## IMPROVED GAP LATHE

We illustrate herewith a new and excellent lathe, which, from the fact that it is claimed to perform all the work usually done on several lathes of different sizes, will commend itself to the careful attention of all who require from their machine tools a wide range of capabilities, for reasons of economy both in space occupied and in first cost. The machine is a 30 -inch swing lathe (ordinary measurement). It is 21 inches over the rest, and 10 feet 6 inches between centers, or 21 feet, if a shaft of not over 4 inches in diameter is passed through the spindle. By the use of the gap, a piece of work 48 inches in diameter and 26 inches in length may be turned; and by the face. plate on the back end of the spindle, a wheel 9 feet or more in diameter can be bored. The boring bar is passed through the spindle, and is supported by a bush at one end, the other extremity being, as usual, carried to the rest. The speed of the lathe, with the countershaft running at 116 revolutions, varies from 290 to $\frac{7}{8}$ countershaft running at 116 revolutions, varies from 290 to $\frac{7}{8}$
revolution per minute. $\quad$ Between these limits are included revolution per minute. Between these limits are included
the proper speeds for turning anything that will swing in the the proper speeds for turning anything that will swing in the
gap. The machine is also screw-cutting, and has a change-
minute; but there are very few engines made which will not do much more than this for each nominal horse power. By this rule, a 10 -horse engine ought to lift 320,000 lbs. 1 foot high each minute. Now some makers will give you an engine that will do more than double that work; while others will give you an engine that will only just do $320,000 \mathrm{lbs}$. and no more. No farmer, then, should buy an engine by its nominal horse power; he should ask some other questions, and get written guarantees from the maker as to what the engine really is. For instance, another of Watt's rules was that 1 cubic foot of water boiled off in an hour was equal to 1 horse power. Another rule to measure an engine by is the boiler surface exposed to the action of the fire, it being the custom nowadays to allow about 20 feet of boiler surface to each nominal horse power, that is to say, a 10 horse en gine would expose about 200 square feet of surface to the action of the fire in the fire box and tubes, and of this from one fifth to one third would be in the fire box and the remainder in the tubes. If I were going to buy an engine, and wished to compare the prices of different makers, I would wished to compare the prices of different makers, I would
ask these questions: 1. Will you guarantee that all parts of
unable to tell the difference between a good and bad engine, would quickly disappear from the scene."

## A Machine Dining Table

A machine has been invented which may bring about a strike in a class of workers who rarely resort to such means of intimidation with objects other than securing more "nights out" or permission to entertain more admirers in the kitchen. We mean the waiting maids, whose occupation the machine dining table aims to destroy. The inventor says that it " is so constructed as to enable each person sitting at the table to bring the various dishes within his reach, which will enable the plates to be changed by mechanical means, allow each person to help himself to water when desired, which will keep bottles of wine and other substances cool, and which "-and here is luxury which reminds one of those frightfully expensive old Roman banquets-"shall be proided with a fountain to keep the air cool and refreshing."
We cannot pretend to describe all the mechanism. There We cannot pretend to describe all the mechanism. There
is much of it. It looks destructive to children; but on the other hand it offers the advantage of a useful object for con.


## WATSON'S GAP LATHE.

able cross feed of from 26 to 5 per inch. The rest is compound. The top rest will travel 12 inches, and the main rest the full length across the saddle. The tool post has three set screws, the center one for light and the others for heavy work. All three bear the strain directly through the center of the rest. The saddle is carried or supported over the gap by the lower ways, and on a level with the gap.
This lathe, we are informed, is as easily operated as any ordinary 30 -inch lathe. The large face plate or gear is removable, so that, when the machine is employed for small work, its dead weight need not be carried. The trueness of the lathe, the inventor states, has been proved by turning a piece of work 4 feet in length clamped in the face plate and not supported by the back center. This has been tried, and the work has been found, by caliper measurement, to be accurate
For further particulars, address Mr. James Watson, No. 1608 South Front street (below Tasker), Philadelphia, Pa.

## Agricultural Steam Engines.

"In buying or selling engines," says a writer in the Agricultural Gazette, "it is usuai to speak of them as being so many horse power. Now this is a very loose term, and opens the door to a very great amount of humbug. A horse power, according to Watt, was $32,000 \mathrm{lbs} .$, lifted 1 foot high each
the engine and boiler are calculated to work at the usual pressure of 120 lbs. on the square inch of the safety valve above the atmospheric pressure? 2. Will you guarantee that the boiler has 20 square feet of heating surface for each boinal horse power? 3. Will you guarantee that the boiler will boil off at least one cubic foot of water ( $6 \frac{1}{4} \mathrm{gal}$ lons) for each nominal horse power in the hour? 4. Will you give me two cylinders, and will you guarantee that each
is arranged with separate cut-off valves, so that I can cut off the steam at any period of the stroke, and in such a way that I can alter the cut-off without stopping the engine, and say about 15 square inches of piston for each nominal horse power? 5. Will you give me a separate crank shaft for each cylinder, with a governor and a flywheel for each, and so arranged that I can work them either separately or both together, passing all the power through one flywheel if I wish? 6. If it were a traction engine, I would ask to have two speeds, one intended to use up all the steam (when expanding six times) at four miles per hour, and the other to use up all the steam at two miles per hour.
"If every farmer, before he bought an engine, asked all these questions and got a written reply to them, I venture to think that farmers' engines would very soon be greatly imexist in quality, and that many makers, who at presen
templation or topic of conversation for a dinner party of mechanical engineers. It might lead to disagreeable feeling among guests, if one should insist on revolving the middle portion, on which the dishes are placed, just as another was about to himself to some dainty morsel; and the stronger guests moreover would have an unfair advantage over the weaker ones, because they could forcibly adjust that rotating top so that the tidbits would come before their own plates. And when "the plates are to be changed, the crank, $\mathrm{H}^{1}$, is And when "the plates are to be changed, the crank, $\mathrm{H}^{1}$, is
turned, which lowers the plate that has been used, carries it in beneath the table top, and raises a clean plate through the opening." Supposing somebody should turn, accidentally somebody else's crank, $\mathrm{H}^{1}$, there would be another casus belli, for who could sit silently by and see his dinner sink, like the ghost in Hamlet, without feelings of resentment against some one, especially if hungry? There is a reservoir over the table and a system of waterworks under it, with a faucet for each plate. If something should leak, the unfortunate guests might in politeness sit still, while they contracted violent colds, owing to the soaking of their nether extremi ties. The invention is an ingenious one, but we fear it i not calculated to impress the precepts of the Golden Rule.

A GOOD harness dressing may be made of neatsfoot oil 1 gallon and lampblack 4 ozs., stirred well together.

# surntifir Ammirin. 

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 NO. 69For the Week ending April 28, 187\%.

















MUNN \& Co., Publishers,
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## a bull on the track

When George Stephenson was before a committee who were inquiring into the nature of his locomotive, one farme committee man, after hearing that probably the unexampled speed of twelve miles an hour would be attained, and reali zing that the machine could not leave its rails, sagely re marked: "But, Mr. Stephenson, supposing cows should get on your track, before your engine?" "Well," replied the inventor quietly, "it would be bad for the cows."
If the questioner had framed his query to refer to bovine of the masculine gender, subsequent experience has shown that Stephenson's reply might well have been otherwise; for while the average cow is not run over, as a rule, except in voluntarily, bulls have over and over again scorned to fly from locomotives, and, while being killed themselves, have this happened recently in Virginia, just as a heavy freigh train was approaching a bridge. A bull, with mane and tail
trent crect, placed himself in the middle of the track, breathing fierce defiance. The engineer put on the brakes and blew his whistle; but the brute lowered his head and refused to stir. It was impossible to stop, and the engine struck the animal just as it was passing on the bridge, left the rails, and was precipitated on the trestle work, which gave way. The locomotive, tender, and six freight cars went down into the abyss, the boiler exploded, and the bridge and cars in a few moments were in flames. The bridge, which was 120 feet long, was entirely consumed, the locomotive of course was ruined, and the engineer was mortally injured. Th loss to the railroad company amounts to over $\$ 8,000$. What Mr. Herbert Sull is not stated
Mr. Herbert Spencer, in discussing the subject of the dis tinction which brutes are capable of making between animate and inanimate objects, says that, where intelligence rises be yond the merely automatic, the motion implying life begins
to be distinguished from other motion by spontaneity to be distinguished from other motion by spontaneity That the spontaneity of motion serves as a test, he considers, is clearly shown "by the behavior of tame animals, and even of wild animals, in presence of railway trains. In the early days of railways, they showed great alarm; but after a time days of railways, they showed great alarm; but after a time,
familiarized with the roar and swift motion of this something, which, appearing in the distance, rushed by and dis appeared in the distance, they became regardless of it." This implies that the knowledge acquired by cattle in the early days of the locomotive is hereditary, which is in accordance with Mr. Darwin's well known deductions from observation of other traits, transmitted from generation to generation, in hunting dogs and other trained animals. But such as bulls, it would seem that the sentiment of anger is, as in the case of man, strong enough to overpower the knowledge which is analogous to reason. There can be traced in man, besides, the same tendency to think, in moments of rage, that objects, which he knows to be inanimate, are animate.
Made angry by resistance to his efforts, he may in a fit of anger swear at some senseless thing, or dash it to the ground or kick it. "But," to quote Mr. Spencer again, "the ob vious interpretation is that anger, like every other strong emotion, tends to discbarge itself in violent muscular acsame author goes on to show that, as generally the object of wrath is a living object, to the injury of which the muscular exertions are directed, so this same muscular discharge is, by force of association, turned upon an inanimate thing The similarity of behavior under such like peculiar conditions, between man and the brutes, seems to add another link
to that connection between human beings and the lower orders which the evolution theory aims to establish.

## dUAL LIfe.

We have already discussed in some detail the curious mental condition of persons who apparently possess two distinct mental lives. To such individuals the events of the abnormal life are a blank while existing in normal state, and vice thisa. Dr. Brown-Séquard has advanced the hypothesis that this phenomenal condition is a consequence of our two brains, of which he believes we ordinarily use but one, leaving the
other nearly unemployed. other nearly unemployed.
The Greenlanders have a queer belief that the shadow which by day accompanies us wherever we go, at night wanders away and has adventures. This odd superstition regards the duality of life from another standpoint than the almost purely physically one of Dr. Séquard; and Mr. Her bert Spencer, in his new work on "Synthetic Philosophy," devotes some close reasoning to the primitive idea of ou possessing an alter ego, and to the question of whether we do not form a conception of a mental self through the incomprehensible experiences of dreams. Dreams, he says, can-
not be interpreted as we interpret them, in the absence of the hypothesis of mind as a distinct entity; and this hypothesis cannot exist before the experiences suggesting it. There are dream experiences, which seem to imply two entities; and differs from the first simply in being absent and active a night while the other is at rest. Only as this supposed dupli cate, once thought of as like the original in all things, becomes gradually modified by the dropping of physical characters irreconcilable with the facts, does the hypothesis of mental self become established.
It is a notable fact that this belief in the duality of self is constantly found among savages, and that they bring the same forward in explanation of the peculiar states known as
well as for sleep. Insensibility following a blow or violent exertion, the Fijian believes, is due to the duplicate self wandering away from the body; and as the desertion is mor determined than in the case of sleep, the return of the duplicate is followed by silence as to what has been seen or done in the interval. In our own common speech, we show the way in which syncope yields seeming verification of the primitive notion of duality. We speak of one who revives from a fainting fit as "coming back to himself;" we use the term "absent-minded" or "abstracted," literally meaning drawn away. "Wits gone wool-gathering" is an apt vulgarism in point. All of these terms clearly express the idea of some thing having departed from the present self, for a time.
In apoplexy, the patient suddenly falling betrays a "total loss of consciousness, of feeling, and of voluntary move ment;" there is snoring as in deep sleep. Yet the sufferer cannot be "brought back to himself" by ordinary means, and the stvage witnesses such effects, and, recalling his dream experiences, believes that the second self has gone way for a time beyond recall. Some time afterwards ther is a like prolonged insensibility, and then revival, and another silence as to what has happened in the interval; on he third time, the absent something does not return.
Similar in the suddenness with which it commences, but otherwise dissimilar, is the state of insensibility called cata lepsy. Instantaneous loss of consciousness is followed by state in which the patient " presents the air of a statue rather than that of an animated being," and control of the nembers is lost. There is no recollection of occurrence during the attack; and interpreting the facts according to their primary meanings, the wandering other self will give no account of its adventures. The Chippewas, believing in the journeying of souls, think that those of persons in a trance "being refused a passage, return to their bodies and reani ate them."
There is still another state of insensibility which has shown itself repeatedly of late among persons who have been pro foundly impressed by the religious revivals. We refer to ecstasy, in which the subject shows that he is "not him self," and seems to have vivid perceptions of things else where. During this state, in which the muscles are often rigid, and there is a total suspension of voluntary motion visions of an extraordinary nature occasionally occur. Thes phenomena tend to strengthen the primitive belief that eac man is double. All the various phases of coma, from a state of slight drowsiness up to permanent and profound stupor, re similarly interpretable.
It will be seen, from Mr. Spencer's reasoning before given, that the supposition peculiar to the savage is not withou some justification; and if the prevalence of a hypothesis is any support, this is certainly one most widely extended. The Fijian may sometimes be heard to bawl out lustily to his own soul to return to him. Among the Karens, a man is constantly in fear lest his other self should leave him : sick ness or languor being regarded as signs of its absence Among the northern Asiatic tribes, disease is ascribed to the soul's departure. By the Algonquin Indians, a sick man is regarded as having his "shadow" " unsettled or detached from his body." Like interpretations are met with among the Australians and Tartars. A remarkable instance of the survival of the primitive idea that the soul leaves the body during sleep is instanced among certain Jewish sects:where he prayer on awakening is one of thanks for the return of the soul, and an immediate duty is the washing of hands and face to cleanse away the impurites of this minor death.

## THE CENTENNIAL SURPLUS

Congress, prior to the opening of the Centennial, appro priated $\$ 1,500,000$ toward defraying the expenses of th same, and provided that, after the debts of the Exhibition had been paid, the United States should be reimbursed before any profits should be distributed among the stockholders. ffter the Exposition was over, the Centennial Board of Finance declined to refund the above sum to the National Treasury out of the funds on hand, on the ground that the same could be reclaimed by the United States only afte the accruing of profits, and that, as no profits had accrued, the Exhibition not having paid expenses, the United State was barred from taking any part of the balance in the hands of the Board, and that said balance was the property of the stockholders and was divisible only among them. Issues were framed, and the controversy put in action in the United States Circuit Court, which rendered decision in favor of the stockholders. The Government then appealed, and the judgment of the Supreme Court, delivered by the Chief Jus ice, reverses that of the court below, mainly on the ground that the act of 1876 " appropriated moneys to be paid back under certain circumstances, and the accepting of them only by the Board of Finance created a liability to repay it by the act of 1872 ." The assets of the corporation were to be divided among the stockholders only after the payment of all liabilities; and unless the contract entered into otherwise pro vides, it is clear the United States must be paid in full before the stockholders can claim distribution among themselves. The million and a half of dollars will therefore be paid into the United States Treasury.
This decision will, it is said, materially affect the interests of the permanent Exhibition in Philadelphia, as the sub scription to that enterprise consisted in large part in Cen tennial stock worth some $\$ 500,000$ at par. It was expected that $\$ 300,000$ could be realized thereon; but now it seem that its val e is but 30 cents on the dollar, so that the avail able capital, including $\$ 130,000$ in cash, amounts to but
about $\$ 280,000$. The preparations for opening will not be
interrupted, and it is thought that the future income from interrupted, and it is thought that the future income from admissions will be ample to insure the success of the undertaking.

## ALLEGED MAGNETO-PHOTOGRAPHY.

Mr. William Brooks has recently communicated to the South London Photographic Society some astonishing statements (which we find in both the Photographic News and the British Journal of Photography) regarding impressions which he claims to have obtained in a sensitive plate exposed in total darkness to the influence of a magnet-said impressions be-
ing analogous to those due to light. The probabilities are that the investigator has overlooked conditions in his experiments which would give another and more likely cause for his results; and certainly no one will accept the latter according to his interpretation, in the absence of proof of the most convincing and conclusive nature.

Mr. Brooks places a horseshoe magnet, about 8 inches in length, poles uppermost, in a dark box. Over the poles, and about three eighths of an inch distant, he suspends a card blackened with Indian ink on both sides, and pierced with certain letters and geometrical figures. One eighth inch above the card, he places his sensitized plate, so that the latter is thus half an inch distant from the magnet. The exposure lasts from three to fifteen minutes, after which the plate is removed and developed. Where the perforated parts of the card have not intercepted the magnetic aura, or influence, or mode of motion, or vibration (the reade may choose his own term), sometimes a negative and sometimes positive image is developed, as if ordinary daylight had had access to the plate. It will doubtless astonish many to find that a card is capable of intercepting magnetism, as it is cur-
rently believed that that natural force acts through all interposed bodies-as would-be inventors of magnetic cut-offs have discovered to their confusion. But this is not ordinary magnetism-it is aura-od-the imponderable agent which Reichenbach conceived and supposed to emanate from most substances, and to affect people as well as sensitive plates. Mr. Brooks wisely offers no opinion on the matter; but not content with the remarkable statements already made, he adds that upon his plate appeared a portion of a word, which was not in perforated letters on his card screen. After exam ining the latter with great care, he discovered that the word was printed on the card, but was illegible except when the
card was held at an angle, and then only very faintly, being thickly covered with Indian ink. This spoils a good story by making it too strong. If the card intercepted the magnetic aura so that the same could only act through the per forations in the first case, how could the same influence, act ing on another part of the card at the same time, go through that card where the printed letters were impressed? And why did it not reproduce all the printing on the card instead of selecting a portion of a word? There is a mysterious discrepancy about it all, which makes us think that Mr. Brooks is a "medium."

REMARKABLE RESULTS OF EVAPORATION AND RAINFALL.
The general belief that all dry land on the earth's surface must necessarily be above the ocean level is erroneous. Land is above the level of the sea only where there is a direct water communication, by the drainage streams of the district with the ocean. But there are many instances where such a
communication does not exist; and in such cases the drained communication does not exist; and in such cases the drained level, where there are depressions in the soil. Large regions that are below the occan level will not necessarily be entirely filled with water, because as a rule the amount of evaporation far surpasses the amount of rainfall. To realize this fact, we have only to consider that one quarter of the terres-
trial surface is land and the rest is water; and it is certain that the evaporation from the land cannot amount to much, compared with that from the aqueous surface. It is true that vegetation throws some watery vapor into the air; but so on the other hand vegetation consumes a great deal of water, the elements of which are fixed in the plants. We may
assume, therefore, that the evaporation from three quarters of the earth's surface, occupied by ocean and lakes, provide all the water falling on the whole; therefore, as a rule, the evaporation from a given surface of land surpasses the amount of rainfal. quantity than the amount of rainfall, which, by peculiar local circumstances, such as mountain chains, air currents ascending from arid plains, etc., is often so much interfered with as to leave in some places rainless regions: such districts are the southern extremity of California, and New
Mexico, near the mouth of the Colorado river, and there is another in the center of the Mexican Republic, and still another in a very elongated strip of land with its neighboring sea extending along the western coast of South America, from Peru to Chili. A larger surface of this kind is found in Central Asia, in and around the great desert of Gobi or Shamo, situated in Mongolia and Chinese Tartary. But the largest rainless surface is that which extends in Northern Africa, beginning some 300 miles inland from the western extremity, over a width of not less than 1,000 miles in an east by north direction. It covers a large part of Egypt and the surrounding lands, including Arabia, and a narrow belt of it passes througin Asia and Persia. In the last named country,
a long strip of country, extending some 200 miles on each a long strip of country, extending some 200 miles on each
side of the 70th meridian of longitude east of Greenwich
separates it from the ne
Asia, mentioned above.
On the other hand, there are a few regions of perpetual rain. These appear to be, as far as they are known, Cape Horn, at the southern extremity of South America, and the neighborhood of Sitka, at the southern part of Alaska Territory, which formerly belonged to Russia, but which now forms part of the United States. It follows, therefore, that equally distributed, and the fall of rain must be very un equally distributed; and we have compiled a series of obser
vations as follows, which gives the average rainfall per year in inches for several localities.

| No. of inches falling | Locality. |
| :---: | :---: |
| 13 | Erfurt, Germany. |
| 16 | Cambray, France. Upsala, Sweden. |
|  | St. Petersburgh, Russia. Copenhagen, Denmark. Toulon, France. |
|  | Brussels, Belgium. Francke, Holland. |
|  | Stockholm, Sweden. |
| 20 | Marseilles, France. Coblenz, Germany. Glasgow, Scotland. |
| 25. | Rotterdam, Holland. Strasburg, Germany. Li bon, Portugal. |
| 30. | Funchal, Madeira. Rome, Italy. |
|  | Liverpool and the Isle of Man, England. |
|  | Mafra, Portugal. Florence, Italy. |
| 45 | Dover, England. Genoa, Italy. |
| 80. | Bergen, Norway. |
| 110 | Coimbra, Portugal. |

At the western limit of the rainless region of Central Asia are situated several lakes, receiving their water supply from rivers; these lakes are without communication with th ocean, but they are all situate on a table land, some of them many hundred feet above the ocean level. But they all dis pose of their supply of water by evaporation.

Every such locality forms a water system by itself, surounded as it is on all sides by mountain ranges, without any local depression to permit the exit of the water; thus all the rain received must necessarily be disposed of by simple evaporation.
When we proceed westward from these lakes of Central Asia, the elevation becomes less and less until we reach the Sea of Aral, which is the largest of these inland seas, covering about 10,000 square miles; its surface has been found to be only 21 feet above the level of the ocean, while our Grea
Salt Lake in Utah is not less than 420 fee Salt Lake in Utah is not less than 4,220 feet above the sea. Proceeding further west, the ground is still more depressed and gives evidence that a gradual sinking has taken place towards the shores of the Caspian Sea, which at its nearest which the surface is 112 feet below that of Aral, and 86 fee below the level of the ocean. It is the largest body of water in existence which has no communication with the ocean. It separates the southeastern extremity of European Russia from Asia, and it covers a surface of about 100,000 square miles; it is separated by a high mountain chain from Persia, a great portion of which empire is situated in the largest of the four or five rainless belts. This belt extends through the whole of Central Africa and Southwestern Asia, as far as the sources of the river Indus. This sea, therefore, receives no supply of water of any importance from the south; and on its eastern side only one river of any importance empties itself into it. This river is the Attruck, which has its source in the Persian mountain chain mentioned. The western
shore receives the waters of several rivers, among which are the Kooma, the Terek, the Koor, the Avan, etc.; but the northern side receives an enormous amount of water from two large rivers, the Volga and the Ural. The first is the largest river of Europe, having a length of 2,300 miles; it drains a surface of not less than 640,000 square miles, more
than half the area drained by the Mississippi and the Missouri, and more than the whole of the watershed of the mighty St. Lawrence, which with its chain of large lake drains a surface of 600,000 square miles. The latter river, the Ural, which belongs as much to Asia as to Europe, form ing as it does a part of the southern boundary between the two continents, has a length of some 1,050 miles, and drains a surface estimated to be nearly equal to that of the Caspian Sea. East of the Ural, several other considerable rivers each about as large as our Hudson, Delaware, or Susque hanna, pour their waters also in the northern extremity of the Caspian Sea; and it is no wonder, therefore, that old geo-
graphers, who did not know that its level was below that of the ocean, and who had no idea of the results of powerful evaporation, were unable to account for the disposal of all this mass of water, and so they imagined that there was a subterranean outlet toward the Black Sea or the Persian Gulf. Kircher, in his book on the subterranean world. gives a picture of this supposed channel, traversing at great depth the bases of mountain barriers and passing under the bed of rivers, etc.
These suppositions were definitely set at rest by the dis covery that the surface of the Caspian Sea, as before stated, is 86 feet below the surface of the ocean; while the surend for shores, especially in the nor and ex level. These data were ascertained many years ago by the urveys for canals constructed with the intention of estab lishing water communication between the Caspian and Black Seas by means of a canal uniting the Volga and the Don. At one point these rivers are close together; but the Don flows into the Black Sea, and the Volga, as we have stated, nto the Caspian.
The Caspian Sea is a forcible illustration of the fact that
he evaporation on a given surface may far surpass the rain
fall. It receives the drainage of a surface more then ten
times its own size; and if we times its own size; and if we suppose that three fourths of the water falling in rain is utilized by vegetation, and so never reaches the streams, there is still the watershed from two and a half times the Caspian's area, besides the rain which falls in that sea itself, which must be disposed of by evaporation; and such is undoubtedly the case. It is scarcely necessary to go into calculation of the million of tons of water which the Volga and the Ural supply annually-a calculation which offers no difficulty when we consider that the average rainfall on the ground drained by those rivers is nearly 12 inches, making 1 foot of water over a surface of about $1,000,000$ square miles; we leave this calculation to our readers, merely drawing attention to the enormous amount of saline matter washed out by this water from the soil through which and over which it flows. This salt is all carried to the Caspian Sea; and as only pure water is removed by evaporation, the salt remains behind, and that body of water must necessarily become more and more salt, up to the point of saturation, which is now nearly reached, the Caspian Sea being already much salter than the ocean. the Caspian Sea being already much salter than the ocean.
The rivers continuing to pour in water, of course of less The rivers continuing to pour in water, of course of less
purity than that which evaporates, the process goes on; and purity than that which evaporates, the process goes on; and
this consideration solves not only the question in regard to the salting of this particular lake, but of all lakes having no outlet, and also the question, so often asked: Where does the salt of the ocean come from? The ocean is, in fact, nothing but a huge lake without an outlet, into which all the rivers of the earth continue to pour their impure waters, while nothing but pure distilled water is taken out by evaporation. Even the ocean, therefore, must steadily increase in its salt Even the ocean, therefore, must steadily increase in its salt-
ness, and only its immense size retards the change which will take several thousand years to become appreciable to man.

## Time Ball in New York City

An arrangement has been concluded between the Super intendent of the United States Naval Observatory at Wash ington and the Western Union Telegraph Company, for the purpose of disseminating the standard time, as determined daily by the Naval Observatory, to shipowners and masters, business men in general, railways, chronometer makers, and others, and to the public generally. In pursuance of this agreement, a time ball of large size is to be dropped daily from the tower of the Western Union Telegraph Company's main building at New York city; and arrangements will be made for controlling public clocks in New York and other places. and also for distributing the noon signal of the United States Naval Observatory to various cities in the United States having more than 20,000 inhabitants. In New York, at 11 h .55 m ., a time ball will be hoisted halfway up the iron flagstaff on the tower of the Western Union building at the corner of Broadway and Dey street. This ball is 3 feet 6 inches in diameter, and can be seen by ail the shipping lying at the New York and Brooklyn docks and on the New Jersey shore, as well as by all vessels lying in the bay, even beyond quarantine. For long distances an ordinary ship's glass will be needed. It can also be seen on Broadway from Tenth street nearly to the Battery and from suitable posi tions it can be seen by a large majority of the citizens of New York, Brooklyn, Hoboken, Jersey City, etc.
The ball will remain at half mast from 11 h .55 m . to 11 h . 58 m . At 11 h .58 m . it will be hoisted to its highest point, about halfway up the main staff-that is, over 250 feet above the street. It will be dropped by an electric signal at exactly noon by New York time. The longitude of New York being assumed to be that determined by the United States Coast Survey for the City Hall. 12h. 0m. 0s. 00 New York time $=11 \mathrm{~h} .47 \mathrm{~m} .49 \mathrm{~s} .53$ Washington time. 12 h .0 m .0 s .00 New York time $=4 \mathrm{~h} .56 \mathrm{~m} .1 \mathrm{~s} .65$ Greenwich time.
If, on account of high winds, etc., the ball fails to fall at 12 h .0 m .0 s ., it will be kept at the mast head till 12 h .5 m . and then dropped at 12 h .5 m .0 s . In such cases, a small red flag will be hoisted at 12 h .1 m . and kept flying till 12 h .10 m The time of falling of the ball will record itself automati cally, by electricity, near the standard clock of the Western Union Company (which is regulated by signals from the Washington Observatory); and if by any cause it does not fall precisely at noon, its error will be known. In the even ing papers of the day, and in the papers of the next morn ing, a notice will be regularly inserted, stating whether the ball fell at the correct time, and if not, then its error fast or slow. In this way, even signals which high winds or other causes have prevented from being given precisely will still be available for the regulation of clocks and chronometers. This ball will therefore serve to regulate the clocks of New York city to standard New York time, and will also serve to correct chronometers of ships lying in the harbor.

Business Stagnation in Germany.
Herr Krupp, of Essen, Germany, the great gun maker, has issued a memorandum to his workmen, dilating on the present stagnation of business, and the short hours necessitated by the restriction of the market. Herr Krupp exhorts his men to submit with patience to the passing slackness and reduced wages, and points to the conduct of the laboring classes in England, under like circumstances, as an example not to be followed. England has had its period of industrial activity and prosperity. "England has grown great and powerful by her industry. Then her working men have formed trades' unions, and struck work for the purpose of enforcing higher wages. The consequence has been that the work of England has, to a great extent, been carried abroad. work of England has, to a great exter
That ought to be a warning to us."


## STRAIGHTENING SAWS

In the manufacture of saws, the straightening forms a large proportion of the manipulative processes. The cut ting of the teeth, the grinding, the polishing, the tempering and the finishing: each of these processes is accompanied by a straightening operation; for in insuring an equal amount of tension at all parts of the blade lies one of the principal elements necessary to the production of a good saw, and a blade can hardly have any mechanical operation performed upon it without affecting its tension and straightness. In the use of saws, it is found that band and frame saws are, under ordinary conditions, comparatively easily kept true and straight; whereas hand and circular saws are readily affected by several causes, among which the most prominent is the setting of the teeth. The blades of circular saws, moreover, frequently become hot, and the heating of a blade is almost certain to impair its straightness, and hence the equilibrium of its tension.
The set of a saw tooth should all be given to the tooth it self, and in no case should it extend below the bottom of the tooth into the solid blade; because in that case it affects the straightness of the same and renders it liabte to break. The harder any cutting tool is, the more cutting duty it will per form without becoming dull. On the other hand, the strength depends upon the degree of hardness or temper. In a saw, the temper is made to conform to the requirements of strength and elasticity, the latter element including its resistance to becoming bent or taking a permanent set, if bent much out of the straight line; and this degree of temper (which is shown by a blue color) is found to be the highest which it is practicable to give to the saw teeth: which, being formed out of the plate itself, are necessarily of the same temper as the plate. Furthermore, the blue shows the high est temper which it is practicable to give to the teeth, and still allow them the capability of being bent to obtain the set. Indeed, it is only from the fact of their being weakened by the spaces between them that they will permit of being set without becoming broken; for were we to attempt to set the solid edge of a plate or blade, it would break, if properly tempered. If then, in setting saw teeth, we allow the setting to extend below the tooth, the strength of the latter is destroyed, and the straightness of the plate or blade is impaired.

What is commonly called a buckle or a bend in a saw plate is known to the trade as a tight or a loose place, meaning that the want of straightness is produced by parts of the blade being unduly contracted or expanded; and all the ef forts of the straightener are directed to the end of removing the contraction or of accommodating the expansion, so that, the unequal tension or strain being removed, the plate will be true and straight. If we take a saw plate that is quite true, and lay it upon a truly planed iron plate and allow it to become first heated and then cooled thereon, we shall find that it has become warped by the process, and it is apparent that the warping has been produced by the expansion and contraction of the plate, and possibly mainly from irregular heating and cooling; for it is impossible to insure that the heat can be imparted to and extracted from the plate equally in all parts. The varying widths, the extra exposure of the teeth due to their partial isolation (and hence their increased susceptibility to heat and cold), and other elements, would all cause inequalities in heating, against which it would be impossible to provide. The circular saw affords the best example of the vicissitudes caused by unequal tension, as well as the most striking instance of the minuteness and skill in mechanical detail required in the saw straightener's art.
Suppose, for example, that we have a circular saw of three feet diameter, and that it is made straight and true, and with an equal degree of tension existing all over it. Let its circumference travel at a speed of 2,500 feet per minute: it is obvious that the centrifugal force generated by the motion will tend (and actually does, to a slight extent) to expand the saw plate, and it is equally obvious that this expansion decreases in amount as the center of the saw is approached. The equality of the tension on the plate is destroyed; and though stiff and true when in a state of rest, the saw is loose on the outside (or, in other words, center-bound) when rotated, the looseness of the plate decreasing from the circum ference towards the center as the radius shortens. As a consequence the extreme edge will, when in motion, flop over from one side to the other, according to the side on which the duty offers the most resistance; and this resistance will vary, from the curves in the grain in the wood, from knots, and from a variety of more minute causes. It follows, then, that the sawing cannot be smooth, and that, as the saw bends or flops over on one side, the opposite side of the blade will come into close contact with the work, entailing friction and, as a result, heating; the latter will cause the saw to dish, and to remain permanently dished.
The method employed by the saw straightener to compensate for the expansion due to the centrifugal motion is to place upon the saw a tension insufficient to dish the saw when at rest, and yet sufficient to accommodate the expansion due to the centrifugal force. This he does by the delivery of blows upon the plate, the effect of which will be to create a tension sufficient to tend to enlarge the plate without overcoming the resistance to enlargement offered by the plate itself until such time as the centrifugal force diminishes this resistance: when the tension follows up the advantage afforded by the centrifugal force, and holds the plate from becoming loose on its outer circumference. If from an error of judgment the tension is insufficient to accommodate the centrifugal force, the saw becomes loose in the middle, or,
in other words, it becomes rim-bound when in motion; and the result is that it dishes, as shown in Fig. 1. So that one side contacts with the work; and if the saw teeth meet with
 different resista which may sides from the waves in the also in irom the waves in the direction the grain of the denoted by the
timber, or from oth- arrow, C, the timber, or from oth er causes), the dish will jump from one side to the other of he saw, because, from being rimoound, it is impossible that it remain traight. And a
over the straight line, it springs to the dished form, which is the only one capable of accommodating the tension. Now when it is remembered that cutting out the metal to form the teeth weakens the saw, rendering it more susceptible to sar expansion from the centrifugal force, and that the number and the depth of the teeth, and the temper, thickness, and size of the saw, as well as the speed at which it rotates, are all elements tending to vary the force and effect of the centrifugal motion, it will be readily perceived that it requires unusual judgment and skillful manipulation to enable the workman to give to a saw the exact amount of tension called for by the particular circumstances under which it is to operate. Yet so skillful are some of the straighteners that they have been known to remedy a defect in a saw from the delivery of a single light blow.
The blows delivered are in no case quick ones, nor are they sufficient to leave an indentation or impression upon the saw blade or plate. Each is given with a view either to create or remove tension, and not to give to the metal a permanent set; and although in explaining the method of manipulation it will be necessary to show, in the illustrations, the hammer marks, it is to be understood that those marks are not visible upon the work, and are only employed to denote where the blows were delivered
In Figs. 2 and 3 are shown the hammers used by the saw straighteners. The first is called a "doghead." Its weight is about 3 lbs., its diameter is about $1 \frac{5}{8}$ inches, and its length is about $5 \frac{1}{2}$ inches. Its handle which is about 14 inches long, stands at an angle of $85^{\circ}$ to the body of the hammer. Its face is rounding, and of an even sweep. That shown in Fig 3 is called a blocking called a blocking hammer; the face at A is
slightly rounded. In Figs. slightly rounded. In Figs. 4 and 5 are presented the straightening blocks; that shown in Fig. 4 is of iron faced with steel. The face is bright, smooth, and slightly rounded. Fig. 5
 upon which the straightening of the finished saws is per formed.


The doghead hammer, Fig. 2, is used mainly for stretch ing, that is, for removing a tension. The reason for its handle being at an angle is that by this means the handle of the hammer stands, when the blow is delivered, in the line

of the hammer's
motion ; hence he blow delivered is a dead one, that is to say, it has as little spring or re bound as possi ble. By this means the effect produced by the blow is kept at a maximum; and the speed of the hammer being comparatively slow, it does not leave hammer sinks or marks upon the saw plate or blade.
The part of the saw plate being operated upon must always be kept flat upon the anvil, so that the blows will be received on a solid: otherwise they would distort the blade by bending it instead of stretching it. The motion of the doghead hammer, shown in Fig. 2, is sometimes such that it strikes the plate or blade fair, so that its effects extend equal-
y in all directions, as shown in Fig. 6, at A, in which the dark center shows where the hammer fell, and the radiating lines denote the stretching effects of the blow. At othe times, the direction in which the hammer falls is aslant, a shown in Fig 6, at B, in which the hammer, while falling stretching low being de noted by the radial lines around the center, at B. The motion of the

Fig. 6
hammer, how
ever, is never varied so as to travel towards, but always away from, the operator, the saw (if not a circular one) being turned end for end upon the straightening block when necessary.
The method of using the blocking hammer, shown in Fig. , is as follows: The shape of the face of the hammer, in inunction with the line of motion in which it falis, deter mine the direction in which the effects of the blow shall extend. If, for example, the face, A , of the blocking hammer were flat, and the blow fell vertically true, the effect of the blow would radiate equally on all sides of the spot which received the blow. If, however, the face, A, of the blocking hammer, while falling, traveled also laterally, the effects of the blow will be greatest on the side towards which the lat eral travel took place. Thus, in Fig. 7, if the hammer, in falling, traveled from B towards the hammer mark shown,

Fig. 7. the effect of the as denoted by the radial lines while if the position of the hammer face were turned to a right angle, and a blow were struck with the
hammer travelhammer travel effects upon the plate would be in the direction denoted by the radial lines, shown at C. The curve of the face of the blocking hammer, at A, also has an influence in extending the effects of the blow forward; and the result of these combined elements is that the blows lift the plate in front of them, so that, if blows were delivered as shown in Fig. 8, at A, the plate would $i=0$ nd upwards, assuming the shape de noted by the dotted lines at that end: while by blows delivered in the direction indicated by the marks at B , the plate

Fig. 8

or blade would curl up, as shown by the dotted lines at that corner of the plate
A saw plate or blade may have a bend in it that is not discernible to the unpractised eye; and yet the expert workman will readily detect the defect as the saw lies upon the straightening block; and all the coarser defects can be at tacked and remedied without sighting the plate at all. But when the finer part of the straightening is to be performed, and the tension of the blade, as well as its straightness, is to be perfected, the workman casts his eye along the blade nearly in a line with its length, when, the light coming in front of the operator, any unevenness upon the blade will be denoted by shadows, as shown in Fig. 9, which represents

an ordinary handsaw being sighted, the shadows showing the want of straightness. Having detected the part of the blade which is out of true, the workman reverses the posi-
tion of the blade, holding it in his hands as shown in Fig.

10, and he then bends the plate slightly backwards and for wards, the object of which is as follows: The defects in the

plate exist by reason of some part being either unduly ex panded or contracted, thus creating undue local tension in one place, and removing the natural tension in another. The workman, when bending the plate backward and forward, finds that the loose place (or, in other words, the expanded part) moves easily, while the contracted part offers a resist ance to the bending movement; so that, by noticing the amount of the movement during the bending, the workman discovers where the contracted part is, and he proceeds to remove it by stretching the blade in that spot. Thus while straightening the blade its tension is also equalized, giving to the plate a uniform resistance to its becoming bent or sprung. During the hammering process, the straight edge is frequently applied to the blade as a guide to test the work by. If, while attacking the necessary places, the saw blade does not lie solid upon the straightening block, the hamme will drum, as it is called; and the effect of the blow will be to stretch the outside skin of the saw blade, causing it to rise up because of its being elongated. Thus, were the blade to be hammered all over one face without bedding solid on the block, it would become bow-shaped, the face struck being the convex side.
In Fig. 11 is shown a saw blade having a loose place in the


Figy.la.

middle, as denoted by the shade shown upon the face. The method of attack here would be to deliver the blows denoted by the marks shown at A and B , using the doghead hammer for the purpose. The parts so struck would be stretched, giving room for the loose place to flatten, and taking the undue tension from the outer surface and imparting it to the loose place, the saw becoming slightly elongated by the process. If, however, the bending process or test showed the contraction to be in the middle of the blade, the doghead would be used to deliver the blows shown in Fig. 12, at A, which would stretch the metal there, removing the contraction and equalizing the tension. Suppose, however, that the saw was atwist, as shown in Fig 13: the method of attack
rigy.zs.

Fig. TH.

would be to take the blockinghammer, and deliver the blow denoted by the marks shown, using the hammer so that, while falling, it would travel laterally slightly from the workman. The blade would be placed upon the block with the drooping side downwards, because the effect of the blows of the blocking hammer is, as before noted, to lift the plate in front of them.

If one edge of the saw blade had a kink or wave in it, as shown in Fig. 14, the method of procedure would be as follows: The blade would be placed upon the block with the hollow side of the kink downwards, as shown in Fig. 14, and the blows shown at A would be delivered. The effect of these blows will be to stretch the metal of the plate, re moving the tension behind the kink, and producing a ten sion tending to lift the part kinked. The plate is then turned
upside down, and the blows denoted by the marks shown in ig. 14, at B, are delivered, which will remove the kink. In performing any one of these operations new contrac tions or expansions of parts may be induced; and it not unfrequently happens that a kink and a twist, or a twist and a loose place, may be attacked at the same time. Numerous combinations of contracted or expanded places may of course exist in a blade, and the process for removing one may be modified or carried on in conjunction with that necessary to remove another; the principles employed, however, are in all cases those explained above, the application being varied to suit the circumstances.
In the edge view of Fig. 15 is shown a circular saw dished and here it may be noted, that in this case as well as when the saw is out of straight, the first thing to do is the first the dish out, and to get the dish out, and afterwards proceed
with the straightening. with the straightening.
To remove the dish, the saw is placed upon the block with the concave side uppermost; and the blows are delivered with the dog-
 head in the places de-
noted by the marks shown on the face view of the saw in Fig. 15. The testing of the saw is made by bending it, by sighting it, and by applying a straight edge to its surface. Some circular saws are too thick and strong to be easily bent, and in that case the bending test is omitted. If a cir cular saw is atwist or has a kink in it, the method of attack is the same as that already described for similar defects in hand or frame saws: except that, as before explained, a slight tension is left upon the outer diameter so as to allow for the expansion of the saw created by the centrifugal mo tion and force.
J. R.

## Commaniationg

Our Washington Correspondence

## To the Editor of the Scientific American

The letter of the Commissioner of Patents to the Secretary of the Interior on the general management of the Pat ent Office has been followed by a meeting of the different heads of bureaus of the Interior Department, for a genera interchange and comparison of views and a discussion of the reports submitted by them upon the subject of civil ser vice reform as applicable to the department. General Spear earnestly advocated the system of competitive examination, which prevailed in the Patent Office for several years before it was ignored by Secretary Chandler from the failure of Congress to provide means of paying the Civil Service Commission. It is to be hoped that competitive examination will again be the rule in making appointments, instead of the question as to a man's usefulness as a politician, as the examinations formerly made undoubtedly led to a great improvement in the examining corps during the time the sys tem was in force. But in forming a new set of rules to govern the competitive examinations, should this system be adopted, those who will have the matter in charge should see that the questions asked the applicants have some con nection with the duties they will be called on to perform Under the old Civil Service Commission a large proportion of the queries asked would not have the least possible connec tion with Patent Office business, such, for instance, as geo graphical, historical, and astronomical questions, that would have been very proper if put to applicants for pedagogue ships, but which could not, when answered corrcctly, give any indication as to the answerer's knowledge of mechanic or patent law. Such questions as these could be readily an swered by young men just fresh from school; while old Pat ent Office examiners, who had learned these things in their youth, but in the course of acquiring the requisite knowledge of the classes of inventions under their charge had forgotten them, had, consequently, to take back seats, and see beard less youths who did not possess a tithe of their technical knowledge, and who in some cases actually knew nothing of the classes to which they were appointed, pass over their heads to higher positions.
Bids were to have been opened to-day at the Post Office department for supplying postal cards for four years from the first of May next. The advertisement required the bids to be for cards conformable to the sample furnished by the department, and this sample was one with different tints to the two faces-a buff and a pale green. A number of the leading paper manufacturers having represented to the Post-
master-General that this would virtually establish a monopo-master-General that this would virtually establish a monopo
ly in bidding, as but two or three manufacturers had th machinery necessary for this kind of paper, and that the result would be that the department would be compelled to pay a larger amount for the cards, the Postmaster-General decided to reject all bids, and to call for new proposals for ard such as can be made by any first class paper maker.
The Agricultural Department is continually troubled wit applications for seed; but its distribution has ceased for the season, except to those districts of the West which were af flicted by grasshoppers in 1876, and for which a special appropriation was made by Congress a short time before the
not therefore be responded to, and parties outside of the
grasshopper districts will save time and trouble by not mak ing application.
Congress last session appropriated $\$ 18,000$ for the purpose of sending a commission to investigate the grasshopper plague, and suggest remedies for the relief of the suffering farmers whose crops have been yearly devastated by this rapacious insect. The President has appointed Professor C. V. Riley, State Entomologist of Missouri; Professor Cyrus Thomas, Entomologist of Illinois; and Professor Packard, o Salem, Mass., as the Commission. This action is the result of a conference held in Nebraska by the Governors and prominent men of the States and Territories interested in which Professors Riley and Thomas each took a promi nent part. The commission is an excellent one, and wil probably make a report of great value. They propose to go as far west as the breeding places of the insect, and study its habits, and from them deduce a plan for its destruction, if possible. The Southern farmers are reported as grumbling at the neglect of their section, and ask: If the grasshopper is to be investigated, why should not the habits of the tobac co or cotton worm be examined by a commission also? They think they have as much right to a commission as the West ern agriculturists.
Washington, D. C.

## IMPORTANT OBSERVATIONS ON THE ROCKY MOUNTAI

 LOCUST, OR "GRASSHOPPER" PEST OF THE WEST.In a few weeks the ravages of the Rocky Mountain locust (caloptenus spretus) will, in all probability, be creating more attention than ever, as the area threatened by the young insects is larger than ever before, beginning in Southeastern Dakota, including the Southwestern half of Minnesota, the Western half of Iowa, 4 counties in Northwest and 12 in Southwest Missouri, Benton County in Arkansas, Texas from that point to the mouth of the Sabine river, thence along the Gulf to Austin, and more or less all the country west of these points to the mountains. In view of this probability, the following observations, which are largely extracted from my ninth report, now going through the press, and which are here recorded for the first time, will doubtless prove of interest to your large circle of readers: I propose to follow them with the results of a series of experiments on the eggs and the young insects, with a view of most effectually destroying them, which experiments these observations will render more intelligible
does the female form more than one egg mass?
Whether the female of our Rocky Mountain locust lays her full supply of eggs at once, and in one and the same hole or whether she forms several pods at different periods, are questions often asked, but which have never been fully and definitely answered in entomological works. It is the rule with insects, particularly with the large number of injuriou species belonging to the lepidoptera, that the eggs in th ovaries develop almost simultaneously, and that when ovi position once commences it is continued uninterruptedly until the supply of eggs is exhausted. Yet there are many notable exceptions to the rule among injurious species, as in the cases of the common plum curculio and the Colorado potato beetle, which oviposit at stated or irregular intervals during several weeks or even months. The Rocky Moun tain locust belongs to this last category; and the most casual examination of the ovaries in a female taken in the act of ovipositing will show that, besides the fully formed eggs being then and there laid, there are other sets, diminishing in size, which are to be laid at future periods. This, I re peat, can be determined by any one who will take the trouble to examine a few females when laying. But just how often, or how many eggs each one lays, is more difficult to deter mine. With spretus, I have been able to make comparatively few experiments, but on three different occasions I obtained two pods from single females, laid at intervals of 18, 21 and 26 days respectively. I have, however, made extended experiments with its close congeners, femur rubrum and Atlanis, and in two cases with the former have obtained four different pods from one female, the laying covering periods of 58 and 62 days, and the total number of eggs lai being in one case 96 , and in the other 110. A numbe of both species laid three times, but most of them-owing perhaps to their being confined-laid but twice. They couple with the male between each period, and I have no doubt but that, as in most other species of animals, there is reat difference in the degree of individual prolificacy
I have frequently counted upward of a hundred ova in the ovaries of spretus, and as the largest and most perfect pods seldom contain more than thirty, we may feel confident that the Rocky Mountain locust will sometimes form as many as our pods, and perhaps even still more.
The time required for dril ing the hole and completing the pod will vary according to the season and the tempera ture. During the latter part of October, or early in Novem ber last year, when there was frost at night and the in ects did not rouse from their chilled inactivity till 9 o'clock A.M., the females scarce had time to complete the proces during the four or five warmer hours of the day; but with higher temperature not more than two or three hours would be required.

How the eggs are laid.
The question as to how best to treat the soil, or to manag the eggs so as to most easily destroy their vitality, is a most
important and practical one; and as assisting to a decisive the upper or head ends of the outer rows are necessarily bent ments which freed it from the earth, and which now burst answer, I have carried on a series of experiments which to the same extent over the inner rows-the eggs when laid will be presently detailed. To make the experiments the more being somewhat soft and plastic. There is, consequently, an intelligible, I will first give the reader a deeper insight into the philosophy of the processes of egg-laying and of hatching than I have hitherto done, and this the more readily that it has never been given by any other author.
I have already explained (Report VII, page 122) how, by means of the horny valves at the end of her abdomen (Fig. 1), the female drills a cylindrical hole in the ground in which to consign her eggs. The curved abdomen stretches to its utmost for this purpose, and the hole is generally a little curved and is always more or less oblique. (Fig. 2, ed.) If we could manage to watch a female during the arduous work of ovi positing, we should find that, when the hole is once drilled, there com mences to exude at the dorsal end of the abdomen, from


Rocky Mountain Locust.- $a, a, a$, female laying; $b$, egg-pod partly Rocky Mountain Locust. $-a, a$, $a$, female laying; $\delta$, egg-plod partly
broken; $c$, loose eggs; $a$, burrow showing oviposition; $e$, completed pod $f$, covering to one.
a pair of sponge-like exsertile organs (Fig. 3, $k$ ) that are nor Fig. 3. mally retracted and hidden bencath the super-anal plate near the cerc
(Fio. $3, i$ ), a frothy mucous matter,
 (Fig. 3, $i$ ), a frothy mucous matter, which fills up the bottom of the hole. Then, with the two pairs of valves brought close together, an egg would be seen to slip down the oviduct ( $j$ ) along the ventral end of the aldomen, and, guided by a little, finger like style (g), pass in between the horny valves (which are admirably constructed, not only for drill ing, but for holding and conducting the egg to its appropriate place), and issue at their tips amid the mucous fluid already spoken of. Then follows a period of convulsions, during which more mucous material is claborated, until the whole end of the body is bathed in it-when another egg passes down and is placed in position. These alternate processes continue until the full complement of eggs are in place, the number ranging from 20 to 35 , but averaging about 28 . The mucous matter binds all the eggs in a mass, and when the last is laid, the mother devotes some time to filling up the somewhat nar rower neck of the burrow with a compact and cellulose mass of the some material, which, though light and easily penetrated, is more or less impervious to water, and forms very excellent protection. (Fig. 4, d.)


Egg Mass of Rocky Mountai
piIILOSOPHY of tile egg mas
To the casual observer the eggs of our locust appear to be thrust indiscriminately in the hole made for their reception A more ca:eful study of the egg mass or egg pod will show however, that the female took great pains to arrange them, not only so as to economize as much space as possible con sistent with the form of each egg, but so as to best facilitate the escape of the young locust; for as the bottom eggs were the first laid, and are generally the first to hatch, their issue would, in their efforts to escape, disturb and injure the other eggs, were there no provision against such a possibility. The eggs are, indced, most carefully placed side by side in four rows, each row generally containing seven. They oblique a little crosswise of the cylinder. (Fig. 4, a.) The posterior or narrow end which issues first from the oviduct is thickened and generally shows two pale rings around the darker tip (Fig. 5, a). This is pushed close against the bottom of the burrow, which, being cylindrical, does not permit the outer or two side rows to be pushed quite as far
down as the two inner ones; and for the very same reason


Egg of Rocky Mountain Locust.- $a$, sculpture of outer shell; $b$, same more enlarged; $c$, with the outer shell removed, just before hatching; $d e$ foints where the shell is ruptured
irregular channel along the top of the mass (Fig. 4, $c$ ) which is filled only with the same frothy matter which surround each egg, and occupies all the space in the burrow not occupied by the eggs. The whole plan is seen at once by a reference to Fig. 4, which represents, enlarged, a side view of the mass within the burrow (a) and a bottom $(b)$ and top (c)
view of the same, with the earth which adheres to it review of
moved.
how the young locust escapes from the egg.
Carefully examined, the egg shell is found to consist of two layers. The outer layer, which is thin, semi-opaque and gives the pale cream-yellow color, is scen, by aid of a high magnifying power, to be densely, minutely, and shal lowly pitted; or, to use still more exact language, the whole surface is netted with minute and more or less irregular, hexagonal ridges (Fig. 5, $a, b$ ). The inner layer is thicker of a decper yellow, and perfectly smooth. It is also translucent, so that, as the hatching period approaches, the form and members of the embryon may be distinctly discerned through it. The outer covering is more easily ruptured and is rendered all the more fragile by freczing; but the inner cover ing is so very tough that a very strong pressure between one's thumb and finger is required to burst it. How, then, will the embryon, which fills it so completely that there is scarcely room for motion, succeed in escaping from such a prison? The rigid shell of the bird's egg is easily cracked by the beak of its tenant; the hatching caterpillar, curled within its egg shell, has room enough to move its jaws and eat its way out the egg coverings of many insects are so delicate and frai that the mere swelling of the embryon affords means of es cape; those of others so constructed that a door flies open or a lid lifts up by a spring, whenever pressure is brought to bear; in some, two halves open, as in the shell of a muscle whilst in a host of others the embryon is furnished with special structure, called the egg burster, the office of which is to cut or rupture the shell, and thus liberate its occupant But our young locust is deprived of all such contrivances, and must use another mode of exit from its tough and sub elastic prison. Nature accomplishes the same end in many
different ways. She is rich in contrivances. Every one who has been. She is rich in contrivances. Every one shanks (tibiæ) of our locust, as of all the members of its family, are armed with spines. On the four anterior leg these spines are inside the shank; on the long, posterior legs outside. The spines of the hind shanks are strongest, and the terminal ones, on all legs, stronger than the rest. There can be no doubt that these spines serve to give a firm hold to the insect in walking or jumping; but they have first served a more important pre-natal purpose
When fully formed, the embryon is seen to lie within its shell, as at Fig. 5, c. The antenne curve over the face and between the jaws, which are early developed, and with their sharp black teeth, reach on to the breast. The legs are folded up on the breast, the strong terminal hooks on the hind shanks reaching toward the mesosternum.
Now, the hatching consists of a series of undulating contractions and expansions of the several joints of the body, and with this motion there is slight but constant friction of the ips of the jaws and of the sharp tips of the tibial spines, as also of the tarsal claws of all the legs, against the shell, which eventually weakens between the points $d$ and $e$, and finally gives way there. It then easily splits to the eyes or beyond, by the swelling of the head. By the same undulating movements the nascent larva soon works itself entirely out of the egg, when it easily makes its way along the channel already described without in the least interfering with the other eggs, and finally forces a passage way up through the mucous fill ing in the neck of the burrow. (Fig. 4, d.) Once fully scaped from the soil, it rests from its exertions, but for hort time only. Its task is by no means complete: before it can feed or move with alacrity, it must molt a pellicle which completely incases every part of the body. This it does in the course of three or four minutes, or even less, by
a continuance of the same contracting and expanding move-
the skin on the back of the head. The body is then gradually worked from its delicate covering until the last of the hind legs is free, and the exuvium remains, generally near the point where the animal issued from the ground, as a little white, crumpled pellet. Pale and colorless at first, the full born insect assumes its dark gray coloring in the course of half an hour. From this account of the hatching process, we can readily understand why the female in ovipositing prefers compact or hard soil to that which is loose. The harder and less yielding the walls of the burrow, the easier will the young locust crowd its way out.
The covering which envelops the little animal when firs it issues from the shell, though quite delicate, undoubtedly affords protection in the struggles of birth from the burrow and it is an interesting fact that, while it is shed within a few minutes of the time when the animal reaches the free air, it is seldom shed if, from one cause or other, there is failure to escape from the soil, though the young locust may be strug gling for days to effect an escape
While yet enveloped in this pellicle, the young animal possesses great forcing and pushing power, and, if the soil be not too compact, will frequently force a direct passage through the same to the surface, as indicated at the dotted lines, Fig. 4, e. But it can make little or no headway, ex ept through the appropriate channel ( $d$ ), where the soil is at all compressed. While crowding its way out, the antenne and four front legs are held in much the same position as within the egg, the hind legs being generally stretched. But the members bend in every conceivable way, and where several are endeavoring to work through any particular passage, the amount of squeezing and crowding they will endure is re markable. Yet if, by chance, the protecting pellicle is worked off bcfore issuing from the ground, the animal lose all power of further forcing its way out.

## THE BRITISH IRONCLAD ALEXANDRA

On page 258 , we present a fine sectional view of a vesse that is now one of the strongest in the English navy. Judg ing by the past history of ironclad ships, in a very few years hence the Alexandra will be deemed weak, or else withdrawn from service altogether, adding another to the long list of armored vessels which have been set aside as useless because of the progress made in the construction of artillery capable of perforating their plates. Even now the heavy Krupp guns and the 100 -ton English cannon not only pierce 12-inch iron plating, which is the thickest carried by the Alexandra but send their bolts through two plates of that thickness sep arated by 9 inches of solid oak. It will be seen, therefore that against such weapons the sides of the Alexandra offe little resistance, and that the ship before such artillery is practically as vulnerable as a wooden frigate. Nor are there any vessels now afloat which can oppose the shot of the 100 ton gun successfully. The Inflexible, now the most powerful of British ironclads, has 24 inches of plating, and the Dandolo and Duilio, new Italian ironclads, nearly the same; yet the recent trials of the great cannon above mentioned, at Spezzia show that targets representing sections of these vessels wer quickly destroyed. The ironclad of the near future must carry either the 40 -inch plates which Shefficld makers have promised to roll, or clse be incased in steel; for steel armor it now appears, has offered the best resistance to the shot of the 100 -ton gun. The thickest armor of the Alexandra the belt at her water line, is the 12 -inch plating referred to. About her batteries the iron is only 8 and 5 inches thick, so that the men at the guns and the guns themselves are virtually unprotected against shot from modern artillery of even moderate weight
Though laboring under a great disadvantage in point of vulnerability, the Alexandra embodies some of the newes and most important improvements in naval construction She is a central battery ship, and is able to train four guns, ncluding the two heaviest of her armanent of twelve, straigh ahead and two straight astern. This capability is of the reatest moment, since the vessel thus has a range of fire around the entire horizon.
The section of the ship given in our engraving is taken hrough the battery, showing the two gun decks. The sills of the ports of the lower deck are 9 fect, and those of the pper deck ports 17 feet above the water. The guns are of the Fraser pattern, and are constructed of steel tubes surrounded by coils of wrought iron increasing in number and thicknes toward the breech. There are two 25 -ton and ten 18 -ton guns. The Alexandra is an ocean-going cruiser, and is now flagship of the British Mediterranean squadron. Her dimensions, etc., are as follows: Length between perpendiculars, 225 fcet; extreme breadth, 63 feet 8 inches; depth of hold, 18 feet $7 \frac{5}{8}$ inches; tonnage, 6,049 ; displacement, 9,492 tons draught forward, 26 feet; indicated horse power, 8,000 ; speed per measured mile, 16 knots.

A marbie statue of Sir William Fairbairn has now been completed. The statuc, which is to stand in the new Town Hall, Manchester, England, is eight feet high, and represents Sir William standing with papers in his hand as if delivering n address to a scientific audience; the head is bare and slightly inclined, and the statue is an admirable likeness, in the features as well as in the thoughtful expression and quie energy characteristic of the man.
Statistics show that about 250,000 barrels of apples were exported from America last year to Europe. More than hal this quantity was sent to England, and about 11,000 barrel went to St. Petersburgh.

## A NEW HYDRAULIC ENGINE

We frequently receive queries from farmers relative to some simple motor adapted to pumping water from a stream and delivering it through pipes to the barn or dwelling. We usually recommend a windmill for this purpose, but in cases where that cannot be advantageously used, a small engine driven by the current of the stream may prove available. Such a motor is illustrated in the accompanying engraving. It was patented through the Scientific American Patent Agency, February 6, 1877, by Mr. Joseph D. Richardson, of Wheeler's Mills, Ky.
A, Figs. 1 and 2, represents a water wheel of any suitable construction, preferably an overshot wheel. The shaft of the water wheel, A, turns in bearings of a supporting frame, $B$, and intermeshes, by a pinion, $a$, with the gear wheel, $b$, of an intermediate shaft, $d$, which transmits again the power by a pinion, $e$, to a gear wheel, $f$, that is placed, by its sleeve, $f^{\prime}$, loosely on the pump-operating crank shaft, C. A flywheel, $\mathrm{C}^{1}$, of considerable weight and size, is keyed to shaft, C, and thrown into operation by a spring, D , which is attached to the loose gear wheel, $f$, and, by its inner end, to the crank shaft, C. The rotation of the water wheel causes the turning of the spring-acted wheel, $f$, until the power stored up in the spring is sufficient to overcome the resistance of the crank shaft, so as to revolve the same and operate the pump, E, assisted by the flywheel. If the flywheel is not large enough, a brake, $\mathrm{C}^{2}$, Fig. 3, may be used, which engages, by its hook-shaped end, studs, $g$, of the flywheel, and retains the same until the brake is released by a pin, $h$, on the sleeve of the gear whecl, $f$. The pin, $h$, and flywheel. As soon as the contact of stud, $h$, and the brake arm is terminated, the brake is carried down again on the flywheel, and the power of the water wheel is again stored up by the spring until another full revolution of the wheel, $f$, is completed, and thereby the flywheel again released and the pump worked, and so on.
The power of the stream is thus utilized by being stored up by the spring, and intermittently applied to work the pump, furnishing thereby a supply of water to the house situated on elevated ground above.

MARTIN'S GAS REGULATOR FOR STEAM BOILERS.
This invention is a gas regulator for controlling the supply of gas used in steam boilers as fuel. D, in the engrav-

ing, is a mercury chamber, which is connected with the steam room of the boiler by means of the pipes, $a b$, and into which a pipe, E, passes. There is sufficient space between the pipes, E and $b$, to form an open passage between the mercury chamber, D, and the steam room of the boiler. The pipe, E, extends upward, and is connected with a float chamthe float, B, which is cylindrical and beveled downward to- makes lichens. ward its center, forming a sharp edge, which removes deposits made by the gas upon the valve seat. A passage, $h$, A for the pace above the valve seat with the chas,
bears on a spring-acted lever arm of the brake, so as to lift furnace, and $\mathrm{C}^{\prime}$ is a branch pipe leading to the supply ports the same and admit thereby the turning of the crank shaft $e e$, of the regulator. $\mathrm{C}^{\prime \prime}$ is a pipe leading from the gas regu-

Fig.1. Fig.2.


## RICHARDSON'S HYDRAULIC ENGINE

 lator to the pipe, C. Stopcocks are placed in these pipes, by required. The pipe, $a$, is connected with the boiler, so that the pressure upon the surface of the mercury contained in the chamber is the same as that carried by the boiler. The length of the pipe, E , is such that the column of mercury contained by it is counterbalanced by the pressure upon the surface of the mercury in the chamber, D. The pipe, $C$, is stopped between the pipes, $\mathrm{C}^{\prime}$ and $\mathrm{C}^{\prime \prime}$, and the gas flows through the pipe, $\mathrm{C}^{\prime}$, through the ports of the regulator and pipe, $\mathrm{C}^{\prime \prime}$, to the boiler furnace. If the supply of gas is too great, an increase of pressure in the boiler results, and an increased pressure is exerted upon the surface of the mercury in the chamber, D , which drives the mercury through the tube, E , into the float chamber, A , which raises the float, B, and causes the valve, $g$, to close the ports, $e$, more or less, allowing only enough gas to pass to the boiler furnace to maintain the required boiler pressure. When the pressure in the boiler decreases, the operation is the reverse of that just described.This device was patented through the Scientific American Patent Agency, February 6, 1877, by Mr. E. O. Martin, of Greece City, Pa.

## Plowing with Dynamite.

We have already mentioned that dynamite has been used for plowing; and agriculture will derive advantage from this and other compounds heretofore employed in engineering. At the works for the Exposition buildings, now going on at the Trocadero, Paris, passers-by may, at certain hours, be startled by a deep rumbling sound. This is caused by springing of dynamite mines, which, without any violent projection of materials, makes the obstacles crumble away, and breaks up the underground rocks, the fragments of which are used for the buildings. Now, dynamite will perform a similar service in the fields. The Duke of Sutherland, in Scotland, and Dr. Hamm, in Austria, have employed it for clearing land and for digging much deeper than any instrument could. A certain number of dynamite cartridges are buried at regular distances in the soil, and connected together by electric wires. The explosion is simultaneous; and, though nothing is thrown up, the field is effectually plowed.

## Hide-Bound Trees.

Trees that have long stems, exposed to hot suns or drying winds, become hide-bound. That is, the old bark becomes indurated-cannot expand-and the tree suffers much in consequence. Such an evil is usually indicated by gray
lichens, which feed on the decaying bark lichens, which feed on the decaying bark. In these cases,
says the Gardener's Monthly, a washing of weak lye or of lime water is very useful;indeed, where the bark is healthy, it is beneficial thus to wash trees, as many eggs of insects Somes \& Co., Springfield, Mass.
ber, A, that contains the float, B. Upon the upper end of are thereby destroyed. We would, however, again refer to the float chamber, A, a valve seat, $d$, is formed, in which the linseed oil as a wash, as far more effective for insects, and supply ports, ee, are made, which connect with a semi-an- it would, perhaps, do as well for moss and lichens. Afte nular passage, $f$, provided in the upper part of the casting of all, these seldom come when trees are well cultivated. It is the chamber. A valve, $g$, is formed upon the upper end of neglect that makes poor growth, and it is poor growth that

## Great Eruptions.

Two tremendous volcanic eruptions have lately occurred g. $\quad$ C is a gas supply pipe, that leads directly to the boiler group of volcanoes in the world. Mauna Loa, which is 14,000 feet high, has grea cruptions once in seven years which are very energetic during the brief period over which they continue. On February 14, this volcano burst forth. During the preceding afternoon, a heavy cloud pr black smoke had of black smoke had enveioped the top of the mountain, and in the fore noon of the day above mentioned five distinct columns of fire could be seen. The smoke masses, one observer says, were ejected to a height of not less than 16,000 feet, rising with such velocity that an elevation of 5,000 feet was reached within a minute. The sky was darkened over an area of 100 square miles, and at night the illumination was so brillingt that all parts of the island were lighted up This tre mendous ligution up. Tre mendous eruption lasted but a in about six hours.
On February 24, a submarine volcano appeared near the harbor of Honolulu. Columns of smoke arose from the surface of the sea, and large masses of lava were ejected. This volcano seemed to be upheaved by a submarine rupture, running in a straight line for nearly a mile. Several very severe earthquake

## shocks were felt along the neighboring land.

## IMPROVED YARD STICK AND BIAS MEASURE.

The annexed engraving represents a novel and very handy implement, either for the drygoods salesman or the dressmaker. It enables the latter to solve graphically-as the mathematicians say-a geometrical problem which often vexes the feminine mind, and allows of stuff being cut to the best advantage-an important item in these days when the average female robe is a structure rivaling a suspension bridge in intricacy and requiring engineering ability of a high order to construct. Besides, the invention is calculated to secure considerable saving for the retail drygoods dealer, as the inaccurate measuring of expensive fabrics may in time aggregate a waste which figures prominently on the wrong side of the profit and loss account.
The object of the device is to insure the marking of a true bias or angle of $45^{\circ}$ to the selvage. A yard stick is suit ably divided and has two arms attached to it at exactly the angle above mentioned. There are crossbars showing the width of a bias strip. The inner bar serves to give strength, and to enable a double bias to be marked. For example, to cut off a band $3 \frac{1}{4}$ inches wide, a common width for trim mings, etc., the inner bar is adjusted parallel to the end of the cloth, as shown in the engraving. A line is then ruled by the yard stick and the measure is moved a corresponding distance, as indicated by the crossbars. These lines are ruled both by the yard stick and the inner bar. In this way, three strips are marked with one movement of the measure


SOMES' YARD STICK AND BIAS MEASURE
It is then certain that the stuff will be accurately cut, while the whole operation is done very quickly. The yard stick and arms are marked on both sides, so that the measure can be used on either side of the cloth.
The invention was patented October 10, 1876, by Mr. John K. Somes, a silk salesman of long experience. For further particulars regarding agencies, rights, etc., address J. K,

The Missouri Senate has passed a bill offering $\$ 10,000$ re ward for the discovery of a sure cure for hog cholera. Such a handsome prize should certainly stimulate the faculties of scientific men, especially those who are practical farmers.

## PROFESSOR GRAY'S TELEPHONE.

We noticed last week the exhibition of Professor Gray's telephone in this city, the instrument being operated in Philadelphia. In the annexed engravings, reproduced from the New York Daily Graphic, the apparatus is very fully represented.
Although the operation of the instrument is intricate, the description is not difficult, because all the effects that are produced by the magnetization and demagnetization of iron, by means of electric currents passing through coils of wire, may be briefly referred to without the necessity of going into an explanation of how the wires are placed, or as to the arran as to the arrangement and effect of the main and local bat-
teries. By referring to the picture of the apparatus used by the performer in Philadelphia, the reader will observe, beneath the keyboard of two octaves, a series of taves, a series of small pieces of apparatus placed on
shelves. These are shelves. These are
allalike, with an exallalike, with an ex-
ception that will be ception that will be
noted hereafter. An noted hereafter. An enlarged view of one of them is shown, representing a tongue of metal, A , vibrating between coils of wire, B. This tongue of metal vibrates automati-
cally. When it is attached to the right, for example, its own movement is made to affect the electric current in such a manner that the bar of soft iron withiu the coil loses its the coil loses its power, and at the same time the bar on
the left is invested with attractive power. To accomplish this was a simple problem in electro-magnetism and requires no description here. The tongue of metal, which corresponds to a tuning fork, is thus set to moving rapidly backwards and forwards, but the number of times per second depends entirely upon its own length. No matter how violently or how softly a tuning fork may be struck, the number of vibrations is always the same per second for the same fork. The pieces of apparatus beneath the keyboard are all provided with vibratapparatus beneath the keyboard are all provided with vibrat-
ing tongues of metal of different lengths-that is of such
length as will give all the notes of two octaves. As often as independently of those of all other notes. Following, then any particular key is pressed down; and as long as it is kept these multifarious but separately cared-for elements of down, the electric currents operate to make the correspond- "Home, Sweet Home" to New York, we have to discover ing metallic tongue vibrate. These vibrations constitute the how they are received, sorted, and translated into air vibramusic that the performer hears, but they are by no means tions that may strike the tympanum of the ear. The wave the music that is heard at the other end of the line. As the lets are passed through sixteen pieces of apparatus, each tremulous tongues fly back and forth with a rapidity that consisting of an ordinary electro-magnet, C, having, instead defies vision, they open and close the circuit of the main of an armature, a steel ribbon, $D$, stretched in ametallic frame. wirc. This, then, is all that is done so far. Each vibration This ribbon is tuned to vibrate at a particular pitch. Now, wirc. This, then, is all that is done so far. Each vibration
is reproduced at a distance in successive waves of electricity. creased in size very slightly, and when it is demagnetized it is restored to its original dimen sions. This change is accompanied by a slight sound, sup posed to be due to he arrangemen and re-arrangement of molecular parti cles.
The wavelets of electricity produced in Philadelphia by vibrations of the metallic tongue tuned to the note D, for example, will pass through all the apparatus in New York, whose ribbon is tuned to C, with out effect; but as soon as it comes to the $D$ apparatus the ribbon begins to vibrate, producing the note of D. In this way the New York pparatus sorts out the wavelets of elec tricity and trans mutes them into music. These sixteen pieces of ap paratus in New York are each in closed in an oblong sounding box to in crease the sound of the vibrating rib bons. A picture of Just here it is necessary to explain a peculiar discovery $\left.\right|^{\text {these boxes, arranged in symmetrical order, is alsu presented }}$ that has made the telephone, as a musical instrument, possi- herewith. ble. If only one key were pressed at a time it is easily conceivable how the wavelets of electricity peculiar to that key could be sent over the wire from Philadelphia to New York. But suppose two, five, or the entire sixteen notes are struck the same time. Can one wire carry all these wavelets without confusion to New York? It can. How it can is a matter of theories. What is absolutely known is that the

Exports of Ice.-The fine new ship C. C. Chapman, built Bath, Me., recently cleared from Boston. Her cargo con sisted of 2,200 tons of ice for Calcutta and 3500 bales of drills or Madras. The bark R. R. Allen, which cleared from oston in the same week as the C. C. Chapman, took 600 ns of ice vessels loading with ice for export.


Fig. 2.-PROFESSOR GRAY'S TELEPHONE IN PHILADELPHIA.

## For the Scientific A merican.]

## THE FRICTION OF PLAIN SLIDE VALVES

Mr. John Hill's method of calculating the power necessary to operate a slide valve, as published in the Scientific American Supplement of March 10, would be intelligible providing he will tell us his reason for assuming the co efficient of friction of a slide valve to its seat to be 0.75 , and also for assuming that it is possible, or practicable, to make all valves of an equally good fit to their seats, and to prevent that fit from varying, by reason of the expansion and contraction due to variations of temperature, and by furthe reason of the spring of the valve from the pressure upon it.
Mr. Bourne, in his "Handbook of the Steam Engine," says: "Clean and smooth iron drawn over clean and smooth iron, without the interposition of a film of oil or other lubricating material, requires about one tenth of the force to move it that is employed to force the surfaces together. In other words, a piece of iron 10 lbs . in weight would requirc a weight of 1 lb . acting on a string passing over a pulley to draw the 10 lb . weight along an iron table. But if the surfaces are amply lubricated, the friction will only be from $\frac{1}{40}$ to $\frac{1}{60}$ of the weight." The experiments of General Morin on the friction of various bodies without an interposed film of lubricating liquid, but with the surfaces wiped clean by a greasy cloth, have been summarized by Professor Rankine in the following table:


In a paper, of which an abstract has appeared in the Comptus Rendus of the French Academy of Sciences, for April 26, 1858, M. H. Bochet describes a se ries of experiments which have led him to the conclusion that the friction bo tween a pair of surfaces of iron is not as it has hitherto been believed, absolutely independent of the velocity of sliding, but that it diminishes slowly as that velocity increases.
If we class the conditions unde which a slide valve operates under the head of "metals on metals, dry," w are confronted at once with the question: For what reason shall we selec the co-efficient as $0 \cdot 15$ in preference to the $0 \cdot 2$, or vice versa? If we class those conditions under any other of the head ings in the table, where are we to get co-efficient of 0.15 ? And if, as M. H Bochet concludes, the co-efficient varies with the velocity of sliding, how can we assume a fixed co-efficient for slide valve when its velocity of sliding varies with every variation in the speed of the engine, as well as at every inch of its movement? In the case of slide valves, however, the weight upon the valve is not a dead weight, but live steam; and hence, before we can make a calculation to determine the friction we have to determine the pressure of the valve to its seat, and this, as may very easily be demonstrated, depend upon the fit of the valve to its seat.
In Appleton's " Cyclopædia" occurs the following: "Two glass or meta plates with well ground surfaces, when pressed together, will adhere with such force that the upper one will not only support the lower, but an additional weight will be required to separate them. The amount of this adhesive force has been measured by recording the weights necessary for their separation. The records of the old experimenters on this subject are worthless, because they placed a lubricating fluid (oil or fat) between the plates; they found thus the cohesion of the oil or fat, and not the adhesion of the plates. In later times, Prechtl, in Germany, has made the most careful experiments in this line; he took polished metal plates of $1 \frac{1}{2}$ inches diameter, suspended the upper one to a balance, brought it to an equilibrium in a horizontal position, and attached the lower plate to a support beneath it. Both plates were then brought into contact, so that the flat polished surfaces covered one another perfectly, and the weights required in the scale, at the other end of the balance beam, to separate the plates were the measures of adhesion. He found thus the following remarkable law: The adhesion between two plates of the same material is the same as that between one of the plates and any material which possesses a less adhesive force. Prechtl found also that an attraction of the plates manifested itself at an appreciable distance before actual contact, and he even measured the amount of this attraction at the distance of $\frac{1}{24}$ of an inch by means of weights in fractions of grains. The suspended plate, when brought within this distance, was attracted with an accelerated motion till the contact took place with a slight concussion. The idea that the pressure of the air was the chicf cause of the adhesion of two such plates, as it is in the case of the well known experiment with the Madgeburg hemispheres, was set at rest by Boyle, who suspended the adhesive plates charged with weight in the vacuum of an
air pump; the plates were not separated, while the hemi spheres, held together by the vacuum alone, fell apart. Now whether Mr. Hill, in assuming the co-efficient of friction for slide valves to be $0 \cdot 15$, has assumed the valve to fit so closely to its seat as to induce the adhesion here refcrred to, I know not; but it is self-evident from the forego ing that, if the valves do not fit sufficiently closely to induce adhesion, the co-efficient will be less than if, from closenes of fit, such adhesion was induced. And furthermore, a self feeding oil cup affixed to the steam chest or steam pipe will according to Rankine, vary the co-efficient of friction accord ing to the amount of lubricant it supplied to the valve; for all the above authorities vary the co-efficient with the conditions. And I now propose to demonstrate that those con ditions, as existent in a slide valve, cannot be known, and cer tainly are never constant. First, then, beginning with scraped surfaces, is it not a fact that only a part of such sur faces are in contact, and what are we to presume fills or oc cupics the hollows of the scraping marks? According to Mr. Hill, they are under a vacuum; for he assumes th pressure on the back of the valve to be the area multiplied by the steam pressure. But what, in the conditions under which a slide valve operates, is to exclude the steam from filling the hollows.
In your own office, Mr. Editor, are a pair of surface plates used to surface valves and valve seats with. They are of cast iron, smoothly surfaced to a good fit; and beside them lies another similar plate, surfaced about as true as an ordinary slide valve. When newly fitted, either of these plates, weighing about 22 lbs ., will, from the vacuum between the two surfaces, lift a plate of its own size and weioht. The sizes


Friction in terms
the weight.
${ }_{0.3}^{0.15}$ to 0.2 0.3
0.07 to 0.08 0.03 to 0.36
ther, it has taken $341 \frac{1}{2}$ lbs. to slide one over the other (allow ance being made for the weight of the top plate), as a certificate given by the Fairbanks Scale Company at the Centen nial (which certificate now lays beside the plates) attests From this we may proceed to test Mr. Hill's co-efficient of riction. According to his theory, every 15 lbs. required to lide the plate will represent 100 lbs . pressing them torether then the $341 \frac{1}{2} \mathrm{lbs}$. it takes to slide the top one divided by 15 will represent the number of hundred pounds with which the plates are pressed together: hence $341 \frac{1}{2} \div 15=22 \cdot 76 \times 10$ $=2,276 \mathrm{lbs}$. Now let us suppose that these plates have perfect vacuum, of say 15 lbs . per inch, between them, and hence have the full atmospheric pressure of say 15 lbs . pe inch upon them. Then the area of the plate ( 96 inches) mul iplied by the atmospheric pressure (15) equals $1,440 \mathrm{lbs}$ and the difference between 1,440 and 2,276 is the actual equivalent of friction, and that assumed by Mr. Hill. It may be said that there is about 1,440 lbs. of atmospheric ressure upon the plates, and that the other 836 lbs . neces ry to make up the $2,276 \mathrm{lbs}$. (that a co-efficient of 0.15 as umes there to be upon the plates, holding them together) is to be found in the adhesion above referred to. But the equivalent of friction of 0.15 is given by Rankine as in term of the weight, and not in terms of the combined weight and whatever adhesion the smoothness of the surfaces may in duce. Nor is it possible to give a definite co-efficient of friction, if the friction due to the weight or pressure is to be supplemented by an amount of adhesion induced by and varying with the smoothness and perfection of the fit. If we disregard the element of adhesion, and use, as Mr. Rankine does, a co-efficient in terms of the weight (vide Bourne) and if we then allow that co-efficient to be 0.237 instead of Mr. Hill's 0.15 (and 0.237 will be about the co-eflicient al lowed by General Morin, the excess of the last two figures being accounted for in the fact that 0.2 is for an angle of ro pose, whercas my plates lay level), then we have as follows: Every $23 \cdot 7$ it requires to slide these plates represents 100 lbs, pressing them together; henc the 341.5 lbs. required to slide the plate divided by $23 \cdot 7$, equals 1,440 (nearly), and this equals the allowed atmospheri pressure of $1,440 \mathrm{lbs}$. resting upon the plates. It is not to be presumed, how ever, that these plates are in perfec contact, and hence there is presumably air. to some extent, between them; and it is only reasonable to assume that i they had, instead of about 15 lbs . pe inch upon them, the 130 lbs . per inch under which many slide valves operate they would be in more perfect contact and would require more power to slide them. In other words, the co-efficient of friction would be increased in pro portion as the air was more perfectly excluded from between the surfaces providing, however, that there were no elements tending to warp the plates ou of truth, and therefore to impair the contact of the surfaces and thus admit the pressing element, be it air or steam, between them. In a slide valve, how ever, there are several elements which preclude the possibility of the surface of the valve and the scat being of a perfect fit, and these I will now separately discuss
Suppose that all slide valves were made of an equally good fit to their seats (and
the two fincly fitter plates is $12 \times 18$ respectively. Thei weigh
If these two plates are carefully cleaned, and one is lowered upon the other, it does not take an ounce to slide one upon the other; indeed, unless the lower one is made to stand level, the top one will glide off. At the same time, it will lift the lower plate and suspend it (from a partial vacuum) for an indefinite length of time. It can scarcely then be said that such a surface would not be stcamtight when under a steam pressure. Now accepting, for the sake of illustration, a co-efficient of friction of $0 \cdot 15$, and the weight of the plate as 20 lbs ., it should take 3 lbs . to slide the top plate, even allowing that it was entirely free from any atmospheric pressure. What it actually does take I have never determined; but I should judge certainly not more than three ounces, and I doubt if it takes an ounce. If, however, one drop of oil is distributed by the hand over the two surfaces (having 96 inches of area each), it requires from 50 to 100 lbs. to slide the top one, according to the cleanli ness from the particles of dust which fill the atmosphere (and these fall upon the surfaces even when the utmost care is taken and the greatest practicable despatch is employed in putting them together) which the surfaces may have, and on how much the plates are rubbed together.
An experiment, however, which is much more to the point, is as follows: If the surfaces of these plates are wiped as clean as it is practicable to get them by rubbing them wel with dry and clean old rags, and if then we place them in contact at one corner only, and slide the top one over the
this is supposing a good deal when we
remember that some engine builders put in the valves just a they were planed, making no attempt to fit them to their seats on the cylinder port faces, while others file them to a fit, and others again scrape both valve and seat true to a surface plate). Suppose that the co-efficient of friction, whether due to the pressure only of the valve to its seat or to the combined pressure and induced adhesion from perfect contact, was in all cases alike, when the valves wore put in new. Let us see how long they would remain so. First, then, an iron or brass casting, heated after having the surface removed by planing or filing, warps, and its fit is impaired. With the loss of the fit goes a loss of the adhesion, and an admission of steam beneath that part of the surface of the valve which does not fit. How much it will warp depends upon the temperature to which it is heated, on how much was cut off the planed face, on how unevenly the valve casting cooled after being taken out of the mould, on the shape and thick ness of the valve, and on several other clements. Let us presume, however, that a casting could be made so that it would not warp from having its surface skin removed, and that, by heating the valve after it had been once surfaced, the reset had taken place, and the valve, being refaced true would not again warp from being reheatcd (as experience de monstrates that it always does), and that, being heated to given temperature, it would remain as close a fit to its sea as it was when cold. Then, just so soon as the temperatur varied, the expansion and shape of the valve would vary Cast iron expands by heat, in proportion to the temperature The valve has, acting on the inside area of its exhaust port
the cooling effects of the atmosphere, which finds ingres
through the exhaust pipe. The exhaust steam itself lowers in temperature as its pressure decreases, and the live steam on the back of the valve is comparatively constant in temperature: as a result, then, the valve is continually changing in form from the expansion due to the high temperature of the exhaust steam during the early part, and the lower temperature during the latter part, of the exhaust. Now c omes another and more important question, and that is: How far will the spring of the valve, from the pressure of the steam upon its back, affect the fit to its seat, and will it so spring as to permit of a fine film of steam finding its way beneath the wings of the valve, thus relieving, to a certain extent the a mount of its pressure to its seat?
If we take a pair of the plates shown in Fig. 1, and get them so closely together that it requires, say, 340 lbs., to slide one upon the other, and then take hold of the plates by the handles, as shown in our engraving, we can pull them apart by exerting a force of about 130 lbs ; in other words, it will require but little more than one third as much power to pull them apart, in this manner, as it requires to slide one upon the other. In thus pulling them apart, we have, upon the back, whatever weight of the atmosphere the fineness of the fit leaves unbalanced, and, in addition, whatever amount of adhesion the perfect contact of the surfaces may induce. Hence, allowing a co-efficient of friction of $0 \cdot 15$, we should have $2,276 \mathrm{lbs}$. holding the plates together; and while allowing a co-efficient of $23 \cdot 7$, we should have $1,440 \mathrm{lbs}$. resisting the effort to pull the plates apart. The fact, therefore, that 130 lbs . will actually, under the conditions shown, pull the plates apart, appears at first sight not a little singular. The solution, however, is simple enough. The plates spring from the pressure placed by the hands upon them, and hence they unlap and come apart just as if we took two sheets of paper, placed together and soaked with water, and then took hold of two corresponding corners and pulled them apart. The plates are $\frac{1}{2}$ inch thick in the body, and the ribs are each $\frac{7}{16}$ inch thick and $2 \frac{3}{8}$ inches high; and yet 130 lbs. applied as shown will spring them sufficiently to let the air get in between them. Let us in the light of this fact examine the shape and pressure upon a slide valve (assuming for the nonce that the pressure is the unbalanced area in contact multiplied by the steam pressure), and ascertain whether it is reasonable to suppose that th pressure of the steam upon the valve springs the wings, and permits the steam to find its way beneath them.
In Fig. 2 is shown an ordinary locomotive slide valve, the ports being $1 \frac{1}{4} \times 17$ inches, the bridges between ports 1 inch wide, the cylinder exhaust port $2 \frac{1}{2}$ inches wide, and the valve having 1 inch of steam lap, covering the ends of the cylinder ports 1 inch at each end. When the valve is in the position shown, it will be noted that there is a very large proportion of the area of the valve unsupported by the seat the area of this portion will be in this case $5 \frac{3}{4}$ inches, as marked in the engraving, one way, and 17 inches the othe $=97.75$ inches. Now supposing the steam pressure to be 130 lbs. per inch: then $97.75 \times 130=12,707$ lbs., the assumed pressure of the valve to its seat, tending to spring the flanges
or wings in the direction denoted by the dotted lines, E and F, respectively. What have we to offset this amount? Th area of one bridge equals 17, the area covered under th valve flange at D equals 11 inches, and the amount of the valve flange overlapping the ends of the steam ports equal $15 \%$; total 43.5 square inches, which, multiplied by the steam pressure, would give 5,855 lbs. as the pressure tending to spring the valve wings in the direction marked. Ther will, it is true, be a pressure placed on the underneath side of the valve by the exhausting steam, the area thus acted on being, in the position shown, 97.79 square inches; but it can
scarcely be advanced that this pressure can be sufficient to scarcely be advanced that this pressure can be sufficient to
relieve the valve from its liability to spring from the 5,855 lbs. on the other side.
Theoretically, a valve will spring of its own weight; and that it will spring from the pressure which a man can put upon it with his hands, I have often found in facing valves up. For example, if, in trying the valve on the surface plate, the former is pressed in the middle by the hands to make the plate mark the face plainly, and the valve is fitted
under these conditions to under these conditions to a practically perfect fit, the surface
plate marks showing equally all over, we may then let the valve lie upon the plate of its own weight only, and the marks will show (after of course moving the valve back and forth) at and near the edges of the valve only, showing that the pressure of the hands sprung it. There are plenty of in stances of metal in the most solid of forms springing of its own weight: witness the Morton Poole rolls, which, though of chilled cast iron and 12 inches in diameter, spring and bend by the insertion between them of a piece of gold lea ${ }^{50} \frac{1}{2}$ inch thick. There is yet another part of this question,
however, which is found in practice to be of the utost however, which is found in practice to be of the utmost im portance, and that is (as a visit to any locomotive repair shop will demonstrate, by the engines that come in to be repaired), that the valve wears out of truth, and so does the seat. In my experience, I have chipped a full $\frac{1}{16}$ inch off valve seat faces without cutting the worn grooves out. I have examined, or had come under my observation, at least 400 slide valves, and I never saw one that was, after working three months, of a sufficient fit to its seat to require 1 lb . more than its own weight to lift it from its seat; whereas, if such
a valve as is shown in Fig. 2 were of a practically a valve as is shown in Fig. 2 were of a practically perfect
fit, it would require, when in mid-position, some 800 lit, it would require, when in mid-position, some 800 lbs. to
lift it vertically, taking hold of the ribs outside the arch. The fact is that the bridges wear hollow lengthways, and hollow, as denoted by a straight edge, over the seat and
across the bridges. Then there usually wears in the sea the ports. To remedy this, a practice sprung up in in Eng land, in about the year 1865, of drilling, in the face of the valve and in a line with the exhaust port edge, a hole in each wing; and this hole may be found mentioned in recent en gine specifications published in this city. Now just so soon as a valve face loses its smoothness, though the grooves may be only the one hundredth of an inch deep, or like coarse
file marks, it becomes impracticable to exclude the surround file marks, it becomes impracticable to exclude the surround
ing air at atmospheric pressure, let alone steam at a high ing air at atmospheric pressure, et
pressure, from between the surfaces.
I have a plate of the same size as those shown in Fig. 1 which has been planed and not fitted in any way. The planer marks are all intact. By placing a finished true plate upon it, the partial vacuum between the two will lift the planed one; but in about ten seconds it will fall, because the weight of the plate causes it to sag, and the air travels along the fine planer marks until there is not sufficient vacuum to sustain the weight of the plate, which is about 20 lbs . Now since the planed plate can be lifted by the vacuum, it is a least as good a fit as an ordinary slide valve, and under a steam pressure would undoubtedly be steam-tight, although the steam, like the air, would find its way along the planer marks, and thus counterbalance a large proportion of the pressure placed by the steam on the back of the valve. How much the elements of warping from expansion, changing form from irregular temperature, and counterbalancing from steam finding its way beneath the valve, will affect the pressure of a valve to its seat whether these causes act cither in concert or partly counteract each the other, will depend upon the shape, size, strength, etc., of the valve. Isaa Walton said, in giving instructions how to cook a trout "first catch your trout;" so it may be justly said, in calcu New Ye friction of a slide valve, first find your pressur New York city.

Joshua Rose.

## the cat teaser.

No one who in the chill midnight air has hurled improper anguage and miscellaneous toilet articles at feline vocalists chanting on the back fence can afford to remain in ignorance of the merits of the ingenious little device represented in our engraving. It prevents cat concerts, simply by preventing the cats from prowling on the top of fences; and it compels them to take refuge on the fences of one's neighbors. Distance then lends enchantment to their howls, and the thoughtful man who has provided himself with the cat teaser "may wrap the drapery of his couch about him and lie down to he profanity of some one several doors away, both reduced o gentle murmurs ere they reach his ear.


The cat teaser consists of a strip of sheet metal in which $V$-shaped cuts are made. The pointed pieces of the metal are then bent upward so as to stand perpendicularly; and the strips are tacked on the top of the fence. It is not necessary
to surround an entire back fence with the device, because if to surround an entire back fence with the device, because, if
he fence at the rear end of the yard, and for a short dis tance adjoining on each side, is covered, cats cannot jump into the yard from the adjoining fences. It is impossible for a cat to walk on the points, nor can she insert her paws between them. Not only fences but roofs may thus be pro tected, while the device may also be used for keeping cat way from flower beds
Practical tests of the invention have shown that it is discouraging to cats in a high degree. Tom cats of exceptiona intelligence, who have long treated with contempt such trivial obstacles as spikes and broken glass, have retreated baffled before the teaser. As a means of preventing chickens roosting on unauthorized fences, the device has also proved very useful, and carries far deeper conviction to the mind of the average hen than does throwing stones at her after she is omfortably settled for the night.
Persons who value slumbers unbroken by feline melodies should address the inventor, Mr. C. L. Topliff, P. O. box 773 New York city.

## A Silk-Spinning Fish.

There is a mollusk-the pinna of the Mediterraneanhich has the curious power of spinning a viscid silk which is made in Sicily into a textile fabric. The operation of the nollusk is rather like the work of a wire-drawer, the sub stance being first cast in a mould formed by a sort of slit in he tongue, and then drawn out as may be required. The mechanism is exceedingly curious. A considerable number of the bivalves possess what is called a byssus, that is, a bundle of more or less delicate filaments, issuing from the base of
the foot, and by means of which the animal fixes itself to the foot, and by means of which the animal fixes itself to
to the proper place and to glue them there; and it can repro duce them when cut away. The extremity of the thread is attached by means of its adhesive quality to some stone; and this done, the pinna, receding, draws out the thread throug the perforation of the extensile member. The material when gathered is washed in soap and water, dried, straightened, and carded- 1 lb . of coarse filament yielding about 3 ozs. of fine thread, which, when made into a web, is of burnished golden brown color A large manufactory for this material exists in Palermo.

## Ross Winans

Mr. Ross Winans, one of the many inventors who have massed colossal fortunes, recently died in Baltimore, Md., at the age of 81 years. Mr. Winans began life as a merchant's clerk, but laid the foundation of his fortune by rear ing horses. His first invention was a plow, that had a larg sale. In 1830, he became interested in the building of rolling stock for the Baltimore and Ohio Railroad Company and for the succeeding thirty years of his life he devoted himself to the designing of railroad cars and locomotives The heavy freight engine known as the camel-back is his invention; and he also claimed to have originated the moder eight-wheeled passen ger car. His shop became famous, and he built a large number of locomotives, and in this way ac cumulated the greater part of his wealth. During the war, he devised a steam gun for the Southern army, but it wa captured by the Federal forces almost immediately, and thu never used. It was not a formidable weapon. Since his withdrawal from locomotive huilding, Mr. Winans has tested plans for improved working men's dwellings with much success. Thirty years ago he was offered the management of the Russian railways by the Czar, but this he declined in favor of his sons, who brought much ability to the work Recently, Mr. Winans has resided on his model farm near Baltimore.

## Blocking the Straits of Belle Isle.

In this city a kind of mild war is chronic between the Harbor Commissioners on one hand and the police authoriies on the other, the subject being the disposition of ashes and solid refuse of all kinds, not susceptible of utilization which if thrown into the bay tends to fill up channels and therwise to obstruct navigation. At present, this material is carried out to sea in large scows, and there dumped. A new engineering scheme, rather startling in its magnitude has recently been advocated, which, as a daily contemporary suggests, if ever seriously regarded, will afford an outlet for all the ashes, etc., New York and all other Atlantic coast cities can furnish. The project is to block up the Straits of Belle Isle, the object being to divert the ice which come down every year from Baffin's Bay, through the Straits, and which makes the shores past which the icebergs float many degrees colder than those to the eastward, which face the cean and get the benefit of the Gulf Stream. It is believed that, if this project could be accomplished, the climate of Anticosta and of the Gulf of St. Lawrence would be greatly modified, and navigation through the neighboring water could be kept open during the whole year. In the narrowest portion, the width of the Straits is $8 \frac{1}{2}$ miles.

## whole ox soup.

In Australia, where the horned stock has increased of late in a more rapid ratio than the population, the supply of meat is much greater than the demand; and at the presen time the price of cattle is commonly quoted "at boiling rate;" that is, the animals will fetch no more from th butchers than can be realized for their hides, horns, hoofs, allow, etc., for exportation. In large establishments de voted to preparing these utilizable portions of the bullock, here was of course an immense waste when the ox went nto the melting pot; but this loss is now in a great measure avoided by boiling the animal at once into soup, or concen trated extract of beef. After the head, horns, hoofs, etc. are removed, the meat is cut into convenient sized pieces and conveyed to immense steam-tight double cylinders capa le of holding upwards of fifty bullocks at a time. In seve hours, during which they are subjected to a pressure of team of 15 lbs . per square inch, the bones and meat are re duced to a pulp. The steam is then condensed, and the tal ow, which floats on the surface, drawn off. The pulp is re moved and placed in a powerful press, which squeezes ou the soup. The latter is, however, not yet sufficiently concentrated; and to render it so, it is placed in a peculiarly constructed boiler, there reduced by evaporation, and finally run off into bladders. When cold, the essence is semi ransparent, of a rich reddish brown color, and sweet to the smell and taste, almost like confectionery. A whole bullock after being thus treated, yields but 20 lbs. of soup.

## Telephonic Music.

At a recent telephonic concert in Washington, it was stated by the lecturer that the electric waves of sound sent through a single wire are frequently conveyed, indirectly, by othe wires running parallel with it on the same poles, although entirely disconnected from it. This statement was verified in the Washington office of the Associated Press, where a number of the tunes played in Philadelphia, and conveye electrically to Lincoln Hall in Washington, were distinctly heard on the relay used in the Press office, which had no con nection with the wire that was attached to the telephone The tones thus conveyed, although not loud, were stated to be audible at a distance of several yards from the instru ment.

## Canceling Postage Stamps.

Every year, in something over 30,000 offices, the Post Office department cancels a thousand million postal stamps of one sort and another. It was really a little more than this last year- $1,049,767,507$-but a few thousand more or less make small difference. The thousand million give work enough. One third, the stamped envelopes and the postal cards, cancel themselves, in a sense. No one can use them twice. The stamps nobody has yet been able to cancel fairly and completely, and within the past month the departmen closed two years of experiment no wiser than it began.
A new ink is generally the stronghold of canceling genius, and to the fat inks-printers' and metallic inks-writing fluid, the three principal acids, caustic potash, and a drug shop of other chemicals have been added by genius at work on a letter stamp. Thereis a sulphuric acid ink there which came from Cincinnati, warranted to cancel a stamp, and which eats a hole through the envelope into the bargain. There is one of caustic potash, backed by a distinguished chemist, which blisters a man's fingers at touch, and has its effects on the glass bottle which holds it. Nitric acid is at the bottom of another ink, and fills the air as it is used with the fumes familiar to laboratories. All these inks do too much. Most of them too little. Your average inventor never tests his invention.
There are other ways to cancel stamps, by genuine cancellee. They have all been invented-a good many separate times. There is one ingenious contrivance which brings a disk down with a half turn at the stamping-a slanting slot does the work-and rips half the features off G. W. or Franklin. Somewhere along the ten-thousandth letter this dulls and takes a blow like a sledge hammer to do its work. The New York Post Office cancels two million of stamps a year, and the New York clerk takes more kindly to the firm, light tap of a wooden stamp. No invention has displaced that any more than the ink
So the department has given over the attempt to cancel. Gets three cents for a good many stamps, and carries six or nine cents mail matter under the stamp. Is it not a profitable operation? " ‘Do they have this bother in England?' I asked. 'Oh, no; they black their stamps up so thoroughly.' 'Why can't we?' 'Well, our postmasters are not so careful, and in England they make a row with a man if a stamp is not properly canceled. We can't do that. The department doesn't have enough control, and can't get at a man so sharply.' 'Then this whole loss is simply a question of a civil service, efficient or not?' 'Well, yes; about that.' "-Nero York World.

## Spring Ailments.

The remedy for spring diseases, says Hall's Journal of Health, by whatever name, is: Eat less. We do not mean that you shall starve yourself, or that you shall deny yourself whatever you like best, for, as a general rule, what you like best is best for you; you need not abandon the use of tea or coffee, or meat, or anything else you like, but simply eat less of them. Eat all you did in winter, if you like, but take less in amount. Do not starve yourself, do not reduce the quantity of food to an amount which would scarcely keep a chicken alive, but make a beginning by not going to the table at all, unless you feel hungry; for if you once get there, you will begin to taste this and that and the other, by virtue of vinegar, or mustard, or syrup, or cake, or some thing nice; thus a fictitious appetite is waked up, and be-
fore you know it you have eaten a hearty meal, to your own fore you know it you have eaten a hearty meal, to your own
surprise, and perhaps that, or something else, of those at surprise, and pe
table with you.
The second step towards the effectual prevention of all spring diseases, summer complaints, and the like, is: Diminish the amount of food consumed at each meal by one fourth of each article, and to be practical, it is necessary to be specific; if you have taken two cups of coffee, or tea, at a meal, take a cup and a half; if you have taken two biscuits, or slices of bread, take one and a half; if you have taken two spoonsful of rice, or hominy, or cracked wheat, or grits, or farina, take one and a half; if you have taken a certain or uncertain quantity of meat, diminish it by a quarter, and keep on diminishing in proportion as the weather becomes warmer, until you arrive at the points of safety and heallh, and they are two: 1. Until you have no unpleasant feeling of any kind after your meals. 2. Until you have not eaten so much at one meal, but that, when the next comes, you shall feel decidedly hungry.
Supplies being thus effectually cut off, that is, the cause being first removed, Nature next proceeds to work off the surplus, as the engineer does unwanted steam; and as soon as this surplus is got rid of, we begin to improve; the appetite, the strength, the health return by slow and safe degrees, and we at length declare we are as well as ever.

## Hurry and High Pressure.

It is the pace that kills; and of all forms of overwork, that which consists in an excessive burst of effort, straining to the strength, and worrying to the will, hurry of all kinds -for example, that so often needed to catch a train, the ef fort required to complete a task of head work within a period of time too short for its accomplishment by moderate energy -is injurious. Few suffer from overwork in the aggregate; it is too much work in too little time that causes the breakdown in nineteen cases out of twenty, when collapse occurs. Most sufferers bring the evil on themselves by driving off the day's work until the space allotted for its performance is past, or much reduced. Method in work is the great need
of the day. If some portion of each division of time wa devoted to the apportioning of hours and energy, there would be less confusion, far less hurry, and the need of
working at high pressure would be greatly reduced, if not working at high pressure would be greatly reduced, if not
wholly obviated. A great deal has been written and said of late, to exceedingly little practical purpose, on the subject of "overwork." We doubt whether what is included under this description might not generally be more appropriately defined as work done in a hurry, because the time legitimately appropriated to its accomplishment has been wasted or misapplied. Hurry to catch a train generally implies starting too late. High pressure is, says the Lancet, eithe the consequence of a like error at the outset of a task, or the penalty of attempting to compensate by intense effort for in adequate opportunity. If brain is bartered for business in this fashion, the goose is killed for the sake of the golden eggs, and greed works its own discomfiture.

## Stream Power and its Utilization.

Almost every man has about him in his daily walk sufficient apparatus for a tolerably accurate estimate of the quantity of water flowing in any stream. A walking stick, a jack-knife, and a watch, provided the walking stick is just three feet long, are all the tools necessary for the pur pose. With these simple appliances, says The Millstone, the power may be measured in the following manner:
Take a section of the stream as uniform in breadth and depth as possible, and measure off upon its bank some definite length, say from one to four hundred feet, according to the rapidity of the water; set a stake close to the water at each end of this section, then throw into the water, opposite the upper stake, a green twig or limb of a tree or other ob ject of such specific gravity as to nearly but not quite sink and of such size that one portion shall remain at the surface while another portion nearly touches bottom, the object being to get the average speed of the water. The resistance caused by the bed and banks of the stream necessitate some care in this part of the experiment.
Note accurately the time the object is passing from stake to stake, and repeat the operation several times and at as many points towards the opposite shore; the sum of the sev eral times divided by the number of points at which the peed was taken gives the average speed of the water
Now measure the depth at several equidistant points acros

## he stream, $a, b, c, d, e, f$, (the diagram showing a cross sec


tion of the stream). The sum of these depths divided by the number of points at which the depth was measured gives the average depth; this average depth multiplied by the breadth of the stream gives the area of the cross sections; this area multiplied by the length of the section, gives the cubic con tents of body of the water embraced in the section. Thus we have the quantity and its velocity, which are element necessary to show the value of a stream for manufacturing purposes, provided it has sufficient fall anywhere to render it available.
Allowing 62 lbs . for each cubic foot of water, and supply of 1,000 cubic feet per minute, and a fall of 10 feet, we have 1,000 multiplied by 62 , equals 62,000 lbs.; 62,000 multiplied by 10 equals 620,000 lbs. momentum; 620,000 di vided by 33,000 equals $18 \cdot 7$ horse power. One fifth at least must be deducted for friction and loss, making in this case about 15 horse power.

## Velocity of Electricity

Dr. Sabine has devised a method of measuring the contour of electric waves passing through telegraph lines. It is have a velocity. The sense alone electricity time elapsing between starting electricity into one end of a conductor and receiving it at the other end, gave totally contradictory results. This interval would depend on the electromotive force employed, the resistance and capacity of the conductor, and the sensitiveness of the receiving instrument. It would therefore by no means be proportionate to the length. By the following method the electrical condition of any point of the line may be examined quantitatively at intervals of 0.001 of a second or less after starting the electric impulse. It thus becomes possible to measure the form and speed of a wave. Suppose one end, A, of a conductor, A B, is placed to earth, and that the other, B , is connected with one pole of a battery whose second pole is put to earth. Then any point of the conductor, as C, will assume a potential which will be proportional to the resistance of A C. This potential may be measured by connecting $C$ for an instant with a con-
denser or accumulator, and then discharging the latter denser or accumulator, and then discharging the latter
through a delicate galvanometer. When the circuit is first through a delicate galvanometer. When the circuit will at tain its full potential measurements made of the relation of these quantities, showing the form of the electric wave passing the point, C. The only mechanical difficulty is to construct a chronograph which will allow C to be connected with the condenser, a small but accurately determined time after A is connected with the battery. A heavy wheel of brass is set
in motion by a steel spring so that it shall revolve exactly twice a second. The interval through which the spring act being always the same, a nearly constant velocity is always imparted. The disk is divided into 500 equal parts. A
the disk turns between the two connections to be recorded The time of revolution of the disk was first determined by noting the figures read in succession under the film of a smal telescope, when the disk was illuminated by half-second flashes of an induction coil. Theforce of the spring and the position of the trigger releasing it were adjusted until the right velocity was obtained. Recently a condenser was dis charged through a known resistance for some interval indi cated by the disk, and the time calculated, according to the leakage formula, from the initial and final readings of the galvanometer. If the two do not agree, the spring is altered until they do; but its action is found to be very constant and not to need alteration, except after taking the apparatus to pieces for alteration. Several series of experiments are given and the results show the delicacy and accuracy of the method -Philosophical Magazine.

## NEW BOOKS AND PUBLICATIONS

Elements of Geometry. By G. M. Searle, C.S.P. Price $\$ 1.50$. New York city: John Wiley and Sons, Pub auth, 15 Astor Place.
desire to reduce what is supposed in the preparation of thiswork has been the be amount, and thus to make the science more strictly logical. There are several peculiarities about the treatise, notably the avoidance of definitions until the thing to be deflned has been shown to be possible, the omistions therefor, besides various other minor points, which tend to frac the work conformable to the author's general plan. The volume as a result is rendered much smaller than the ordinary school geometry, and
therefore, while giving the student a more legical and connected view o the sc
time.
Strength and Determination of the Dimensions of Structures of Iron and Steel. By Dr. P. J. J.
Weyrauch. Translated by A. Jay Du Bois, Ph.D.
Price $\$ 2$. New York city: John Wiley and Sons, Publishers, 15 Astor Place.
"More attention to just such facts as are here set forth and worked into
a general method of dimensioning-facts which have long been at disposal, but never before properly set forth in a shape to meet the daily wants of
the practising engineer and constuctor-wold the practising engineer and constructor-would make such sad disasters a
that at Ashtabula impossible " (Translator's preface). True, so far as th that at Ashtabula impossible " (Translator's preface). True, so far as the
facts are concerned, but not so as regards this book. When authors attain facts are concerned, but not so as regaras this book. When authors attain
that happy facility of producing works with say seventy-five per cent less
formulas andheavy mathematics, then (and not untilthen) willtheir books formulas andheavy mathematics, then (and not until then) will their book
"meet the daily wants of the practising engineer." If all practising engi "meet the daily wants of the practising engineer." If all practising engi-
neers were scientists of the rank of Dr. Du Bois or Dr. Weyrauch, we do not doubt but that this book would be just the thing needed. But we venture to assert that not one practising engineer in fifty would take th
time to time to stop in the middle of his work and pore over this volume to find out
what the formulas mean and how they are to be applied. Literature for what the formulas mean and how they are to be applied. Literature fo
the study may be as theoretical and as abstruse as the authors choose to make it; but where it is meant for practical purposes, it cannot be too
clearand smple. For an illustration of clearand smple. For an illustration of our meaning, we refer to the pages of this journal, where many a subject, which has appeared elsewhere
buried in calculus and the Greek alphabet, is elucidated in plain English buried in calculus and the Greek alphabet, is eluciated in plain Englis and by simple computation. Professor Thurston adds an appendix on his
strain diagrams, all of which is old and has been repeatedly published in
substance elsewhere.

Inventions Patented in England by An
From March 9 to March 22 , 1877, inclusive. Animal Pulp.-L. Coburn, Worcester, Mass.
Boiler funnace, CANEELING STAMPS, ETC.-W. Worris, Richmond, Va.
CALE Elechoplating Wire.- W. Waliace, Ahsonia, FISH Plate, etc.-J. Eno, Council Bluffs, Iowa.
GAS RETORT Process.- W. Karr, Frostburgh, Md. Horseshoe Bars.-W. M. Greenwood et al., Cincinnati, Ohio.
Latie.-W. S. Cooper, Philadelphia, Pa. Lathe.-W. S. Cooper, Philadelphia, Pa
Lime Kiln Flue, etc.-W. S. Sampson,
Makivg Ice, etc.-E. A. Gillet, New York city.
MAKing STEEL.--S. Barker, Knoxville, Tenn.
RABBoN Holder. , ETC.--H. V. Dempster. Washington, D.
RULING MACHINE.-W. O. Hickok, Harrisburgh, Pa
RULING MACHINE.-W. O. Hickok, Harrisburgh, Pa
SACK-Sewing Machine, ETC.-W. Webster, San Francisco, Cal.
Smeitivg Furnace, etc.-G. H. Moller et al., Plainfield, N. J. STOP VALVE.-E. Russell, New York city.
TrAMWAY CAR - J. Stephenson, New York
FRAMWAY CAR.-J. Stephenson, New York city.
WASHER, GASKET, ETC.-Vulcanized Fibre Comp

## zecent Ammericam and foreign zatents.

## NEW MISCELLANEOUS INVENTIONS.

improved method of attaching knobs to spindles. William De Courcy May, Baltimore, Md.-The object of this invention that fastens the knob of a door to its shaft. The improvements relate to the use of a band, ring, or sleeve, made to encompass the socket portion of the knobs so as to cover the screw, and consist, first, in constructing such band, or sleeve, with a transverse slit to permit the same to be opened and be sprung laterally upon the socket or shank of the knob; and, secondly, in constructing such band, or sleeve, with one or more tongues which enter
the nick of the screw and prevent it from turning. e nick of the screw and prevent it from turning.

IMPROVED SADDLE.
Henry Ruwart, Jefferson City, Mo.-This invention embodies certain improvements in saddletrees designed to render the saddle convertible a
will into either a gentleman's saddle, a lady's saddle, or a "muly " or har will into either a gentleman's saddle, a lady's saddle, or a "muly" or har-
ness saddle. The improvement consists in constructing the tree at its front ness saddle. The improvement consists in constructing the tree at its front
end, opposite the cantle, with a key and a locking bolt, and the pommel, ena, opposite the cantle, with a key and a locking bolt, and the pommel,
horns, or cap with a bottom plate provided with a slot corresponding to the key, and a perforation or recess for the locking bolt; so that when the pommel, or its equivalent, is placed upon the tree and turned around to a given position it is securely attached to the saddletree.

## IMPROVED THILL COUPLING.

John L. Crist, William E. Crist, and George H. Smith, Sacramento, Cal. -This coupling, for thills or shafts of vehicles, consists of a spring for con necting each of the shafts with a clamp or clip attached to the axle, and upon the lower end of the said spring a nib is formed that engages with
the clip when the end of the spring is clamped by a set screw in the clip. the clip when the end of the spring is clamped by a set screw in the clip.
The spring is sufficiently rigid to support the thills, while it is also suf The spring is sufficiently rigid to support the thills, while it is also suf
ficiently flexible to permit of the required latitude of motion. All rattling and noise are obviated by the improvement, and the thills are readily at and noise are obviated by the improvement, and the thills are readily at-
tached and removed. To afford additional security, a ring may be added tached and removed. To afford additional secur
for receiving a strap that is attached to the thills.

## NEW MECHANICAL AND ENGINEERING INVENTIONS.

improved automatic wagon brake.
Charles T. Warren, Atlanta, Ga.-This improved brake for vehicles is so ing back, and at the same time will allow the vehicle to be backed without its being thrown into action. The construction is simple and ingenious, rendering the derice excellently adapted to its purpose.

## 

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23, 1877. Number of Patents 172,919 and 186,550. Address 23, 1877. Number of Patents 172,919 and 188,550. Address
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Company, 166 Fulton St., New York city.
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for the price. N. W. Twiss, New Haven, Conn.
Machine Diamonds, J. Dickinson, 64 Nassau St., N. Y
Parties desiring to establish large or small Factories
on Water Power, address A. P. Smith, Bock Falls, IIL A. J. K., who asked as to drying sand, p. 171, vol 36 : ease address Allen Glass Monuments, patented Sept. 7, 1875. The whole
Patent or state rights for sale. For description and Patent or state rights for sale. For description and
terms, address the inventor, A. Pfeiffer, 13 Ave. A., N.Y, For Sale.-U. S. Patent No. 187,562, for Traveling
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## THedest (4unins

G. H. will find a table of the electric con ductivities of metals on p. 107, vol. 33.-J. H. will find Scientific American Supplement.-A. W. G. will find good recipe for brass for small castings on p. 171, vol. 30.-E.S. B. will find directions for making a concrete pavement on p. 185, vol. 33.-A. L. B.'s query as to the manufacture of postage stamps was answered on pp. 208,277, vol. 27.-J. I. S.'s query as to the telephone is
answered on p. 191, vol. 36.-J. C. E. will find a recip forswered on p. 191, vol. 36.-J. C. E. will find a recipe
for a depiatory on p. 186, vol. 34.-W. H. J. will find on p. 344, vol. 32, a recipe for cementfor marble.-C. E. marble.-C. B. will find an answer to his query as to troubles with the feet on p. 123, vol. 33.-C. B. should trace his map on cloth with a pen and Indian ink.-A. E. will find directions for lead burning on p. 167, vol. 32 .
E. P. H. will find something E. P. H. will find something on spring power on p.
20 , vol. 31.-H. T. P. will find that a remedy for mildew on cloth is described on p. 138, vol. 27.-R. H. H. will ind an article on impressions on the retina on p. 193, vol. 36.-G. H. W.can polish German silver by following he directions on p. 37, vol. 34.-J. C. C. can bleach beeswax by the method described on p. 299, vol. 31.-J. H.T. will find something on silvering glass globes on p. 267,
ool. 31.-W. T. A. will find a recipe for silverplating on p. 299, vol. 31. For gold plating, see p. 116, vol. 32 G. should try some of the boiler scale preventives advertised in our columns.-W. T. will find directions for dyeing felt hats black on p. 101, vol. 30.-A. M. P. M. power, for locomotive purposes, on p . 277 , vol. 34.-G.
E. D. will find directions for gilding picture frames on . 90, vol. $30-$ J. V. will ind directions for gilding on p. 229, vol. 33, something about boilers for small engines. As to horse power of small engines, see p. 33,
vol. 33.-J. W. C. will find directions for making soap on pp. 331, 379, vol. 31.-C. A. A. will find something on the manufacture of vinegar on p. 106, vol. 32.- N. L. R.,
W. C., F. J. B., C. K. W., R. . ., J. F. S., J. S., W. M., J.H. N., J. F. McG., G. W. S., F. M. L., and others,
who ask us to recommend books on industrial and who ask us to recommend books on industrial and scifirms, for catalogues.
(1) H. S. asks: How can I make a platinum chain? How can I melt platinum? A. Pure platinum can Place the metal in a small cavity cut out of a piece of pure caustic lime, and cause the flame to impinge upon it
strongly until fused. The hottest part of this flame is, strongly until fused. The hottest part of this flame is, wharter of an inch of the mouth of the blowpipe.
quase
(2) C. B. says: You give directions for removing stains of smoke from marble. I have some
white marble badly stained with wine and beer. How can I clean it? A. Try the following: Take 2 part common soda (sal soda), 1 part pumicestone, and 1 part finely powdered chalk; sift it through a fine sieve, and parts of the marble; and, after a short time, wash clean
(3) E. H. T. says: I found on the Old Millstone Hill, in Worcester, Mass., several fine speciound before in Massachusetts. A. It has been found in considerable quantities at the Southhampton lead mines, and elsewhere.
(4) C. A. F. asks: How can I test a syrup (made from starch) for dextrin or gum? I want to know when the saccharification is complete. The ordinary odine test will not apply to this case. A. The entire conversion of the dextrin into grape sugar cannot be ascertained with certainty by the iodine test, as in some cases change. The most reliable test is that with alcohol founded on the known insolubility of dextrin in an alcoholic menstruum. To 1 part of the solution to be tested, there are added 6 parts absolute alcohol; if no
precipitate is observed, there is no dextrin remaining precipitate is observed, there is no dextrin remaining,
(5) C. C. S. asks: 1. Why is it that the day does not increase or decrease in length at both ends, by
the same number of minutes? A. Taking one half of the year from January 1 to July 2 inclusive, the days in crease in length $5 \mathrm{~h} .44 \mathrm{~m} . ;$ one half, 2 h .52 m ., is in the norning, the other in the evening. Taking it altogether motion of the earth in its orbit, in combination with its diurnal motion, makes the daily variation sometimes at one end of the day, and again at the other end. 2. Why vary so? A. They appear to have a daily fluctuation be cause the seconds are not taken into account. They also have a regular increase or
(6) E. A. asks: In what position between the lenses which constitute the eyepiece should the diaphragms be placed? A. In the combination at the eye
end, it should be in the focus of the eye lens; in the other combination, Fraunhofer placed it in the middle The French opticians place it about six tenths of the
distance between the two lenses, toward the eye end. (7) C. E. A. asks: Can a person receive ing in the same room? A. Probably not.
(8) R. W. S. asks: 1. What cheap chemical can be used to change ink to a deep or jet black? A.
Try a little solution of extract of logwood. 2. Can aqueuct water be used in place of rain water for making too hard.
(9) J. McC. asks: Is there anything that would answer for a condensing coil in a distillery that
would be cheaper than copper, and at the same time be as durable? A. No; copper is best.
(10) A. R. T. asks: Can a drive well be riven in rock? A. Yes.

## not injurious.

A friend says that the saw does not possess any of the mechanical powers. I say that each tooth acts he principle of the inclined plane. A. You are right. (11) D. H. E. says: 1. Professor Silliman, in his "Chemistry," says: Put bicarbonate of soda and water in one end of a strong cylindrical vessel; and in a tube in the other end put sulphuric acid. The arrange-
ment is such that, when the vessel is inverted, the conment is such that, when the vessel is inverted, the would it keep therein six months under high pr
Yes. 2. Could a small vessel be made to hold it so long with rubber or leather packing under the cap screwed on? A. Yes.
(12) C. B. says: Will goldfish live in the water of a fountain, rain or cistern water being used?
A. Yes. Sprinkle a few bread crumbs in the water very day.
(13) C. K. asks: 1. Is it injurious to health to sleep in a room containing a rather large amount of green fruit? A. If the room is properly ventilated, you
willexperience no injurious effects. 2 , Does the fruit exhale carbonic acid at night? A. Very little.
(14) J. C. K. asks: What is the diameter a circle whose area is 1 inch? A. $1 \cdot 1284$ inches.
Is there a dictionary of mechanical and chemical for new articles, or ideas, it is not probabie then coined or new articles or ideas, it is not probabie that diction aries which have
have them all.
Why does a circular saw make marks in the lumber wery revolution? A.
wider than the others.
(15) C. R. asks: What is the difference in er, under 70 between the steam and the water in a boilral, is not more than $5^{\circ}$ or $6^{\circ}$ Fah.
(16) W. T. says: 1. I understand that, if pesssure is high and the water low, there would be danger of an explosion. If this be so, will you have the kindness to tell me why? A. A sudden escape of steam
might carry up some of the water into contact with the might carry up some of the water into contact with
overheated plates. 2 . In a small yacht boiler, would it quantitios water into the furnace? A. It would be better to use a damper and cover the fire. 3. It is rec ommended to raise the safety valve to let the air out of
the boiler when getting up steam. If this is not doun the boiler when getting up steam. If this is not done, what would be the consequences? A. The pipes and
connections fill with air, which sometimes is troubleconnections fill with air, which sometimes is trouble-
some to expel. Considerable instruction as to the dusies of an engineer is scattered throughout treatises on the steam engine, as well as through the pages of the
(17) R. H. T. says: I am running an engine of 62 horse power in connection with three breast
wheels of 100 horse power. Owing to back water on the wheels, they are not able to do their work. The reg. ulator of the wheels is disconnected, and the engine does the regulating. How much of the work ought the
engine to do, to do the regulating? I claim that the engine to do, to do the regulating? I claim that the en I also contend that, if the engine and the wheels are regulated at 40 lbs . pressure, and the steam goes up to 65 lbs ., it is the same as putting more back water on the wheels? Am I correct? After the engine and the wheels are regulated at a pressure of 65 lbs. (this is the amount of steam that she is intended to carry if the team drops down to 50 ibs.), can she do her work without more water on the wheels? A. Your views, as we
understand them, are generally correct. Suppose the whole power is 150 , of which the wheels at most do 100 , and the engine 50 -but that at times the work of the wheels falls off to 88 -then, in order that the power may
be uniform, the engine must exert 62 ; and the engine will do the regulating if it can change its power prompty , within the limits of the variation in the power of the
(18) A. S. asks: What ingredients and proportions are used to produce the different shades of light the composition of the mixtures commonly employed for colored fires in tableaux, etc. These fires, however, hould never be used within doors, as the gaseous products of some of them are extremely poisonous (see ar ticles on pp. 84 and 171 , vol. 36 ). The lime light langenerally substituted for these fires, and give much bet ter results.

Chlorate of potash
Sharcoal
Nitrate of
"4
" ".
$\begin{gathered}\text { Ammonium } \\ \text { of copper } \\ \text { Saltpeter } \\ \text { Black sulph }\end{gathered}$



It is hardly necessary to mention that great care is re-
quired in mixing these materials, and that each shour be pulverized separately.
(19) R. A. asks: Does the Dipper revolve Star are on opposite sides of the pole, and as regards each other are very nearly stationary. They both have
two apparent revolutions around the pole, one every day,
which is due to the diurnal revolution of the earth on its axis, the other nce a year which is due to the annual motion of the earth in its orbit around the sun.
(20) R. N. says, in answer to H. M. C., who ked: If the three sides of a triangle be given, what is its area? Consider the longest side the base; from the
square of the base take the product of the sum and difference of the other sides, and divide the remainder by wice the base; multiply the square of the base by the product of the sum and difference of the shortest side and the quotient; half the square root of the result will
be the area. Example: Let the sides be 10,7 , and 5 ; $\frac{100-(12 \times 2)}{20}=3 \cdot 8$, and $1 / 2 \sqrt{100 \times 8 \cdot 8 \times 1 \cdot 2}=1 / 2 \sqrt{1056}$
(21) C. asks: What is the best cement for
(21) C. asks: What is the best cement for
rubber bags, to be used for hot water? A. Dissolve rubber bags, to be used for hot water? A. Dissolve
caoutchouc, cut into small fragments, in naphtha, by heat and agitation. Strain this solution through a linen cloth and concentrate to the consistency of a thin paste.
The cement is best applied slightly warm, and the joint strongly clamped between strips of wood for 24 hours ore using.
(22) G. S. asks: What will take the smell out of porpoise oil? A. Agitate the oil with about 3 per ent of sulphuric acia, and then with 10 per cent of chloride of lime (hypochlorite of lime) wine mederately hot. Finally wash thoroughly with hot water and alodorize the oil, but it will correct all rancidity.
(23) L. H. says: 1. I have an engine of $\frac{1}{2}$ horse power, which I would like to put into a boat 30
feet long of 5 feet beam. Is it powerful enough to propel said boat at the rate of 8 miles an hour? A. No. 2. How can llearn the signals of the steamboat whistle,
such as the pilots use? A. We advise you to interview such as the
(24) S. S. C. asks: 1. In a silver-plating bath, should the surface of anode immersed equal the surface of cathode? A. They should be about alike. 2. Is there any way of testing the amount of free cyanide
in a plating solution? A. Yes. See Sprague's "Electricity; its Theory Sources and Applications." "Elec nickel ammonia sulphate solution, does the ammonia or acid act upon the nickel anode to keep the strength of the solution up? A. The acid.
(25) D. A. R. says, in answer to E. L., who asked of what diameter should drills be to fit $1 / 1,1 / 4$, etc., pipe taps, I send you a table and rule for computation. The outside diameter


The taper used in calculating is that given by Pratt and to $3 / 8$ is $1 /$ inch $1 / 6$ to 1 is $3 / 4,11$ to 2 is 7 and $21 / 2$ to 4 nches is $11 / 4$ inches. The rule for computing size of drillsis: Subtract from the outside diameter (after allowing for the taper) the product of the pitch by $1 \cdot 732$,
which gives the diameter at the bottom of the thread, or size of the required drill.
(26) M. C. H. says: I am building a time egulator and want to make a mercurial compensating and the bob a glass tube filled with mercury. At what height must the mercury stand in the tube to compenheight by experiment. It will probably be between 61 and $63 / 4$ inches.
(27) G. W. J. says: I have been making a plain cylinadrical boiler, without flues. It is 9 inches in The seam is lapped $11 / 4$ inches, and riveted with 2 rows of iron rivets, ${ }^{\frac{5}{2}}$ of an inch in diameter, 35 in each row, and the rows are $1 / 2$ inch apart; the edges of the iron are soldered inside and out. The heads are of cast iron $1 / 4$ inch thick, with flange $1 / 4$ inch thick and $5 / 6$ inch wide, to receive rivets. Each is riveted with 56 iron rivets sia
inch in diameter. Where is the weakest point, and what pressure would it be safe to run it for a small engine? A. The heads are probably the weakest parts. Working pressure, 20 lbs . per square inch.
(28) J. R. S. says: I claim that, when the gauge on a steam boiler shows a presence of 10 lbs . or all parts of the boiler. A friend claims that it is not. Who is right? A. The one who claims that the press(29) J. W. P. asks: 1. If a wind wheel be put at the mouth of a bellows, will it not have power enough to replace more air into the bellows than it takes to turn the wheel? A. No. 2. If the wheel is to be 2 feet in diameter and a pulley on its axle be 6 inches in diameter,
(30) I. says: An inventor of a steam boiler with muddy water, and his boiler for eighteen months scale or sediment, although the boiler has never been blown off. He claims that all sediment and scale-forming impurities of the water pass off with the steam into the cylinder of the engine. He states that his boiler primes less than two per cent. What experience have
you that makes it credible that a boiler that will not prime will carry the sediment into the cylinder? A chemist has told him that the scale-forming impurities,
both of salt and fresh water, will not injure the cylinder, but will act as lubricators. Is this true of all scaleorming impurities? A. These statements are not veri, fied, in general, by experience.
(31) S. U. says: We have a cast iron secional steam boiler, for heating. As soon as the steam gauge commences to indicate pressure, the water leaves
the boiler and goes off in the supply pipes. Can you the boiler and goes off in the supply pipes. Can you
tell us how to remedy this? A. As we understand you, the water goes from the boiler to the heating pipes, and then returns. We presume this is what is intended. If not, it is probable that the insertion of a valve will pr vent the escape of the water.
(32) M. M. C. asks: 1. Which is best for annealing cast iron-charcoal or bituminous coal, and why? A. Charcoal, generally, as it contains less impu-
rities. 2. What is the formula for calculating the tensile strain on the iron of a boiler shell, diameter of boiler, thickness of shell, and pressure of steam being given? A. See Van Buren on the "Strength of the Iron
Parts of Steam Machinery." 3 . How many square feet of heating surface in a boiler are generally required for a horse power? A. We do not know what is meant by the horse power of a boiler. 4. Is an oblique cone, that is, a cone whose axis is inclined to the plane of its base, measured by the area of its base into $1 / 3$ the perpendicu-
lar height? A. Yes. 5 . What is the formula for finding the volume of a cylindroid? A. Area of base multiplied by altitude.
(33) G. T. P. says: 1. I have a glass tube $\frac{1}{2}$ inch inside diameter. How many inches shall $I$ ave to raise the mercury in it to equal 1 lb . pressure? A.
Height of column $2 \frac{2}{2}$ inches. 2 . How much mercury hall I use? A. Volume oí mercury, about $\frac{i}{10}$ of a cubic inch. F L asks: 1 Could I boil about 45 (34) F. L. asks. the steam and the steam pipe running into the oill, o would the water from the condensed steam affect the il? A. No; some of the steam would condense in the oil. 2. Do you think it would take any more than one or two barrels of oil (of 45 gallons each) to varnish a 40
foot balloon, giving it three orfour coats of the varnish? A. The quantity would be amply sufficient. 3. Would inseed oil that is sold already boiled, do for a balloon varnish, just by painting it on the balloon when it is cold, or should I warm it up to some degree? A. No. 4. Do you think it improves linseed oil varnish to put beeswax in it when boiling, say about $11 / 2$ ozs. to the gallon? A. No. Boil the oil with the addition of $1 / 2 \mathrm{lb}$. of borate to the barrel, and apply to the cloth slightly warm. 5 . Is it best to varnish the muslin once before it is cut, and nce after the ballo holes, or to put no oil on the muslin until it is all made up? A. Give it one coat before and one or two after-
ward. 6. Would the black gum waterproofs, that the dies wear in damp weather, do for making balloons
(35) N. V. says: I have been trying to make ink according to the recipe on p. 250, vol. 34, Scithought that perhaps there was too much of the sulphate of indigo, and I increased the quantities of nutgalls the difficulty? A. If we understand you, the ink in question was not intended to stand washing with water. Judging from your letter, you have nothing to complain ompares very favorably with the best inkse mentioned compares very favorably with the best inks of this char-
acter in the market.
(36) W. S. asks: In building a residence, is there anything that is of value as preventing conflagra-
tion from sparks on shingle roofs? tion from sparks on shingle roofs? A. There is an as-
(37) A. E. R. says: 1. I desire to burn some of the old style burning fluid. How can I make
it? A. Use alcohol mixed with one fifth of turpentine or benzine. 2 . Will it be dangerous to use with a blow pipe? A. It is not dangerous when used in suitably con structed blowpipe lamps.
(38) G. H., Jr., asks: 1. How would hard lue burnt brick, set endwise in cement mortar, answe or a public street wi h heavy traffic, if the brick resists
crushing power of $8,000 \mathrm{lbs}$. to the square inch? A. It is not resistance to crushing so much as resistance to mpact that is required in a good paving material, and he latter quality is not possessed even by the hardest busy thoroughfare undergoes would be fatal to the permanency of brick construction-the effect upon the brick being to pulverize its surface. 2. What effect would the hot and cold weather have on a layer of c ment 1 inch thick under the brick, and $1 / 4$ inch all roun he sides of them, built in arch shape? A. When th cement is once s
(39) R. C. asks: How many degrees of Fah enheit does it require to hatch chickens' eggs? A. From find an article on this subject on p. 849 of Scientific amepican Suppiement, No
(40) B. A. asks: Can you tell us the best method of making concentrated lye from ashes? A. suitable vessel, and leach with water for several days, with occasional stirring. Then transfer the clear liquid o a suitable clean iron vessel, and boil off the water. Collect the impure carbonate of potash thus obtained, mix it with half its weight of slaked lime and 15 parts of warm water, stir for a few minutes, allow to settle, mon caustic lye. A lye may also be obtained by treat ing ordinary pearlash or carbonate of soda (sal soda) with lime and water, as stated.
(41) J. A. L. asks: How can I make a phopinghile in one end and the photographic plate at the other. The next higher order is to insert a convex lens in the end (where the pinhole is) with a focus equal to the: length of the box. From this to as many as six lenses are used to constitute the opticalpart, these being arranged with diaphragms, rack and pinion, etc. The boxes (from the above simp'e form) have an endless varifront, the swing back in several varieties, then the multiplying box, in which from one to one dozen pictures
may be made at one sitting; and the shield which holds (42) E. D. F. says: I am cons fiter of 11 . D. F. says. I am constructing a ly with fine powdered charcoal, sand, and gravel. The water passes through 121 feet of filtering material which is arranged in sections which can be cleaned or renewed every month. Our river water is the worst in the United States, extremely muddy for six months in the year; but it comes through the charcoal as clear as from a mountain pring. I want to put a tank above the filter, square or ob
long in shape. What metal shall Iline it with, or of what material shall I make it? A. A cast iron tank would answer your purpose. Plates 18 by 18 incles and 18 by inches are kept in stock for this purpose; they are provided with flanges around theiredges, by means of hich theyare put together with bolts.
(43) S. G. says: Why is it that sewer gas finds its way through the traps into houses? Is it because to siphon? Or does the pressure of the sewer gas force the water out of the trap, or forces its way past or
through the water? A. To remedy the pressure of sewer through the water? A. To remedy the pressure of sewer
gas, which forces itself through the water in the traps into the rooms of your house, let the main waste pipe xtend without obstruction from the sewer up through
he roof to discharge its surplus air into the atmosphere there. Then let the several articles of plumbing have branch waste pipes, and each one be trapped as near to
its opening as possible. The upper part of said main
in waste pipe being only an air pipe, may be of much less e of larger dimensions.
(44) T. B. says: I recently had to put on false valve seat on a locomotive. There had been one three of the old holes in the cylinder. I filled these with Babbitt metal hammered carefully; and I made the metal fush with the surface, put on the seat, and took all precautions to make a good job. When the engine went on he road she "blowed" badly, and continued to get worse so much so that I had to take the seat off again; and face of the old seat fully $\frac{1}{3}$ of an inch. Two of the old holes were between set screws $4 \frac{3}{4}$ inches apart, and one iderably screws $2 \frac{3}{4}$ inches apart, and the two were conmetal to expand so much as to cause that seat to leak . No doubt the leak was caused by the expansion of (45) R. M. says: I wish to sink a well in order to provide myself with wholesome water. At what
distance must I keep from a privy well in rear of house? The soil is very stiff clay, and I dug my privy well 16 feet deep to secure good soakage. A. Locate the well as far as possible from the cesspool, at least 50 feet rom it. Let the well be 3 feet diameter in the clear after it is stoned up, and provide at the top two length of well-curb, 3 feet high each, to keep out the surface depth at which $h$ water runs in the locality. You had better employ a professed well er, who will contract to dig your well and stone it up certain price per foot in depth. The cucumber pump highly spoken of.
Minerals, etc.-Specimens have been re ceived from the following correspondents, and examined, with the result stated:
G. H.M.-It contains pyrolusite (oxide of manganese) ist B.-It is clay slate.-H. M. A.-It appears to con sist principally of wood pulp, chalk, a little Vandyke
brown, and glue. -J. F. I.-It consists principally of copper with some zinc. You should send larger spec mens.-J. L. R., Jr.-It is marmoite, a variety of se pentine. It contains silicate of magnesia, magnesia, a
race of iron, and water. It is of common occurrence. trace of iron, and water. It is of common occurrence salts, and, when in large, perfect pieces, as material fo ornamental vases.-W.H. C.-It is galena-sulphide o lead-a valuable lead ore. It contains about 80 per cent

## COMMUNICATIONS RECEIVED.

an acknowledges
iginal papers and
and contributions upon the following subjects On Micro-Photographs, etc. By C. M. On Combustion in Lamps. By A. K. S. On Aerial Propulsion. By L. C.
On Squares and Cubes. By E. H. B On Squares and Cubes. By E. H. B.
On Lightning Rods. By J. M. M. On the Ball and Jet Puzzle. By H. G. W. On Kerosene Lamps. By E. B. W. On Boiler Explosions. By D. R., and by G. B. B. On Mountains in the Moon. By P. E. S.
On Steam Engine Economy. By W. A. M. On Steam Engine Economy. By
On the Gyroscope. By J. M. A.
also inquiries and answers from thollowing H. M.-P. W. C.-E.P.S. A.-W. H.-J. C. S., Jr.-
C. J. K.-G. C.-G. M.-C. M.-F. R. N.-A. J. - A B. С.

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Correspondents whose inquiries fail to appear should Ceat them. If not then published, they may conclude ddress of the writer should always be given. Inquiries relating to patents, or to the patentability ore inventions, assignments, etc., will not be publishe are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasre in answering briefly by mail, if the writer's addres is given. sent: "Whor rolls thin plates of spring the following are and without flaws? Who makescastingsto order? Whose is the best theodolite? Who makes the best recording pressure gauge? Who makes the best steam engine for ranning small machines? Who sells horse power pumps?" in the personal inquiries are printed,as will be observed cially set sum of "Business and Persoual," which is spe mentioned at the head of that column. Almost any desired information can in this way be expeditiously ob-
tained.

## INDEX OF INVENTIONS

 Granted in the Week Ending

March 20, 1877
ND EACH BEARING THAT DATE
[Those marked (r) are reissued patents.]
A complete copy of any patent in the annexed list ncluding both the specifications and drawings, will be furnished from this office for one dollar. In ordering, lease state the number and date of the patent desired and remit to Munn \& Co., 37 Park Row, New York city

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