade is daily becoming more fixed in the definiteness and limit of the Bradford field, as the last of the several "rich streaks" in the region are being worked.

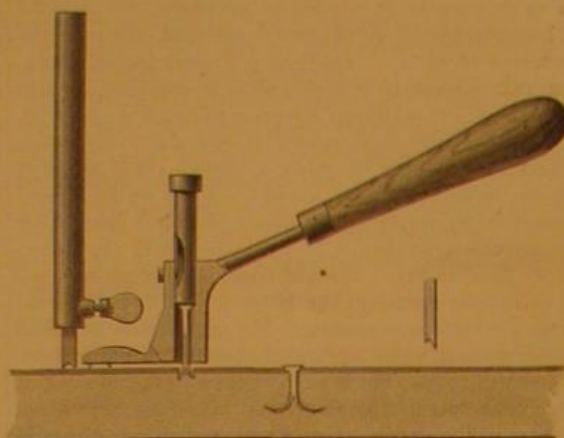
We entertain an increased belief that the coming year will exhibit a continued falling off in the volume of production, notwithstanding all the modern improvements in drilling and the great energy with which they are employed.

For the past few weeks the markets of both crude and refined seem to have been rigorously and artificially held by the refining interest. The refined has been quoted at 12 cts. for four weeks without change—and as a consequence the exporter has taken oil very sparingly. The exports of last year to November 1, as compared with the exports of this year to November 1, show a decrease of 1,269,646 barrels in crude equivalent. The falling off of production, taken together with the increased demand which must result from the present reluctance of exporters, unite in warranting us in the belief above expressed, in enhanced prices for the coming year.

Our figures show a decrease in production for last month, compared with the preceding month, of 923 barrels per day, notwithstanding the number of wells drilled was slightly greater than in the preceding month. It will be noticed, too, that the average per well of the new wells for last month is a little less than that of the new wells for the month before; besides, it is generally recognized that the force of the gas in the region is gradually becoming less, and pumping is more commonly resorted to. As nearly as we can ascertain, about one-eighth of all the wells of the Bradford region are now pumping. We believe, however, on the whole, judging the character of the Bradford producing field, that the falling off of production will be quite gradual. Our reason for this is that the Bradford field is essentially different from its predecessor—the Butler field. The wells in the Butler field were often close together, many of them were very large and fell off rapidly; while the wells of the Bradford region are smaller, farther apart, much greater in number, have a greater area from which to draw oil, and consequently decline very much more slowly. —Stonell's Reporter.

TOOL FOR DRIVING AND CLINCHING NAILS.

A novel method of making a nail hole and driving and clinching the nail is shown in the annexed engraving. The instrument for making the hole has a notched end which leaves a ridge in the center of the hole at the bottom. The nail driving tool consists of a socket provided with a suitable handle, and containing a follower which rests upon the



TOOL FOR DRIVING AND CLINCHING NAILS.

head of the nail to be driven, and receives the blows of the hammer in the operation of driving the nail. The nail is split for one half its length, and the two arms thus formed are slightly separated at the point, so that when they meet the ridge at the bottom of the hole they will be still further separated and will clinch in the body of the wood.

This invention was recently patented by Mr. Charles P. Ball, of Danville, Ky.

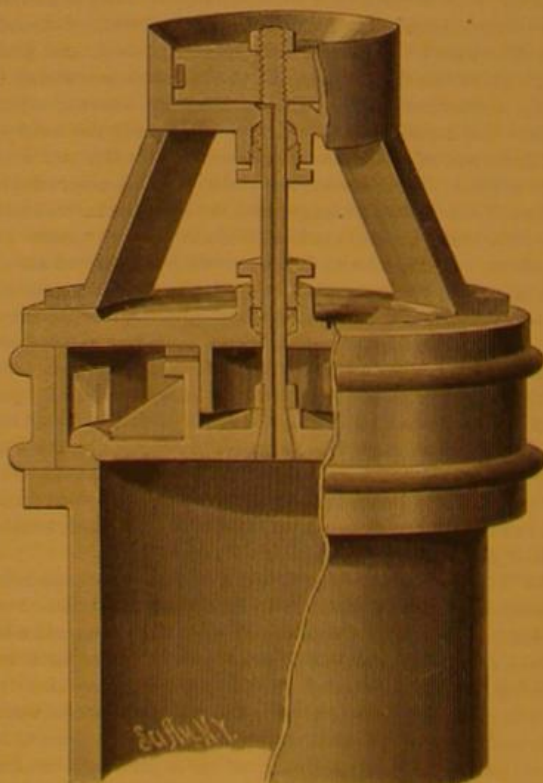
AUTOMATIC BALANCE ATTACHMENT FOR VALVES.

It is well known that in all air compressors and water pumps the pressure in cylinder of air compressors or in working barrel or cylinder of pumps is much greater at the point of opening the delivery valves than the actual pressure in the air receivers of compressors or in water column of pumps, because of the difference in area between the top and bottom of delivery valves. In some air compressors a hundred and twenty-five pounds pressure to the square inch is required in the cylinder to eighty pounds in the receiver, and in some instances a hundred pounds pressure is required in the cylinder to eighty pounds pressure in the receiver or column.

The engraving shows an invention designed to remedy this defect in air compressors and pumps, to provide a device which will enable the compressors and pumps to operate with equal pressure on both sides of the delivery valve.

The invention consists of an auxiliary valve arranged outside of the cylinder, where it is not subjected to back pressure, and connected with the delivery valve by a hollow valve stem.

In the engraving, which is a sectional view, the cylinder of an air compressor is represented, on the end of which there is a ring containing delivery ports, through which the air from the cylinder is forced into a receiver or conducting



AUTOMATIC BALANCE ATTACHMENT FOR DELIVERY VALVES OF AIR COMPRESSORS AND WATER PUMPS.

pipe. This ring is provided with an inner flange or valve seat on which rests the delivery valve. These parts are similar to those seen in some of the air compressors in common use, and with this construction and arrangement one hundred pounds pressure to the square inch in the cylinder is required to open the valve against eighty pounds pressure in the receiver or in the conducting pipes.

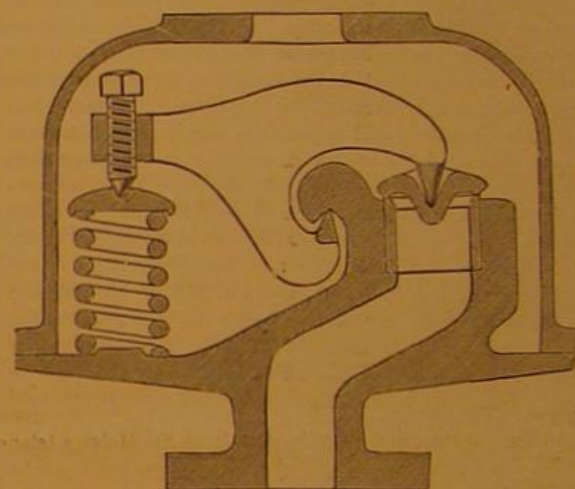
A drum having an open end is connected with the cylinder head by inclined standards, and contains a piston connected with the valve by means of a rod that extends centrally through the cylinder head. On the outer end of this rod is screwed an adjusting nut, by means of which the piston may be adjusted. This rod is bored longitudinally, establishing communication between the compressor cylinder and the drum containing the piston.

It will be seen that the upper face of the piston is exposed so as to be subjected to atmospheric pressure only, and when the compressor is in operation a portion of the air in the compressor cylinder passes through the hollow rod into the space beneath the piston, and there exerts sufficient pressure, in combination with the pressure on the inner face of the valve, to open the valve against an equal pressure in the receiver or conducting pipes, so that when the pressure in the cylinder equals the pressure in the receivers the valve is opened and held in place until the piston in the cylinder starts on the return stroke, when the pressure under the piston is immediately relieved through the hollow rod and the main valve closes.

The space between the valve and its seat is made as shallow as possible, so that the space may be quickly filled and exhausted. The piston may be adjusted to regulate this space. This invention was recently patented by Messrs. Samuel B. Connor and Henry Dods, of Virginia City, Nevada.

IMPROVED SAFETY VALVE.

In the annexed cut we have represented a steam safety valve, which is the invention of M. Schmidt, M.E., of Zurich, Switzerland. It consists of a lever terminating in two prongs, one of which extends downward and rests upon



IMPROVED SAFETY VALVE.

the cap, closing the top of the tube through which the steam escapes. The other prong extends upward and catches under a projection of the steam tube, and forms the fulcrum for the lever. The opposite end of this lever is provided with an adjustable screw pressing upon a plate that rests on the top of a spiral spring, which keeps the valve closed by pressing the outer end of the lever upward. As soon as the pressure of the steam overcomes the pressure of the spiral spring the valve will be raised, permitting the steam to escape. The apparatus is contained in a case having a central aperture for the escape of steam.

Raising Sunken Vessels.

An experiment recently took place in the East India Dock Basin, Blackwall, London, by permission of Mr. J. L. du Plat Taylor, the secretary of the Dock Company, for the purpose of testing and illustrating the mode of raising sunken ships by means of the apparatus patented by Mr. William Atkinson, naval engineer, of Sheffield. The machinery employed consists of the necessary number and size, according to the power required, of oval or egg-shaped buoys constructed of sheet iron, having an internal valve of a simple and effective character. Captain Hales Dutton, the dock-master, who assisted during the operations, had placed his small yacht at the inventor's service for the occasion. The vessel was moored in the basin, and a set of four buoys were attached to it, one on each side near the bow and the stern. Air was supplied from a pump on the quay by a pipe communicating with a small copper globe resting on the deck of the vessel, and from which place proceeded four other flexible tubes, one to each buoy, thus distributing the air to each one equally. The vessel being flooded and in a sinking condition, the buoys were attached and the valves opened; they rapidly filled with water, and the vessel immediately sank in about 30 feet. Upon the first attempt an air chamber in the stern had been lost sight of, causing the vessel to come up to the surface stern uppermost; this being rectified, the vessel was again sent to the bottom, and allowed to remain a short time to allow her to settle down. When the order was given to work the pump, the vessel was brought to the surface, perfectly level, in about three minutes. The apparatus used, although only models, and on a comparatively diminutive scale (the buoys measuring 3 feet 4 inches in height and 2 feet 6 inches in diameter), was estimated to be capable of lifting a weight of nearly 20 tons, and that it needed, as represented by the patentee, only a corresponding increase in the lifting power to deal successfully with vessels of any tonnage.

NEW HAND POWER BAND SAW.

The engraving shows a new hand power band saw made by Frank & Co., of Buffalo, N. Y., and designed to be used in shops where there is no power and where a larger machine would be useless. It is calculated to meet the wants of a large class of mechanics, including carpenters and builders, cabinet makers, and wagon makers. It is capable of sawing stuff six inches thick, and has a clear space of thirty inches between the saw and the frame. The upper wheel is adjusted by a screw pressing against a rubber spring which compensates for the expansion and contraction of the saw.

The machine has a very complete device for raising, lowering, and adjusting the wheel, and all of the parts are made with a view to obtaining the best results in the simplest and most desirable way.

The machine is six feet wide and five feet high, and weighs 380 lb. The wheels are covered with pure rubber bands well cemented.

Further particulars may be obtained by addressing Messrs. Frank & Co., 178 Terrace street, Buffalo, N. Y.

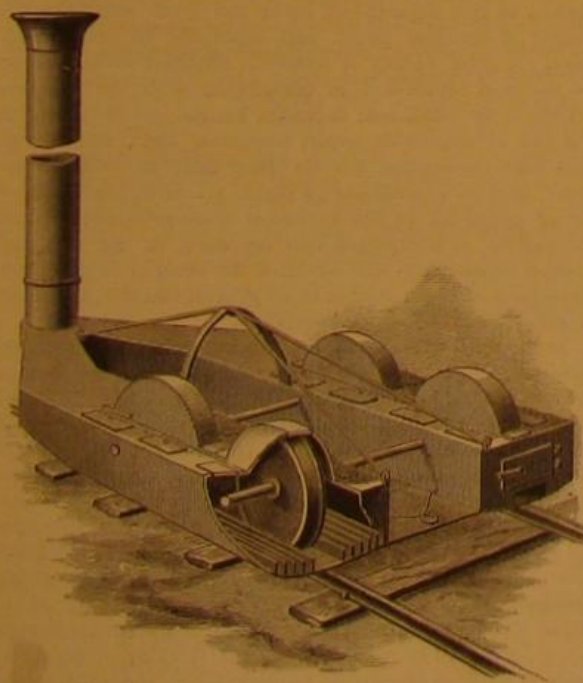
The Harbor of Montreal.

A plan for the improvement of the harbor of Montreal, Canada, has been submitted to the City Board of Trade by James Shearer, a well known citizen. Mr. Shearer's plan is to divert the current of the St. Lawrence opposite the city into the channels between St. Helen's Island and the southern shore, and by having various obstructions removed from the channel, and running a dam, or "peninsula," as he calls it, built from Point St. Charles, in the west end of the city, to St. Helen's Island, midway in the river, thus stopping the current from running through the present main channel between the city and St. Helen's Island.

Among the practical advantages that will accrue to the city and harbor from the carrying out of this project, Mr. Shearer sets forth the following: The dam will prevent the shoring of ice opposite the city, and the consequent flooding of the Griffintown district, which is annually very destructive to property, and will make a still harbor, where vessels may lie during the winter. It is estimated that the construction of the dam, which would be 2,700 feet long and 900 feet broad, would raise the water two feet in the river and lower it ten feet in the harbor. This would give a head of twenty-five feet for mills, elevators, and factories, and the transportation of freight. The dam would afford a roadway across the river, upon the construction of a bridge from St. Helen's Island to St. Lambert, thus removing the necessity of a tunnel. The roadway could be utilized for a railway, a road for carriages and foot passengers. The estimated cost of the improvement is \$7,000,000.

APPARATUS FOR REMOVING ICE FROM RAILROADS.

The engraving shows an improved apparatus for removing snow and ice from railroads and streets by means of heat. The invention consists of a double furnace mounted on wheels, which are incased in the fire boxes of the fur-



APPARATUS FOR REMOVING ICE FROM RAILROADS.

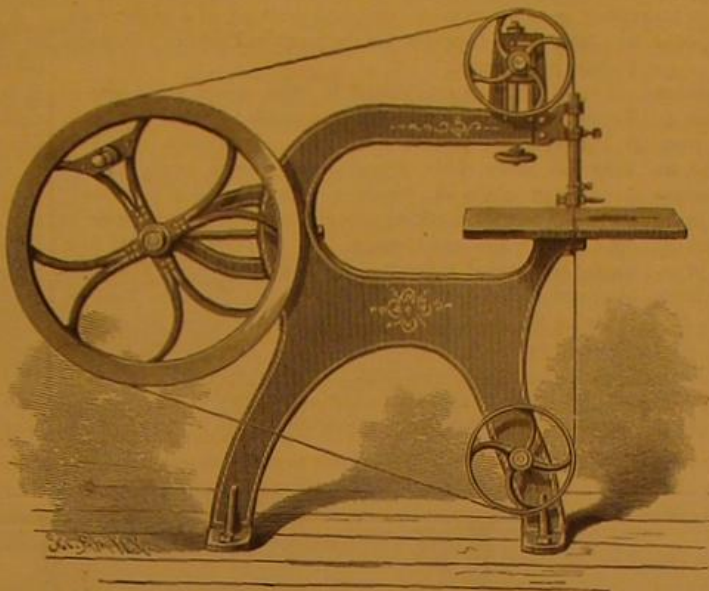
nace, so that in use the entire apparatus, including the wheels, will become highly heated, so that the snow and ice will not only be melted by radiant heat, but by the actual contact of the hot surfaces of the furnace and wheels. This apparatus was recently patented by the late E. H. Angmar, of New Orleans, La.

Ericsson's New Submarine Gun.

The protracted trials conducted on board the Destroyer to test its submarine gun terminated last week. Having, says the *Army and Navy Journal*, in a previous issue described this novel type of naval artillery, it will suffice to remind

our readers that its caliber is 16 inches, length of bore 30 feet, and that it is placed at the bottom of the vessel, the muzzle passing through an opening formed in the wrought iron stem.

We have hitherto, in discussing the properties of the Destroyer, referred to its offensive weapon as a "torpedo," a term not altogether inappropriate while it was actuated by compressed air. But Capt. Ericsson having in the meantime wholly abolished compressed air in his new system of naval attack, substituting guns and gunpowder as the means of producing motive energy, it will be proper to adopt the constructor's term, *projectile*. It will not surprise those who are



HAND POWER BAND SAW.

acquainted with the laws of hydrostatics and the enormous resistance offered to bodies moving swiftly through water, that the determination of the proper form of projectile for the submarine gun has demanded protracted experiments, commencing at the beginning of June and continued up to last week, as before stated. The greater portion of these experiments, it should be observed, has been carried out with a gun 30 feet long, 15 inches caliber—not a breech-loader, however, as in the Destroyer, but a muzzle-loader, suspended under the bottom of two wrecking scows, the gun being lifted above the water, after each shot, by shears and suitable tackle. The present projectile of the Destroyer is the result of the extended trials referred to; its length is 25 feet 6 inches, diameter 16 inches, and its weight 1,500 pounds, including 250 pounds of explosive materials. We are not at liberty at present to describe its form, but we may mention that the great length of the body and the absence of all internal machinery enable the constructor to carry the stated enormous quantity of explosive matter. With minimum charge of powder in the chamber of the gun, the speed attained by the projectile reaches 310 feet in the first three seconds.

The question may be asked, in view of these facts, whether the boasted costly steam ram is not superseded by the cheap aggressive system represented by the Destroyer. Evidently the most powerful of the English steam rams could not destroy an armored ship as effectually as the projectile from the submarine gun, the explosion of which is capable of shattering any naval structure.

It should be borne in mind, also, that being protected by heavy inclined transverse armor, the Destroyer, attacking bows on, can defy ordnance of all calibers. Again, the carrier of the submarine gun, in addition to the swiftness of its projectile, can outrun ironclad ships.

RECENT INVENTIONS.

Mr. Francis M. Osborn, of Port Chester, N. Y., has patented a covering for a horse that protects him from the weather and from chafing. The blanket has a band, also stays and straps, the use of which does away with the surcingle and affords a most efficient protection for the horse, and may be easily worn under harness in wet weather or at other times, when desirable.

A novel device, designed especially for containing boxes of cigars and protecting and displaying their contents, has been patented by Mr. Robert B. Dando, of Alta, Iowa. The invention consists of a case containing shelves, on which are fixed the covered cigar or other boxes, cords connecting the box lids and case doors, so that the opening of the case doors causes the box lids to open.

An improved bottle stopper has been patented by Mr. Andrew Walker, of Cincinnati, O. The invention consists in combining with the stopper caps connected by an intermediate spring.

Mr. James B. Law, of Darlington Court House, S. C., has patented an improved construction of buckle for fastening the ends of cotton and other bale bands; it consists in a buckle having a permanent seat for one end of the bale band, a central opening, into which the other end of the band is entered through an oblique channel, and a bar offsetting from the plane of the buckle, notched or recessed to prevent lateral movement of the band, and connecting the

free ends of the buckle on each side of the oblique channel to strengthen the buckle.

An improved buckboard wagon has been patented by Mr. William Sanford, of Cohoes, N. Y. The invention consists in combining with the buckboards curved longitudinal springs placed beneath the buckboards, and curved cross springs connected at their ends with the buckboards by cap plates so as to increase the strength and elasticity of the wagon.

An improved vehicle wheel has been patented by Messrs. George W. Dudley and William J. Jones, of Waynesboro, Va. The main object of this invention is to form a wheel hub for vehicles in such manner that the wheel will yield sufficiently when undue and sudden strains or jars may come upon it to receive the force of the blow and shield the other portions of the vehicle from the destructive effects of such action, as well as to afford ease and comfort of motion to the occupant; and the improvement consists in securing the inner ends of the spokes to rim plates, to form a fixed and solid connection therewith, the rim plates being loosely secured to the butt flanges and box of the hub, so that it is free to move in a vertical plane, but prevented from moving laterally and limited in its vertical movement by an elastic packing interposed between the inner ends of the spokes and the hub box.

Mr. Francis G. Powers, of Moweaqua, Ill., has patented an improvement in the class of atmospheric clothes pounders, that is to say, pounders which are constructed with one or more chambers or cavities in which the air is alternately compressed and allowed to expand at each reciprocation.

An improved means for connecting the body of a baby carriage to the running gear has been patented by Mr. Charles M. Hubbard, of Columbus, Ohio. It consists in supporting the rear end by one or more coil springs, and hinging the front portion of the body to a pair of upturned supports rising from the front axle.

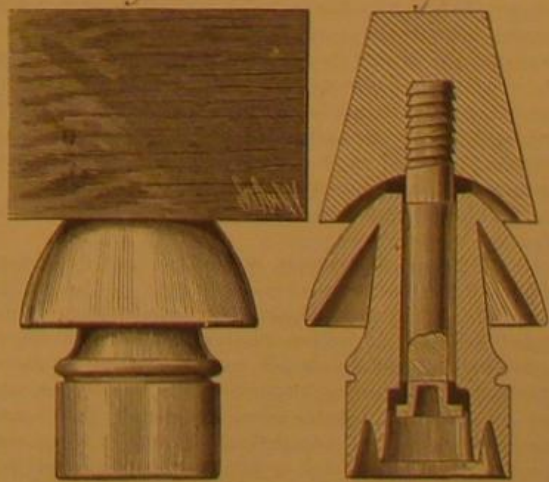
An improved ferrule for awl handles has been patented by Mr. Jules Steinmeyer, of St. Louis, Mo. The object of this invention is to prevent splitting of the handle, to secure both the ferrule and leather pad firmly in place, and to furnish a durable and serviceable awl handle.

NEW TELEGRAPH INSULATOR.

The insulator represented in the annexed engraving was originally designed to meet the requirements of South American telegraph service, but it is equally well adapted to lines in other places. The main idea is to avoid breakage from expansion and contraction in a climate subject to sudden changes of temperature, and to avoid the mischief occasioned by a well known South American bird, the "hornero," by building nests of mud on the brackets and insulators. With this insulator these nests cannot cause a weather contact or earth; on the contrary, the nest rather improves the insulation. The sectional view, Fig. 2, shows the construction of the insulator and the manner of fastening it to the cross arm or bracket. A rubber ring is placed between the upper end of the porcelain insulator and the cross arm, and another similar ring is placed between the head of the suspending screw and the bottom of the insulator. It will be noticed that with this construction the insulator cannot

Fig. 1.

Fig. 2.



IMPROVED TELEGRAPH INSULATOR.

be broken by the contraction of the screw or by the swelling of the cross-piece. This insulator can be used on an iron bracket and in connection with either iron or wooden posts, and is in every way more secure than the insulators in common use. The first cost of these insulators compares favorably with the cheapest in market, while it is less liable to breakage, lasts longer, and gives better results. It has been patented in this country and in Europe.

Further information may be obtained by addressing Mr. J. H. Bloomfield, Concordia, Entre Reos, Argentine Republic, South America.

BUSINESS COLLEGES.

PACKARD'S BUSINESS COLLEGE.

There are two very general prejudices against the class of schools known as business colleges. One is that their chief aim—next to living the pockets of their proprietors—is to turn out candidates for petty clerkships, when the country is already overrun with young men whose main ambition is to stand at a desk and “keep books.” The other is that the practical outcome of these institutions is a swarm of conceited flourishers with the pen, who, because they have copied a set or two of model account books and learned to imitate more or less cleverly certain illegible artistic writing copies, imagine themselves competent for any business post, and worthy of a much higher salary than any merely practical accountant who has never been to a business college or attempted the art of fancy penmanship as exhibited in spread eagles and impossible swans.

As a rule popular prejudices are not wholly unfounded in reason; and we should not feel disposed to make an exception in this case. When the demand arose for a more practical schooling than the old-fashioned schools afforded, no end of writing-masters, utterly ignorant of actual business life and methods, hastened to set up ill-managed writing schools which they dubbed “business colleges,” and by dint of advertising succeeded in calling in a multitude of aspirants for clerkships. In view of the speedy discomfiture of the deluded graduates of such schools when brought face to face with actual business affairs, and the disgust of their employers who had engaged them on the strength of their alleged business training, one is not so much surprised that prejudice against business colleges still prevails in many quarters, as that the relatively few genuine institutions should have been able to gain any creditable footing at all.

The single fact that they have overcome the opprobrium cast upon their name by quacks, so far as to maintain themselves in useful prosperity, winning a permanent and honorable place among the progressive educational institutions of the day, is proof enough that they have a mission to fulfill and are fulfilling it. This, however, is not simply, as many suppose, in training young men and young women to be skilled accountants—a calling of no mean scope and importance in itself—but more particularly in furnishing young people, destined for all sorts of callings, with that practical knowledge of business affairs which every man or woman of means has constant need of in every-day life. Thus the true business college performs a twofold function. As a technical school it trains its students for a specific occupation, that of the accountant; at the same time it supplements the education not only of the intending merchant, but equally of the mechanic, the man of leisure, the manufacturer, the farmer, the professional man—in short, of any one who expects to mix with or play any considerable part in the affairs of men. The mechanic who aspires to be the master of a successful shop of his own, or foreman or manager in the factory of another, will have constant need of the business habits and the knowledge of business methods and operations which a properly conducted business school will give him. The same is true of the manufacturer, whose complicated, and it may be extensive, business relations with the producers and dealers who supply him with raw material, with the workmen who convert such material into finished wares, with the merchants or agents who market the products of his factory, all require his oversight and direction. Indeed, whoever aspires to something better than a hand-to-mouth struggle with poverty, whether as mechanic, farmer, professional man, or what not, must of necessity be to some degree a business man; and in every position in life business training and a practical knowledge of financial affairs are potent factors in securing success.

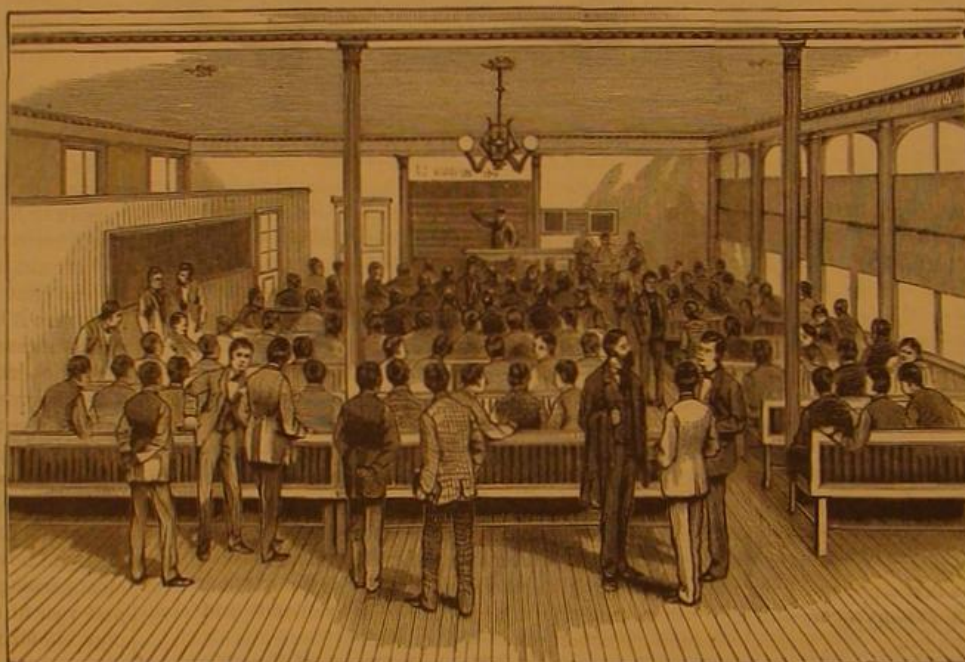
How different, for example, would have been the history of our great inventors had they all possessed that knowledge of business affairs which would have enabled them to put their inventions in a business-like way before the world, or before the capitalists whose assistance they wished to invoke. The history of invention is full of illustrations of men who have starved with valuable patents standing in their names—patents which have proved the basis of large fortunes to those who were competent to develop the wealth that was in them. How often, too, do we see capable and ingenious and skillful mechanics confined through life to a small shop, or to a subordinate position in a large shop, solely through their inability to manage the affairs of a larger business. On the other hand, it is no uncommon thing to see what might be a profitable business—which has been fairly thrust upon a lucky inventor or manufacturer by the urgency of popular needs—fall disastrously through ignorance of business methods and inability to conduct properly the larger affairs which fell to the owner's hand.

Of course a business training is not the only condition of success in life. Many have it and fail; others begin without it and succeed, gaining a working knowledge of business affairs through the exigencies of their own increasing business

needs. Nevertheless, in whatever line in life a man's course may fall, a practical business training will be no hindrance to him, while the lack of it may be a serious hindrance. The school of experience is by no means to be despised. To many it is the only school available. But unhappily its teachings are apt to come too late, and often they are fatally expensive. Whoever can attain the needed knowledge in a quicker and cheaper way will obviously do well so to obtain it; and the supplying of such practical knowledge, and the training which may largely take the place of experience in actual business, is the proper function of the true business college.

Our purpose in this writing, however, was not so much to enlarge upon the utility of business colleges, properly so called, as to describe the practical working of a representative institution, choosing for the purpose Packard's Business College in this city.

This school was established in 1858, under the name of Bryant, Stratton & Packard's Mercantile College, by Mr. S. S. Packard, the present proprietor. It formed the New York link in the chain of institutions known as the Bryant & Stratton chain of business colleges, which ultimately embraced fifty co-working schools in the principal cities of the United States and Canada. In 1867 Mr. Packard purchased the Bryant & Stratton interest in the New York College, and changed its name to Packard's Business College, retaining the good will and all the co-operative advantages of the Bryant & Stratton association. The original purpose of the college, as its name implies, was the education of young men for business pursuits. The experience of over twenty years has led to many improvements in the working of the



LECTURE AND RECITATION ROOM.

school, and to a considerable enlargement of its scope and constituency, which now includes adults as well as boys, especial opportunities being offered to mature men who want particular instruction in arithmetic, bookkeeping, penmanship, correspondence, and the like.

The teachers employed in the college are chosen for their practical as well as their theoretical knowledge of business affairs, and every effort is made to secure timeliness and accuracy in their teachings. Constant intercourse is kept up with the departments at Washington as to facts and changes in financial matters, and also with prominent business houses in this and other cities. Among the recent letters received in correspondence of this sort are letters from the Secretary of State of every State in the Union with regard to rates of interest and usury laws, and letters from each of our city banks as to methods of reckoning time on paper, the basis of interest calculations, the practices concerning deposit balances, and other business matters subject to change. The aim of the proprietor is to keep the school abreast of the demands of the business world, and to omit nothing, either in his methods or their enforcement, necessary to carry out his purpose honestly and completely. An idea of the superior housing of the college will be obtained from the views of half a dozen of the rooms at No. 805 Broadway, as shown in this issue of the SCIENTIFIC AMERICAN—the finest, largest, most compact, and convenient suite of rooms anywhere used for this purpose.

The college is open for students ten months of the year, five days each week, from half past nine in the morning until half past two in the afternoon. Students can enter at any time with equal advantage, the instruction being for the most part individual. The course of study can be completed in about a year. The proprietor holds that with this amount of study a boy of seventeen should be able—

1. To take a position as assistant bookkeeper in almost any kind of business;
2. To do the ordinary correspondence of a business house, so far as good writing, correct spelling, grammatical construction, and mechanical requisites are concerned;
3. To do the work of an entry clerk or cashier;
4. To place himself in the direct line of promotion to any desirable place in business or life, with the certainty of holding his own at every step.

In this the student will have the advantage over the uneducated clerk of the same age and equal worth and capacity, in that he will understand more or less practically as well as theoretically the duties of those above him, and will thus be able to advance to more responsible positions as rapidly as his years and maturity may justify. It is obvious that the knowledge which makes an expert accountant will in all probability suffice for the general business requirements of professional men, the inheritors of property and business, manufacturers, mechanics, and others to whom bookkeeping and other business arts are useful aids, but not the basis of a trade. For the last-named classes, and for women, shorter periods of study are provided, and may be made productive of good results.

A sufficient idea of the general working of the college may be obtained by following a student through the several departments. After the preliminary examination a student who is to take the regular course of study enters the initiatory room. Here he begins with the rudiments of bookkeeping, the study which marks his graduation. The time not given to the practice of writing, and to recitations in other subjects, is devoted to the study of accounts. He is required, first, to write up in “skeleton” form—that is, to place the dates and amounts of the several transactions under the proper ledger titles—six separate sets of books, or the record of six different business ventures, wherein are exhibited as great a variety of operations as possible, with varying results of gains and losses, and the adjustment thereof in the partners' accounts, or in the account of the sole proprietor. After getting the results in this informal way—which is done in order as quickly as possible to get

the theory of bookkeeping impressed upon his mind—he is required to go over the work again carefully, writing up with neatness and precision all the principal and auxiliary books, with the documents which should accompany the transactions, such as notes, drafts, checks, receipts, invoices, letters, etc. The work in this department will occupy an industrious and intelligent student from four to six weeks, depending upon his quickness of perception and his working qualities. While progressing in his bookkeeping, he is pursuing the collateral studies, a certain attainment in which is essential to promotion, especially correcting any marked deficiency in spelling, arithmetic, and the use of language.

Upon a satisfactory examination the student now passes to the second department, where a wider scope of knowledge in accounts is opened to him, with a large amount of practical detail familiarizing him with the actual operations of business. The greatest care is taken to prevent mere copying and to throw the student upon his own resources, by obliging him to correct his own blunders, and to work out his own results; accepting nothing as final that has not the characteristics of real business. Much care is bestowed in this department upon the form and essential matter of business paper, and especially of correspondence. A great variety of letters is required to be written on assigned topics and in connection with the business which is recorded, and thorough instruction is given in the law of negotiable paper, contracts, etc. During all this time the student devotes from half an hour to an hour daily to penmanship, a plain, practical, legible hand being aimed at, to the exclusion of superfluous lines and flourishes. It is expected that the work in the first and second departments will establish the student in the main principles of bookkeeping, in its general theories, and their application to ordinary transactions.

In the third department the student takes an advanced position, and is expected, during the two or three months he will remain in this department, to perfect himself in the more subtle questions involved in accounts, as well as to shake off the crude belongings of schoolboy work. He will be required to use his mind in everything he does—to depend as much as possible upon himself. The work which he presents for approval here must have the characteristics of business. His letters, statements, and papers of all kinds are critically examined, and approved only when giving evidence of conscientious work, as well as coming up to strict business requirements. Before he leaves this department he should be versed in all the theories of accounts; should write an acceptable business hand; should be able to execute a faultless letter so far as relates to form, spelling, and grammatical construction, should have a fair knowledge of commercial law, and have completed his arithmetical course.

The next step is to reduce the student's theoretical knowledge to practice, in a department devoted to actual business operations. This business or finishing department is shown at the upper left corner of our front page illustration. The work in this department is as exacting and as real as the work in the best business houses and banks. At the extreme end of the room is a bank in complete operation, as perfect in its functions as any bank in this city or elsewhere. The records made in its books come from the

real transactions of dealers who are engaged in different lines of business at their desks and in the offices. The small office adjoining the bank, on the right, is a post office, the only one in the country, perhaps, where true civil service rules are strictly observed. In connection with it is a transportation office. From fifty to a hundred letters daily are received and delivered by the post office, written by or to the students of this department.

The correspondence thus indicated goes on not only between the students of this college, but between members of this and other similar institutions in different parts of the country. A perfected system of intercommunication has for years been in practice between co-ordinate schools in New York, Boston, Brooklyn, Philadelphia, Chicago, Baltimore, and other cities, by which is carried on an elaborate scheme of interchangeable business, little less real in its operations and results than the more tangible and obtrusive activity which the world recognizes as business.

The work of the transportation office corresponds with that of the post office in its simulation of reality. The alleged articles handled are represented by packages bearing all the characteristic marks of freight and express packages. They are sent by mail to the transportation company, and by this agency delivered to the proper parties, from whom the charges are collected in due form, and the requisite vouchers passed. Whatever is necessary in the way of manipulation to secure the record on either hand is done, and, so far as the clerical duties are concerned, there is no difference between handling pieces of paper which represent merchandise and handling the real article.

In the bank is employed a regular working force, such as may be found in any bank, consisting of a collector or runner, a discount clerk, a deposit bookkeeper, a general bookkeeper, and a cashier. The books are of the regular form, and the work is divided as in most banks of medium size, and the business that is presented differs in no important particular from that which comes to ordinary banks. After getting a fair knowledge of theory, the student is placed in this bank. He begins in the lowest place, and works up gradually to the highest, remaining long enough in each position to acquaint himself with its duties. He is made familiar with the form and purpose of all kinds of business paper, and the rules which govern a bank's dealings with its customers. He gets a practical knowledge of the law of indorsement and of negotiability generally, and is called upon to decide important questions which arise between the bank and its dealers. Wherever he finds himself at fault he has access to a teacher whose duty it is to give the information for which he asks, and who is competent to do it.

Throughout the whole of this course of study and practice the students are treated like men and are expected to behave like men.

The college thus becomes a self-regulating community, in which the students learn not only to govern themselves, but to direct and control others. As one is advanced in position his responsibilities are increased. He is first a merchant or agent, directing his own work; next, a sub-manager, and finally manager in a general office or the bank, with clerks subject to his direction and criticism, until he arrives at the exalted position of "superintendent of offices," which gives him virtual control of the department. This is, in fact, an important part of his training, and the reasonable effect of the system is that the student, being subject to orders from those above him, and remembering that he will shortly require a like consideration from those below him, concludes that he cannot do a better thing for his own future comfort than to set a wholesome example of subordination.

This, however, is not the only element of personal discipline that the college affords. At every step the student's conduct, character, and progress are noted, recorded, and securely kept for the teacher's inspection, as well as that of his parents and himself. Such records are kept in the budget room, shown in the lower left corner of the front page.

This budget system was suggested by the difficulties encountered in explaining to parents the progress and standing of their sons. The inconvenience of summoning teachers, and of taking students from their work, made necessary some simpler and more effective plan. The first thing required of a new student is that he should give some account of himself, and to submit to such examinations and tests as will acquaint his teachers with his status. This account and these tests constitute the subject-matter of his first budget, which is placed at the bottom of his box, and every four weeks thereafter, while he remains in the school, he is required to present the results of his work, such as his written examinations in the various studies, his test examples in arithmetic, his French, German, and Spanish translations and exercises, various letters and forms, with four weekly specimens of improvement in writing, the whole to be formally submitted to the principal in an accompanying letter; the letter itself to exhibit what can be thus shown of improvement in writing, expression, and general knowledge. These budgets, accumulating month by month, are made to cover as much as possible of the student's school work, and to constitute the visible steps of his progress.

Besides this is a character record, kept in a small book as signed to each student, every student having free access to his own record, but not to that of any fellow student. Each book contains the record of a student's deportment from the first to the last day of his attendance, with such comments and recommendations as his several teachers may think likely to be of encouragement or caution to him.

In addition to the strictly technical training furnished by

the college, there is given also not a little collateral instruction calculated to be of practical use to business men. For example, after roll call every morning some little time is spent in exercises designed to cultivate the art of intelligent expression of ideas. Each day a number of students are appointed to report orally, in the assembly room, upon such matters or events mentioned in the previous day's newspapers as may strike the speaker as interesting or important. Or the student may describe his personal observation of any event, invention, manufacture, or what not; or report upon the condition, history, or prospects of any art, trade, or business undertaking. This not to teach elocution, but to train the student to think while standing, and to express himself in a straightforward, manly way.

Instruction is also given in the languages likely to be required in business intercourse or correspondence; in phonography, so far as it may be required for business purposes; commercial law relative to contracts, negotiable paper, agencies, partnerships, insurance, and other business proceedings and relations; political economy, and incidentally any and every topic a knowledge of which may be of practical use to business men.

In all this the ultimate end and aim of the instruction offered are practical workable results. Mr. Packard regards education as a tool. If the tool has no edge, is not adapted to its purpose, is not practically usable, it is worthless as a tool. This idea is kept prominent in all the work of the college, and its general results justify the position thus taken. The graduates are not turned out as finished business men, but as young men well started on the road toward that end. As Mr. Packard puts it: "Their diplomas do not recommend them as bank cashiers or presidents, or as managers of large or small enterprises, but simply as having a knowledge of the duties of accountantship. They rarely fail to fulfill reasonable expectations; and they are not responsible for unreasonable ones."

American Institute of Architects.

The fourteenth annual convention of the American Institute of Architects began in Philadelphia, November 17. Mr. Thomas U. Walter, of Philadelphia, presided, and fifty or more prominent architects were present. In his annual address the president spoke of the tendency of the architectural world as decidedly in the direction of originality. But little attention is paid to the types of building drawn from the works of by-gone ages or to the mannerisms of the more recent past. Progress in the development of the elements of taste and beauty, and the concretization of aesthetic principles with common sense in architectural design, are now everywhere apparent. The responsibilities of architects are greater than they have ever before been; the growing demand of the times calls for intelligent studies in all that relates to architecture, whether it be in the realm of aesthetics, in sciences that relate to construction, in the nature and properties of the materials used, in the atmosphere that surrounds us, or in the availability of the thousand-and-one useful and ingenious inventions that tend to promote the convenience and completeness of structures.

Papers were read by Mr. A. J. Blood, of New York, on "The Best Method of Solving the Tenement House Problem;" Mr. George T. Mason, Jr., of Newport, on "The Practice of American Architects during the Colonial Period;" Mr. Robert Briggs, of Philadelphia, on "The Ventilation of Audience Rooms;" Mr. T. M. Clark, of Boston, on "French Building Laws, etc."

The following named officers were elected: President, T. U. Walter, Philadelphia; Treasurer, O. P. Hatfield, New York; Secretary, A. J. Blood. Trustees, R. M. Hunt, H. M. Congdon, J. Cady, Napoleon Le Brun, New York. Committee on Publication, R. M. Upjohn, New York; T. M. Clark, Boston; John McArthur, Jr., Philadelphia; A. J. Blood, H. M. Congdon, New York. Committee on Education, W. R. Narr, Boston; Russell Sturgis, New York; N. Clifford Ricker, Champagne, Ill.; Henry Van Brunt, Boston; Alfred Stone, Providence. Corresponding Secretary, T. M. Clark, Boston.

The time and place of the next annual convention were left to the Board of Trustees, with a request that Washington be selected.

Vennor's Winter Predictions.

He communicates as follows to the *Albany Argus*: "December will, in all probability, open with little snow, but the weather will be cloudy, threatening snow falls. During the opening days of the month, dust, with the very light mixture of snow which may have fallen, will be swept in flurries by the gusty wind. There will probably be some snow from about the 4th of the month. With the second quarter of the month colder weather will probably set in with falls of snow. The farmers will be able to enjoy sleigh rides in the cold, exhilarating air, but good sleighing need not be expected until after the middle of the month. There will be a spell of mild weather about the 13th and 14th. After a brief interval of mild weather, during which more snow will fall, the third quarter of the month will probably see blustering and cold weather—a cold snap with heavy snow storms and consequent good sleighing. Very cold weather may be expected during this quarter. The last quarter of the month will bring milder weather, but will terminate, probably, with heavy snow-falls and stormy weather; in fact, the heaviest snow falls will be toward the end of the month, and snow blockades may be looked for, the snow falls extending far to the southward, possibly as far as Washington, with very

stormy weather around New York and Boston." Mr. Vennor's latest predictions are that the coming month will be "decidedly cold, with tremendous snow-falls during the latter half and early part of January, causing destructive blockades to railroads."

The London Underground Railway.

The opening recently of the extension of the Metropolitan Railway to Harrow, and the early commencement of another of the lines of the company, give especial prominence to it. The Metropolitan Underground Railway is emphatically the great passenger railway of the country, for its few miles of line carry more than the hundreds of miles of line of companies such as the London and North Western or Great Western. Seventeen years ago—in 1863—the Metropolitan carried less than 10,000,000 passengers, and in the full year's work of the following twelve months it carried less than 12,000,000. But year by year, almost without exception, the number of passengers has grown. In 1865, over 15,000,000 passengers were carried; in 1867, over 23,000,000; and in 1870, over 39,000,000 passengers traveled on the line. The years that have since passed have swollen that number. In 1872, over 44,300,000 were carried, but in the following year there was one of the few checks, and not till 1875 was the number of 1872 exceeded. In 1875 it rose to 48,302,000; in 1877 it had advanced to 56,175,000; in 1878 to 58,807,000; and in 1879 to 60,747,000. In the present year there has been a further advance, the number carried for the first six months of the present year being 31,592,429. When it is borne in mind that this is equal to 7,272 passengers every hour, and that the length of line worked by the company's engines, including that of the "foreign" line worked, is slightly less than 25 miles, the fecundity in traffic of the metropolitan district must be said to be marvelous. It is to be regretted that the official account from which these figures are given does not give any idea of the number of passengers in the different classes, for such a return would be of value. It is a marvelous fact in the history of locomotion that this great passenger traffic is worked with not more than 53 engines, while the total number of carriages, 195, is in comparison with the number of travelers in them a marvel in railway history. But it is tolerably clear that there is yet a vast amount of undeveloped metropolitan traffic, and it is also certain that as that traffic is developed the future of the Metropolitan as it attains more completeness will be brighter even than it has been in the past. The great city is more and more the mart of the world, and the traffic and travel to and in it must increase. That increase will be shared in considerable degree by the "underground" companies, and as they have shown that their capabilities of traffic are almost boundless, it may be expected that the oldest and the chief of these will in the early future know a growth as continuous if less rapid than in the past.

We take the above from the *Engineer*, London. In this city there are now existing 27 miles of elevated steam railways for local passenger traffic. These roads have carried during the past year 61,000,000 of passengers. In this service they employ 175 locomotives and 500 passenger cars. It is a terrible nuisance to have these locomotives and cars constantly whizzing through the public streets; still the roads are a great accommodation. The only underground railway in this city is that of the New York Central and Hudson River, 4 miles in length, extending under Fourth avenue from Forty-second street to Harlem River. Over this road the enormous traffic of the Central, Harlem, and the New Haven roads, with their connections, passes. But so removed from public sight are the cars and locomotives that the existence of this underground railway is almost forgotten.

Tempering Chisels.

A practical mechanic communicates to the *SCIENTIFIC AMERICAN* the following: In hardening and tempering a cold chisel care should be taken to have a gradual shading of temper. If there is a distinct boundary line of temper color between the hard cutting edge and softer shank portion, it will be very apt to break at or near that line. The cutting edge portion of the chisel should be supported by a backing of steel gradually diminishing in hardness; and so with all metal cutting tools that are subjected to heavy strain. Not every workman becomes uniformly successful in this direction, for, in addition to dexterity, it requires a nice perception of degree of heat and of color in order to obtain the best result.

Mr. A. A. KNUDSON, of Brooklyn, N. Y., has lately perfected and patented a system of protecting oil tanks from lightning, which is approved by several prominent electricians. The invention includes a device for distributing a spray of water over the top of the tank for condensing the rising vapor and cooling the tank; a system of lightning conductors connected with a gutter surrounding the tank, and a hollow earth terminal connected with the gutter by a pipe, and designed to moisten the earth, and at the same time prevent the earth around the terminal from becoming saturated with oil.

A CORRESPONDENT of the *Christian Union*, writing from Constantinople, says that Abd ul-Hamid, the Sultan of Turkey, reads the *SCIENTIFIC AMERICAN*, the engravings in which seem to specially interest him. The writer adds that whatever in literature the Sultan may chance to hear of which he thinks may interest him, he has translated into Turkish.

AMATEUR MECHANICS.

A SIMPLE SINGLE-ACTING STEAM ENGINE.

The great bugbear staring the amateur mechanic in the face when he contemplates making a small steam engine is the matter of boring the cylinder. To bore an iron cylinder on a foot lathe is difficult even when the lathe is provided with automatic feed gear, and it is almost impossible with the ordinary light lathe possessed by most amateurs. To bore a brass cylinder is easier, but even this is difficult, and the cylinder, when done, is unsatisfactory on account of the difficulty of adapting a durable piston to it.

The engravings show a simple steam engine, which requires no difficult lathe work; in fact the whole of the work may be done on a very ordinary foot lathe. The engine is necessarily single-acting, but it is effective nevertheless, being about 1-20 H. P., with suitable steam supply. It is of sufficient size to run a foot lathe, scroll saw, or two or three sewing machines.

The cylinder and piston are made from mandrel drawn brass tubing, which may be purchased in any desired quantity in New York city. The fittings are mostly of brass, that being an easy metal to work.

The principal dimensions of the engine are as follows:

Cylinder.—Internal diameter, $1\frac{1}{4}$ in.; thickness, $\frac{1}{8}$ in.; length, $3\frac{1}{4}$ in.

Piston.—External diameter, $1\frac{1}{4}$ in.; thickness, $3\frac{3}{4}$ in.; length, $3\frac{1}{4}$ in.

Length of stroke, 2 in.

Crank pin.—Diameter, $\frac{1}{4}$ in.; length of bearing surface, $\frac{1}{2}$ in.

Connecting rod.—Diameter, $5\frac{1}{16}$ in.; length between centers, $5\frac{1}{4}$ in.

Shaft.—Diameter, $\frac{1}{2}$ in.; diameter of bearings, $\frac{1}{4}$ in.; length, 6 in.; distance from bed to center of shaft, $1\frac{1}{4}$ in.

Flywheel.—Diameter, 8 in.; weight, 10 lb.

Valve.—Diameter of chamber, $9\frac{1}{16}$ in.; length, $1\frac{1}{4}$ in.; width of valve face working over supply port, $3\frac{3}{4}$ in.; width of space under valve, $\frac{1}{4}$ in.; length of the same, 1 in.; distance from center of valve spindle to center of eccentric rod pin, $\frac{3}{4}$ in.

Ports, supply.—Width, $1\frac{1}{16}$ in.; length, 1 in. Exhaust.—Width, $\frac{1}{4}$ in.; length, 1 in.; space between ports, $5\frac{1}{16}$ in.

Pipes.—Steam supply, $\frac{1}{4}$ in.; exhaust, $\frac{1}{4}$ in.

Eccentric.—Stroke, $\frac{1}{4}$ in.; diameter, $1\frac{1}{16}$ in.

Length of eccentric rod between centers, $8\frac{3}{4}$ in.

Cut off, $\frac{1}{4}$

Thickness of base plate, $\frac{1}{4}$ in.

Wooden base, $6\frac{1}{4}$ in x 8 in.; $2\frac{1}{4}$ in. thick.

Thickness of plate supporting cylinder, $\frac{1}{4}$ in.

Total height of engine, $13\frac{1}{4}$ in.

Distance from base plate to under side of cylinder head, $9\frac{1}{4}$ in.

Diameter of vertical posts, $9\frac{1}{16}$ in.; distance apart, $3\frac{1}{4}$ in.; length between shoulders, $6\frac{1}{4}$ in.

Base plate fastened to base with $\frac{1}{4}$ in. bolts.

The connecting rod, eccentric rod, crank pin, and shaft, are of steel. The eccentric-rod and flywheel are cast iron, and the other portions of the engine are of brass. The screw threads are all chased, and the flange, *a*, and head of the piston, *F*, in addition to being screwed, are further secured by soft solder.

Fig. 1 shows the engine in perspective. Fig. 2 is a side elevation, with parts broken away. Fig. 3 is a vertical transverse section. Fig. 4 is a partial plan view. Fig. 5 is a detail view of the upper end of the connecting rod and its connections; and Fig. 6 is a horizontal section taken through the middle of the valve chamber.

The cylinder, *A*, is threaded externally for 1 inch from its lower end, and the collar, *a*, $\frac{1}{4}$ inch thick, is screwed on and soldered. The face of the collar is afterward turned true. The same thread answers for the nut which clamps the cylinder in the plate, *B*, and for the gland, *b*, of the stuffing box, which screws over the beveled end of the cylinder, and contains fibrous packing filled with asbestos or graphite. The posts, *C*, are shouldered at the ends and secured in their places by nuts. Their bearing surface on the plate, *D*, is increased by the addition of a collar screwed on. The posts are made from drawn rods of brass, and need no turning except at the ends.

The cylinder head, *E*, which is a casting containing the valve chamber, is screwed in. The piston, *F*, fits the cylinder closely, but not necessarily steam tight. The head is screwed in and soldered, and the yoke, *G*, which receives the connecting rod pin, is screwed into the head. The connecting rod, *H*, is of

steel with brass ends. The lower end, which receives the crank pin, is split, and provided with a tangent screw for taking up wear. The crank pin is secured in the crank disk, *I*, by a nut on the back. The eccentric rod, *J*, is of steel, screwed at its lower end into an eccentric strap of cast or wrought iron, which surrounds the eccentric, *K*.

The valve, *L*, is slotted in the back to receive the valve spindle, by which it is oscillated. The ports are formed by

It is desirable to construct a flat pasteboard model to verify measurements and to get the proper adjustment of the valve before beginning the engine. M.

MISCELLANEOUS INVENTIONS.

An improved finger ring has been patented by Mr. David Untermyer, of New York city. The object of this invention is to furnish finger rings so constructed that they can be opened out to represent serpents, and which, when being worn, will give no indication of being anything more than rings.

An improved heel skate-fastener has been patented by Mr. Elijah S. Coon, of Watertown, N. Y. This invention consists, essentially, of a screw-threaded hollow plug or thimble, a dirt plate for covering the opening in the plug, and a spring for holding the dirt plate in place. This fastener possesses several advantages over one that is permanently attached to the heel. Being cylindrical, it is more easily connected, because the hole for its reception can be made with a common auger or bit without the necessity for last- ing the boot or shoe or using a knife or chisel. Being screw threaded it can be readily screwed into place with a common screwdriver; this also enables it to be screwed either in or out, in order to make it fit the heel key. The screw thread permits of screwing it in beyond the surface of the heel, so as to prevent it from wearing out by the ordinary wearing of the shoe.

An improved velocipede has been patented by Messrs. Charles E. Tripler and William H. Roff, of New York city. The object of this invention is to obtain a more advantageous application of the propelling power than the ordinary cranks, to avoid the noise of pawls and ratchets, and to guard the velocipedes against being overturned should one of the rear wheels pass over an obstruction.

Mr. Philip H. Paxon, of Camden, N. J., has patented a machine that will cut lozenges in a perfect manner, and will not be clogged by the gum and sugar of the lozenge dough.

Mr. John H. Robertson, of New York city, has patented an improved mat, which consists of longitudinal metal bars provided with alternate mortised and tenoned ends, and composed of series of sockets united by webs and of wooden transverse rods entered through said sockets and held therein by vertical pins.

Mr. Charles F. Clapp, of Ripon, Wis., has patented a novel arrangement of a desk attachment for trunks. The desk and tray may be lifted from the trunk when the desk is either raised or lowered.

A combined scraper, chopper, and dirter has been patented by Messrs. Francis A. Hall and Nathaniel B. Milton, of Monroe, La. The object of this invention is to furnish an implement so constructed as to bar off a row of plants, chop the plants to a stand, and dirt the plants at one passage along the row, and which shall be simple, convenient, and reliable.

Mr. Hermann H. Cammann, of New York city, has patented a basket so constructed that it can be compactly folded for transportation or storage.

Messrs. David H. Seymour and Henry R. A. Boys, of Barrie, Ontario, Canada, have patented an improvement in that class of devices that are designed to be applied to steam cylinders for introducing oil or tallow into the cylinder and upon the cylinder valves. It consists of an oil cup provided with a gas escape, a scum breaker, an interior gauge, and an adjustable feed pipe extension.

Mr. John H. Conrad, of Charlotte, Mich., has patented a portable sliding gate which will dispense with hinges and which can be used in any width of opening. It may be readily connected with a temporary opening or gap made in the fence.

An improved reversible pole and shaft for vehicles has been patented by Mr. Francis M. Heuett, of Jug Tavern, Ga. The object of this invention is to so combine the parts of shafts for vehicles that they may be readily transposed and re-employed to form the tongue without removing the thill arms or hounds from the axle.

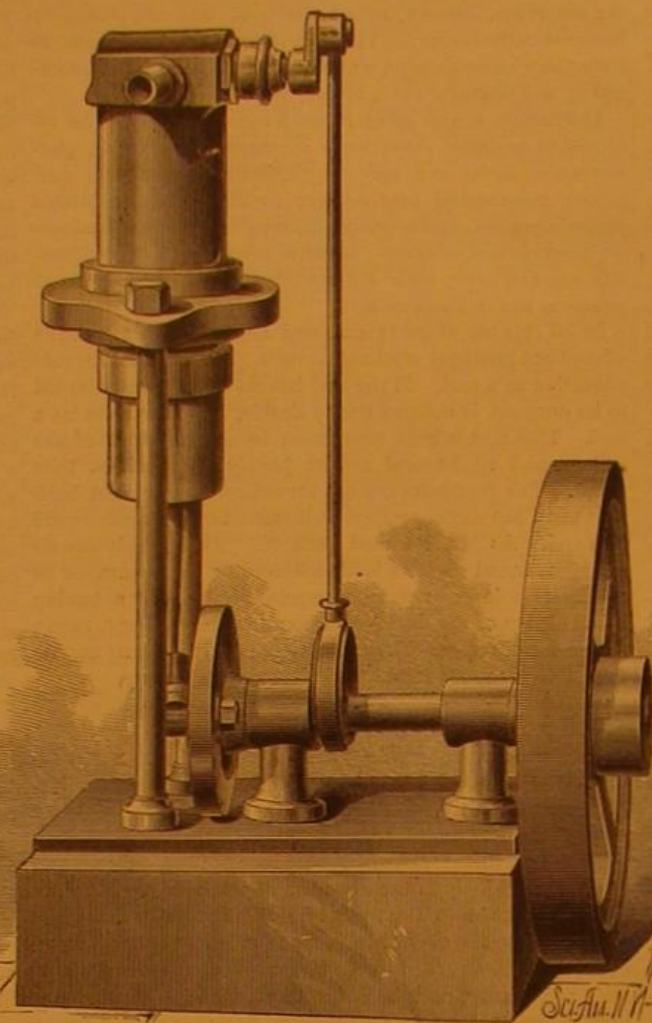
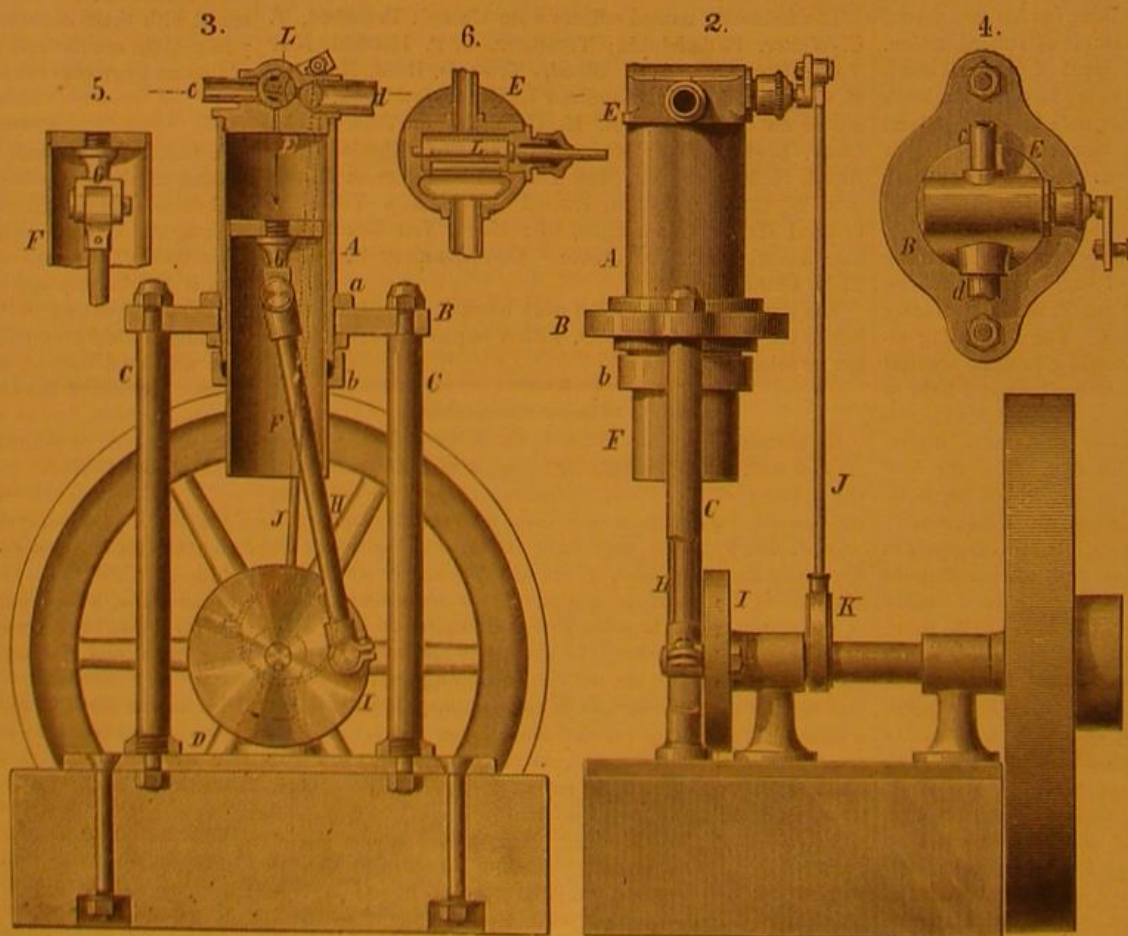


Fig. 1.—SIMPLE SINGLE-ACTING STEAM ENGINE.



SIDE ELEVATION, SECTIONAL, AND DETAIL VIEWS OF SIMPLE ENGINE.

drilling from the outside, and afterward forming the slot with a graver or small sharp chisel. The supply port, for convenience, may be somewhat enlarged below. The holes for the exhaust port will be drilled through the hole into which the exhaust pipe is screwed. The chamber communicating with the exhaust is cored out in the casting.

The easiest way to make the valve is to cut it out of a solid cylinder turned to fit the valve chamber.

An engine of this kind will work well under a steam pressure of 50 lb., and it may be run at the rate of 200 to 250 revolutions per minute.

Mr. William Jones, of Kalamazoo, Mich., has patented an improved box which is useful for various purposes, but is particularly intended for shipping fourth class mail matter. The feature of special novelty is the means of fastening the hinged cover.

Mr. Louis J. Halbert, of Brooklyn, N. Y., has patented an improved slate cleaner, which is simple, convenient, and effective.

An improved boot, which is simple in its make, fits well, and is convenient to put on and take off, has been patented by Ellene A. Bailey, of St. Charles, Mo. The boot is provided with side seams, one of which is open at its lower end, and is provided with lacing, buttons, or a like device, so that it can be closed when the boot is on the wearer's foot.

THE HERCULES BEETLE.

In the handsome engraving herewith are shown the male and female of the Hercules beetle (*Dynastes hercules*) of Brazil. The family of the *Dynastidae* comprises some of the largest and most beautiful of the beetle race, and all of them are remarkable for enormous developments of the thorax and head. They are all large bodied and stout limbed, and by their great strength abundantly justify their generic name, *Dynastes*, which is from the Greek and signifies powerful. The larvae of these beetles inhabit and feed upon decaying trees and other rotting vegetable matter, and correspond in size with the mature insects. Most of them inhabit tropical regions, where they perform a valuable service in hastening the destruction of dead or fallen timber.

An admirable example of this family of beetles is the one here represented. In the male of the Hercules beetle the upper part of the thorax is prolonged into a single, downward curving horn fully three inches long, the entire length of the insect being about six inches. The head is prolonged into a similar horn, which curves upward, giving the head and thorax the appearance of two enormous jaws, resembling the claw of a lobster. The real jaws of the insect are underneath the lower horn, which projects from the forepart of the head. The under surface of the thorax-horn carries a ridge of stiff, short, golden-yellow hairs, and the under surface and edges of the abdomen are similarly ornamented.

The head, thorax, and legs are shining black; the elytra, or wing-covers, are olive-green, dotted with black spots, and are much wrinkled. The wings are large and powerful.

The female Hercules is quite unlike the male. It is much smaller, being not more than three and a half inches long, is without horns, and is covered with a brown hairy felt.

These beetles are nocturnal in habit, and are rarely seen in the daytime, except in dark hiding places in the recesses of Brazilian forests.

A Poulterer's View of Mechanical Poultry Raising.

A prominent dealer in poultry, Mr. H. W. Knapp, of Washington Market, gives a discouraging opinion of the probable success of chicken raising by artificial means in this country. He said recently when questioned on this subject by a representative of the *Evening Post*:

"I went to France to study the matter, for if it can be made to succeed it will make an immense fortune, as it has already done in Paris. I was delighted with what I saw there, and the matter at first sight seems to be so fascinating that I do not wonder that new men here are always ready to take hold of it as soon as those who have bought dear experience are only too glad to get out of it. Even clergymen and actors are bitten with the desire to transform so many pounds of corn into so many pounds of spring chicken. The now successful manager, Mackaye, spent about a thousand dollars in constructing hatching machines and artificial mothers in Connecticut, but he found that the stage paid better, and his expensive devices may now be bought for the value of old tin.

"Enthusiasts will tell you that by the new discovery

chickens may be made out of corn with absolute certainty. In Paris this has been done; but the conditions are entirely different here. There the land is valuable, and they cannot devote large fields to a few hundred chickens; the French climate is so uniform that the markets of Paris cannot be supplied from the south with produce which ripens or matures before that of the neighborhood of Paris; the price of chickens is so high and labor so cheap that more care can be given with profit to one spring chicken than one of our poultry raisers could give to a dozen. Here we have plenty of land, the climate south of us is so far advanced in warmth that even with steam we cannot raise poultry ahead of the south, and the margin of profit is so small that one failure with a large batch of chickens sweeps away the profits from several successful experiments.

"When persons wanted me to go into the project I declined and was called an old fogey. One man spent a fortune on the enterprise in New Jersey, and at first was hailed as a public benefactor. What was the result of all his outlay

astrously than the chicken business. Size and weight are wanted in turkeys; and that reminds me," continued Mr. Knapp, "that the newspapers ought to impress the country people with the necessity of improving their poultry stock; breeding in and in is ruining poultry; every year the stock we receive is deteriorating, and this is the cause. I could give you some striking examples from my experience of forty years in the business. Some years ago we poulterers thought that ducks were going to disappear from bills of fare altogether; they were tasteless, worthless birds which people avoided. On Long Island a farmer made experiments in breeding with an old Muscovy drake, tough as an alligator, and the common duck. The result was superb and has changed the whole duck industry. If the farmers of Southern New Jersey, the sandy country best suited to turkeys, would bring from the West a few hundred wild turkeys we should have an immediate improvement. I see no such turkey now as we had twenty years ago. The breast is narrow and the body runs to length; it is all neck and legs, and can be bought by the yard. Rhode Island sends us the best turkeys, but they are not what they used to be. If, instead of attempting to beat nature at her own game, the rich men who have money to spend would devote it to better breeding, there would be an improvement. I do not yet despair of seeing immense farms wholly devoted to raising better poultry than we yet have."

The Embrace of the Mantis.

Mr. Addison Ellsworth favors us with a transcript of a letter from Mr. Albert D. Rust, of Ennis, Ellis County, Texas, describing a remarkable exhibition of copulative cannibalism on the part of the mantis. The ferocious nature of these strange insects is well known, and is in striking contrast with the popular name, "praying mantis," which they have gained by the pious attitude they take while watching for the flies and other insects which they feed upon.

About sunrise, August 28, 1880, Mr. Rust's attention was attracted by a pair of mantis, whether *Mantis religiosa* or not, he was not sure, but from the length of the body and the shortness of the wings he was inclined to think them of some other species. The female had her arms tightly clasped around the head of the male, while his left arm was around her neck. Mr. Rust watched intently to see whether the embrace was one of war or for copulation. It proved to be both. As the two abdomens began to approach each other the female made a ferocious attack upon the male, greedily devouring his head, a part of the body, and all the arm that had encircled her neck. A moment after the eating began, Mr. Rust observed a complete union of the sexual organs, and the eating and copulation went on together. On being forcibly separated the female exhibited signs of fear at her headless mate, and it was with difficulty that they were brought together again. On being suddenly tossed upon the back of the female the male seized her with a grasp from which she could not extricate herself, and immediately the sexual union was renewed, to all appearances as perfectly as before.

The pair were accidentally killed, otherwise, Mr. Rust thinks, the female would have continued her cannibalistic repast until she had devoured the entire body of her companion.

This peculiarity of the mantis seems not to have been observed before, though their mutually destructive disposition has been noted by several. Desiring to study the development of these insects, M. Roesel raised a brood of them from a bag of eggs. Though plentifully supplied with flies, the young mantis fought each other constantly, the stronger devouring the weaker, until but one was left.

M. Poiret was not more successful. When a pair of mantis were put together in a glass they fought viciously, the fight ending with the decapitation of the male and his being eaten by the female.



THE HERCULES BEETLE.

and work? He managed to hatch quantities of young chickens every February, but although he could fatten them by placing them in boxes and forcing a fattening mixture down their throats, he could not make them grow; they had no exercise; they remained puny little things, and another defect soon appeared; though fat they were tough and stringy. The breeder sent lots of them to me, and they looked fat and tender; but my customers complained that they could not be young, for they were tough and tasteless, and that I must have sold them aged dwarfs under the name of spring chickens. It was found absolutely necessary to let them run out of doors as soon as the weather allowed it, and by the time that they were ready for market the southern chickens were here and could be sold for less than these. The upshot of the business is that this breeder has sold out, and another man has now taken hold of a small part of his old establishment to try other methods of making it a success.

"As to raising turkeys in that manner it will fail more dis-

VARIATION OF LEAVES.

BY JAMES HOGG.

At the meeting of the Association of Nurserymen in Chicago, last July, one of our prominent horticulturists described leaf variegation as a disease. Incidentally this brought up the question: Does the graft affect the stock upon which it is inserted?

Much confusion of ideas exists upon this subject, largely due to a loose application of the term disease. Strictly speaking, this term is only applicable to that which shows the health of the plant to be impaired. It should be distinguished from aberrant or abnormal forms, for these are not necessarily indicative of disease. Nobody thinks of saying that red or striped roses are diseased because they are departures in color from the white flower of the type species; or that white, yellow, or striped roses are diseased when the color of the type species is red. Nobody thinks of saying that double flowers are evidences of disease in the plant, or that diminution in the size of leaves or variation in their form is a disease. Why then should it be said that because leaves may become of some other color than green, or become partly-colored, therefore they are diseased? If it be said that flowers are not leaves, and that therefore the analogy is not a good one, the reply is, that flowers in all their parts, and fruits also, are only leaves differently developed from the type. This fact is a proven one, and so admitted to be by all botanists and vegetable physiologists of the present day. If it be objected that, by becoming double, flowers lose the power of reproducing the variety or species, the answer is, that this loss of power is not necessarily the result of disease, but may arise from various other causes. Because an animal is castrated, it surely will not be claimed that therefore it is diseased. In man and in the higher animals the power of reproduction ceases at certain ages, but it cannot therefore be said that such men or animals are diseased. Neither is a redundancy of parts an unequivocal evidence of disease.

Topknot fowls and ducks are as healthy as those which do not have such appendages, and a Shetland pony is as healthy as a Percheron horse, notwithstanding the difference in their size and weight. Again, color in block or in variegation is not positive evidence of disease in animal life. The white Caucasian is as healthy as the negro, the copper-colored Malay as the red Indian. The horse, ox, and hog run through white and red to black both in solid and partly-colored, and all are equally healthy; so with the rabbit, dog, cat, and others of our domestic animals. In wild animals, birds, reptiles, fishes, and insects, it is the same, so that mere difference in color or combinations of color are not *prima facie* evidence of disease.

But some will say this may be true of animal life, but not of plant life. That there is a strong and evident analogy, the one with the other, is now universally admitted by physiologists. Formerly many physiologists considered leaf variegation a disease, because it generally ran in stripes lengthwise of the leaf or in spots. In the former case it was supposed to originate from disease in the leaf cells of the leaf stalk, which, as the cells grow longitudinally, naturally prolonged it to the end of the leaf. But the originating of varieties in which the variegation did not assume this form, with other considerations, has done much to upset this theory. In the variegated leaved snowberry we have the center and border of the leaf green, separated the one from the other by an isolated white or yellow zone. In the zebra-leaved eulalia and the zebra-leaved juncus, from Japan, we have the variegation of the leaf transversely instead of longitudinally, so that according to the old theory we have the anomaly of a healthy portion of the leaf producing an unhealthy portion, and that again a healthy one, and thus alternately along the whole length of the leaf.

When we dissect a leaf in its primal development, we find that its cells contain colorless globules, by botanists called chlorophyll or phyto-color; these undergo changes according as they are acted upon by light, oxygen, or other agents, producing green, yellow, red, and other tints. This chlorophyll only exists in the outer or superficial cells of the parenchyma or cellular tissue of the leaf, and thus differs from starch and other substances produced in the internal cells, from which the light is more or less excluded. It is a fatty or wax-like substance, readily dissolved in alcohol or ether. The primal color of all leaves and flowers is white or a pale yellowish hue, as can readily be seen by cutting open a leaf or flower bud. The seed leaves of the French bean are white when they come out of the earth, but they become green an hour afterward under the influence of bright sunshine. A case is on record where in a certain section, some miles in extent, in this country, about the time of the trees coming into leaf, the sun did not shine for twenty days; the leaves developed to nearly their full size, but were of a pale or whitish color; finally, one forenoon the sun shone out fully, and by the middle of the afternoon the trees were in full summer dress. These facts show that the green color of leaves is due to the action of light. Variegation is sometimes produced independently of the chlorophyll, as in *Begonia argyrostigma* and *Carduus marianus*, in which it is produced by a layer of air interposed between the epidermis or outer skin of the leaf and the cells beneath; this gives the leaf a bright, silvery appearance.

To what, then, are we to ascribe leaf variegation? I think that it is entirely due to diminished root power; by this I do not mean that the roots are diseased, but that they are either in an aberrant or abnormal state; but disease cannot be predicated upon either of these states. To explain: everybody knows *Spiraea callosa* to be a strong growing shrub, having

umbels of rosy-colored flowers and strong, stout roots; the white flowered variety is quite dwarf, is more leafy and bushy than the species, and has more fibrous and delicate roots than the type; the crisp-leaved variety is still more dwarf, very bushy, and very leafy, and has very fine thread-like roots. This would indicate that the aberrance is in the roots; the two varieties are much more leafy in proportion to their size than the species, so that if the leaves controlled the roots, the latter should have been larger in proportion than those of the species. Again, once when, in the autumn, I was preparing my greenhouse plants for their winter quarters, I cut back a "Lady Plymouth" geranium, which chanced to be set away in a cool and somewhat damp cellar. When discovered the following February and started into growth in the greenhouse it produced nothing but solid green leaves, and never afterward produced a variegated leaf. This I attributed to its having gained greater root power during its long season of rest. By this I mean that the roots had grown and greatly increased in size, although there had not been any leaf growth. That roots under certain circumstances do so is well known. The roots of fir trees have been found alive and growing forty five years after the trunks were felled. The same has occurred in an ash tree after its trunk had been sawn off level with the ground. A root of *Ipomoea sellowii* has been known to keep on growing for twelve years after its top had been destroyed by frost; and in all that time it never made buds or leaves, yet it increased to seven times its original weight. The tuberous roots of some of the *Tropaeolum*s will continue to grow and increase in size after the tops have been accidentally broken off; and potatoes buried so deep in the earth that they cannot produce tops will produce a crop of new potatoes.

On the other hand, I have had an oak-leaved geranium overlooked in a corner of the greenhouse until it was almost dried up for lack of water. When its branches were pruned back and it was started into growth only one branch showed the almost black center of the leaf, all the rest were clear green. This was an evident case of diminished root power, but the plant grew as thriftily as ever. The lack of the dark marking in the leaves was equivalent to the variegation in other varieties, only in a reverse direction.

In practice, when gardeners wish to produce an abnormal condition in a tree or plant, they will, if they wish to dwarf it, graft it on a species or variety of diminished root power, and contrariwise, if they wish to increase its growth, will graft it upon a stock of strong root power. But in neither case can the graft be said to be diseased by the action of the roots of the stock.

When this root power is so far diminished as to produce complete albinism, the shoots from such roots appear to partake of this diminished power, and to lose the power of making roots, and thus become very difficult to propagate. It is sometimes said that albino cuttings cannot be rooted at all, but this is a mistake, for I have succeeded in striking such cuttings from the variegated leaved *Hydrangea*. It required much care to do it; they did not, however, retain their albino character after they rooted and started into growth.

Albinism and white variegation in leaves appear to be due to the chlorophyll in such leaves being able to resist the action of the three (red, yellow, and blue) rays of light. What we call color in any substance or thing is due to its reflecting these different rays in various proportions of combination and absorbing the rest of them, the various proportions giving the various shades of color. White is due to the reflection of all of them, and black to the absorption of them. In some plants with variegated foliage we have the curious fact that the cells containing chlorophyll reflecting one color produce cells which reflect an entirely different color. In the coleus "Lady Burrill," for instance, the lower half of the leaf is of a deep violet-crimson color, and the upper half is golden yellow. In other varieties of coleus, in *Perilla nankiensis*, and other plants, we have foliage without a particle of green in it, and yet they are perfectly healthy. This shows that green leaves are not absolutely necessary to the health of a plant.

As a proof of leaf variegation being a disease, the speaker alluded to cited a case in which a green leaved abutilon, upon which a variegated leaved variety had been grafted, threw out a variegated leaved shoot below the graft. This can easily be explained. The growth of the trunk or stem of all exogenous plants, or those which increase in size on the outside of the stem, is brought about by the descent of certain formative tissue called cambium, elaborated by the leaves and descending between the old wood and the bark, where it is formed into alburnum or woody matter. Some think that it is also formed by the roots and ascends from them as well as descending from the leaves. Be this as it may, there is no doubt about its descent. In such comparatively soft-wooded, free growing plants as the abutilon the descent of the cambium is very free and in considerable quantity, so that the stock would soon be inclosed in a layer of it descending from the graft. When being converted into woody matter it also forms adventitious buds which under certain favorable circumstances will emit shoots of the same character as the graft from which it was derived. The graft is such cases may be said to inclose the stock in a tube of its own substance, leaving the stock unaffected otherwise. The variegated shoot in this case was in reality derived from the downward growth of the graft and not from the original stock, which was not therefore contaminated by the graft. In cases where the stock is of much slower growth than the graft, or the graft is inserted upon

a stock of some other species, the descending cambium does not inclose the stock, but makes layers of wood on the stem of the graft, which thus, as is frequently seen, overgrows the stock, sometimes to such an extent as to make it unsightly. Nobody ever saw an apple shoot from a crab stock, a pear from a quince stock, or a peach shoot from a plum stock. This is one of the arguments in favor of the view that cambium also rises from the roots.

Again, to show that the stock is not affected by the graft, or the graft by the stock, except as to root power, let any person graft a white beet upon a red beet, or contrariwise, when about the size of a goosequill, and when they have attained their full growth, by dividing the beet lengthwise he will find the line of demarkation between the colors perfectly distinct, neither of them running into the other.

The theory that leaf variegation is a disease has been held by many distinguished botanists and is in nowise new. But this theory has been controverted, and we think successfully, by other botanists, and it is not now accepted by the more advanced vegetable physiologists. There are now so many acute and industrious students and observers in every department of science, and the accumulation of facts is so rapid and so great, that very many of the older theories are being set aside as not in accord with the newly discovered facts. A student brought up in institutions where the old theories are inculcated has afterward to spend half his time in unlearning what he had been previously taught, and the other half in studying the new facts brought to his notice and testing the theories promulgated by men of science. Botanical science does not wholly consist in the classification and nomenclature of plants, but largely consists in a knowledge of vegetable anatomy and physiology, and these require much study and some knowledge of other sciences, such as chemistry, meteorology, geology, etc. Without such general knowledge it is difficult to form a harmonious theory in regard to any of the phenomena of plant life.

Vanilla, Cinnamon, Cocoanut.

The following interesting facts concerning the cultivation of the above products in the island of Ceylon, were given in Mr. H. B. Brady's recent address before the British Pharmaceutical Conference at Swansea:

The vanilla plant is trained on poles placed about twelve or eighteen inches apart—one planter has a line of plants about three miles in length. Like the cardamom, it yields fruit after three years, and then continues producing its pods for an indefinite period.

The cinnamon (*Cinnamomum zeylanicum*) is, as its name indicates, a native of Ceylon. It is cultivated on a light sandy soil about three miles from the sea, on the southwest coast of the island, from Negumbo to Matura. In its cultivated state it becomes really productive after the sixth year, and continues from forty to sixty years. The superintendent of the largest estate in this neighborhood stated that there were not less than fifteen varieties of cinnamon, sufficiently distinct in flavor to be easily recognized. The production of the best so injures the plants that it does not pay to cut this at any price under 4s. 6d. to 5s. per lb. The estate alluded to above yields from 30,000 to 40,000 lb. per annum; a uniform rate of 4½d. per lb. of finished bark is paid for the labor. Cinnamon oil is produced from this bark by distillation; the mode is very primitive and wasteful. About 40 lb. of bark, previously macerated in water, form one charge for the still, which is heated over a fire made of the spent bark of a previous distillation. Each charge of bark yields about three ounces of oil, and two charges are worked daily in each still.

The cultivation of the cocoanut tree and the production of the valuable cocoanut oil are two important Cingalese occupations. These trees, it appears, do not grow with any luxuriance at a distance from human dwellings, a fact which may perhaps be accounted for by the benefit they derive from the smoke inseparable from the fires in human habitations. The cultivation of cocoanuts would seem to be decidedly profitable, as some 4,000 nuts per year are yielded by each acre, the selling price being £3 per thousand, while the cost of cultivation is about £2 per acre. In extracting the oil, the white pulp is removed and dried, roughly powdered, and pressed in similar machinery to the linseed oil crushing mills of this country. The dried pulp yields about 60 per cent by weight of limpid, colorless oil, which in our climate forms the white mass so well known in pharmacy.

Learning to Tie Knots.

A correspondent suggests that it would be a handy accomplishment for schoolboys to be proficient in the handling, splicing, hitching, and knotting of ropes. He suggests the propriety of having the art taught in our public schools. A common jackknife and a few pieces of clothes line are the main appliances needed to impart the instruction with. He concludes it would not only be of use in ordinary daily life, but especially to those who handle merchandise and machinery. Any one, he adds, who has noticed the clumsy haphazard manner in which boxes and goods are tied for hoisting or for loading upon trucks, will appreciate the advantage of practical instruction in this direction. Probably a good plan, he further suggests, would be to have one schoolboy taught first by the master, and then let the pupil teach the other boys. Our correspondent thinks most boys would consider it a nice pastime to practice during recess and at the dinner hour, so that no time would be taken from study or recitation time.

DECISIONS RELATING TO PATENTS. Supreme Court of the United States

PEARCE vs. MULFORD et al.

Appeal from the Circuit Court of the United States for the Southern District of New York.

1. Reissued patent No. 5,774 to Shubael Cottle, February 24, 1874, for improvement in chains for necklaces, declared void, the first claim, if not for want of novelty, for want of patentability, and the second for want of novelty.

2. Neither the tubing, nor the open spiral link formed of tubing, nor the process of making either the open or the closed link, nor the junction of closed and open spiral links in a chain, was invented by the patentee.

3. All improvement is not invention and entitled to protection as such. Thus to entitle it it must be the product of some exercise of the inventive faculties, and it must involve something more than what is obvious to persons skilled in the art to which it relates.

The decree of the circuit court is therefore reversed, and it is ordered that the bill be dismissed.

By the Commissioner of Patents.

DICKSON vs. KINSMAN.—INTERFERENCE.—TELEPHONE.

The subject matter of the interference is defined in the preliminary declaration thereof as follows:

The combination in one instrument of a transmitting telephone and a receiving telephone, so arranged that when the mouthpiece of the speaking or transmitting telephone is applied to the mouth of a person, the orifice of the receiving telephone will be applied to his ear.

1. While it is true that the unsupported allegations of an inventor, that he conceived an invention at a certain date, are not sufficient to establish such fact, the testimony of a party that he constructed and used a device at a certain time is admissible.

2. Abandonment is an ill-favored finding, which cannot be presumed, but must be conclusively proven.

The decision of the Board of Examiners-in-Chief is reversed, and priority awarded to Dickson.

Characteristics of Arctic Winter.

Lieutenant Schwatka, whose recent return from a successful expedition in search of the remains of Sir John Franklin's ill-fated company, combats the prevalent opinion that the Arctic winter, especially in the higher latitudes, is a period of dreary darkness.

In latitude 83° 20' 20" N., the highest point ever reached by man, there are four hours and forty-two minutes of twilight on December 22, the shortest day in the year, in the northern hemisphere. In latitude 82° 27' N., the highest point where white men have wintered, there are six hours and two minutes in the shortest day; and latitude 84° 32' N., 172 geographical miles nearer the North Pole than Markham reached, and 328 geographical miles from that point, must yet be attained before the true Plutonic zone, or that one in which there is no twilight whatsoever, even upon the shortest day of the year, can be said to have been entered by man. Of course, about the beginning and ending of this twilight, it is very feeble and easily extinguished by even the slightest mists, but nevertheless it exists, and is quite appreciable on clear cold days, or nights, properly speaking. The North Pole itself is only shrouded in perfect blackness from November 13 to January 29, a period of seventy-seven days. Supposing that the sun has set (supposing a circumpolar sea or body of water unlimited to vision) on September 24, not to rise until March 18, for that particular point, giving a period of about fifty days of uniformly varying twilight, the pole has about 188 days of continuous daylight, 100 days of varying twilight, and 77 of perfect inky darkness (save when the moon has a northern declination) in the period of a typical year. During the period of a little over four days, the sun shines continuously on both the North and South Poles at the same time, owing to refraction parallax, semi-diameter, and dip of the horizon.

The Collins Line of Steamers.

The breaking up of the Baltic, the last of the famous Collins line of steamships, calls out a number of interesting facts with regard to the history of the several vessels of that fleet. There were five in all, the Adriatic, Atlantic, Pacific, Arctic, and Baltic. They were built and equipped in New York. Their dimensions were: Length, 290 feet; beam, 45 feet; depth of hold, 31½ feet; capacity, 2,800 tons; machinery, 1,000 horse power. In size, speed, and appointments they surpassed any steamers then afloat, and they obtained a fair share of the passenger traffic. A fortune was expended in decorating the saloons. The entire cost of each steamer was not less than \$600,000, and notwithstanding their quick passages, the subsidy received, and the high rates of freight paid, the steamers ran for six years at great loss, and finally the company became bankrupt.

The Atlantic was the pioneer steamship of the line. She sailed from New York April 27, 1849, and arrived in the Mersey May 10, thus making the passage in about thirteen days, two of which were lost in repairing the machinery; the speed was reduced in order to prevent the floats from being torn from the paddle-wheels. The average time of the forty-two westward trips in the early days of the line was 11 days 10 hours and 26 minutes, against the average of the then so-called fastest line of steamers, 12 days 19 hours and 26 minutes. In February, 1852, the Arctic made the passage from New York to Liverpool in 9 days and 17 hours.

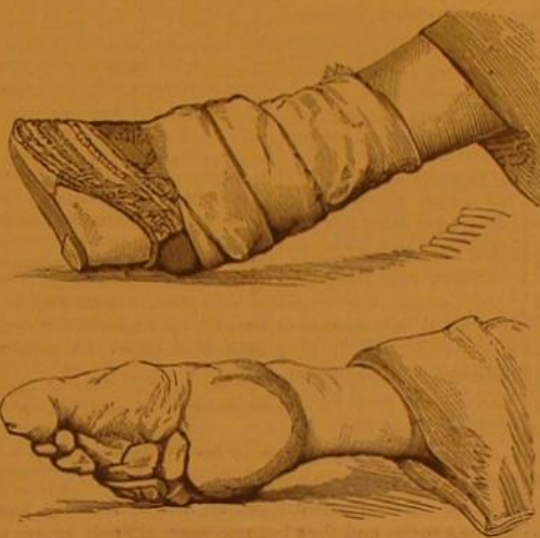
The Arctic was afterward run into by a French vessel at sea and only a few of her passengers were saved. The Pacific was never heard from after sailing from Liverpool, and all the persons on board were lost. The Atlantic, after rotting and rusting at her wharf, was deprived of her machinery and converted into a sailing vessel, and was broken up in New York last year. The Adriatic, the "queen of the fleet," made less than a half dozen voyages, was sold to the Galway Company, and is now used in the Western Islands as a coal hulk by an English company.

The Baltic was in the government service during the war as a supply vessel, and was afterward sold at auction; her machinery was removed and sold as old iron. She was then converted into a sailing ship, and of late years has been used as a grain carrying vessel between San Francisco and Great Britain. On a recent voyage to Boston she was strained to such an extent as to be made unseaworthy, and for that reason is to be broken up.

One cannot but remark in this connection how small has been the advance in steamship building during the quarter century since the Collins line was in its glory.

CHINESE WOMEN'S FEET.

An American missionary, Miss Norwood, of Swatow, recently described in a *Times* paragraph how the size of the foot is reduced in Chinese women. The binding of the feet is not begun till the child has learnt to walk. The bandages are specially manufactured, and are about two inches wide and two yards long for the first year, five yards long for subsequent years. The end of the strip is laid on the inside of



CHINESE WOMEN'S FEET.

the foot at the instep, then carried over the toes, under the foot, and round the heel, the toes being thus drawn toward and over the sole, while a bulge is produced on the instep, and a deep indentation in the sole. Successive layers of bandages are used till the strip is all used, and the end is then sewn tightly down. The foot is so squeezed upward that, in walking, only the ball of the great toe touches the ground. After a month the foot is put in hot water to soak some time; then the bandage is carefully unwound, much dead cuticle coming off with it. Frequently, too, one or two toes may even drop off, in which case the woman feels afterward repaid by having smaller and more delicate feet. Each time the bandage is taken off, the foot is kneaded to make the joints more flexible, and is then bound up again as quickly as possible with a fresh bandage, which is drawn up more tightly. During the first year the pain is so intense that the sufferer can do nothing, and for about two years the foot aches continually, and is the seat of a pain which is like the pricking of sharp needles. With continued rigorous binding the foot in two years becomes dead and ceases to ache, and the whole leg, from the knee downward, becomes shrunk, so as to be little more than skin and bone. When once formed, the "golden lily," as the Chinese lady calls her delicate little foot, can never recover its original shape.

Our illustrations show the foot both bandaged and unbandaged, and are from photographs kindly forwarded by Mr. J. W. Bennington, R. N., who writes: "It is an error to suppose, as many do, that it is only the Upper Ten among the daughters of China that indulge in the luxury of 'golden lilies,' as it is extremely common among every class, even to the very poorest—notably the poor sewing women one sees in every Chinese city and town, who can barely manage to hobble from house to house seeking work. The pain endured while under the operation is so severe and continuous that the poor girls never sleep for long periods without the aid of strong narcotics, and then only but fitfully; and it is from this constant suffering that the peculiar sullen or stolid look so often seen on the woman's face is derived. The origin of this custom is involved in mystery to the Westerns. Some say that the strong-minded among the ladies wanted to interfere in politics, and that there is a general liking for visiting, chattering, and gossip (and China women can chatter and gossip), both and all of which inclinations their lords desired, and desire, to stop by crippling them."

To the alteration and metamorphism of rocks by the infiltration of rain and other meteoric waters, M. De Koninck, of the Belgian Academy of Sciences, assigns the cause of many hitherto unexplained phenomena in geology.

Correspondence.

Ice at High Temperatures.

To the Editor of the Scientific American:

Your issues of October 23 and 30 contain some remarkable articles under the heading of "Ice at High Temperatures."

Prof. Carnelley says: "In order to convert a solid into a liquid, the pressure must be above a certain point, otherwise no amount of heat will melt the substance," as it passes at once from the solid state into the state of gas, subliming away without previous melting. And, "having come to this conclusion, it was easily foreseen that it would be possible to have solid ice at temperatures far above the ordinary melting point."

The first conclusion of the professor is correct, but not new. The second conclusion is new, but very doubtful as to its correctness, and certainly does not follow as a sequence from his premise.

If we try to heat ice in a vacuum, we cannot apply any heat to the ice direct, but only to the vessel containing the ice. The vessel may be much heated; but whether it will convey heat to the ice quick enough to heat it over 32°, and whether at all it can be heated over 32°, this is a question of a different nature. Before crediting such a conclusion we must know more of the details of the experiments which the professor made in order to verify its correctness. When saying that "on one occasion a small quantity of water was frozen in a glass vessel which was so hot that it could not be touched by the hand without burning it," he evidently assumes that if the vessel is hot, the ice inside must be equally so; but this assumption is erroneous. Faraday has made water to freeze in a red hot platina pot; the ice thus formed was not red hot like the platina, but was below the freezing point. Just so with Professor Carnelley's glass vessel: the vessel was hot, but the ice inside no doubt was "ice cold." If the professor would surround a thermometer bulb with ice and then make the mercury rise above the freezing point, we would believe in "hot ice;" not before. Until he does, we prefer to believe that the heat conveyed through the vessel to the ice is all absorbed in vaporizing the ice, and not in raising its temperature above 32°.

Professor Carnelley's further statement, apparently proving his theory, that the ice at once liquefies as soon as pressure is admitted (say by admitting air), is readily accounted for by the phenomena connected with the "Leydenfrost Drop." Water in a red hot vessel will vaporize off much slower than in a vessel heated a little above the boiling point, from the reason that in the red hot vessel no real contact takes place between the vessel and the water. At the place where the two ought to touch, steam is formed quicker than it can escape, which steam prevents the contact between vessel and water; therefore, as no real contact takes place, the heat from the vessel can pass into the water but slowly, viz., in the proportion as it works itself through the layer of steam, which in itself is a bad conductor. Just so in Prof. Carnelley's experiment: The heated glass vessel will convey heat to the ice only at those points where it touches the ice; at those points at once a formation of vapor takes place, which prevents an intimate contact between the glass and the ice, so that they do not really touch each other, consequently the heat can pass into the ice but slowly, having to work its way through the thin layer of rarefied vapor between the two. As soon as pressure is admitted by admitting atmospheric air, vapors can no longer form; an intimate contact will take place between the glass and the ice, and consequently the heat be conveyed over quick enough to make the ice melt away rapidly.

The professor's experiments, therefore, so far as published, do not prove anything to justify his strange conclusion. It is perfectly true that in a vacuum of less than 4-6 mm. mercury pressure, no amount of heat will melt ice, all heat that can be conveyed to the ice being absorbed by vaporization. But before crediting the professor's further conclusion, that ice can be heated much above the freezing point, he must actually produce "hot ice," not only a hot vessel containing ice.

N. J.
Brooklyn, N. Y., October 25, 1880.

Schools of Invention.

The school of invention has not yet been established, but its germ is growing in the mechanical schools. This school, according to Hon. W. H. Ruffner, in *Va. Ed. Journal*, will educate men, and women too, for the special career of inventing new things. Why not? We already have something closely analogous in schools of design, where the pupil is trained to invent new forms or patterns, chiefly of an artistic or decorative character. The same idea will be applied to the invention of machinery, or improvements in machinery, or the adaptation of machinery to the accomplishment of special ends. Inventions usually spring from individuals striving to lighten their own labor, or from some idea entering the brain of a genius. But we shall have professional inventors who will be called on to contrive original devices, and his success will depend on the sound and practical character of his prescriptions.

Proposed Exhibition of Bathing Appliances.

The Board of Health of this city has recently been notified that a Bacteriological Exhibition, to illustrate the various systems of bathing, bath appliances, and kindred matters, is to be held in Frankfurt-on-Main, Germany, next summer. The exhibition will last from May to September, 1881.

H. H. Heinrich, No. 41 Malden Lane, New York, Inventor, Patentee, and Sole Manufacturer of the Self-Adjusting Chronometer Balance, which is not affected by "extremes" of high and low temperatures, as fully demonstrated by a six months' test at the Naval Observatory at Washington, D. C., showing results in temperatures from 134° down to 18°, of 5.10 of a second only unparalleled in the history of horology and certified to by Theo. F. Kane, Esq., Commander U. S. N. in charge of the Observatory. Mr. Heinrich is a practical working mechanic and adjuster of marine and pocket chronometers to positions and temperatures, and is now prepared to apply his new balance wheel to any fine time-keeping instrument, either for public or private use; he also repairs marine and pocket chronometers, as well as all kinds of complicated watches, broken or lost parts made new and adjusted. Mr. Heinrich was connected for many years with the principal manufacturers of England, Geneva and Locle, Switzerland, and for the last fifteen years in the United States, and very recently with Messrs. Tiffany & Co., of Union Square, New York. Shipowners, captains naval and army officers, railroad and telegraph officials, physicians and horsemen, and all others wanting true time should send to him. Fine watches of the principal manufacturers, for whom he is their agent, constantly on hand. His office is connected by electric wires with the Naval Observatory's astronomical clock, through the Western Union Telegraph, thus giving him daily New York's mean time. Many years ago the British Government made an offer of £5,000 for a chronometer for her navy, keeping better time than the ones in use, but no European horologist ever discovered the sequel, which Mr. Heinrich has now worked out to perfection, overcoming the extremes, as stated above. With him is connected Mr. John F. Krugler, for thirty years connected with the trade as salesman.—Ade.

Toope's Felt and Asbestos Covering for Steam Pipes and other surfaces, illustrated on page 357, present volume, received a Medal of Excellence at the late American Institute Fair. See advertisement on another page.

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.

The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.

Chard's Extra Heavy Machinery Oil.
Chard's Anti-Corrosive Cylinder Oil.
Chard's Patent Lubricants and Gear Grease.
B. J. Chard, Sole Proprietor, 6 Burling Slip, New York.
Wanted—Superintendent for six thousand spindle cotton yarn mill. State salary and references. Rosalie Yarn Mills, Natchez, Miss.
Use Vacuum Oil Co.'s Lubricating Oil, Rochester, N.Y.
50,000 Sawyers wanted. Your full address for Emerson's Hand Book of Saws (free). Over 100 illustrations and pages of valuable information. How to straighten saws, etc. Emerson, Smith & Co., Beaver Falls, Pa.

Interesting to Manufacturers and Others.—The world-wide reputation of Asbestos Liquid Paints, Roofing, Roof Paints, Steam Pipe, Boiler Coverings, etc., has induced unscrupulous persons to sell and apply worthless articles, representing them as being made of Asbestos. The use of Asbestos in these and other materials for structural and mechanical purposes is patented, and the genuine are manufactured only by the H. W. Johns Mfg. Co., 87 Maiden Lane, New York.

Three requisites—pens, pins, and needles. The two latter you can get of any make, but when you want a good pen get one of Esterbrook's.

For Heavy Pumps, etc., see illustrated advertisement of Hilles & Jones, on page 385.

Frank's Wood Working Mach'y. See illus. adv., p. 382.
Painters' list of 65 good recipes. J. J. Callow, Cleveland, O.

Improved Speed Indicator. Accurate, reliable, and of a convenient size. Sent by mail on receipt of \$1.50. E. H. Gilman, 21 Doane St., Boston, Mass.

Astronomical Telescopes, first quality & low prices. Eye Pieces, Micrometers, etc. W. T. Gregg, 75 Fulton St., N.Y.

Engines. Geo. F. Shedd, Waltham, Mass.

The Mackinnon Pen or Fluid Pencil. The commercial pen of the age. The only successful reservoir pen in the market. The only pen in the world with a diamond circle around the point. The only reservoir pen supplied with a gravitating valve; others substitute a spring, which soon gets out of order. The only pen accompanied by a written guarantee from the manufacturer. The only pen that will stand the test of time. A history of the Mackinnon Pen: its uses, prices, etc., free. Mackinnon Pen Co. 20 Broadway, New York.

Among the numerous Mowing Machines now in use, none rank so high as the Eureka. It does perfect work and gives universal satisfaction. Farmers in want of a mowing machine will consult their best interests by sending for illustrated circular, to Eureka Mower Company, Towanda, Pa.

Peck's Patent Drop Press. See adv., page 383.

The Inventors Institute, Cooper Union Building, New York. Sales of patent rights negotiated and inventions exhibited for subscribers. Send for circular.

Fragrant Vanity Fair Tobacco and Cigarettes. 7 First Prize Medals—Vienna, 1873; Philadelphia, 1876; Paris, 1878; Sydney, 1879—awarded Wm. S. Kimball & Co., Rochester, N. Y.

Superior Malleable Castings at moderate rates of Richard P. Pim, Wilmington, Del.

Wood-Working Machinery of Improved Design and Workmanship. Cordeman, Egan & Co., Cincinnati, O.

The E. Stebbins Mfg. Co. (Brightwood, P. O.), Springfield, Mass., are prepared to furnish all kinds of Brass and Composition Castings at short notice; also Babcock Metal. The quality of the work is what has given this foundry its high reputation. All work guaranteed.

The "1880" Lace Cutter by mail for 50 cts.; discount to the trade. Sterling Elliott, 92 Dover St., Boston, Mass.

The Tools, Fixtures, and Patterns of the Taunton Foundry and Machine Company for sale, by the George Place Machinery Agency, 121 Chambers St., New York.

Improved Rock Drills and Air Compressors. Illustrated catalogues and information gladly furnished. Address Ingersoll Rock Drill Co., 14 Park Place, N. Y.

Mineral Lands Prospected, Artesian Wells Bored, by Pa. Diamond Drill Co. Box 423, Pottsville, Pa. See p. 349.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Corrugated Wrought Iron for Tires on Traction Engines, etc. Sole mfrs. H. Lloyd, Son & Co., Pittsburg, Pa. Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

Power, Foot, and Hand Presses for Metal Workers, Lowest prices. Peerless Punch & Shear Co., 51 Dey St., N.Y. Recipes and information on all Industrial Processes. Park Benjamin's Expert Office, 50 Astor House, N. Y.

For the best Slave, Barrel, Keg, and Hoghead Machinery, address H. A. Crossley, Cleveland, Ohio.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 40 John St., N. Y.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 349.

The Brown Automatic Cut-off Engine; unexcelled for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Fitchburg, Mass.

Gun Powder Pile Drivers. Thos. Shaw, 915 Ridge Avenue, Philadelphia, Pa.

For Separators, Farm & Vertical Engines, see adv. p. 349.

For Patent Shapers and Planers, see illus. adv. p. 349.

Best Oak Tanned Leather Belting. Wm. F. Forepaugh, Jr. & Bros., 381 Jefferson St., Philadelphia, Pa.

Slave, Barrel, Keg, and Hoghead Machinery a specialty, by E. & B. Holmes, Buffalo, N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

C. B. Rogers & Co., Norwich, Conn., Wood Working Machinery of every kind. See adv., page 348.

National Institute of Steam and Mechanical Engineering, Bridgeport, Conn. Blast Furnace Construction and Management. The metallurgy of iron and steel. Practical instruction in Steam Engineering, and a good situation when competent. Send for pamphlet.

Reed's Sectional Covering for steam surfaces; any one can apply it; it can be removed and replaced without injury. J. A. Locke, Agt., 32 Cortlandt St., N. Y.

Downer's Cleaning and Polishing Oil for bright metals, is the oldest and best in the market. Highly recommended by the New York, Boston, and other Fire Departments throughout the country. For quickness of cleaning and luster produced it has no equal. Sample five gallon can be sent C. O. D. for \$8. A. H. Downer, 17 Peck Slip, New York.

Presses, Dies and Tools for working Sheet Metal, etc. Fruit & other can tools. Bliss & Williams, B'klyn, N. Y.

For Pat. Safety Elevators, Hoisting Engines, Friction Clutch Pulleys, Cut-off Coupling, see Frisbie's adv. p. 349.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna lime, crocus, etc. Condit, Hanson & Van Winkle, Newark, N. J., and 92 and 94 Liberty St., New York.

Sheet Metal Presses, Ferracute Co., Bridgeton, N. J.

Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N. Y.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Solomon's Parallel Vice, Taylor, Stiles & Co., Riegelsville, N.J. Rollstone Mac. Co.'s Wood Working Mach'y adv. p. 366. Silent Injector, Blower, and Exhauster. See adv. p. 380.

Fire Brick, Tile, and Clay Retorts, all shapes. Borgner & O'Brien, M'rs. 24 St., above Race, Phila., Pa.

Clark Rubber Wheels adv. See page 381.

Diamond Saws. J. Dickinson, 64 Nassau St., N. Y.

Steam Hammers, Improved Hydraulic Jacks, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Eclipse Portable Engine. See illustrated adv., p. 382.

Peerless Colors.—For coloring mortar. French, Richards & Co., 410 Callowhill St., Philadelphia, Pa.

Tight and Slack Barrel machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 380.

Elevators, Freight and Passenger, Shafting, Pulleys and Hangers. L. S. Graves & Son, Rochester, N. Y.

Steam Engines; Eclipse Safety Sectional Boiler. Lambertville Iron Works, Lambertville, N. J. See adv. p. 349.

Magic Lanterns, Stereoscopes, and Views of all kinds and prices for public exhibitions. A profitable business for a person with small capital. Also lanterns for home amusement, etc. Send stamp for 116 page catalogue to McAllister, M'g Optician, 49 Nassau St., New York.

Lenses for Constructing Telescopes, as in Sci. Am. SUPPLEMENT, No. 32, \$4.50 per set; postage 5 cts. The same, with eye piece handsomely mounted in brass, \$50. McAllister, M'g Optician, 49 Nassau St., N. Y.

For best low price Planer and Matcher, and latest Improved Bash, Door, and Blin Machinery, Send for catalogue to Rowley & Hermance, Williamsport, Pa.

The only economical and practical Gas Engine in the market is the new "Otto" Silent, built by Schleicher-Schumm & Co., Philadelphia, Pa. Send for circular.

Penfield (Palley) Blocks, Lockport, N. Y. See adv. p. 381.

4 to 40 H. P. Steam Engines. See adv. p. 381.

Tyson Vase Engine, small motor, 1.5 H. P., efficient and non-explosive; price \$50. See illus. adv., page 380.

For Yale Mills and Engines, see page 381.

Lighting Screw Plates and Labor-saving Tools, p. 383.

English Patents Issued to Americans.

From November 9 to November 12, 1880, inclusive. Book binding, L. Finger, Boston, Mass.

Draining and sewerage, G. E. Waring, Newport, R. I.

Electric gas lighter, G. D. Bancroft, Boston, Mass.

Electric signal, E. H. Johnson et al., Menlo Park, N. J.

Horse nail manufacture, S. S. Putnam, Boston, Mass.

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. If not then published, they may conclude that, for good reasons, the Editor declines 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) L. L. asks: 1. How can I grind and polish quartz and agate rock, and what kind of grinding and polishing material should I use? A. Quartz and agate are split with a thin iron disk supplied with diamond dust moistened with brick oil. The rough grinding is done on a lead wheel supplied with coarse emery and water. The smoothing is done with a lead lap and fine emery, and the polishing may be accomplished by means of a lead lap, whose surface is hacked and supplied with rottenstone and water. 2. What is the best method of polishing steel? A. The usual method is to grind first on a coarse wet stone, then on a fine wet stone, then on a lead lap supplied with fine emery and oil, and finally polish on a buff wheel supplied with dry crocus and revolving rather slowly.

(2) R. L. J. asks how to make copying black and red inks. A. 1. Bruised Aleppo nutgalls, 2 lb.; water, 1 gallon; boil in a copper vessel for an hour, adding water to make up for that lost by evaporation; strain and again boil the galls with a gallon of water and strain; mix the liquors, and add immediately 10 oz. of copperas in coarse powder and 8 oz. of gum arabic; agitate until solution of these latter is effected, add a few drops of solution of potassium permanganate, strain through a piece of hair cloth, and after permitting to settle, bottle. The addition of a little extract of logwood will render the ink blacker when first written with. Half an ounce of sugar to the gallon will render it a good copying ink. 2. Shellac, 4 oz.; borax, 2 oz.; water, 1 quart; boil till dissolved, and add 2 oz. of gum arabic dissolved in a little hot water; boil and add enough of a well triturated mixture of equal parts indigo and lampblack to produce the proper color; after standing several hours draw off and bottle. 3. Half a drachm of powdered drop lake and 18 grains of powdered gum arabic dissolved in 3 oz. of ammonia water constitute one of the finest red or carmine inks.

(3) X. inquires: What is the rule for making a counterbalanced face wheel for engines? A. It is a common practice to place the counter weight directly opposite the crank, with its center of gravity at the same distance from the center of the shaft as the center of the crank pin, making its weight equal to weight of piston, piston rod, crosshead, and crank pin, plus half the weight of the connecting rod.

(4) A. R. asks: What is the best way to remove cinders from the eye? A. A small camel's hair brush dipped in water and passed over the ball of the eye on raising the lid. The operation requires no skill, takes but a moment, and instantly removes any cinder or particle of dust or dirt without inflaming the eye.

(5) D. F. H. asks: Can I move a piston in a half inch glass tube by the expansion of mercury? A. Yes, but you will require a long tube to get any appreciable motion of the piston.

(6) J. W. asks: What size of a bore and what length of a stroke I would want for a rocking valve engine of half a horse power? A. About 2 inches cylinder and 3 inch stroke, depending upon pressure and velocity.

(7) R. W. H. writes: In a recent discussion on hot air and steam portable engines it was decided to ask your opinion, which should be final. Water is scarce, though enough to use steam is easily procured. The country is hilly, so that lightness is desirable. The power wanted is 6 horse, and movable, that is, on wheels. Which will be best, hot air engine or steam engine? Which consumes most coal for a given power? Which will be cheapest in above case? A. For small powers the hot air engine is most economical, but we do not think it adapted to your purpose. We would recommend the steam engine for a portable power.

(8) J. C. T. writes: 1. I have a water tank for supplying my boiler, which is made of No. 22 galvanized iron; size 30 inches by 9 feet 4 inches. How many gallons will it hold? A. 342 gallons. 2. Will it be better to have it painted inside? A. Yes. 3. How many years will the tank wear under favorable circumstances, using well water? A. Depends upon the care taken of it.

(9) W. H. C. asks: Is there any way of deadening the noise of machinery overhead from the engine room below? The noise comes from machinery in the weave room of an alpaca mill. A. This is generally accomplished by setting the legs of the machines on thick pieces of India-rubber or other non-conductor of sound.

(10) G. H. asks: How can I mount photos on glass and color them? A. Take a strongly printed photograph on paper, and saturate it from the back with a rag dipped in castor oil. Carefully rub off all excess from the surface after obtaining thorough transparency. Take a piece of glass an inch larger all round than the print, pour upon it dilute gelatin, and then

"squeegee" the print and glass together. Allow it to dry, and then work in artists' oil colors from the back until you get the proper effect from the front. Both landscapes and portraits can be effectively colored by the above method without any great skill being required.

(11) C. W. S. asks: 1. Is there any practical and effective method known for cutting screws by connecting the slide rest with the mandrel of the lathe by gears or otherwise? A. This can be done in this way: attach a spur wheel to the back of the face plate. Mount a similar wheel on a short hollow shaft, and support the shaft by an arm bolted to the lathe bed so that the two spur wheels will mesh together. Fit right and left hand leading screws to the hollow shaft of the second spur wheel, and drill a hole through them as well as through the hollow shaft to receive the fastening pin. Now remove the longitudinal feed screw of the slide rest and attach to one side of the carriage an adjustable socket for receiving nuts fitted to the leading screws. The number of leading screws required will depend of course on the variety of threads it is desired to cut, unless a change of gear is provided. 2. A writer in a foreign journal claims to make slides, or V-shaped pieces for slide rests, eccentric chucks, etc., on his lathe. Is any such process known here, or any process within the capabilities of an amateur mechanic by which the planing machine can be dispensed with? A. For small work held between the lathe centers a milling device fitted to the slide rest in place of the tool post will answer an excellent purpose. This device consists of a mandrel carrying at one end the cutter and at the other end a large pulley. This mandrel is journaled in a hinged frame supported by a block replacing the tool post, and is adjusted as to height by a screw passing through an arm projecting from the supporting block. The direction of the belt is adapted to this device by means of pulleys.

(12) J. E. B. asks: 1. What is the best turbine water wheel now in use? A. There are several wheels in market that seem equally good. You should examine all of them and decide from your own observation which is best. 2. What is the rule for finding the horse power of water acting through a turbine wheel which utilizes 80 per cent of the water? A. Finding the weight of water falling over the dam and its velocity in feet per minute, multiply the weight in pounds by the velocity, and the result is foot pounds, divided by 33,000, the quotient is theoretical horse power; if your wheel gives out 80 per cent, then 80 per cent of that result is the horse power of the wheel. 3. How can I calculate the capacity of a belt? A. You will find an exhaustive article on the subject of belts on pp. 101, 102, Vol. 42, SCIENTIFIC AMERICAN, which contains the information you desire. 4. What machine now in use is the best, all things considered, for the manufacture of ground wood pulp? Where are they manufactured? A. This information can probably be obtained by inserting an advertisement in the Business and Personal column of this paper.

(13) C. A. R. writes: Wishing to renew my Leclanche batteries, which were giving out, I bought some new empty porous cells. Please give the following information: 1. Can I use the carbon plates of the old elements over again? If so, do they need to undergo any washing or soaking; or are they as good as ever? A. Yes. Soak them for a few hours in warm water. 2. Is there anything I must add to the granular manganese with which I fill the cells, in order to obtain maximum power and endurance? Some makers add pulverized or even coarsely broken carbon. Is it an advantage? A. It is an advantage to add granulated carbon to the manganese. Use equal parts of each. 3. What is the exact composition of the curdy mass which forms around and especially underneath the zincs of newly mounted and old gravity batteries. Is this substance formed naturally, or is it the result of using poor zinc or sulphate of copper? A. It is copper, and should be removed, for it weakens the battery. It is the result of placing the zinc in the sulphate of copper solution. 4. Is there any real advantage in amalgamating the zincs of the above batteries? A. No. 5. Is there a speedy way of cleaning them when coated with this substance? A. They can be cleaned by scraping. 6. At certain occasions my electric bells began ringing without anybody apparently closing the circuit. I often notice that if I unjoin the batteries and let them remain thus for a few hours, on reconnecting them the bells would work all right for a week, sometimes a fortnight, when the same trouble would again occur. Can you in any way explain this phenomenon? The batteries are not placed in a very dry part of the house, but the wires, which run pretty closely together, are nearly all exposed, so that I can control the slightest corrosion or uncovering of the conductors. A. There must be some accidental closing of the circuit. We could not explain the action of your line without seeing it.

(14) J. E. E. asks: What is the number of layers of wire, and the size used for the primary of the induction coil in the Blake transmitter, and as near as you can the amount used for secondary? A. For primary, use three layers of No. 30 magnet wire, and for the secondary use twelve or fourteen layers of No. 36 silk covered copper wire. The resistance of the secondary wire should be from 100 to 150 ohms.

(15) J. M. I. asks how to make a barometer by coloring ribbon, so that they will change color, indicating weather changes. A. Use a moderately strong solution of chloride of cobalt in water.

(16) O. C. H. writes: In reply to R. A. R. question 22, in SCIENTIFIC AMERICAN, December 4, I will say that some months ago I was engaged in running a saw mill, lathe, and shingle factory; was troubled with two hot boxes, and frequently had to stop and apply ice. Seeing in the SCIENTIFIC AMERICAN a reference to the use of plumbago, I sent for some, and after three or four applications was troubled no more with hot boxes.

(17) F. W. asks: What is the best way for return pipe to go into the boiler from radiators—steam at 60 lb. per square inch, fall 15 feet? A. If your job is properly piped you can bring your return pipe in at any convenient place in your boiler below the water line. If you go into the feed pipe, have your connection inside all other valves.

(18) L. T. G. writes: I have four cells of carbon battery; the solutions are bichromate of potash and sulphuric acid. Also three cells of the Smee; sulphuric acid one part, to ten of water; and the four cells of the carbon battery are not sufficient to run my small electro-magnetic engine for more than two or three minutes. I wish to know if it would be injurious to either one of the batteries if I should unite them both in one circuit, to run the engine, for about one or two hours at a time. A. The batteries will not be injured, but they will not work well together. Better increase the number of carbon elements. 2. Will either of the above batteries freeze in winter, or will cold weather affect their working? A. They will not freeze, but it is better to keep them at a temperature above freezing. 3. Is it always best to use the largest wire in connecting batteries with any instrument, say, above No. 11 or No. 12 wire, as the larger the wire the less the resistance, thereby getting nearly the full power of the battery? A. Yes. 4. What purposes are quantity and intensity electricity best suited for respectively? A. Batteries are arranged for quantity or intensity according to the work to be done. The maximum effect is obtained when the battery elements are combined, so that the total resistance in the elements is equal to the resistance of the rest of the circuit.

(19) J. H. asks: Which would be the strongest, two 2-inch by 4-inch joists nailed together, or one 4-inch by 4-inch joist? A. One 4-inch by 4-inch.

(20) J. K. B. writes: I suppose every experimenter who uses a carbon battery has been troubled by the uncertainty of the carbon connection. The makers of the Grenet battery seem to have solved the problem. Can you tell us through your correspondence column what solder they use, and how they make it stick? A. The carbon is coated with copper by electro-deposition; this coating is readily soldered to the carbon support with common soft solder.

(21) M. D. M. asks: 1. Is there a difference in a steam engine between the boiler pressure and the pressure on the piston when the piston is moving 400 feet per minute? A. Yes. 2. About what difference? A. From 2 to 8 lb., depending upon size and length of steam pipe. 3. Does the difference between them vary with a difference in the motion of the piston in the same engine? A. Not appreciably within usual limits of speed.

(22) F. writes: We have just closed up our steam stone works for this season, and we wish to know what is best to coat the inside of our steam boilers to keep them from rusting. Some say black oil, and others common tallow; which do you recommend as the best? A. We think the black oil quite as good and cheaper than tallow. Have the surfaces thoroughly cleaned before applying the oil.

(23) C. H. asks for a cheap and easy way of amalgamating battery zincs. A. It depends on the kind of battery. In the Fuller the mercury is placed in the porous cell with the zinc. In bichromate batteries all that is necessary is to dip the zinc in the bichromate solution and then pour on a drop or two of mercury. It soon spreads over the entire surface of the zinc. Another method is to dip the zinc in dilute sulphuric acid and then pour on a little mercury, but these methods, except in the case of the Fuller battery, are wasteful of mercury. It is better to apply an amalgamating solution with a brush. This solution is made by dissolving one part (by weight) of mercury in five parts of nitromuriatic acid (nitric acid one part, muriatic acid three parts), heating the solution moderately to quicken the action; and, after complete solution, add five parts more of nitro-muriatic acid.

(24) G. W. asks: 1. Would a perfectly round ball of the same specific gravity throughout lie still on a level surface? A. Yes. 2. Can a mechanic's square be made so true that a four-inch block may be made exactly square by such an instrument? A. Yes.

(25) W. H. asks: 1. What is the weight of a boiler 24 feet long, 44 inches diameter, $\frac{1}{4}$ inch thick? A. With two flues, 16 inches diameter, 6,900 lb. 2. What is the contents (in gallons) of a tank 15 feet deep, 10 feet in diameter, top and bottom diameters being equal? Please give me a formula. A. Area of 10 feet diameter = 78.54×15 feet deep = 1,178 cubic feet, and, allowing $7\frac{1}{2}$ gallons per cubic foot = $1,178 \times 7.5 = 8,835$ gallons.

(26) C. L. W. writes: I have constructed a small induction coil to be used for giving shocks. It is 3 inches long. The primary coil is wound with 3 layers of No. 18 cotton covered wire, and the secondary consists of about 12 layers of No. 28 silk covered. 1. How many cells and what kind of battery shall I use to get the best results? A. For temporary use one cell of Grenet battery would answer, but for continued use some form of sulphate of copper battery is to be preferred. 2. Is it necessary that the spring and screw in the interrupter should be coated with platinum? A. Yes; otherwise they would soon burn out.

(27) H. C. P. writes: In the SCIENTIFIC AMERICAN of September 18, Mr. E. Y. D., query 26, asks whether a sun dial, made for latitude $48^{\circ} 15'$, can be utilized in latitude $38^{\circ} 50'$ for showing correct time. To make his dial available in the lower latitudes, he has only to lift the south side, so as to give the face a slope to the north, equal to the difference of the latitude, in this case $9^{\circ} 25'$. For then the plane of the gnomon being in the plane of the meridian, the edge of the gnomon casting the shadow will be parallel with the earth's axis; and the face of the dial will be parallel with the horizon of the latitude for which the dial was made, and the graduation will show the time required; that is, on the supposition that it was correctly made, and for a horizontal dial.

(28) C. M. M. asks for a cheap process of plating steel case knives with tin. A. Clean the metal thoroughly by boiling in strong potash water, rinsing, pickling in dilute sulphuric acid, and scouring with a stiff brush and fine sand. Pass through strong aqueous sal ammoniac solution, then plunge in hot oil (palm or tallow). When thoroughly heated remove and dip in a pot of fused tin (grain tin) covered with tallow. When tinned, drain in oil pot and rub with a bunch of hemp. Clean and polish in hot sawdust.

(29) V. R. P. writes: I have an aquarium which contains $4\frac{1}{2}$ gallons of water. How many fish must I have in it—average length of fish $1\frac{1}{2}$ to 2 inches, to insure the health of the fish? At present, I refill the aquarium semi-weekly. Please tell me a process by which I can lengthen the time. A. Put in three fish, $1\frac{1}{2}$ inches in length, to one gallon of water, one small bunch of fresh water plants to one gallon of water. Tadpoles (after they have cast their branchia or gills), newts, and rock fish can be used to the extent of six to the gallon. The aquatic plants will supply the fish with sufficient oxygen, so that the water will seldom require changing.

(30) A. S. writes: I am about to construct an aqueduct 1,300 feet in length, the water level differing 40 feet. By placing a forcing pump in the valley I could then raise the water to a height of 40 feet, and having erected a tank at that height and connected it by means of pipes with another tank 1,300 feet distant, but on the same level, the water according to a law of nature would travel over the distance of 1,300 feet. But finding it very difficult to erect tank 40 feet high, I would prefer to construct the whole on the incline. Will the forcing pump having just power enough to raise the water 40 feet perpendicularly into the tank have sufficient power to force it into a tank of the same elevation through 1,300 feet of pipe running on the incline, or must I have more power, and how much more? A. The forcing pump must have enough more power to overcome its own additional friction and the friction of water in the long inclined pipe. Allow 20 per cent more power at least.

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

Box marked C. H. (no letter).—1 and 2. Garnetiferous quartz rock. 3 and 4. Micaceous quartz rock. 5. Granite. 6. Basalt with traces of chalcopryite. —L. C. G. —They are fossil sharks' teeth, common in marl beds. —J. E. C.—1. Iron sulphide and lead sulphide. 2. Quartzite, with traces of galena and molybdenic sulphide. 3 and 4. Dolomite. 5. Fossiliferous argillaceous limestone, containing traces of lead sulphide. 6. Lead sulphide in argillite. —O. T. M.—1. A silicious kaolin. 2. Similar to No. 1. Useful if mixed with finer clay for white ware. 3. Silicious carbonate of lime—some of this would probably make fair cement. 4. Brick—the clay from this was made would probably be useful to potters. 5 and 6 are very silicious clays.

COMMUNICATIONS RECEIVED.

Liniment. By J. L. T.
Seen and Tangible and the Unseen and Intangible. By J. L. T.
On Cheap Railroads. By R. P. N.
On a Meteor. By W. E. C.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were
Granted in the Week Ending

November 16, 1880.

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1866, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1866; but at increased cost, as the specifications not being printed, must be copied by hand.

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(From the Mayor of Saratoga.)

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Round Lake Camp-Meeting Grounds, Saratoga Co., N. Y., June 5, 1880.

Your Brush is certainly a remarkable cure. I am highly pleased with it. Its effect is most wonderful, and you

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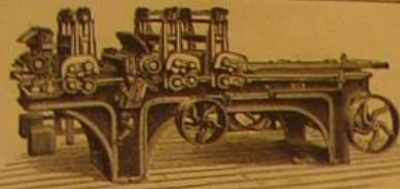
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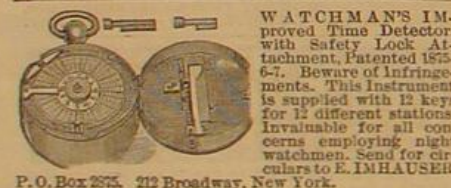
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AMERICAN INDUSTRIES.—No. 63.

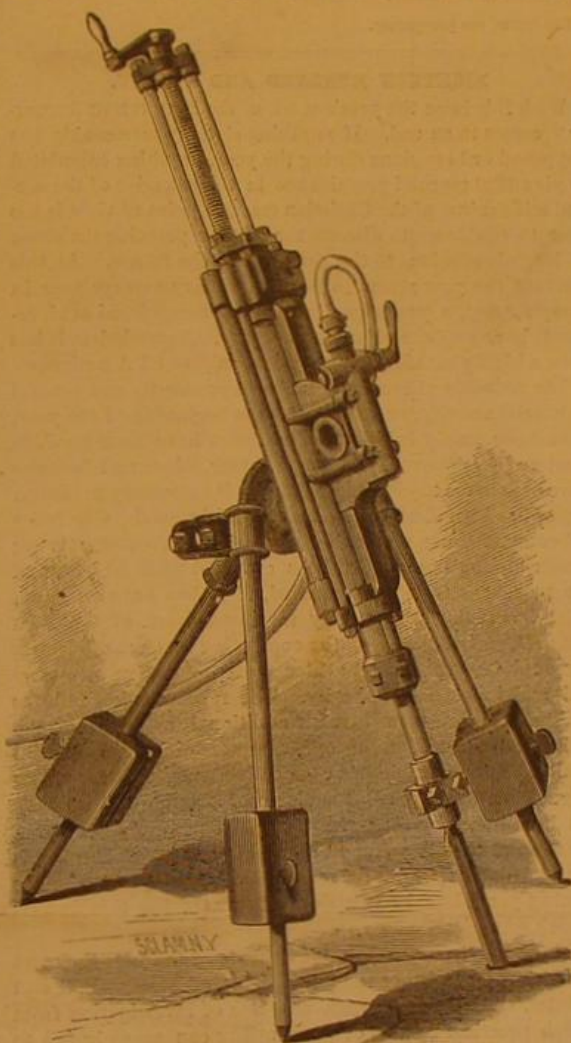
THE MANUFACTURE OF POWER DRILLS FOR MINING, EXCAVATING, ETC.

Although mining, tunneling, etc., have been of more or less importance, as calling for the labor of large numbers of men, in all ages and in nearly every quarter of the globe, it is only within a few years that the tools and appliances with which such work can be prosecuted have shown any great improvement over those employed in early times. After the use of gunpowder for blasting purposes had been commenced, it seemed for a long period as though there was a complete cessation of all idea of improvement in this direction, until the comparatively recent introduction of the power drill in connection with more powerful explosives. It is not too much to say, however, that from these two causes, but more particularly from the introduction of the power drill, the past twenty years has shown greater improvement in the means and appliances for the rapid and economical prosecution of this class of work than all the years that had gone before. Besides this, also, many projects which were heretofore entirely impracticable have been brought well within the scope of modern engineering ability, and mines which could never have been made to pay under the old system of hand drilling are now contributing to the substantial wealth of the world.

The power drill may be worked with either compressed air or steam, but in many cases, from the location where the drill is operated and the inconvenience attending the getting rid of the exhaust steam, it would be only at a great disadvantage that steam could be employed, while the circulation of pure fresh air provided by the working of the drill with compressed air affords a most valuable result in the way of ventilation for the shafts of mines, in tunnels, and all kinds of ordinary underground work. The manufacturers of the Rand Little Giant rock drill, of the practical working of which we present illustrations on this page of the paper, are also manufacturers of an improved air compressor for use in connection therewith. They have recently furnished the most powerful air compressing plant employed in mining in the world, and it is now in successful operation at the Calumet and Hecla mines on Lake Superior. These compressors furnish cool and perfectly dry air, the last particular being absolutely essential in cold climates or at great elevations.

The requirements for a perfect rock drill are numerous, but it should first of all be simple in construction and strong in every part, the parts, as far as possible, being so arranged that any broken or worn portion may be easily removed and a new part substituted without causing delay in the work. It should occupy but little space, with the striking part relatively of great weight, and to give the blow directly, so that

only the piston should feel the shock of concussion. Of course the piston must be so arranged as to make a variable stroke, so that no damage will result from the sudden re-



THE RAND ROCK DRILL

removal of resistance, which often occurs in boring through rocks of different density, or where flaws or breaks occur. Such a machine, if disconnected from frame or carriage, should be as light as possible, and so arranged that it may be readily put up and taken to pieces.

The Rand Little Giant rock drill is the result of many years of experiment for the attainment of these ends, and from the testimonials of some of our largest mining companies who are using the drills and compressors of this company with the utmost satisfaction, it is believed that success has been practically attained. The first point to notice in the construction of this machine is its simplicity, there being no connecting rod or other device outside the steam chest and cylinder to get out of order, the valve being thrown in the same direction the piston is moving, and the port remaining open until the full stroke has been made. The lever for operating the valve is placed in a recess between the ends of a double-headed piston, and is struck at the ends as the piston reciprocates, the arm of the lever driving the valve. The valve is of steel, and the whole mechanism is so simple and direct that there is never any difficulty in running at any desired speed, as high as 600 to 700 double strokes per minute having been made, the double stroke meaning the forward and backward motion of the piston.

In the working of this drill the full force of the compressed air or steam is brought to bear directly at the point where the stroke is delivered. The piston rod enters the piston on a taper, and the rotation bar, which is nearly triangular in cross section, is made very strong; the ratchet wheel for rotating is proportionately large, and the teeth strong. This piston is hardened and then ground to a perfect fit on an emery wheel.

These drills are used either mounted on a tripod or attached to a vertical column or a horizontal duplex swivel-jointed bar, according to the location in which the boring is to be performed. In vertical work, either the horizontal bar or the tripod may be used, the former, however, only between comparatively narrow side walls, against which the bar can be made firm. The legs of the tripod are arranged to telescope, so that they can be lengthened or shortened at will, thus allowing holes to be bored in very difficult places and at almost any angle. The column, with an arm, is particularly advantageous in all kinds of tunnel work, and the horizontal bar is more especially advantageous in shaft sinking. The latter is one of the most valuable inventions which has been brought out for some time. It allows two drills to operate simultaneously at any angle by means of the supplemental jointed bars. The rapid blows given by the drills upon the solid rock cause great vibration; this would tend to loosen the bar by turning the jack screw in the nut; to prevent this a lock nut is used, which keeps the screw in place and prevents any loosening of the bar after it is once set up. It can be readily adjusted, the arms folded parallel to the bar, with the drills mounted upon them, and

[Continued on page 402.]



ROCK DRILLS AND THEIR USES.

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NEW YORK, SATURDAY, DECEMBER 25, 1880.

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EIGHTEEN HUNDRED AND EIGHTY.

With this issue the year's work of the SCIENTIFIC AMERICAN comes to an end. If anything signally memorable has happened or been done during the year, anything calculated to give 1880 especial prominence in the calendar of the second millennium of the Christian era, our point of view is too near to enable us to discern the fact or perceive the event in its true relations to the present and the future. At this moment the year seems to be an ordinary average year in every respect, a year signalized by no exceptional achievements in any sphere of human activity. Nevertheless it has been a highly satisfactory year, certainly to all Americans.

The promises of increased business prosperity and general industrial activity, so apparent at the beginning of the year, have been amply fulfilled. The crops have been good, in most respects above the average. Our mines and factories have been made to yield more than their customary products. Labor has been abundant and wages fairly good. Our internal commerce was never in a condition of greater activity; canals and railways have been crowded with freight, and the passenger traffic has equaled, if it has not surpassed, what is usual. The largely increased work of the Post Office Department and of the competing systems of electric telegraph bears abundant evidence of progressive commercial and industrial prosperity. The relatively few failures among business men furnish additional evidence of the satisfactory condition of our commercial and industrial affairs. Foreign trade has been active, and the steady flow of gold this way from Europe is proof enough that we have not been losers by the year's traffic. The steady decline in the amount of ocean freight carried in American bottoms is the one dark spot in the otherwise bright picture. The coming year should see a decided turn of the tide in this branch of national effort.

Of the purely scientific achievements of the year the most promising is probably the photophone of Messrs. Bell and Tainter, since it opens up a new line of investigation from which practical results of great utility can scarcely fail to flow. In other departments of scientific investigation there has been a reasonable measure of progress, but no signally important discoveries. A vast multitude of small advances have been made in a thousand different directions, advances whose significance may not yet be fully apparent; yet at this moment we fail to recall any that are likely ever to rank among era-making discoveries or achievements.

In the applications of electricity considerable progress has been made. The practical substitution of dynamo-electric machines for galvanic batteries in telegraphing is a decided step in the direction of economy. Recent improvements in harmonic telegraphy, and in devices for rapid telegraphing, promise to add materially to the usefulness and cheapness of electric communication. The development of telephone lines and telephonic exchanges has gone on with considerable rapidity. We fail to discover, however, any marked improvement in the character of the service. There seems also to be a decided lull in the work of improving the range and efficiency of the telephone itself. Has the limit been reached in this direction? It was reported a few weeks ago that the problem of telephoning through considerable lengths of submerged cable had been solved in England, but nothing seems to have come of it. Equally disappointing have been the promises so often made of the speedy connection of distant cities; that is, cities from one to two or three hundred miles apart, by means of the telephone. Quite a number of new telephones have been patented during the year, but as yet they have given no evidence of superiority.

Though not a product of the year, the electric railway has shown signs of real progress, and possibly great utility since the year began. The same may be said of the electric light. The use of lamps employing the voltaic arc has been steadily extended. In several American towns they have been successfully introduced for public lighting; and preparations are making for their speedy trial on a considerable scale in this city.

The incandescent lamp of Mr. Edison has been practically tested during a voyage around Cape Horn, on the steamer Columbia, and by continuous use at Menlo Park. The Maxim lamp is doing good service in the Equitable Building in this city, and good reports are received of the working of the Sawyer lamp in one or more public build-

ings in Philadelphia. Before the coming year is done with, we may expect to see one, perhaps several, forms of the incandescent lamp in pretty general use in the business part of our city.

Among the larger engineering operations and undertakings of the year mention may be made of the rapid progress of the railways which are pushing across the continent to make new connections between the Atlantic and the Pacific; the junctions of the two sections of the St. Gothard Tunnel; the revival of the Hudson River Tunnel project, and its prosecution in the face of difficulty and disaster; the completion of the preliminary work in connection with the proposed tunnel under the British Channel, and the beginning of what claims to be a serious attack upon the main work; the railway up Vesuvius; the rapid progress of the great East River Bridge; the successful transference of Cleopatra's Needle from Egypt to Central Park; the laying of several new and important Atlantic and other ocean cables; the final acceptance of the Panama route for the proposed ship canal, and the vigorous prosecution of that work (on paper) by De Lesseps; the theoretical development of Capt. Eads' plan of a ship railway at Tehuantepec.

In naval architecture we have the completion of the Czar of Russia's huge novelty the Livadia, and the launching of the Italian war ship Italia, the largest, most powerful, most heavily armed and armored floating fortress in the world. By contrast mention may be made here of the completion of the loftiest and one of the most beautiful and costly of temples of worship, the Cathedral at Cologne, after centuries of intermittent construction.

The dephosphorizing processes by means of which the immediate conversion of certain refractory iron ores into steel has been made possible, are not new; but not until within a few months have they proved to be practical and economical on a large scale.

The De Bay propeller is not new; but not until this year has it been tried on a vessel large enough to furnish an assured demonstration of its superior value and efficiency. In like manner the Perkins system of steam boilers belongs to a period earlier than the past twelvemonth; but it was left to the recent successful voyages of the Anthracite across the Atlantic Ocean to illustrate if not to demonstrate the advantages of high-pressure steam for seagoing vessels. We recall no radical improvements made this year in machinery for the artificial production of ice; yet the scarcity of ice due to the unusual openness of last winter has given a remarkable impetus to the construction and use of such machinery.

It was our purpose to speak in this connection of the very creditable records made by American arts and industries in the international competitions at Sydney, Australia; at Berlin, in connection with fish and fisheries; at Cincinnati, in the Millers' Exhibition; at the exhibition of sheep and wool in Philadelphia; but there is no room for it here, and probably no need, for they are fresh in every mind. There is no room either, and possibly no occasion, for saying much about our work in the past or our intentions for the future. The steady annual progress which the SCIENTIFIC AMERICAN has made for nearly two score years is the best guarantee that no pains will be spared to make the paper more and more worthy of the large and increasing favor bestowed upon it by an intelligent and highly appreciative public.

ELECTRIC LIGHTS IN BROADWAY, NEW YORK.

Last year the New York Board of Aldermen passed a resolution requesting the Gas Commission to cause experiments to be made with electric lights, with a view to testing their adaptability for lighting streets, avenues, parks, and squares. No action was taken by the commission until recently, when permission was granted to the Brush Electric Light Company to test their system at their own expense on Broadway, from 14th to 34th street, a distance of a mile. The posts for the new lamps are now being set up, and it is promised that the lights will be in operation by Christmas. The iron lamp posts are twenty feet high from the base to the foot of the lamp. Their upper portions are supplied with projecting teeth, which are intended to be used as steps by the men assigned to keep the lamps in good condition. The lamps are constructed in accordance with the Brush patent, being from four to five feet in height and surmounted with an iron hood.

The whole number of lamps will be twenty-two; the wires will be carried from the top of one post to the top of the next for the present, or until the city decides to adopt the system, when they will be sunk under ground. Each lamp will, it is promised, give a two thousand candle power light, equal to about one hundred gas lamps.

The central station will be at No. 133 West 25th street, where the Corliss engines and boiler which operate the electric generators have been placed. About twenty-five horse power will be required for the twenty-two lamps, and one wire will convey the current to the entire series. It is promised that the light will be much cheaper than gas light of equal power. The success of the Brush system elsewhere reduces this experiment to a test of cost and the ability of the lamps to satisfy the requirements of the public eye.

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THE SCIENTIFIC AMERICAN FOR 1881.

A new year—the thirty-seventh since the publication of the SCIENTIFIC AMERICAN began—will be entered upon with our next issue.

It is gratifying to believe that, during all these years of varying national prosperity, there was never one that opened with broader or more substantial grounds for expecting the largest measure of national well-being—the largest activity in all the useful arts, under the most favorable conditions for success—than are promised for the year about to begin.

Never in their history have the United States presented so cheerful and hopeful an aspect; and in common with all other worthy American institutions the SCIENTIFIC AMERICAN enjoys a bountiful share of the general prosperity. Manufacturers, merchants, farmers, artisans—indeed all classes of men to whom this paper is addressed, are busily employed and are making money; and the number who regularly look to its pages for information, suggestion, or entertainment, is larger than ever before. With such abundant and hearty support, the proprietors can confidently pursue their set policy of striving continually to increase the usefulness of the paper to its readers and advertisers. Having no rivals in this field the only competition they can enjoy is in a constant endeavor to surpass their own best achievements. Whoever will take the trouble to compare this volume just finished with any that has preceded it, cannot fail to be impressed with the manifest fact that the publishers' policy has not been altogether fruitless of results calculated to make the SCIENTIFIC AMERICAN increasingly worthy of the popular favor bestowed upon it.

The SCIENTIFIC AMERICAN SUPPLEMENT will continue to put within easy reach of American readers the best contributions to the practical literature of the sciences and industrial arts that the public journals afford, besides a large amount of original matter of special value to scientific and practical men. As heretofore, a full table of contents of each issue of the SUPPLEMENT will be printed in the corresponding issue of this paper, in which every reader of the SCIENTIFIC AMERICAN is kept informed of all important papers bearing on the subjects or industries he is specially interested in, should he not feel able to subscribe to both papers. Scarcely a week passes in which the SUPPLEMENT does not contain special articles worth more than the year's subscription to readers interested in the subjects treated. The ample pages of the SUPPLEMENT enable us to present full details pertaining to topics discussed with working drawings where such illustrations are useful.

SITE OF THE NEW YORK FAIR OF 1883.

The Executive Committee of the World's Fair of 1883 have at length agreed upon Inwood as a site. The tract selected lies in the extreme northern part of New York city, eleven miles from the City Hall, and has a mile frontage on Broadway or King's Bridge Road, and a mile frontage on Harlem River. It contains 250 acres, the free use of which the owners have offered to give to the Commission for the purposes of the Fair. The ground is already served with gas and Croton water, and is level or gently undulating. The water along the Harlem front is from 18 to 40 feet deep at low tide. There is also an admirable water front along the Hudson river, which is separated from the Fair site by a ridge, in which is a convenient depression for a railway for passengers and freight. The least distance to the Hudson, where abundant docking privilege has been secured, is 1,400 feet, and the exhibits from foreign ports can be landed at Inwood pier, within half a mile of the grounds. The only objection to the site is its distance from the lower part of the city. The means of access to it, however, are the best. Its drives are park roads. The old track of the Hudson River Railroad passes one side, the new track lies just across the Harlem. It is nearer than any other site proposed to all the other railroads tributary to New York except the Long Island Railroad. The Western lines terminating at Jersey city can deliver their passengers at the grounds by means of ferryboats. All the elevated roads can readily be called into requisition in carrying passengers, and the facilities for water transit and the accommodation of shipping are abundant. The ground is ample, naturally drained, and well suited to the needs of the fair; and the location is one of the most beautiful in New York. It has many historic associations, the site being bounded on the east by Harlem River and heights, on the south by Fort George, formerly Fort Clear View; on the southwest and west by Forts Washington, Nelson, and Tryon, and on the north by Inwood Hill.

COMPRESSED AIR AS A MOTIVE POWER.

It is very well known that in the matter of the consumption of fuel, the most economical steam locomotive compares very unfavorably with first-class stationary engines, the difference being so great as to admit of allowing a large margin for loss in applying the power of stationary engines to the propulsion of trains.

The use of electricity for this purpose has its advocates, and wire rope transmission is believed by some to meet the requirements for short lines, but among the various practicable methods of applying power from a fixed source to the propulsion of trains, nothing has been developed thus far that promises better than compressed air. It is clean, safe, and free from the many objections raised against steam, and seems in every way adapted to railway purposes, especially on short routes and for underground roads.

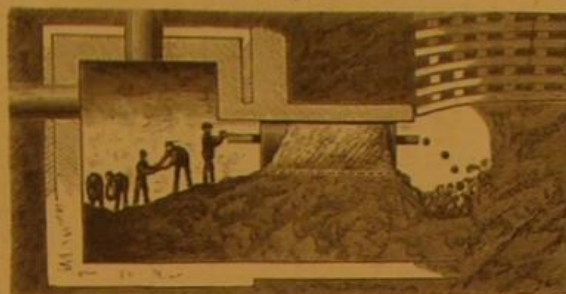
A new method of using compressed air, and a novel locomotive for carrying out the method, is being introduced by Mr. R. Ten Broeck, who is located at the Windsor Hotel, in this city. The new system is the invention of a well-known English engineer, who has studied the capabilities of compressed air as a motive agent, and has devised machinery for utilizing it to the best advantage.

PROGRESS OF THE HUDSON RIVER TUNNEL.

The crib-work of the river bulk head, which has been the source of so much delay in the prosecution of the tunnel under the Hudson River, is again giving trouble.

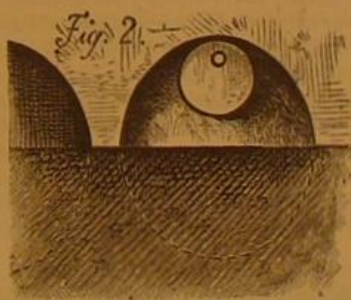
As a matter of prudence the work on the north tunnel, which was in no way injured by the influx of water, has been suspended until the south tunnel can be carried past the crib-work. This tunnel had been driven as far as the inner edge of the crib-work when the fatal break occurred; and when the water had been pumped out after the sinking of the caisson and the work of tunneling began again, it

Fig. 1.



was discovered that the inrush of water through the loosely constructed crib-work had not only washed out much of the earth which had filled the spaces between the timber and stones, but had excavated the large hole shown in our engraving. Two serious hinderances were thus placed in the way of the work: the absence of support for the timbers of the crib on their original inclination caused them to drop below the upper line of the tunnel, necessitating their removal before the tunnel shield could be pushed forward, and the washing away of the protecting silt allowed the water to flow in, and the compressed air of the tunnel to escape.

The cavity was discovered by sounding. Instead of clearing out the original tunnel at once, a small pilot tunnel, six feet in diameter, was first driven through the washed-in silt almost to the cavity. Then a six inch tube was thrust through the remaining wall of silt, and an attempt was made to pass through the tube a sufficient quantity of mud-balls to fill the opening. It was thought that this had been accomplished, and the mud wall was removed only to discover a leak through the crib that defied the usual means of stoppage by the use of bags of bran and the like. At this stage of the work the recent serious inflow of water occurred, compelling a change in the plan of procedure.



The new plan involves the construction of a movable bulkhead fitting the pilot tunnel like a piston. This is to be driven forward by means of a jack-screw, placed as shown in our engraving, until the inner edge of the crib-work is reached. Meantime through a $3\frac{1}{4}$ inch tube piercing the piston bulkhead, balls of mud are to be forced by the pressure of the air, until the opening under the crib is completely filled. When this has been done, the work of excavation can be narrowed to a small area, the obstructing timbers removed in detail, and any considerable leakage prevented by pushing forward foot by foot the iron shield of the tunnel. The troublesome crib-work being safely passed, and the second tunnel-heading fairly under the river, the work on both tunnels can go on unhindered.

THE SPREAD OF DIPHTHERIA.

The unusually large number of fatal cases of diphtheria, now occurring in this city and Brooklyn, and in many in rural districts as well as in our larger towns, call for especial care and intelligence in preventing the generation and spreading of this terrible disease. The following statement of the symptoms of the disease, and the precautions to be taken where it prevails, is being distributed by the Health Department of this city. Everybody should read it and attend to its warnings.

Cleanliness in and around the dwelling, and pure air in living and sleeping rooms, are of the utmost importance where any contagious disease is prevailing, as cleanliness tends both to prevent and mitigate it. Every kind and source of filth around and in the house should be thoroughly removed; cellars and foul areas should be cleaned and disinfected; drains should be put in perfect repair; dirty walls

and ceilings should be lime-washed, and every occupied room should be thoroughly ventilated. Apartments which have been occupied by persons sick with diphtheria should be cleansed with disinfectants, ceilings lime washed, and wood work painted; the carpets, bed clothing, upholstered furniture, etc., exposed many days to fresh air and the sunlight (all articles which may be boiled or subjected to high degrees of heat should be thus disinfected); such rooms should be exposed to currents of fresh air for at least one week before reoccupation.

When diphtheria is prevailing, no child should be allowed to kiss strange children nor those suffering from sore throat (the disgusting custom of compelling children to kiss every visitor is a well-contrived method of propagating other grave diseases than diphtheria); nor should it sleep with nor be confined to rooms occupied by or use articles, as toys, taken in the mouth, handkerchiefs, etc., belonging to children having sore throat, croup, or catarrh. If the weather is cold, the child should be warmly clad with flannels.

When diphtheria is in the house or in the family, the well, children should be scrupulously kept apart from the sick in dry, well-aired rooms, and every possible source of infection through the air, by personal contact with the sick, and by articles used about them or in their rooms, should be rigidly guarded. Every attack of sore throat, cough, and catarrh should be at once attended to; the feeble should have invigorating food and treatment.

The sick should be rigidly isolated in well-aired (the air being entirely changed at least hourly), sunlit rooms, the outflow of air being, as far as possible, through the external windows by depressing the upper and elevating the lower sash, or a chimney heated by a fire in an open fireplace; all discharges from the mouth and nose should be received into vessels containing disinfectants, as solutions of carbolic acid or sulphate of zinc; or upon cloths, which are immediately burned, or if not burned, thoroughly boiled or placed under a disinfecting fluid.

PETROLEUM FOR HARBOR DEFENSE.

A correspondent in York, Pa., Mr. D. K. Naell, suggests the use of burning petroleum for repelling hostile fleets from harbors like those of Baltimore, Philadelphia, and New York. A hundred thousand barrels of oil poured upon an out-flowing tide would cover a large area of water, and when set on fire would sweep a fleet with a torrent of destruction that nothing could resist. When a stream of burning oil ran down the Allegheny River last winter the flames sometimes leaped up nearly a hundred feet, and threw out lateral tongues of fire terrible to see. Such flames around an iron-clad fleet would asphyxiate all on board.

Another plan would be to link together long lines or rafts of oil barrels and send them against the fleet by small swift steam launches that could be steered by electricity from the shore. The barrels could be exploded and the oil fired by the same agency at the proper moment; and, if necessary, line after line of the fire rafts could be drifted or driven against the enemy until every vessel was destroyed. Such an application of floating fire might also be used to protect a system of torpedoes in a ship channel, by making it impossible to operate any counter system for exploding or removing the torpedoes by men in small boats.

Obviously this plan would not do to rely upon generally; though in certain emergencies it might be resorted to with terrible effect.

A Cup of Tea.

In a recent lecture by Mr. G. R. Tweedie, F.C.S., London, on "A Cup of Tea," the speaker divided his subject into four sections—the tea, the water, the milk, and the sugar. The lecturer first drew attention to tea drinking with everyday life, and showed that the principal components of tea were theine and the essential oil of tannin, which latter possessed astringent properties. He informed the audience that the best time to take tea was about three hours after dinner or any other heavy meal, and deprecated in the strongest terms the excess to which tea drinking is carried by some people, asserting that such a practice induced a nervous disorganization and impeded digestion. He showed that the sole difference between black and green tea was one of preparation, and that both kinds could be obtained from the leaves of the same plant. After asserting that the adulteration of tea had very much decreased of late years, which the tea drinking public will be glad to know, the lecturer proceeded to treat of the various kinds of shrubs grown in different parts of the world and the countries where the different kinds of teas were consumed, the lecturer came to the consideration of the milk, its value as a nutritive agent, and referring to its adulteration he made the astounding assertion that in London alone every year no less than £70,000 was spent on water which was sold as milk. Passing on to regard the sugar, the lecturer denied the common error that sugar was injurious to the teeth, bringing forward as an example the negroes of Jamaica, who, he said, though they were the greatest eaters of sugar in the world, were proverbial for their beautiful teeth.

By remitting to the publishers of this paper \$3.20 you will receive, during the year 1881, fifty-two copies of the SCIENTIFIC AMERICAN, free of postage, each issue of which will contain information and hints of practical use in all branches of manufacture, besides affording the family instructive and entertaining reading in natural history and a variety of other useful subjects.

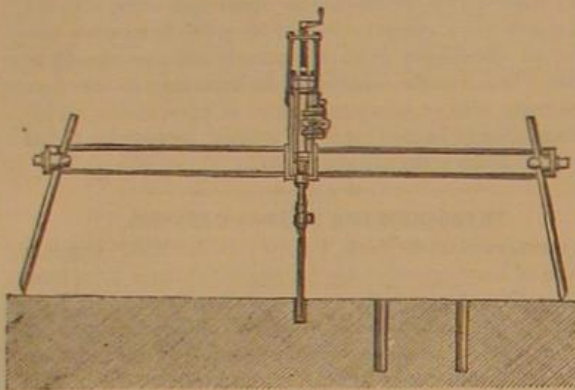
AMERICAN INDUSTRIES.

[Continued from first page.]

the whole plant lowered to its place in the shaft by the hoisting rope. By the use of rock drills mounted in this manner great economy is effected in the sinking of shafts, the work being done at half the cost and in one quarter of the time as against hand labor.

For rock drilling under water, where the work is to be done from the surface and not by tunneling from a sunken shaft, it is usual to anchor a platform or scow over the site of the proposed work. The company have an improved description of drill scow for this class of work, in which the drills, instead of passing through the vessel as formerly, are placed at the ends, and suitable mechanism is provided for raising and lowering them in a vertical line. The bits extend down through tubes attached to movable carriages. The scow is lifted bodily out of the water, if necessary, by spuds forced down against the rock, thus forming a firm stationary platform. One of these scows was used in deepening the St. Lawrence River near the mouth of the Lachine Canal, where the cutting amounted to 9 feet of rock under 9 feet of water, in order to make a clear channel of 18 feet in depth. Four Rand drills, of 5 inches diameter, were employed, and during 1878 and 1879 the scow worked on an average six months per year, removing in that time about 45,000 yards of rock.

These drills are regularly rated, as to size, from No. 0, which weighs 150 lb., and bores holes from $\frac{1}{2}$ inch to 1 inch in diameter, to No. 6, which weighs 900 lb. and drills 3 to 4 inch holes 30 feet deep. These are intended to cover



DRILL MOUNTED FOR QUARRY WORK.

all ordinary classes of boring, from the lightest plug and feather work to the heaviest bores required in deep cuts, railroad tunnels, mining, and submarine drilling, the size of the drill and the speed at which it should be run differing according to the location and the quality of the rock that is to be operated on. The heavier the drill the slower are the strokes generally, but experience has shown that several other conditions must govern in regulating the speed at which the drill is worked, so that while the rock is fractured and the hole bored without quick destruction of the bits the water will wash out the *débris*. The machine drill is far less destructive of bits than hand drilling, for the piston end of the drill is never damaged, as is the hand drill, by the blows of sledges; but yet it has until lately been assumed that in some classes of work hand drilling was the most advantageous. In regard to this point some recent testimony from an iron mining company on Lake Superior is of practical value. The agent in charge says that with these drills "we have no difficulty in drilling the hardest quartz or jasper, though we never before have been able, with power drills, to do as well as men could do with hammers in such ground." Besides the abundant proofs of superior efficiency and economy in the working of the Rand drill with the Rand air compressor, which have been afforded in practical experience, the company have had made a series of scientific tests, in which the speed of the drill and the consumption of air at different temperatures, and all the conditions governing the work, were accurately determined. The blows given by the drill were received by a mass of iron, a blunt-headed rod being used instead of a pointed drill. The maximum stroke of the piston was $6\frac{3}{4}$ inches, and the average stroke during these experiments was 6 inches. The indicator diagrams were taken from the drill cylinder at speeds varying from 111 to 298 double strokes per minute, and at pressures of from 12.5 to 26.5 lb. per square inch above the atmosphere, the piston of the drill being proved practically tight before commencement. When not striking the speed of the drill was controlled by the throttle valve, but for

the other runs the throttle valve was pinned wide open, and a constant pressure maintained in the reservoir. The principal results shown by the diagrams are as follows:

No. of Diagram.	1.	2.	3.	4.	5.	6.
Pressure in reservoir, per sq. in.	12.5	26.5	26.5	12.5	26.5	26.5
No. double strokes per minute	185	298	298	185	298	298
Scale of indicator springs	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Mean effective pressure, pounds per sq. in.	5.78	8.54	13.6	6.66	8	11.5
Ratio of pressure in cylinder working to pressure in reservoir	0.95	0.89	0.89	0.98	0.89	0.89
Fraction of stroke completed to exhaust	0.87	0.85	0.76	0.72	0.73	0.76
Fraction of stroke completed to cushion	0.71	0.81	0.78	0.84	0.83	0.70

Reducing the results obtained in ten experiments, the following facts were obtained:

No. of Experiment.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Pressure in reservoir, per sq. in.	15	20	20	20	20	20	20	20	20	20
Double strokes per minute	225	290	290	290	290	290	290	290	290	290
Temperature reservoir, deg. F.	70	70	70	70	70	70	70	70	70	70
Temperature of air in the exhaust	57	52	52	48	44	42	43	44	44	44
Velocity of air in the exhaust	246	258	250	254	260	1,012	1,250	1,484	1,600	1,788
Cubic feet of air exhausted per minute at exhaust temperature and atmospheric pressure	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3
Probable equivalent of air exhausted at reservoir pressure and temperature	10.4	12.2	14.5	17.9	18.7	19.2	20.0	20.8	21.9	21.2
Cubic feet of air used per minute, calculated from piston displacements	11.1	12.8	13.9	15.3	16.5	17.2	18.6	20.5	21.2	22.4

The air compressor which the company have built for use especially with their drills, but no less desirable for all other work for which compressed air may be needed, has met with general favor. Its cylinder is composed of three shells, forming two annular spaces around the working cylinder; the outer space affords a passage for the air after compression, and a vessel for collecting any moisture there might be in the air, while the inner space forms passages for the water used in cooling. The heads of the cylinder, as also the piston and piston rod, are hollow, with passages for water for cooling. In this way the heat caused by the air compression is effectually got rid of. Self-lubricating piston rings are

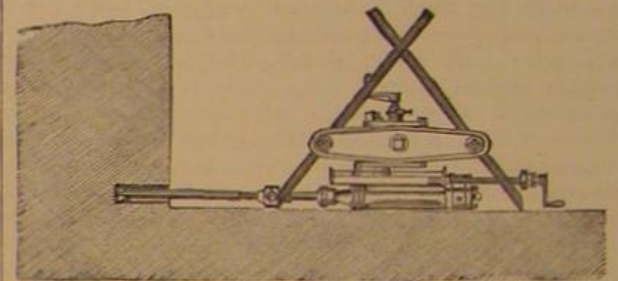
used, reducing friction to a minimum, and only cool dry air is furnished.

The drills and air compressors of the Rand Drill Company have been long enough in use to have their merits abundantly



ROCK DRILL WITH COLUMN.

ly attested, as they are in the most flattering terms by some of the most extensive and successful mining companies in the country. In California, Colorado, Nevada, Utah, and in the whole Rocky Mountain region, in the Lake Superior mining districts, in Pennsylvania, New Jersey, and New York State, they have in many cases furnished the entire working machinery, and in all the different classes of mining work, as well as in tunneling and excavating of every description, their simplicity of construction, non-liability



QUARRY MACHINE.

to get out of repair, the amount of work they will do, and the economy of their operation, the machines have recommended themselves to practical men everywhere.

The New York office and salesroom of the company is at No. 21 Park Row.

WESTERN SIDEWHEELERS.

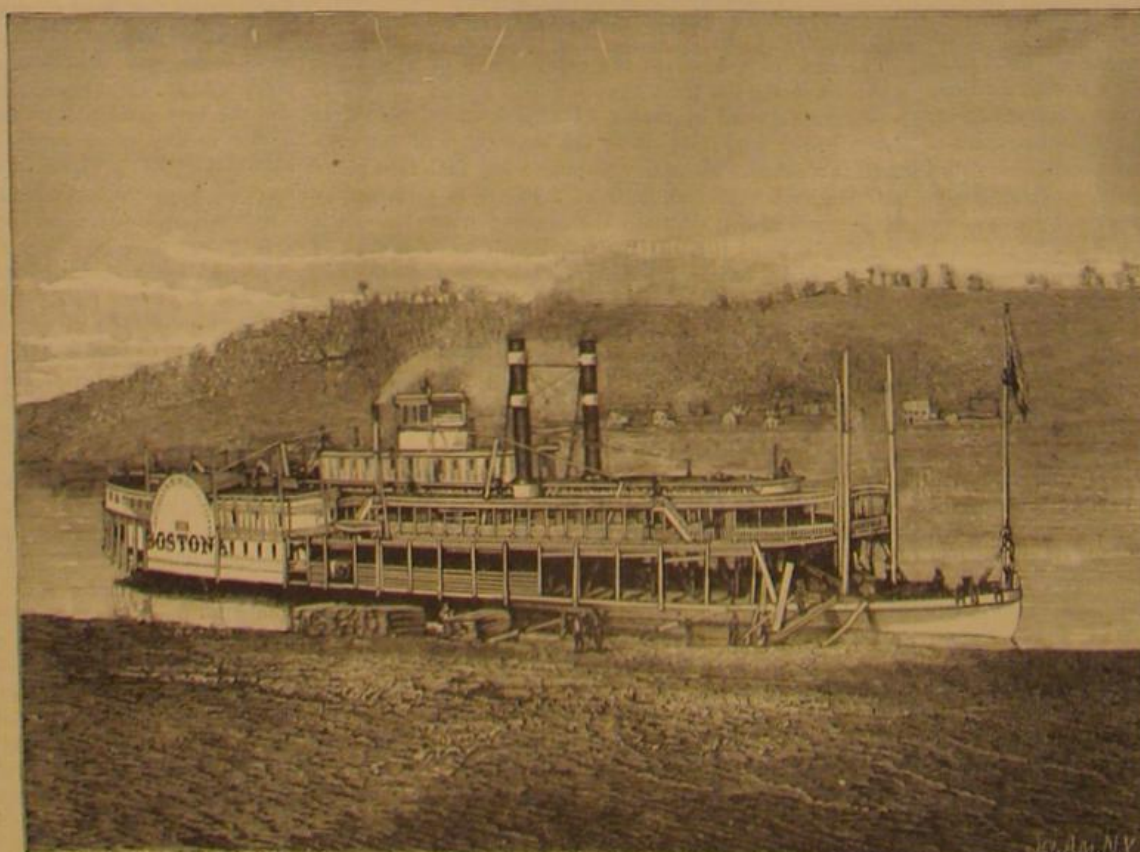
The illustration is not only an accurate delineation of one of the most remarkable steamers ever built, but it may be taken as a representative of the general appearance and detail of the Western river steamers as a class. The wheels in these boats are always abaft midship, and the boilers are located on the lower (main) deck amidships.

The *Bostona*, shown in the engraving, was built at Cincinnati, in 1879, to ply on the Ohio between that city and Huntington, W. Va., the western terminus of the Chesapeake and Ohio Railway. She measures 302 feet long, 43 $\frac{1}{2}$ feet beam, 6 feet hold, and carries 1,000 tons freight, yet with steam up and fuel aboard, draws only slightly over two feet. She has complete accommodations for about 200 passengers. There are four steel boilers, 30 feet long, 47 inches in diameter, with six return flues each; two engines, horizontal, high pressure, 25 inches diameter, and 8 feet stroke. The wheel shafts are located 98 feet from the stern.

As this trade demands that the freight be handled as quickly as possible, all cargo is carried on deck. This brought about an ingenious arrangement, by which the fuel box, which heretofore had encumbered considerable space on deck, was done away with and the unused hold utilized. A double railway track is laid throughout the length of the steamer's hull, on which are a number of small cars containing the fuel.

By the shifting of these coal cars the steamer is trimmed even when running light.

H. L. BRIDWELL.
Hillsboro, Ohio.



THE LIGHT DRAUGHT STEAMER BOSTONA.

NEW GUN OF REMARKABLE POWER.—Sir W. Armstrong & Co. have lately produced a five ton (95 cwt.) gun that discharges a 120 lb. projectile with a velocity of 2,064 feet per second, which is equal to 3,545 foot tons of stored up energy, or 746.3 foot tons per ton weight of gun.

NEW POLISHING MACHINE.

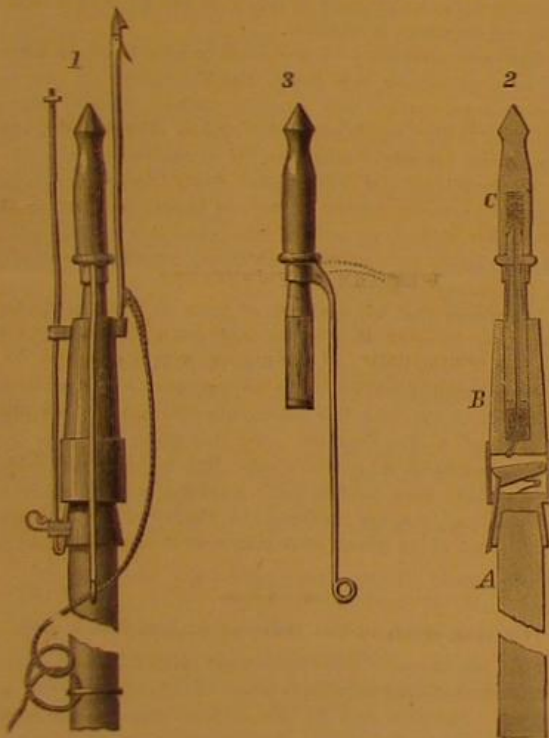
We give an engraving of an improved machine for polishing knives and other similar articles, recently patented by Mr. M. R. Chase, of Warren, R. I. The machine consists of two disks of yielding material having radial grooves in their adjacent faces for conveying the polishing powder from the tubular shaft outward. These disks are inclosed by a circular casing having openings through which the articles to be polished are thrust. On one side of the machine there is a crank for turning the polishing disks, and upon the opposite side there is a smaller crank for turning a worm which carries the polishing material from the hopper into the shaft, whence it passes through lateral holes to the radial grooves in the polishing disks. To render the grooves more effective in feeding the polishing material they are slightly curved, and the grooves of one disk alternate with the grooves of the other. By this arrangement all of the polishing surface is utilized and the best distribution of the polishing powder is insured.

The polishing material used with this machine consists of any suitable polishing powder mixed with cork sawdust and moistened with soap and water. The powder thus prepared, when dry and evenly distributed on the polishing disks, forms a soft pliable surface, which is very effective in polishing all parts of the surface being operated on.

The pressure between the disks may be easily regulated, and only a few turns of the machine are required to give a knife a fine polish. The machine may be run by hand or foot or by any other convenient power.

IMPROVED BOMB LANCE.

An improved bomb lance, patented by Mr. E. Pierce, of New Bedford, Mass., is shown in the annexed engraving.



PIERCE'S BOMB LANCE.

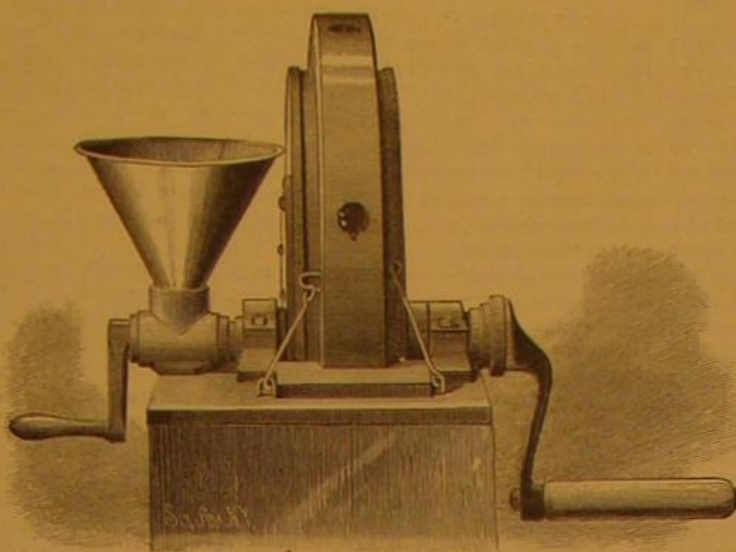
Fig. 1 is a side elevation, Fig. 2 is a longitudinal section, and Fig. 3 shows the bomb lance detached from the gun.

The invention consists of a gun mounted on a suitable shaft and adapted to the bomb lance shown in Fig. 3. The gun has a lock which is operated by impact against the body of the lance. The bomb lance has a cavity for receiving a charge of powder, and is provided with a wooden staff through which a fuse passes. The staff of the lance is received by the gun barrel. On throwing the lance the lock of the gun is released and the gun discharged as the point of the lance touches the body of the whale; the fuse of the lance is at the same time ignited, so that immediately after the lance enters the body of the whale its charge of powder is exploded, killing or injuring the whale. The bomb lance is provided with a rod having an eye in the end for receiving the line.

The Rarity of Food Adulterations.

In awarding the prizes offered by the National Board of Trade a year ago, for essays in relation to the adulteration of food, the committee makes the gratifying announcement that none of the competing essayists produce any definite or satisfactory evidence as to the widespread existence of very dangerous adulterations in this country. Such dangerous adulterations appear to be mainly in the form of poisonous colors or coloring matters, as, for instance, in confectionery, and even these are rare. The question of the adulteration of food, with, perhaps, the exception of milk, should therefore be considered not so much from a sanitary standpoint as from that of commercial interests, as being in the nature of a fraud, in aiding the sale of articles which are not what they are represented to be. The committee is of the opinion that there is much more danger to health and life in this

country from adulterated drugs than from adulterated food, and that any legislation which is to deal with the one should also deal with the other. A Board of Health is recommended for each State, and both State and national legislation on the subject of adulteration is deemed desirable. The committee will endeavor to prepare and place in the



CHASE'S POLISHING MACHINE.

hands of the President of the National Board of Trade, as soon as possible, drafts of acts prepared in accordance with the general principles contained in its report.

NEW CISTERN FILTER.

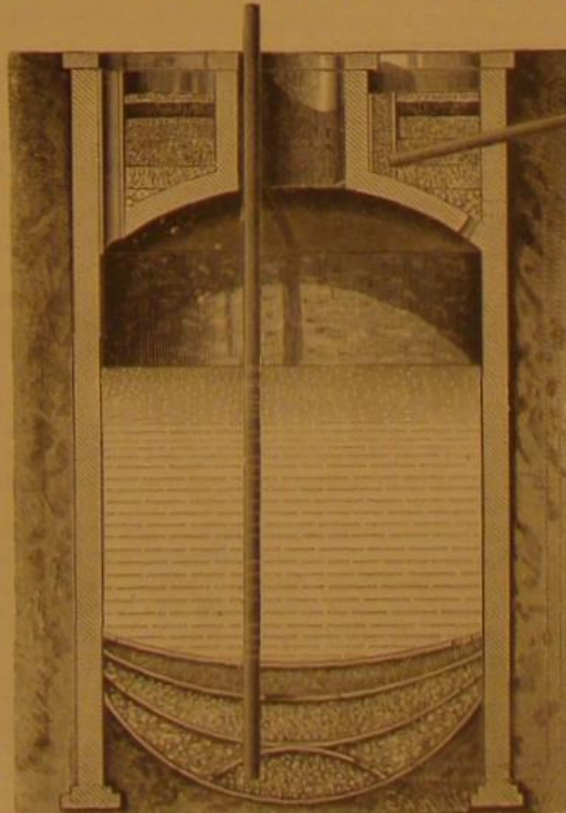
The engraving shows a filter designed to secure in any given cistern space a more thorough removal of suspended matter than is effected in the ordinary cistern filters, to eliminate from the water matters harmful to health by a process which depends mainly on the concentration of atmospheric oxygen and in part by oxygen dissolved in water.

The process of oxidation is carried on during the passage of the water through a finely divided and aerated filter bed, the aeration of which takes place during fair weather.

The filter bed in which the oxidation and aeration take place is not constantly submerged, as are those now used, but is open to air pressure, to the action of light and heat in summer, and to the disinfecting, cleansing, and healthful influence of cold and frost in winter, agencies essential to secure good water.

A tonic or mineral quantity can be given to the water by the introduction of iron filings or small scraps of iron in the filter bed, when desirable.

The engraving is a vertical section of the filter, with its walls extending from base of arch to ground surface. It has on its arch a main aerated filter bed, and on its bottom four more filter beds. In the main aerated filter bed there are six layers, as follows: First, gravel stones or pebbles at the bottom, to allow free drainage; second, a layer of coarse gravel; third, one of finer gravel; fourth, one of sand; fifth, one of coarsely granulated charcoal and fine sand; sixth, one of small pebbles on top, to keep charcoal in place and allow it to dry out between showers in fair weather. There is a space for water above the filter bed, and an overflow pipe, with



DAY'S CISTERN FILTER.

top below outer cistern wall, is provided to take water not passing through the main filter by a direct passage into the

cistern; there is also a pipe to allow water discharged from conduit pipe, to come from main aerated filter bed to its surface and then spread over it. Through the arch there is an opening to carry the water into the cistern after it has passed through the filter bed in a circuit around the man-hole.

The arrangement and composition of the four filter beds on the bottom of the cistern are as follows:

The hemispherical filter on bottom of cistern is composed of granulated granite, or limestone, or cleanly-washed pebble stones. This is gravel concreted an inch thick, and perforated, before concrete sets, with twenty-five to fifty small holes midway between its base and top. Around this there is a filter bed made of coarse gravel and gravel concreted in form of an inverted arch, with fifty to seventy-five small holes near its outer edge, and above this there is a filter bed made of fine gravel and gravel concreted in form of an inverted arch, with a twelve inch opening at the center. The upper filter bed is made of closely compacted clean and sharp sand, and concreted with gravel an inch or more in thickness, with fifty to seventy-five small holes near its outer edge.

It will be noticed that the water is filtered as it enters the cistern, and filtered again as it is pumped out.

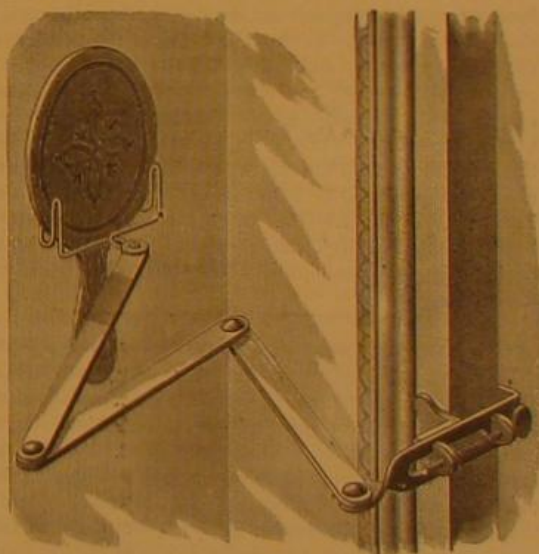
This invention was lately patented by Mr. Samuel Day, of Ann Arbor, Mich.

A Steel Steamboat for Venezuela.

A steel steamboat in sections was recently sent from this port to Lake Maracaibo, to be used in the transportation of coffee and other products of Northern Venezuela. The Zulia and other rivers of that fertile basin are apt to be very shallow during the dry season, making transportation by the river craft there in use not only uncertain but expensive. The design is to substitute therefor a fleet of steamboats, of which the one lately sent is a pioneer.

HAND MIRROR HOLDER.

The engraving shows a simple and very convenient device for holding a hand mirror when it is desirable to use



HAND MIRROR HOLDER.

both hands in making the toilet. The bracket is readily clamped to the frame of the mirror, and may be extended sufficiently for ordinary purposes.

This invention was recently patented by Messrs. Webb & Myrick, of Stockton, Cal.

AGRICULTURAL INVENTIONS.

A check row corn planter, so constructed as to drop the seed at uniform distances apart, and at the same time mark the position of the hills, so that the planting can be done in accurate check row, has been patented by Messrs. Alfred A. McIntosh and Lysander J. Lishness, of Pontiac, Ill.

Mr. Edson M. Gaskill, of Edenton, Ohio, has patented a churning machine so constructed that it will be operated by giving oscillating movements to the chair upon which the operator sits.

An improved manure fork has been patented by Mr. George P. Ruhle, of Swengel, Pa. This invention relates to certain improvements on the combined scraper and fork for which Letters Patent No. 233,390 were granted to the same inventor January 6, 1880, and it has particular reference to the construction of the fork.

An improved check row corn dropper, or device for automatically planting corn in perfect check rows, has been patented by Mr. Alonzo J. Simmons, of Pana, Ill. It comprises the following features: Means for rendering the distance between the hills dropped uniform and independent of the rough character of the surface of the soil; in a peculiar mechanism for converting the rotary movement of the driving shaft into the reciprocating movement of the seed slide; and in the peculiar construction and arrangement of the marking devices.

oil Lubricants.

On the score of annual accumulation our case is even better, relatively far better. The annual accumulation of wealth in Germany is \$200,000,000; it is \$325,000,000 in the United Kingdom; \$375,000,000 in France, in the United States it is \$825,000,000! Our increase of national wealth since 1850, says a good English authority, would be enough to purchase "the whole German Empire, with its farms, cities, banks, shipping, manufactures, etc. The annual accumulation has been \$825,000,000, and therefore each decade adds more to the wealth of the United States than the capital value of Italy or Spain. Every day that the sun rises upon the American people it sees an addition of \$2,300,000 to the wealth of the Republic."

MISCELLANEOUS INVENTIONS.

An improved bob sleigh has been patented by Mr. Charles R. Walkley, of Churubusco, Ind. This invention consists in a novel construction of the knee, and the arrangement thereof with relation to the runner and the bolster, and of the runner with relation to the knee and to the draught bar, whereby provision is made for enabling the runners of each pair to move independently.

An improvement in underground telegraph lines has been patented by Mr. Stephen D. Field, of New York city. The object of this invention is to prevent the accumulation of and to remove moisture from underground tubes containing telegraph wires, and thereby insure the insulation of the wires. The invention consists in the combination, with a system of underground tubes, of mechanical means for maintaining a circulation of dry air and drying or condensing chambers for relieving the air of moisture.

An improved boat plug which is simple, self-acting, and reliable, has been patented by Mr. Lewis H. Raymond, of New York city. The invention consists of a plate attached to the bottom of the boat over an aperture, and provided with a perforated neck having an external thread to receive a cap on the upper side, and with a hinged valve on the bottom side, this valve being protected by a suitable cage.

An improved baker's oven has been patented by Mr. George Brake, of Lansing, Mich. This invention is an improvement on the baker's oven for which Letters Patent No. 215,088 were granted to the same inventor May 6, 1879.

Mr. James Lidstone, of Farmington, Me., has patented an improved steam cooker for cooking meats, vegetables, etc. The novelty consists in the arrangement of parts whereby the steam and odors of the cooking food are conducted from the several compartments of the cooker into the fire space below, and thereby prevented from escaping into the room.

An improved apparatus for balancing or adjusting the running millstone upon its spindle has been patented by Mr. James Comerford, of Rathdrum, Ireland. This improved balance consists of a ring fixed in the eye of the stone by three or more radial set screws, and connected to the universal joint or other bearing on the cock head of the spindle, the ring being sufficiently smaller than the eye to admit of the stone being shifted by means of the set screws in any direction radial to the spindle, with which the ring remains concentric. The stone is supported on the ring by an inwardly projecting flange or lugs on a lining or a set of legs fixed in the eye and rising through it (more or less) toward the back of the stone, it being generally preferred that the ring should be high up in the eye, so that the bearing on the spindle may be at or above the center of gravity of the stone, although it is not limited to this position.

Mr. George Oliver, of London, England, has patented improvements in the apparatus for use in gymnastic or theatrical performances for which two applications for Letters Patent in the United States were filed by the same inventor on the 19th day of June, 1880; the invention consists in the combination, with the springs and the wire by which the performer is raised, of a drum and brake interposed between the springs and the wire for the purpose of taking up the slack of the wire after the performer has received an upward impetus from the springs, and of retaining the performer at any height to which he may be raised and checking his descent.

An improved self-inking stamp, which is simple, convenient, and effective, has been patented by Mr. Louis K. Scottford, of Kansas City, Mo. The invention consists in a self-inking hand stamp mechanism by which the die is pressed against the ink pad when the handle is raised, and is oscillated by depressing the handle.

Mr. James V. Pomeroy, of Boulder, Col., has patented a process of amalgamating ores containing gold and silver, which consists in introducing chlorine gas or chloride of lime with an acid into the pulverized ore with the mercury.

An improved eyeglass has been patented by Mr. Gideon C. Hilpert, of Hill, N. H. The object of this invention is to provide eyeglasses that are adjustable upon the nose in a straight horizontal line instead of with the rolling motion common in other eyeglasses. The improvement consists in lenses connected with each other by means of a straight rod, and adjustable with respect to each other by means of a spiral spring encircling the rod.

An improved can opener, so constructed that it can be readily adjusted to cut larger or smaller openings as required, has been patented by Messrs. George A. Snow and Franklin L. Coe, of New York city.

A wrench especially adapted to the unscrewing of bolts and nuts where but little room is given for the movement of the wrench handle, has been patented by Mr. Leslie P. Hiatt, of Peru, Iowa.

A device for preventing the lateral vibration of a circular saw while running, has been patented by Mr. Clarence A. Sherman, of Plover, Wis. The invention consists of a pair of laterally adjustable guide arms and guides fixed on an adjustable bar that passes laterally through a centrally mortised sliding block, which together with its attachments are held in place by means of a cam-operated bar.

Mr. Jacob R. Scott, of Nyack, N. Y., has patented a machine for sewing boots and shoes that will meet the peculiar requirements of that class of work without complicated mechanism; and the invention consists, specially, in the mechanism for tightening the stitch, whereby the layers of leather are tightly drawn together, and also in the looping mechanism for forming the stitch.

An improved lathe tool has been patented by Mr. Joseph

V. Hoffman, of Raritan, N. J. The object of this invention is to prevent the springing of the work and the chattering of the cutting tool when a shaft or other piece of work is being turned, faced off, or centered in a lathe.

Messrs. Stephen H. French and William J. Maltby, of Belle Plain, Texas, have patented a vehicle wheel whose spokes may be adjusted radially outward, and also forced tightly together around the axle box to compensate for shrinkage.

An improvement in the class of wardrobe bedsteads has been patented by Mr. Ernest N. Doring, of New York city. It consists in the construction of the stationary and folding parts which adapt them to close together and in the means for connecting and balancing the folding part.

James C. Watson.

James C. Watson, Professor of Astronomy in the Wisconsin State University and Director of the Washburn Observatory, died at Madison, Wisconsin, November 23. For a week or more Professor Watson had been suffering from a severe cold contracted while superintending the construction of a large addition to the observatory and a new solar observatory which he was constructing at his own cost. He was better the day before his death, and unwisely exposed himself to chill, which in his exhausted condition he was unable to withstand.

Professor Watson was born, in 1838, at Elgin, Canada, of American parentage; and when he was still a child his parents returned to the United States, settling in Ann Arbor, Mich. At the age of fifteen he entered the State University at that place, and took his first degree at the age of nineteen. Two years later he was elected Professor of Astronomy and Instructor in Mathematics in the university where he had studied, and rapidly rose to eminence as an original discoverer and contributor to scientific periodicals.

In the course of his connection with the university he added twenty-three planets to the list of those already known, besides the more important discovery of the planet Vulcan. For these contributions to the world's knowledge he received, in the year 1870, the award of the gold medal of the French Academy of Sciences; was made member of the National Academy of Sciences in 1867; the American Philosophical Society in 1877; of the Royal Academy of Sciences, of Italy, in 1870; and in 1875 Knight Commander of the Imperial Order of the Medjidieh, of Turkey and Egypt. The University of Leipzig in 1870, and Yale College in 1871, conferred upon him the degree of Ph.D.; and Columbia College, in 1877, the degree of LL.D. He was also appointed Judge of Awards at the International Exhibition of 1876.

Professor Watson was also repeatedly called upon to take charge of government expeditions for astronomical observation. In this capacity he went to Mount Pleasant, Iowa, in 1860, to observe an eclipse of the sun; to Carlini, Sicily, in 1870, for a like purpose; to Pekin, China, in 1874, to observe the transit of Venus; and to Wyoming Territory, in July, 1878, where, during the solar eclipse, he discovered the planet Vulcan, and satisfied himself of the existence of another unknown planet of lesser magnitude.

In 1879 Professor Watson left Ann Arbor to take charge of the new observatory of the Wisconsin State University at Madison. The private solar observatory which he was building at the time of his death, was on a plan suggested long ago by Bacon, but never tried. A cellar twenty feet deep had been sunk below the surface of the ground at the bottom of the first hill slope, in front of the entrance of Washburn Observatory. Over this a fine stone building was being erected at the top of the hill, which is about sixty feet above the bottom of the cellar. Powerful reflectors were to have been placed to throw rays of light down a long tube which ends in the cellar, where the observer would be stationed.

Professor Watson believed that in this way better observations of the sun could be taken than ever heretofore obtained. All these projects and plans for the future are, however, brought to their end by his untimely death.

Among his best known publications are a "Popular Treatise on Comets," published in 1860; "Theoretical Astronomy," 1868; "Report on Horological Instruments," 1878; and "Tables for the Calculation of Simple and Compound Interest and Discount," 1878. Since 1873 he has been president of the Ann Arbor Printing and Publishing Company, and for several years has been actuary of the Michigan Mutual Life Insurance Company.

Extension of Telephonic Facilities.

The American District Telegraph Company, in this city, have recently placed in a number of their offices telephones for public use. By means of this extension of facilities parties who wish to talk with subscribers of telephone exchanges in New York City, Brooklyn, Jersey City, Newark, Paterson, Elizabeth, Orange, Yonkers, and Coney Island, can do so under certain restrictions for five minutes, on paying a fee ranging from twenty to forty-five cents, according to distance. The next improvement will be the establishment of telephone stations, through which conversation may be had by appointment with non-subscribers.

Thomas S. Hall.

Mr. Thomas S. Hall, inventor of the automatic electric railway signals bearing his name, and in use on many of the railways of this country, died at Hartford, Conn., Dec. 1, at the age of 52 years. Mr. Hall was a man of great force and persistence, and his inventions have done much to diminish the hazards of railway travel.

The St. Gothard Tunnel.

The Geneva correspondent of the London Times writes, under date November 3: "The 94th monthly report of the St. Gothard Railway Company, which has just been presented to the Federal Council, bringing the history of the undertaking to September 30, contains details which, in view of its approaching completion, are more than ordinarily interesting. As for the great tunnel, the enlargement of the upper part is complete over a length of 14,872 meters. There remain now only 40 meters to be enlarged. The excavation is finished and continuous for a distance of 9,539 meters. The completed masonry of the roof measures 13,057 meters; of the west side, 9,830; and of the east side, 9,891; and the length of tunnel entirely finished, with aqueducts, rails, and niches, is reckoned at 9,390 meters, about two-thirds of the whole. The average number of men employed inside the tunnel during the month of September was 3,031. The total outlay on the tunnel to the date in question was estimated at 49,853,545f. The mean maximum temperature of the tunnel was 87° Fah., the mean minimum 85°. The average daily consumption of dynamite was 235 kilogrammes, of oil 578. Good progress is being made with the lines of approach. Between Immensee and Lugano there are five stretches which, taken one with another, are completed, as touching excavations and embankments, in the proportion of 72 to the 100; as touching masonry and rail laying, 67 to the 100. The average monthly rate of progress is about 6 per cent. Of the forty-nine smaller tunnels, thirty-four are pierced and several quite finished. The outlay on the lines of approach to September 30 reached a total of 32,781,000f. The average number of workmen employed in the making of these lines is 13,420. It results from the foregoing particulars that, should no unforeseen delays occur, the St. Gothard line in its entire length can hardly fail to be ready for traffic in the first half of next year. Meanwhile, the differences between the company and the contractors for the great tunnel are being fought out before the Federal Tribunal. The contractors, while expressing their intention to have the tunnel completely finished by the end of April next, contend that, but for the company's sins of omission and commission, it would have been finished 750 days before that time. For this loss of time they claim heavy compensation. The company, on the other hand, disclaim all responsibility for the delays in question, and demand the enforcement of the penalty stipulated in the contract—£200 for every day beyond October 1, 1880, by which the completion of the undertaking is protracted."

Rain Not Produced by Cannonading.

To the Editor of the Scientific American:

Your issue for November 27 has a notice of an invention for causing rain, with a satisfactory engraving of the inventor bringing down a heavy shower simultaneously with the explosion of his patent dynamite balloon. The inventor assumes that it is "well known" that cannonading is always followed by rain.

Now I don't know how that comes to be so "well known" by people who never witnessed the effects of heavy cannonading, and I think it is time that they should know that it is not the case. It may rain after a heavy cannonade, or may not, or may rain just before the cannonade. The cannonade has no effect whatever. The cannon explosions in a battle exceed the explosion in the inventor's patent balloon twenty thousand times or more, and if the former does not cause rain, the patent balloon will not do it.

I was at the battle of Shiloh, which lasted two days, April 6 and 7, 1862. The cannonade was as rapid as the strokes a man could give a base drum with two drum sticks, and it was continuous, to say nothing of the musketry fire, which was not a roll or rattle at all, but a continuous, even roar. What was the effect on the weather? It rained before the action opened, and rained all the first day and night. The second day of the battle was clear and sunny, and so were several succeeding days.

The battle of Corinth was fought in a dry, hot spell, October 3 and 4, 1862. There had been no rain for two weeks. This was a good chance to test the thing. The cannonading was heavier than at Shiloh, and lasted for ten hours. It was a perfect hell on earth. No rain followed the battle. The dry hot weather continued for two weeks more.

The two battles of Lookout Mountain, November 24, 1863, and Missionary Ridge, November 25, which followed each other, were not followed by rain. The night after Missionary Ridge was one of the clearest and loveliest moonlight nights I ever saw. The next week was also clear, except a very light shower the second day after. Very few of the battles of the Atlanta campaign were followed by rain, and in such as were, it would have come anyhow. If there is a popular delusion that heavy cannonades cause rain, it might as well be dispelled, as experience shows there is not the slightest foundation for the notion.

Cincinnati, Nov. 23, 1880. ANDREW VAN BIBBER.

By subscribing for the SCIENTIFIC AMERICAN, a new volume of which commences with the next issue, you will have illustrations and descriptions of the most extensive manufacturing establishments of the country, as well as engravings of the newest and best iron and wood-working machinery and implements made, besides all the most novel and important inventions patented in this and other countries during the year. Remit \$3.20 to MUNN & Co., 87 Park Row, New York.

Sewing Machine Motors.

That there is a large field for a good practical sewing machine motor cannot be denied; but, like perpetual motion, many have tried the "perplexed thing," but failed. A motor, to be practical and popular, must be a part and parcel of the sewing machine—not a heavy, cumbersome contrivance that costs more, and occupying more space, than the sewing machine itself. How it is to be accomplished must be left to the inventive genius of the country, which in time may solve the question. Of course these remarks refer to motors for family use. For factories and workshops, water and steam solve the question.

So far the best motor for sewing machines is the common treadle. Such devices as those which imprison one hand in their operation are useless—as far as practicability and usefulness are concerned. A person might as well have but one arm, as it leaves but one hand to direct the work. Whenever a sewing machine motor is invented that will do the ordinary work of a family, without the aid of steam, water, or electricity, and run a reasonable length of time without replenishing the power exhausted, a step will have been made toward solving this question. But, where more power is expended in storing up what is wanted for use than it takes to operate the machine for a given period of time, such devices are worse than useless—they are time lost. We expect, yet, to see this problem solved.—*The Sewing Machine Journal*.

A Fossil Human Skull.

Dr. T. G. Horn, of Colorado Springs, Colorado, favors us with a photograph of "a petrified human skull," picked up near Gothic, Gunnison County, Colorado. The doctor says that the skull has been examined by quite a number of the medical profession, and all pronounce it the greatest curiosity ever discovered. Every bone, suture, and outline is perfect. As shown in the photograph the posterior half of the skull seems to justify the description; the forepart is less clearly exhibited. The jaw is gone, and a mass of stone resembling a hot spring deposit obscures the facial outline.

No account is furnished with regard to the conditions under which the skull was found, so that no estimate can be made of its probable age. If found in connection with hot spring deposit, it might easily be quite modern. On the other hand, it may be the skull of an "original settler," ancient enough to have used the implements found in the inter-glacial or pre-glacial gold gravels.

A NOVEL STEAM CARRIAGE.

A great many steam wagons and carriages have been devised and built for transporting loads on our ordinary highways without tracks, but although some of the devices were masterpieces of ingenuity, the practical results obtained were never perfectly satisfactory. Walter Hancock, the most persistent of inventors and constructors in this line, built a steam phaeton in 1838, and obtained a maximum speed of 20 miles and an ordinary speed of 10 miles per hour. Within the last few years the interest in steam wagons has been renewed, and some very successful experiments have been made with them, the trip by M. Schmid, M.E., who traveled from Zurich to Paris, in 1878, on a self-propelling steam fire engine of his construction, being an example. A steam carriage, invented and built by the French engineer Bollé, of Le Mans, and exhibited at the Paris Exhibition of 1878, was an object of more than ordinary interest. Its speed was said to surpass that of any ordinary vehicle drawn by horses. The inventor named his carriage "La Manselle," in honor of his native city Le Mans.

This carriage is shown in the annexed cut, taken from the *Leipziger Illustrirte Zeitung*. The casing in the front part of the carriage contains the driving engine, which is controlled by the engineer seated above it, who also operates the steering gear and the powerful brake levers. The rear axle is driven by spur wheels and chains. The boiler is placed above the rear axle, the coal bins are at each side of the boiler, and the water truck is below the seat of the engineer. Experimental trips have been made with one of these carriages on the road from Berlin to Charlottenburg. The average speed attained, according to the above authority, was 18 miles per hour, but a maximum of 22 miles per hour was reached. Coke was used as fuel, which produced but very little smoke, about 8½ to 10 pounds being consumed per hour. The carriage rounded the curves in an excellent manner, and the entire experiment proved most satisfactory.

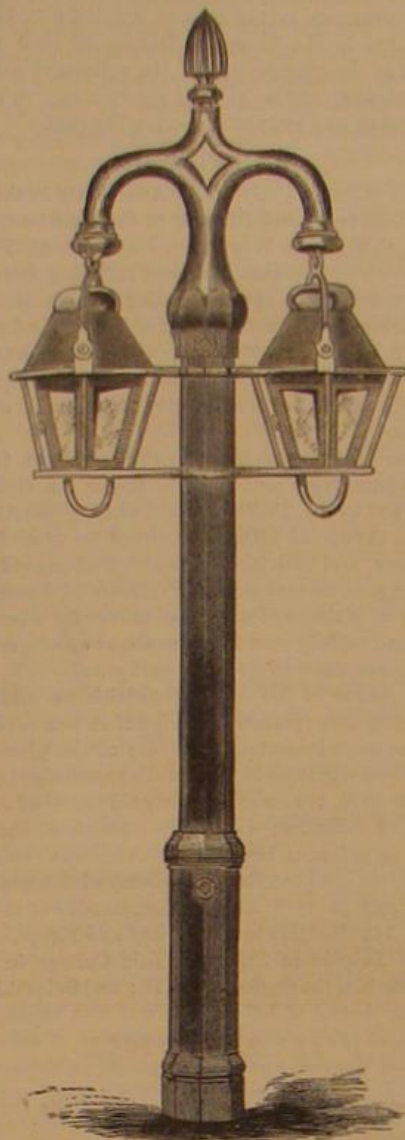


TRIAL TRIP OF THE NEW STEAM CARRIAGE AT BERLIN.

BURTON'S IMPROVED STREET LAMP.

The engraving shows a lamp for lighting streets, parks, and other places where gas lamps are not used. It is a novel arrangement, and has the advantage of simplicity and cheapness.

Projecting from an opening in the cap there are one or more downward curving hollow arms, carrying a series of chains; these chains extend into the base, where their inner



BURTON'S IMPROVED STREET LAMP.

ends are attached to a weight or counterbalance, their outer ends being secured to the sliding lamp frame. There is a pin or bolt threaded to work in a nut at the top of the base; its inner end is shaped to fit a groove in the weight, and forms a key or stop to secure the lamps at any desired elevation. When the key bolt is withdrawn the lamps may be readily raised or lowered by sliding the frame on the post, the chains running freely through the arms, and the weight rising and falling in the body of the post. The weight need

not necessarily be made fast by the key or bolt, as the weight counterbalances the lamps so that they will remain in any desired position.

The post is made of cast iron, in two parts, firmly united by a set screw at the top. The weight weighs 20 pounds, and is secured to the ball of the cage by a three-quarter inch chain. The sliding frame is of cast iron, of sufficient strength to hold and guide the lamp along the body of the post. The lamp is well made of the best material, and may be adapted to either kerosene or gasoline.

With this post the inconvenience of carrying a ladder is avoided, and there is no danger of dropping the chimney or spilling of oil. After the lamps are once filled, a small crooked handle, which is furnished with each post, is all that is required to equip the lamp-lighter for his evening journey to light the streets for one month. All that is required is to draw the lamp down, trim, and light it; a slight push upward replaces it, when it remains in the proper position.

This lamp has been manufactured and sold extensively for the past two years, and we are informed that it is meeting with great favor in the New England States. It has been patented in the United States and in Canada. It was awarded a silver medal at New England Fair, 1878. For cities, towns, suburban villages, and private use, and for other purposes where outdoor lighting is required, it fills a great want.

Further information may be obtained by addressing the inventor, Mr. Geo. D. Burton, New Ipswich, N. H.

ENGINEERING INVENTIONS.

Mr. William H. Weeks, of Dartmouth, Nova Scotia, Canada, has patented a device for the safe and economical burning of liquid hydrocarbons under boilers, evaporators, etc., whereby the combustion is made perfect and the control over the flame absolute.

Mr. Orlando S. Emerson, of Elkhart, Ind., has patented improvements in steam valves. These improvements relate to puppet valves which have heretofore been constructed with an adjustable lip, fitted for movement by a screw ring to adjust the lip, and held in place by screw pins entering notches in the ring. In such valves the screw pins become loose or are jarred off, so that the adjustment is unreliable. The object of this invention is to avoid these difficulties. The invention consists in a spring pin used in place of a screw for retaining the adjustable lip in place.

An improved egg beater has been patented by Mr. George A. Schmidt, of New York city. The object of this invention is to provide an effective and durable device designed especially for use by confectioners, bakers, hotels, etc., when a large number of eggs are to be beaten at a time.

A machine for grinding mower and reaper knives has been patented by Mr. Charles Askew, of Madison, Wis. The invention consists in a novel rest and carrier for the sickle bar and combination and arrangement thereof with relation to the grindstone, whereby provision is made for adjusting the sickle bar to the grinding surface.

Messrs. Leonard A. Cooper and Oliver F. Bostwick, of Atchison, Kan., have patented a combined listing plow and seed planter, so constructed as to open the ridge or clear a space for the row of hills, open a furrow to receive the seed, drop the seed, cover the seed, and roll down the soil. It is simple and readily adjusted and controlled.

An improved injector and condenser has been patented by Mr. Gaspare Mazza, of Turin, Italy. The invention consists in combining a boiler pipe, cones, and connected eccentrics having different throws with a feed water pipe and a steam inlet pipe having a cock.

An improved steam engine governor has been patented by Mr. Walter E. Crane, of Alma City, Minn. The object of this invention is to dispense with all devices depending on centrifugal action or the force of gravity for their operation in the regulation of the speed of steam engines or other motors. The invention consists in a governor wherein the straight line movement for regulation of speed is obtained by the variations in speed between mechanism operated by the engine and mechanism moved by a separate motor at a regulated speed.

Mr. Alexander C. Lewis, of Fayetteville, Ark., has patented an improved rotary engine of the class in which a rotary valve is employed. The novelty consists in a combination of parts which cannot be clearly described without engravings.

SAND AND WATER SPOUTS.

It is a well known fact that all atmospheric changes, winds, thunder storms, tornadoes, etc., originate in changes of temperature, and sand and water spouts are also due to the same cause.

The annexed engravings, showing sand and water spouts, are taken from "Die Erde und ihr organisches Leben. Dr. Klein und Dr. Thomé. Stuttgart: Spemann."

Sand and water spouts are formed when the air rises upward and assumes a rotative movement. It then draws upward the bodies or liquids over which it rises, and moves forward, retaining its longitudinal axis. In many cases these spouts occur during thunder or showers, then clouds and rain descend to unite with the upward moving spouts, as is shown in the representation of the water spout. The mariner can in most cases avoid the water spouts, but the sand spout destroys everything in its path, uprooting the largest trees, demolishing strong buildings, carrying the debris upward and distributing it over large areas. As these spouts always appear simultaneously with thunderstorms, they have been attributed to the action of electricity. But as whirlwinds are often produced, for instance above fires or on a small scale at almost every corner on a windy day, without the co-operation of electricity, it will be safe to say that electricity is generated by the action of the whirling and rising air.

Dr. Th. Reye has shown, by careful calculations, that an unstable equilibrium necessary to the formation of spouts or whirlwinds exists only when the decrease in temperature is 3.42° C. (6.16° F.) for every 325 feet of vertical distance. In this case the ascending column of air being considerably lighter than the air into which it passes, the air ascends with great rapidity.

If the ascending air passes into a layer of air that is so cold as to condense its moisture, the heat will be liberated, and that will expand the ascending air. The unstable equilibrium also causes the upper layers of air to sink into the lower layers; in this case descending spouts are produced.

Generally the air that enters into the column of rarefied air from the side produces the rotative movement. The condensation of the vapors produces rain, and a sudden contact with cold air may produce snow or hail, all accompanying the spouts.

In the engravings the spouts are grouped rather closely in order to show the various forms to the greatest advantage. The spouts, as a rule, do not approach each other nearer than half a mile.

Measurement of Railways.

Measurements for mile posts have been made recently on the New York, Pennsylvania, and Ohio Railroad over its whole line in a somewhat novel way, says the *Railroad Gazette*. A velocipede hand car, with a four foot wheel, was fitted with a revolution counter, and after determining carefully the number of revolutions per mile, the distances were rolled off by running it over the track. There was found to be a slight irregularity in the measurement, owing to the play and coning of the wheels, but the error was far within the limits of ordinary careful chaining and very much more rapid as well.

Thirty-five to forty miles per day were made without much difficulty under the interruption of a heavy traffic, setting a stake every quarter mile—the quarter-mile points being marked with a small stone for convenience of employees. It was judged from the result that a still better way, especially if stakes were to be set only at every mile or half mile, would be to put the counter on an engine. As six miles an hour was made with the hand car, setting stakes every quarter mile, there should be no difficulty in making ten or fifteen miles with a locomotive, which might thus be able to make an ordinary freight run, without too many "lay outs." This very method, by the way, was used, we believe, by the government inspectors on the Pacific railroads, or some of them, to measure off the length of their subsidy bills, and certainly it is vastly more accurate than the chaining which preceded them, or, in fact, any but the most careful and

tance alongside the shafts or thills. The short leather traces are attached to the front ends of these rods by means of keys or eyebolts, which may be withdrawn, for the purpose of releasing the horse from the vehicle, by means of cords or straps that pass through a ring on the crupper or back strap of the harness, and extend back over the dasher of the vehicle, so as to be easily accessible to the driver.

A billiard table cushion of improved shape has been patented by Mr. Samuel May, of Toronto, Canada. The invention consists of a rubber billiard table cushion having a broad steel ribbon embedded in the rubber and running longitudinally through the entire length of the cushion, and extending from a socket in hard rubber at the bottom of the cushion upward in the elastic rubber to a point above where the ball comes in contact with the cushion.

A simple and durable device, by means of which the rain water flowing through the rain water conductors to the cistern may be cut off and made to flow in another direction when the cistern is full, has been patented by Mr. John Strasser, of Manchester, Mo.

Mr. Jean M. Berger, of St. Etienne, France, has patented improvements in magazine fire-arms of that class in which the magazine is in the nature of a supplemental cylinder or barrel just beneath the firing barrel, and from which the cartridges are projected as fast as they are used up by the expansion of a spiral spring within, having a cartridge pusher on its end.

A device to be attached to a vehicle for the purpose of equalizing the draught of three or four horses, has been patented by Mr. Herman E. Schmidt, of Rapidan,

Minn. The invention consists of several bars or levers for carrying the double and single trees, arranged upon the tongue or pole of the vehicle in such a manner that the draught or pull of one horse on the long arm of the main lever will equalize the draught of two or three horses at the short arm.

Mr. William J. Dawson, of Lawrence, Kansas, has patented an improvement in the front running gear of wagons which permits of the independent lateral oscillation of the body.

Messrs. Jules Schmerber and Charles Schmerber, of Paterson, N. J., have patented a process for obtaining a plastic compound by the treatment of the nitro derivatives of cellulose, dextrine, and glucose mixed with gums, balsams, or pigments, which consists in first treating the material while in a wet state with a liquid solvent, then reducing the product to a semi-liquid form by heat, then grinding and mixing the semi-liquid mass, and finally drying the compound to a plastic consistency.

Mr. Claude Varlot, of Grenoble, France, has patented an improved lacing staple which can be firmly attached to the leather or other material, and permits of lacing without passing the lace or string through apertures in the article to be laced.

Mr. Heinrich Baum, of Höchst-on-the-Main, Germany, has patented a red coloring matter, formed by subjecting the diazo compound derived from amidoazo-benzole to the action of disulphobetanaphtholic acid.

An improved fire-escape which is simple, safe, and reliable, and does not deface the building to which it is attached, has been patented by Mr. Felice Tocci, of New York.



SAND SPOUT.

accurate measurements with corrections for temperature. Measuring wheels for ordinary surveying purposes, working on the same principle as the above, have long been in use.

RECENT INVENTIONS.

An improved device, whereby the wind wheel may be thrown from a vertical to a horizontal position, has been patented by Mr. Adam W. Haag, of Fleetwood, Pa. The invention consists in journaling the horizontal axle of the wheel in a box that swings on trunnions and is adjustable in a vertical plane.

An improvement in that class of devices that are designed for releasing a horse instantly from the vehicle to which he may be attached, has been patented by Mr. Whiteford S. Martin, of Maybinton, S. C. An iron rod is attached to each end of the whiffletree and extends forward a short dis-



WATER SPOUT.

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 weekly as Thursday morning to appear in next issue.

Wanted—Superintendent for six thousand spindle cotton yarn mill. State salary and references. Rosalie Yarn Mills Natchez, Miss.

Astronomical Telescopes, first quality & low prices. Eye Pieces, Micrometers, etc. W. T. Greeng, 75 Fulton St., N.Y.

Hutchinson's Mechanical Boiler Cleaner, 84 John St., N.Y. will keep your boiler free from all sediment or mud—prevents scale, no cost save first. Engineers make 10 per cent selling other parties than employers. Circular on application.

Notice—Alden Crushers & Pulverizers manufactured & sold only by patentee, Farrelly Alden, Pittsburg, Pa.

Use Vacuum Oil Co.'s Cylinder Oil, Rochester, N.Y. Samples of Asbestos Liquid Paints, Roofing, Roof Paints, Steam Pipe and Boiler Coverings, Steam Packing, etc., will be sent free on application to the H. W. Johns Mfg. Co., 87 Maiden Lane, New York, sole manufacturers of genuine Asbestos materials.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N.J.

A perfect Mowing Machine is an absolute necessity to a farmer. The best made is the Eureka. It has the lightest draught and will cut at least one-third more grass per hour than any other mower. Simple in construction and durable. Prices reasonable. Send for illustrated catalogue to Eureka Mower Co., Towanda, Pa. Wren's Patent Grate Bar. See adv. page 397.

Exporters of Machinery for Plantations. Sugar Machinery Coffee Roller and Cleaners. Information and estimates on all classes of American machinery and patented devices. Agricultural Implements and Hardware. Jos. H. Adams & Son, 283 Pearl St., New York.

Stereopticon for Sale. See adv. last page.

Steam Cylinders bored from 3 to 110 inches. L. B. Flanders Machine Works, Philadelphia, Pa.

For Sale—A Berryman Patent Heater, very little used—cost \$300; will sell for \$50, f.o.b. Davis & Watts, Baltimore, Md.

Every Machinist and Manufacturer in the country should send to G. B. Grant, Boston, for his list of gears.

Wanted—To hear from an Engineer and Mach'y Manuf. Co. to whom the services of an energetic young man, with experience and some capital, would be an object. J. B. R. Box 773, New York.

Improved Speed Indicator. Accurate, reliable, and of a convenient size. Sent by mail on receipt of \$1.50. E. H. Gilman, 21 Doane St., Boston, Mass.

The Mackinnon Pen or Fluid Pencil. The commercial pen of the age. The only successful reservoir pen in the market. The only pen in the world with a diamond circle around the point. The only reservoir pen supplied with a gravitating valve; others substitute a spring which soon gets out of order. The only pen accompanied by a written guarantee from the manufacturer. The only pen that will stand the test of time. A history of the Mackinnon Pen—its uses, prices, etc., free. Mackinnon Pen Co. 200 Broadway, New York.

Fragrant Vanity Fair Tobacco and Cigarettes. 7 First Prize Medals—Vienna, 1873; Philadelphia, 1876; Paris, 1878; Sydney, 1879—awarded Wm. S. Kimball & Co., Rochester, N.Y.

Superior Malleable Castings at moderate rates of Richard P. Pim Wilmington, Del.

Wood Working Machinery of Improved Design and Workmanship. Cordesman, Egna & Co., Cincinnati, O.

The "1880" Lace Cutter by mail for 50 cts.; discount to the trade. Sterling Elliott, 332 Dover St., Boston, Mass.

The Tools, Fixtures, and Patterns of the Taunton Foundry and Machine Company for sale, by the George Place Machinery Agency, 121 Chambers St., New York.

Improved Rock Drills and Air Compressors. Illustrated catalogues and information gladly furnished. Address Ingersoll Rock Drill Co., 14 Park Place, N.Y.

Experts in Patent Causes and Mechanical Counsel. Park Benjamin & Bro., 50 Astor House, New York.

Corrugated Wrought Iron for Tires on Tractor Engines etc. Sole mfrs., H. Lloyd & Son, Pittsburg, Pa.

Malleable and Gray Iron Castings, all descriptions, by Erie Malleable Iron Company, limited, Erie, Pa.

Power, Foot, and Hand Presses for Metal Workers. Lowest prices. Peerless Punch & Shear Co., 52 Dey St., N.Y.

Recipes and Information on all Industrial Processes. Park Benjamin's Expert Office, 50 Astor House, N.Y.

For the best Stave, Barrel, Keg, and Hoghead Machinery, address H. A. Crossley, Cleveland, Ohio.

National Steel Tube Cleaner for boiler tubes. Adjustable, durable. Chalmers-Spence Co., 40 John St., N.Y.

The Brown Automatic Cut-off Engine; unsurpassed for workmanship, economy, and durability. Write for information. C. H. Brown & Co., Pittsburg, Mass.

Gun Powder Pile Drivers. Thos. Shaw, 915 Ridge Avenue, Philadelphia, Pa.

Best Oak Tanned Leather Belting. Wm. F. Foreman, Jr., & Bros., 251 Jefferson St., Philadelphia, Pa.

Stave, Barrel, Keg, and Hoghead Machinery a specialty, by E. & B. Holmes, Buffalo, N.Y.

Diamond Tools. J. Dickinson, 64 Nassau St., N.Y.

National Institute of Steam and Mechanical Engineering. Bridgeport, Conn. Blast Furnace Construction and Management. The metallurgy of iron and steel. Practical Instruction in Steam Engineering, and a good situation when competent. Send for pamphlet.

Clark Rubber Wheels adv. See page 381.

Downer's Cleaning and Polishing Oil for bright metals, is the oldest and best in the market. Highly recommended by the New York, Boston, and other Fire Departments throughout the country. For quickness of cleaning and luster produced it has no equal. Sample free. Send to C. O. D. for \$4. A. H. Downer, 11 Fack Slip, New York.

The "Fitchburg" Automatic Cut-off Horizontal Engines. The "Haskins" Engines and Boilers. Send for pamphlet. Fitchburg Steam Engine Co., Fitchburg, Mass.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yeoman & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Presses, Dies, and Tools for working Sheet Metal etc. Fruit & other can tools. Bliss & Williams, B'klyn, N.Y.

Eclipse Portable Engine. See illustrated adv., p. 382.

The Student's Illustrated Guide to Practical Draughting. By T. P. Pemberton. Sent on receipt of price, \$1. Address T. P. Pemberton, 5 Dey St., Room 13, New York.

Nickel Plating.—Sole manufacturers cast nickel anodes, pure nickel salts, importers Vienna line, crocus etc. Condit, Hanson & Van Winkle, Newark, N.J., and 92 and 94 Liberty St., New York.

For Yale Mills and Engines, see page 381.

Wright's Patent Steam Engine, with automatic cut off. The best engine made. For prices, address William Wright, Manufacturer, Newburgh, N.Y.

Machine Knives for Wood-working Machinery, Book Binders, and Paper Mills. Also manufacturers of Solomon's Parallel Vice Taylor Stiles & Co., Hightstown, N.J. Rollstone Mac, Co.'s Wood Working Mach'y ad. p. 396.

Steam Engines, Boilers, Portable Railroads, Sugar Mills. Atlantic Steam Engine Works, Brooklyn, N.Y.

Blake "Lion and Eagle" Imp'd Crusher. See p. 397.

Apply to J. H. Blaisdell for all kinds of Wood and Iron Working Machinery. 107 Liberty St., New York. Send for illustrated catalogue.

4 to 40 H. P. Steam Engines. See adv. p. 381.

The Chester Steel Castings Co., office 407 Liberty St., Philadelphia, Pa., can prove by 15,000 Crank Shafts, and 10,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

Brass & Copper in sheets, wire & blanks. See ad. p. 397.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 21 Columbia St., New York.

For best Indirect Radiators, see adv., page 397.

Eagle Anvils, 10 cents per pound. Fully warranted.

Gear Wheels for Models (list free): experimental and model work, dies and punches, metal cutting, manufacturing, etc. D. Gilbert & Son, 212 Chester St., Phila., Pa.

The best Truss ever used. Send for descriptive circular to N. Y. Elastic Truss Co., 683 Broadway, New York.

H. A. Lat's Moulding Machines, Worcester, Mass.

Pays well on small investments.—Magle Lanterns and Stereopticons of all kinds and prices. Views illustrating every subject for public exhibitions and parlor entertainments. Send stamp for 116 page catalogue to McAllister, Mfg. Optician, 49 Nassau St., New York.

New Economizer Portable Engine. See illus. adv. p. 397.

For Shafts, Pulleys, or Hangers, call and see stock kept at 73 Liberty St., N.Y. Wm. Sellers & Co.

Wm. Sellers & Co., Phila., have introduced a new injector, worked by a single motion of a lever.

Saw Mill Machinery. Stearns Mfg. Co. See p. 397.

Skinner & Wood, Erie, Pa. Portable and Stationary Engines, are full of orders, and withdraw their illustrated advertisement. Send for their new circulars.

Ore Breaker, Crusher, and Pulverizer. Smaller sizes run by horse power. See p. 397. Totten & Co., Pittsburg.

Bracket Woods.—Wm. E. Uptegrove, Saw Mills, 463 East 10th St., New York, offers to the trade a choice stock of these woods. Send for price list.

Houston's Sash Dovetailing Machine. See ad., p. 397.

NEW BOOKS AND PUBLICATIONS.

LEARNING TO DRAW; OR, THE STORY OF A YOUNG DESIGNER. By Viollet-Le-Duc. Translated from the French by Virginia Champlin. New York: G. P. Putnam's Sons. \$2.

A story with a purpose, the purpose being primarily to contrast the conventional method of teaching the art of drawing and incidentally everything else with a method that may fairly be called rational. A secondary purpose of the book is evidently to enforce the important truths that industrial art is worthy of high honor, and that its advancement is not likely to be much helped by would-be cultivators of "high" art, or art for its own sake.

SUNLIGHT AND SHADOW; OR, GLEANINGS FROM MY LIFE WORK. By John B. Gough. Hartford: A. D. Worthington & Co. 8vo, cl., pp. 542. Price (by subscription) \$3.25.

Probably no man living has been seen and heard by so many as John B. Gough; and it would be safe to say that no other man living could find ready made so comprehensive and eager a market for the printed story of his life's work. The book is eminently characteristic of the man.

THE UNITED STATES BLUE BOOK; COMPILED FROM OFFICIAL SOURCES. By J. H. Soule. 75 cents. Washington, D. C.: J. H. Soule.

A register of Federal officers and employments in each and every State and Territory in the United States, with their salaries and emoluments, with much other information relative to public officers and employments.

THE HOME WORLD. A MONTHLY MAGAZINE FOR THE HOME. Edited and published by Rev. Elijah C. Baldwin. New Haven, Conn. \$2 per annum. 8vo, pp. 64. Vol. 1. No. 1.

This new venture proposes to make a specialty of home affairs, cultivating the whole field of home interests, social life, health, domestic comfort and thrift, moral and mental advancement, and the like. It comes with a tidy make up and a wholesome table of contents.

DIAGRAM FOR FINDING DISTANCES AND HEIGHTS. By H. von Bayer, C.E. Washington, D. C. Price 40 cents.

The object of this diagram is to enable seamen to readily and easily make use of the heights of prominent coast marks, as commonly set down on sailing charts, in determining their ship's position. It has been approved by the Navy Department and adopted for use on all United States Government vessels. Its simplicity and handiness would seem to make it especially serviceable to our merchant marine.

LYRA BICYCLIA: FORTY POETS ON THE WHEEL. By J. G. Dalton. Boston. Published for the author. Sold by Hall & Whiting, 32 Bloomfield street. 6c.

A book of verses about the bicycle, mostly parodies. Enthusiastic riders of the machine may possibly find some of them amusing.

DIPHTHERIA: ITS CAUSE, NATURE, AND TREATMENT. By Rollin R. Gregg, M.D. Buffalo, N. Y.: Matthews Bros., and Bryant.

Dr. Gregg combats the fungus theory of diphtheria, holding that the supposed bacteria found in diphtheritic exudation are non-living particles of fibrin in various stages of coagulation and disintegration. The fibrin so thrown off is not a cause of the disease, but the result of an effort of the system to expel the excess of fibrin in the blood, an excess brought on by a waste of albumen, the real cause of the physiological disturbance. According to Dr. Gregg, diphtheria is a form of albuminuria, allied to Bright's disease and also to consumption of the lungs, the waste of albumen throwing the constituents of the blood into disproportion, the resulting excess of fibrin, salt, etc., acting poisonously like any other foreign matter in the blood. Where the disease seems to be sudden and violent its malignancy is attributed to the circumstances that the system has previously been subjected to a serious loss of albumen through colds or other causes producing an excessive excretion from mucous surfaces. Local treatment is deprecated, particularly harsh measures likely to irritate the mucous membrane of the fauces. The positive treatment advised is as amazing as the reported results of such treatment. For a virulent "constitutional disease" to yield invariably to single doses of ipecacuanha, 6,000th potency, or lachesis, 2,000th, is quite miraculous. Yet by following the practice indicated, avoiding all local treatment, young practitioners are assured by Dr. Gregg that they can save all their cases of this terrible disease.

PARACENTESIS OF THE PERICARDIUM. A CONSIDERATION OF THE SURGICAL TREATMENT OF PERICARDIAL EFFUSIONS. By John B. Roberts, A.M., M.D. Philadelphia: J. B. Lippincott & Co.

A valuable monograph on an operation rarely performed and on which very little has been written. A very careful search discovers sixty recorded cases in Europe and America, the table collated by Dr. Roberts giving the name of the operator in each, the date, sex, and age of patient, mode and site of operation, results, etc. The record, Dr. Roberts concludes, fully justifies the adoption of the operation into the family of accepted surgical procedures.

THE SCIENTIFIC ENGLISH READER. By Dr. F. J. Wersloven. Leipzig: F. A. Brockhaus.

In this work Dr. Wersloven has carried out an idea which we should like to see adopted by some intelligent maker of German readers for English students. He has brought together some forty or more selections from standard scientific English writers in the departments of physics, chemistry, and chemical technology, giving in footnotes the German equivalents for all the technical terms and expressions used, and for a large number of related terms. The book thus furnishes a valuable technical vocabulary for English readers of German works of science.

SURGERY IN THE PENNSYLVANIA HOSPITAL. By Thos. G. Morton, M.D., and William Hunt, M.D., with papers by Drs. John B. Roberts and Frank Woodbury. Philadelphia: J. B. Lippincott & Co.

Since the foundation of the Pennsylvania Hospital in 1732, its medical officers have recorded more or less fully nearly all the operations performed, with notes of the more interesting cases received. Since 1873 full clinical notes of all cases have been kept. The vast amount of valuable material thus accumulated has now been digested by the surgeons and physicians of the hospital, and published in handsome style by direction of the liberal managers of the institution. The cases are classified according to their nature; and in many instances the progress made in surgical means and methods, during the period covered by the hospital records, has been critically reviewed. The work is illustrated by nearly a hundred engravings and phototypes. It is a positive addition to the literature of surgery, and is in every way a credit to the institution, the results of whose benevolent work and professional experience it summarizes.

A PRACTICAL TREATISE ON NERVOUS EXHAUSTION (NEURASTHENIA), ITS SYMPTOMS, NATURE, SEQUENCES, TREATMENT. By George M. Beard. Second Edition. New York: William Wood & Co.

The value and timeliness of Dr. Beard's essay are well attested by the call for a second edition within a month after the publication of the first edition. The only novel feature of the new issue is a cleverly written preface giving the author's answer to the question: "What Constitutes a Discovery in Science?"

WAS MAN CREATED? By Henry J. Mott, Jr. New York: Griswold & Co. 8vo, cl., pp. 151.

In this expanded lecture Dr. Mott has endeavored to set forth briefly yet broadly the lines of observation and deduction by which science has arrived at the idea of man as a natural growth. Its title should rather be "How Man was Created," creation being regarded as a slow evolution by natural processes, not as a spasmodic or miraculous exhibition of supernatural power. The publisher's work is well done, and the numerous illustrations have been judiciously chosen.

FIELD ENGINEERING. A HAND BOOK OF THE THEORY AND PRACTICE OF RAILWAY SURVEYING AND CONSTRUCTION. By William H. Seares. New York: John Wiley & Sons.

The author's aim has been: To present the general subject of railway field work in a progressive and logical order; to classify the problems of railway engineering so that they may be easily referred to; to discuss all the main practical questions of railway engineering, avoiding matters non-essential, etc., employing throughout a uniform and systematic notation easily understood and remembered; to express the resulting formulae of every problem in a shape best adapted to convenient numerical computation, and to furnish a larger variety of tables especially adapted to the wants of field engineers than has heretofore been published. The manner in which these purposes have been carried out is in keep-

ing with the author's high professional reputation. Many of the thirty odd tables are original, and most of the others have been recalculated or enlarged.

A HISTORY OF THE JETTIES AT THE MOUTH OF THE MISSISSIPPI RIVER. By E. L. Corbitt, C.E., Chief Assistant and Resident Engineer during the construction, New York: John Wiley & Sons.

Our high opinion of the purpose and character of the great undertaking which Captain Eads and his associates have brought to successful issue at the mouth of the Mississippi has been repeatedly expressed during the progress of the work. It is gratifying, now that the victory over physical, financial, and professional obstacles has been grandly won, to have the history of the complex struggle so worthily recorded as it is in this volume by Mr. Corbitt. Though it appeals directly and professionally to engineers, the work has a wider range of interest and should find a place in the library of every man who cares for the development of the resources of his native land or admires American boldness, energy, pluck, and endurance in the prosecution of works of utility. These attributes of American manhood never had a more commendable object, nor were ever exhibited on a more heroic scale, than in the opening of the Mississippi to commerce.

N. W. AYER & SON'S AMERICAN NEWSPAPER ANNUAL FOR 1880. Philadelphia: N. W. Ayer & Son, Newspaper Advertising Agents. 8vo, pp. 616.

A remarkably well-made catalogue of American newspapers, giving their names, frequency of issue, politics, (approximate) circulation and advertising rates, together with statistics of population, political majorities, etc., of the State, county, and town of publication of each. Special lists are also given of class journals. The catalogue includes 10,674 periodicals, of which the new England States have 818, New York 1,341, other Middle States 1,267, Southern States 1,730, Western States 4,855, Territories 190, Canadian provinces 574.

THE COMPEND OF ANATOMY. FOR USE IN THE DISSECTING ROOM AND IN PREPARING FOR EXAMINATIONS. By John B. Roberts, A.M., M.D. Philadelphia: C. C. Roberts & Co.

A concise statement of the more important facts of human anatomy. The descriptions are clear, though necessarily brief, and the matter is well arranged, Gray being followed for the most part.

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. If not then published, they may conclude that, for good reasons, the Editor declines 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) T. W. F. writes: After cutting down a large pine tree I counted 124 rings. How old does this make the tree? Some claim that one, and others say that two rings are made each year, and some that none are made the first ten years in the growth of the tree. A. One ring is formed each year. The tree is 124 years old.

(2) W. H. C. asks: What will dissolve rubber and evaporate readily so that it can be used in mending rubber boots? A. Cut the rubber, gum rubber (common vulcanized rubber cannot be used), into thin shreds, digest it in a corked bottle with eight or ten times its weight of warm benzole. Shake the bottle occasionally, and after several hours add more of the solvent if necessary.

(3) C. D. A. asks how to remove the bone from the inside of a buffalo's horn. A. The bone may be loosened by soaking the horn in soft water for some time.

(4) C. G. H. asks: What will remove the stain of nitro-muriatic acid from dark woolen goods. A. Nothing—aqua regia destroys the coloring matter.

(5) G. L. K. asks: In what way can wood be prepared to prevent worms from working in it in salt or sea water? A. Impregnate with creosote water or the "heavy oil" from coal tar distillation.

(6) J. M. asks how rosin oil and spirits of rosin are made. A. Heat the rosin in a metal retort provided with a large condenser. The rosin yields about 74 per cent of liquid distillates. The first portions are yellow, strong smelling, and mobile, called essence of rosin or rosin spirit. Later in the distillation a viscid fluorescent oil (pinolin) passes over. This is called rosin oil.

(7) J. F. asks how steam gauge dials are plated, and what kind of black cement is used in filling the figures. A. Electroplate with silver and immerse for a few moments in a mixture of equal measures of water and nitric acid, to frost; rinse in running water, dry in hot sawdust, when thoroughly dry use a soft brush to clean and burnish the parts required to be bright. For filling the figure mix fine oil asphaltum with a sufficient quantity of ivory black in impalpable powder.

(8) S. W. P. asks (1) how to toughen a lithograph so that the surface will not peel or rub off. A. Use less water and more glycerine, or expel the excess of water by heating for some time over the water bath. 2. Is there any chemical which will aid in removing the writing? A. No chemical aid. Try the addition of a small quantity of soap to the composition.

(9) S. F. S. asks how to treat sails so that they will not mildew. A. Impregnate with strong hot soap suds, press out the excess, and immerse in strong alum water or in weak lead acetate solution, rinse and repeat the soap, if necessary.

(10) E. S. F. asks for a receipt for making a green ink. A. Dissolve one of the soluble coal tar (aniline) greens in hot water to proper shade and add a few drops of clove oil.

(11) E. E. C. writes: We are running a saw mill composed of one 72 inch circular saw, one muley saw, one gang carrying 42 saws, besides edgers, butting saws, lathe mill, etc. We have seven two-flue boilers, 42 inches by 22 feet; engine, 24x28, running 95 revolutions with 80 to 90 lb. of steam; main driving pulley is eleven feet in diameter. When the saws are all in the cut the mill lags and the motion of the engine drops down as low as sixty. Now, what I want to know is this: can we increase our power by running the engine to 130 revolutions, reducing the diameter of the driving pulley in proportion to offset the increase motion? Can we do it without increasing our boiler surface? How much would the power be increased if such a change were made? A. Your power would be increased in proportion to the increased speed of the engine, provided you have boiler sufficient to maintain the pressure. The demand for steam will also be increased in proportion to the increased speed of the engine.

(12) J. C. writes: Take a given quantity of the atmosphere at its normal pressure, say at 40° Fahr., then raise the heat 300°; what would be its volume? or if confined in an air-tight vessel, what pressure would it show on pressure gauge? A. The increase of volume or pressure would be about 1-480 part for each degree of increase of temperature.

(13) M. M. M. asks: 1. Are engineers required to have a license to run an engine in a factory isolated from other buildings, in Iowa? A. It depends upon the law of the State, or municipal regulations, if in a city. 2. If so, is the law requiring it a State or United States law? A. State or municipal. 3. Where and to whom in Iowa must application for a license be made? A. The law should give you this information.

(14) W. H. L. asks: What is the material and how prepared and used, that anatomists use for injecting the veins and arteries of the cadaver to make them stand out bold and clear and appear as if they were full of blood as in life? A. Chloride of zinc, arsenious acid, and mercuric chloride in aqueous solution have been used most successfully.

(15) E. H. B. writes: Some time since the SCIENTIFIC AMERICAN referred to the danger of lead poisoning from the use of improperly prepared "granite ware," and in the manufacture of citric acid. 1. How can I apply some simple test to detect the presence of lead in the juice of acid fruit or vinegar pickles cooked in such ware? A. Mix a small sample of the suspected liquid with some freshly prepared sulphureted hydrogen water (strong). A black precipitate or coloration indicates lead. 2. I have used citric acid in place of lemons very much this summer, but fear it was harmful. In what way would the lead affect the system if present? A. When taken in any considerable quantity it produces violent spasmodic colic.

(16) R. T. asks how to clean the wool on a sheep's skin and how to cure the skin? A. Nail on a board stretched, wool out, and scour with good soap suds and fuller's earth until properly cleansed. Then rinse thoroughly in hot water, and comb. Nail, wool down, stretched taut on a board, rub in plenty of salt, stand in warm place, and finally scrape off the softened inner membrane with a blunt knife. Then rub in plenty of moist alum powder, and let it stand several days or a week in a dry place. Soften, if desired, by rubbing with hot flour paste and the yolks of a few eggs, or with plenty of oil.

(17) J. A. C. writes: I have a piece of ordinary steel, one and a half inches in length, half inch wide, and one-sixteenth inch in thickness. Now, I wish to temper half of its length and not temper the other half. How am I to proceed? A. Harden throughout, then place half of its length in a vise having smooth jaws, or between two heavy blocks of iron, which must touch both sides of the steel. Now temper the protruding end by applying a gas or alcohol flame, or by means of blacksmith's tongs made hot.

(18) J. W. G. writes: I have a battery of two flue boilers set in the usual manner, the furnace walls extending up to the water line. Would it be any advantage to extend the furnace walls higher and let the hot air and gases extend nearly or quite around the boilers before returning through the flues? Wouldn't it to some extent superheat the steam? A. It would tend to superheat the steam, but would be likely to damage the boilers in a short time. 2. My engine is 16x24 cylinder, slide valve cutting off at one-third of the stroke, making 75 revolutions; the exhaust port is cut out what is called line and line. Would it be any advantage to give the exhaust a little lap, and if so, how much? A. You cannot cut off with an ordinary slide valve so short as one-third with advantage. As a rule exhaust lap is not advantageous in a quick running engine.

(19) J. H. C. writes: We have two batteries of boilers, 42 inches diameter, 22 feet long; one battery is covered over the top, the other is not covered; and we have had considerable trouble with this set of boilers cracking the sheets through the seams of the under-deck or belly of the boilers. I claim it is due to the difference of expansion between the top and bottom of the boilers on account of the top of the boilers being exposed to the air. What are your views? A. We do not think your trouble arises from the difference of expansion,

as there are hundreds, if not thousands, of set that are not covered. It is probably due to poor iron, or careless firing when the boilers are cold. Still it is a good plan to cover the boilers.

(20) G. W. D. writes: I have an excellent water power with 30 feet head, located 4 miles from a railroad. I propose to utilize it for manufacturing purposes, but find some difficulty in deciding whether to build the factories at the dam, or on the railroad; the latter plan would save the labor and expense of hauling the raw materials—grain and wool—and manufactured goods to and from the depot and mills. I am considering the question of transmitting the power from the dam to the railroad, either by wire rope, compressed air, or electricity, and shall thank you for such light as you can throw upon the subject, whether it would be advantageous, and, if so, which system would be most effective and economical? The ground is perfectly level. A. Of the modes named, wire rope would probably be the cheapest and easiest maintained; although, if you have a surplus of power at the dam, electricity might be used to advantage.

(21) G. E. T. writes: Please state formula for mixing the alloy used in bronze butts, door knobs, and other similar articles of hardware. A. Copper, 80; tin, 8; zinc, 3.

(22) A. A. asks how to remove nitric acid stains from dark clothes. A. Nitric acid, if strong, or if permitted to remain long in contact with the fabric, destroys the coloring matter. Ammonia water, if used immediately after the contact, will prevent this action and restore the color.

(23) L. P. asks (1) how to make a solution to plunge small brass articles in to give them a light red color. A. You might try a bath of thin alcoholic shellac suitably colored with aniline red. We know of nothing that will give the metal itself a bright red color. 2. What is the best lacquer for polished brass and how is it applied? A. 1. Seed lac, dragon's blood, annatto, and gamboge, each 4 oz.; saffron, 1 oz.; spirit of wine, 10 pints. 2. Alcohol 1 pint; turmeric, 1 oz. (powder); annatto 3 drs.; saffron, 2 drs.; agitate occasionally for a week, filter and add seed lac 3 oz., and let stand for two weeks with occasional agitation. Keep well stoppered. 3. Is there a cheap way to gild small articles; if so, how? A. If the work is small coat with the lacquer properly thinned, and dry in an oven at about 250° F.

(24) J. D. H. writes: I am engaged in the business of preparing and gilding wooden mouldings, and my preparer is very much troubled with pin holes caused by the formation of small bubbles of gas immediately after the application of each coat of the preparation. I have been told that the addition of a little oil to the mixture (of whiting, china clay, glue, and water) would cure the evil, but this remedy does not seem to be reliable. Any information tending to give relief in this respect will be gratefully received. A. The imperfections are probably due to the sizing used in the first coating. Add to it a few drops of ammonia before using. You will find a good article on the subject, on pp. 301 et seq., Spon's "Workshop Receipts."

(25) J. E. M. asks how to make an analysis of phosphate to find the percentage of ammonia, soluble and precipitated phosphoric acid, insoluble phosphoric acid and potash. A. Consult Fresenius' "Quantitative Chemical Analysis."

(26) W. M. B. asks how to clean and whiten engravings which have become dirty by hanging in a smoky room. A. Moisten with a strong clear solution of chloride of lime until white, then soak in running water. Steep for half an hour in water containing a very little hyposulphite of soda to neutralize any trace of adhering, bleach and dry between bibulous paper under pressure.

(27) C. W. H. asks: How is commercial French mustard prepared? A. The following is M. Leuonard's recipe: Flour of mustard, 2 lb.; fresh parsley, chervil, celery, and tarragon, of each 1/2 oz.; garlic, 1 clove (or head); 12 salt anchovies (all well chopped); grind well together, add salt 1 oz., grape juice or sugar to sweeten, and sufficient water to form the mass into a thin paste by trituration in a mortar. When put into pots a red hot iron is momentarily thrust into the contents of each, and a little wine vinegar poured upon the surface. 2. Also how is chow-chow made? A. Chow-chow, as usually prepared, is a mixture of various pickles, cucumbers, cauliflower, onions, etc., chopped and mixed with mustard and a small quantity of vinegar.

(28) C. K. L. asks: What is the best and cheapest way to store up or accumulate power? A. Depends upon the purpose; the hydraulic accumulator is the best for many purposes. 2. How can the stickiness be taken from adobe or clay soil so as to make it loamy and easy to plow? A. The addition of sand alone can accomplish this.

(29) G. L. L. asks how to plug leaky boiler tubes. A. If the leak is near the head, fit and drive in a short ferrule; if the leak is in the body of the tube where you cannot bolt a band around it, take it out and put in a new tube.

(30) D. D. asks: 1. How far will a siphon draw water perpendicularly, when there is no limit to the discharge? A. If the pipe is perfectly tight, it will draw 20 to 22 feet. 2. How much lower should the discharge end be than the other to get the siphon started after it is filled with water? A. A very small difference in height of the two ends will discharge water, but the greater the difference the greater the quantity discharged in a given time.

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

G. D. M.—1. An impure clay—some of this would probably make good brick. 2. Kaolin containing much silica and some lime carbonate—useful in the manufacture of pottery. They are of sedimentary origin, not suitable for building purposes. Consult Dana's Geology.—A. C. R.—It is composed chiefly of infusorial silica—not derived from any mill waste.—A. F. McC.—The rock contains no precious metals.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States Were
Granted in the Week Ending

November 23, 1880.

AND EACH BEARING THAT DATE.

[Those marked (r) are renewed patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1860, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1860; but at increased cost, as the specifications not being printed, must be copied by hand.

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