SCIENTIFIC AMERICAN

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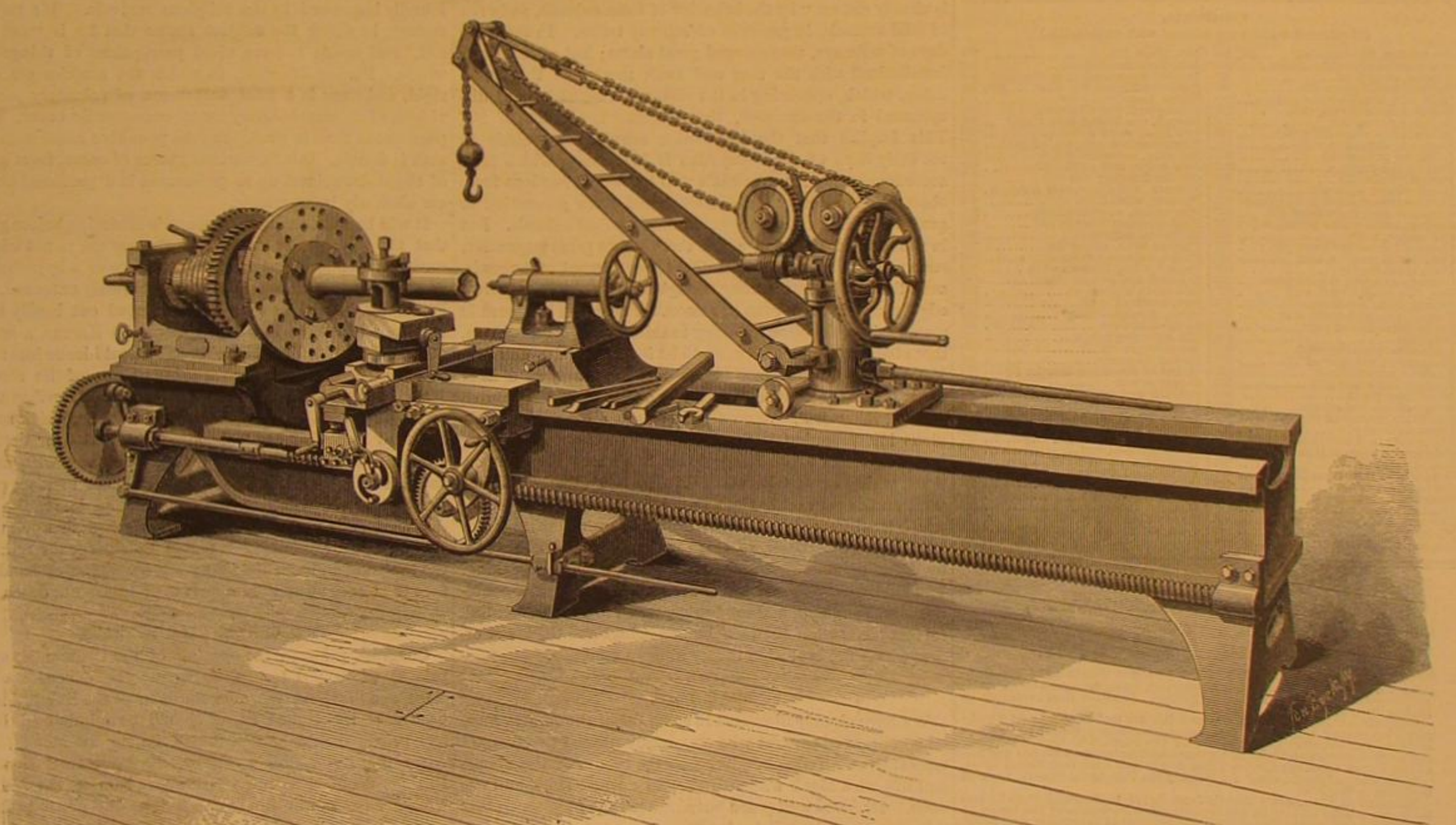
IMPROVED GAP LATHE.

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 ¾ revolution per minute. Between these limits are included the proper speeds for turning anything that will swing in the gap. The machine is also screw-cutting, and has a change-



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 usual 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 lbs., lifted 1 foot high each 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 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 engine 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 ask these questions: 1. Will you guarantee that all parts of 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 nominal horse power? 3. Will you guarantee that the boiler will boil off at least one cubic foot of water (6¼ gallons) 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 improved in quality, and that many makers, who at present exist as makers of engines solely because their customers are 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 provided with a fountain to keep the air cool and refreshing."

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 contemplation 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, 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, 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 extremities. The invention is an ingenious one, but we fear it is 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.

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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 farmer committee man, after hearing that probably the unexampled speed of twelve miles an hour would be attained, and realizing that the machine could not leave its rails, sagely remarked: "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 bovines 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 involuntarily, bulls have over and over again scorned to fly from locomotives, and, while being killed themselves, have wrecked the aggressive train. A remarkable instance of this happened recently in Virginia, just as a heavy freight train was approaching a bridge. A bull, with mane and tail erect, 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. The loss to the railroad company amounts to over $8,000. What became of the bull is not stated.

Mr. Herbert Spencer, in discussing the subject of the distinction which brutes are capable of making between animate and inanimate objects, says that, where intelligence rises beyond the merely automatic, the motion implying life begins 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, familiarized with the roar and swift motion of this something, which, appearing in the distance, rushed by and disappeared 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 in the case of brutes in which there exists great pugnacity, 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 obvious interpretation is that anger, like every other strong emotion, tends to discharge itself in violent muscular actions, which must take some direction or other;" and the same 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 versa*. 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.

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. Herbert Spencer, in his new work on "Synthetic Philosophy," devotes some close reasoning to the primitive idea of our 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, cannot 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 such a supposition involves the notion that the second entity differs from the first simply in being absent and active at night while the other is at rest. Only as this supposed duplicate, 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 a 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 swoon, catalepsy, etc., in which animation is suspended—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 more 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 something 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 movement;" there is snoring as in deep sleep. Yet the sufferer cannot be "brought back to himself" by ordinary means, and the savage witnesses such effects, and, recalling his dream experiences, believes that the second self has gone away for a time beyond recall. Some time afterwards there is a like prolonged insensibility, and then revival, and another silence as to what has happened in the interval; on the 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 catalepsy. Instantaneous loss of consciousness is followed by a state in which the patient "presents the air of a statue rather than that of an animated being," and control of the members is lost. There is no recollection of occurrences 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 reanimate them."

There is still another state of insensibility which has shown itself repeatedly of late among persons who have been profoundly impressed by the religious revivals. We refer to ecstasy, in which the subject shows that he is "not himself," and seems to have vivid perceptions of things elsewhere. 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. These phenomena tend to strengthen the primitive belief that each man is double. All the various phases of coma, from a state of slight drowsiness up to permanent and profound stupor, are similarly interpretable.

It will be seen, from Mr. Spencer's reasoning before given, that the supposition peculiar to the savage is not without 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: sickness 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 the 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 impurities of this minor death.

THE CENTENNIAL SURPLUS.

Congress, prior to the opening of the Centennial, appropriated $1,500,000 toward defraying the expenses of the 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. After 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 after the accruing of profits, and that, as no profits had accrued, the Exhibition not having paid expenses, the United States 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 Justice, 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 provides, 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 subscription to that enterprise consisted in large part in Centennial stock worth some $500,000 at par. It was expected that $300,000 could be realized thereon; but now it seems that its value is but 30 cents on the dollar, so that the available 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 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 being 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 a 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 currently 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 examining 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 perforations in the first case, how could the same influence, acting 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 surface may as well be below as above the general ocean level, where there are depressions in the soil. Large regions that are below the ocean 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 terrestrial 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, provides all the water falling on the whole; therefore, as a rule, the evaporation from a given surface of land surpasses the amount of rainfall. The former differs for every climate, but is for each special belt of latitude a much more constant 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 through Asia and Persia. In the last named country, 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 next largest rainless region of Central 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 over the rest of the earth the fall of rain must be very unequally distributed; and we have compiled a series of observations as follows, which gives the average rainfall per year in inches for several localities.

No. of inches falling per year	Locality.
13	Erfurt, Germany.
16	Cambray, France. Upsala, Sweden.
17......	St. Petersburgh, Russia. Copenhagen, Denmark. Toulon, France.
18......	Brussels, Belgium. Francke, Holland.
19......	Stockholm, Sweden.
20	Marseilles, France. Coblenz, Germany. Glasgow, Scotland.
25......	Rotterdam, Holland. Strasburg, Germany. Lisbon, Portugal.
30......	Funchal, Madeira. Rome, Italy.
35......	Liverpool and the Isle of Man, England.
40......	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 the ocean, but they are all situate on a table land, some of them many hundred feet above the ocean level. But they all dispose of their supply of water by evaporation.

Every such locality forms a water system by itself, surrounded 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 Great 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 point is scarcely 100 miles west of the Sea of Aral, but of which the surface is 112 feet below that of Aral, and 86 feet 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 lakes drains a surface of 600,000 square miles. The latter river, the Ural, which belongs as much to Asia as to Europe, forming 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 Susquehanna, pour their waters also in the northern extremity of the Caspian Sea; and it is no wonder, therefore, that old geographers, 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 beds of rivers, etc.

These suppositions were definitely set at rest by the discovery that the surface of the Caspian Sea, as before stated, is 86 feet below the surface of the ocean; while the surrounding shores, especially in the north and northeast, extend for many miles as an alluvium, also below the ocean level. These data were ascertained many years ago by the surveys for canals constructed with the intention of establishing 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, into the Caspian.

The Caspian Sea is a forcible illustration of the fact that the evaporation on a given surface may far surpass the rainfall. It receives the drainage of a surface more then ten 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 rivers continuing to pour in water, of course of less 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 saltness, and only its immense size retards the change which will take several thousand years to become appreciable to man.

A Time Ball in New York City.

An arrangement has been concluded between the Superintendent of the United States Naval Observatory at Washington 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 11h. 55m., 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 all 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 positions 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 11h. 55m. to 11h. 58m. At 11h. 58m. 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=11h. 47m. 49s.53 Washington time. 12h. 0m. 0s.00 New York time=4h. 56m. 1s.65 Greenwich time.

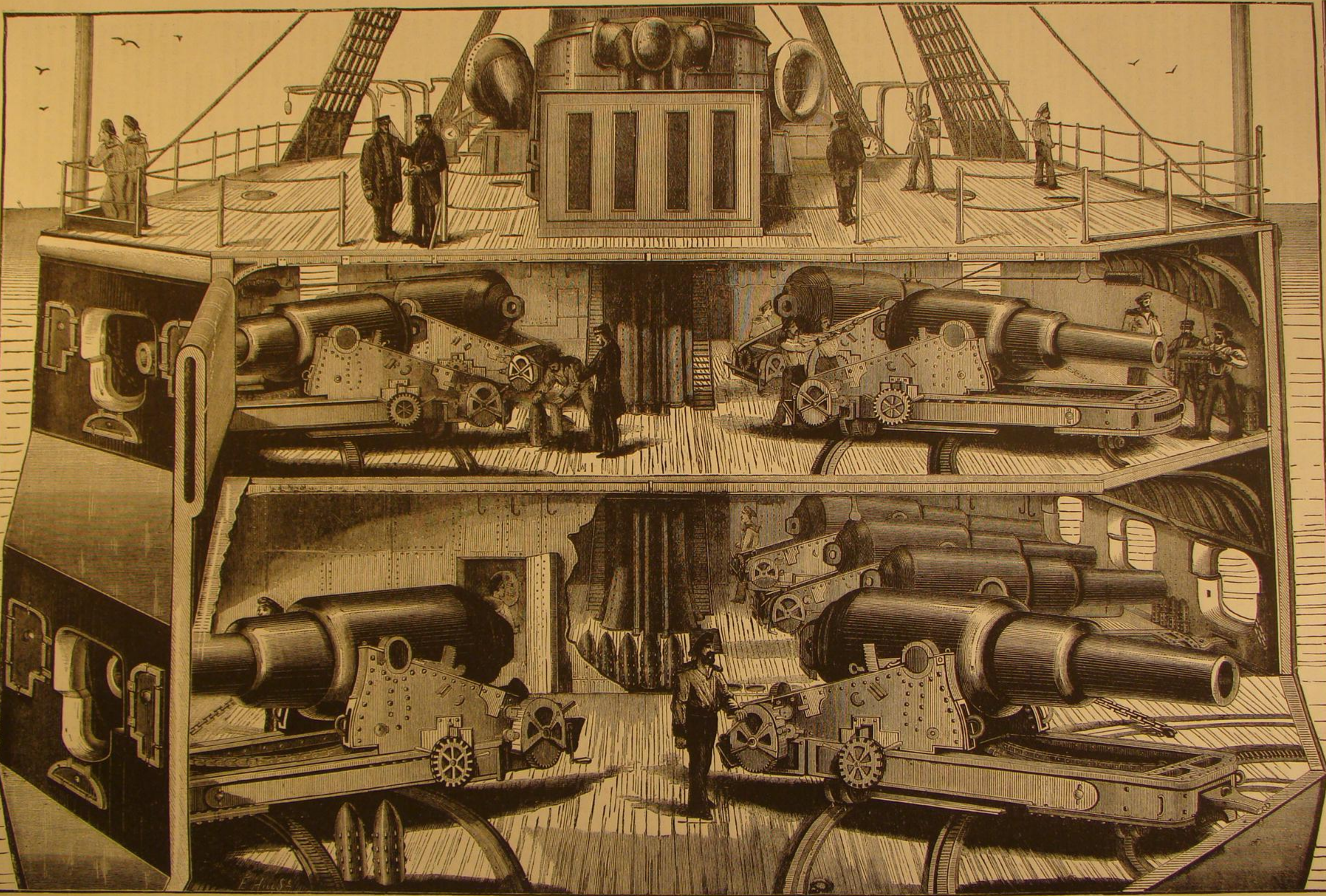
If, on account of high winds, etc., the ball fails to fall at 12h. 0m. 0s., it will be kept at the mast head till 12h. 5m., and then dropped at 12h. 5m. 0s. In such cases, a small red flag will be hoisted at 12h. 1m. and kept flying till 12h. 10m.

The time of falling cf the ball will record itself automatically, 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 evening papers of the day, and in the papers of the next morning, 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. That ought to be a warning to us."



THE IRONCLAD MAN-OF-WAR ALEXANDRA.—[See page 261.]

STRAIGHTENING SAWS.

In the manufacture of saws, the straightening forms a large proportion of the manipulative processes. The cutting 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.

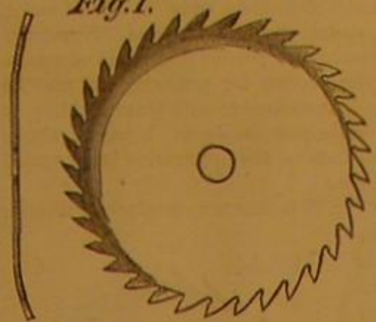
The set of a saw tooth should all be given to the tooth itself, and in no case should it extend below the bottom of the tooth into the solid blade; because in that case it affects the straightness of the same and renders it liable to break. The harder any cutting tool is, the more cutting duty it will perform 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 highest 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 efforts 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 circumference 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 resistances on its two sides (which may occur from the waves in the grain of the timber, or from other causes), the dish will jump from one side to the other of the saw, because, from being rim-bound, it is impossible that it remain straight. And as soon as it is forced 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 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.

Fig. 1.



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 1⅝ inches, and its length is about 5¼ inches. Its handle which is about 14 inches long, stands at an angle of 85° to the body of the hammer. Its face is rounding, and of an even sweep. That shown in Fig. 3 is called a blocking hammer; the face at A is 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 represents a wooden block upon which the straightening of the finished saws is performed.

Fig. 2.

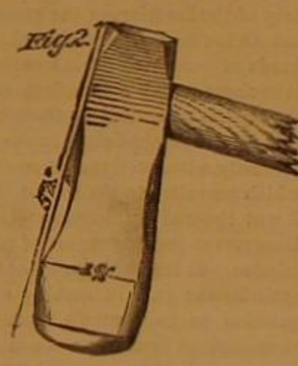
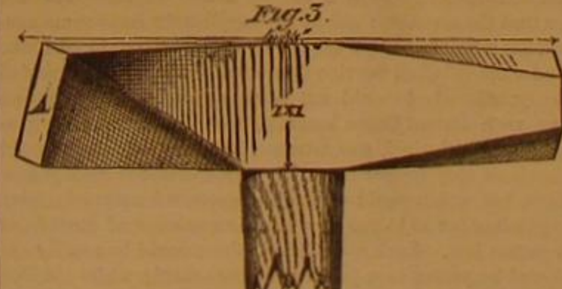


Fig. 3.

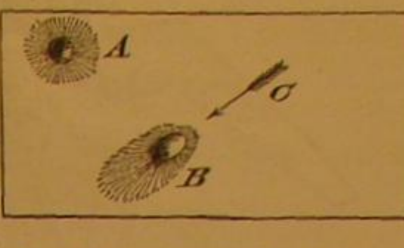


The doghead hammer, Fig. 2, is used mainly for stretching, that is, for removing a tension. The reason for its handle being at an angle is that by this means the handle of the hammer stands, when the blow is delivered, in the line of the hammer's motion; hence the blow delivered is a dead one, that is to say, it has as little spring or rebound as possible. 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.

Fig. 5. Fig. 4.

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 equally 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 other times, the direction in which the hammer falls is aslant, as shown in Fig 6, at B, in which the hammer, while falling, travels also in the direction denoted by the arrow, C, the stretching effects of the blow being denoted by the radial lines around the center, at B. The motion of the hammer, however, 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.

Fig. 6.



The method of using the blocking hammer, shown in Fig. 3, is as follows: The shape of the face of the hammer, in conjunction with the line of motion in which it falls, determine 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 lateral travel took place. Thus, in Fig. 7, if the hammer, in falling, traveled from B towards the hammer mark shown, the effect of the blow would be 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 traveling laterally from C towards the hammer mark shown, the 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 bend upwards, assuming the shape denoted by the dotted lines at that end: while by blows delivered in the direction indicated by the marks at B, the plate or blade would curl up, as shown by the dotted lines at that corner of the plate.

Fig. 7.

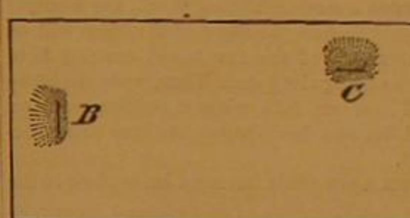
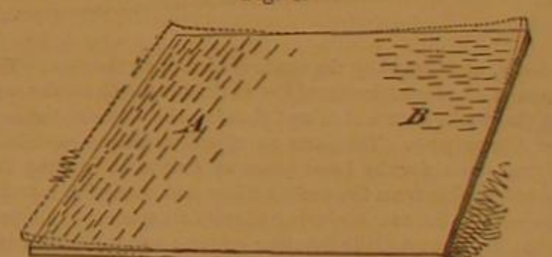
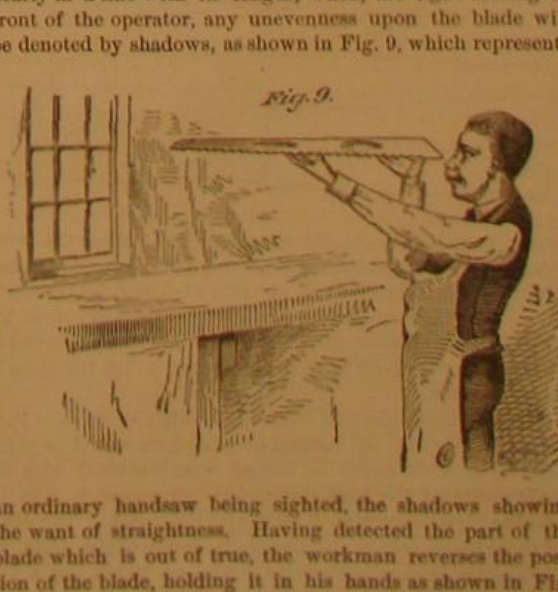


Fig. 8.



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 attacked 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 position of the blade, holding it in his hands as shown in Fig.

Fig. 9.



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


Fig. 10.

plate exist by reason of some part being either unduly expanded 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 resistance 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 hammer 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

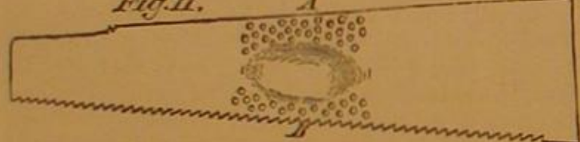
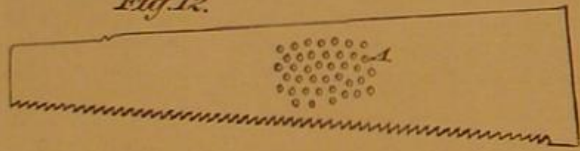
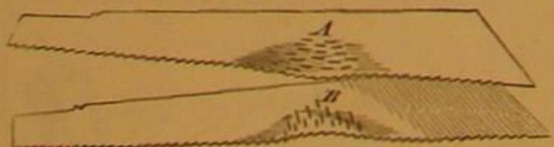
Fig. 11.


Fig. 12.


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

Fig. 13.

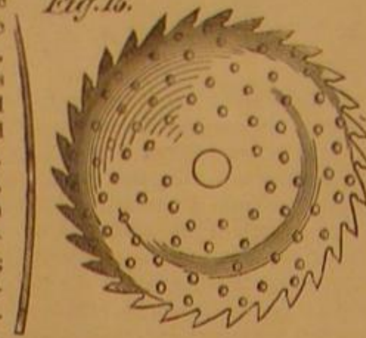

Fig. 14.


would be to take the blocking hammer, and deliver the blows 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, removing the tension behind the kink, and producing a tension tending to lift the part kinked. The plate is then turned upside down, and the blows denoted by the marks shown in Fig. 14, at B, are delivered, which will remove the kink.

In performing any one of these operations new contractions 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 to get the dish out, and afterwards proceed 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 doghead in the places denoted 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 circular 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 motion and force. J. R.

Fig. 15.


Communications.

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 Patent Office has been followed by a meeting of the different heads of bureaus of the Interior Department, for a general interchange and comparison of views and a discussion of the reports submitted by them upon the subject of civil service 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 system 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 connection 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 connection with Patent Office business, such, for instance, as geographical, historical, and astronomical questions, that would have been very proper if put to applicants for pedagogueships, but which could not, when answered correctly, give any indication as to the answerer's knowledge of mechanics or patent law. Such questions as these could be readily answered by young men just fresh from school; while old Patent 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 beardless 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 Postmaster-General that this would virtually establish a monopoly in bidding, as but two or three manufacturers had the 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 a card such as can be made by any first class paper maker.

The Agricultural Department is continually troubled with applications for seed; but its distribution has ceased for the season, except to those districts of the West which were afflicted by grasshoppers in 1876, and for which a special appropriation was made by Congress a short time before the close of the session. Applications from other sections cannot therefore be responded to, and parties outside of the grasshopper districts will save time and trouble by not making 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, of 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 prominent part. The commission is an excellent one, and will 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 tobacco or cotton worm be examined by a commission also? They think they have as much right to a commission as the Western agriculturists.

Washington, D. C. OCCASIONAL.

[For the Scientific American.]

IMPORTANT OBSERVATIONS ON THE ROCKY MOUNTAIN LOCUST, OR "GRASSHOPPER" PEST OF THE WEST.

BY PROFESSOR C. V. RILEY.

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 injurious species belonging to the *lepidoptera*, that the eggs in the ovaries develop almost simultaneously, and that when oviposition 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 Mountain 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 repeat, 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 determine. 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 laid being in one case 96, and in the other 110. A number 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 great 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 four pods, and perhaps even still more.

The time required for drilling the hole and completing the pod will vary according to the season and the temperature. During the latter part of October, or early in November last year, when there was frost at night and the insects did not rouse from their chilled inactivity till 9 o'clock A.M., the females scarce had time to complete the process 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 manage the eggs so as to most easily destroy their vitality, is a most important and practical one; and as assisting to a decisive answer, I have carried on a series of experiments which will be presently detailed. To make the experiments the more 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, *e d.*) If we could manage to watch a female during the arduous work of ovipositing, we should find that, when the hole is once drilled, there commences to exude at the dorsal end of the abdomen, from

Fig. 1.

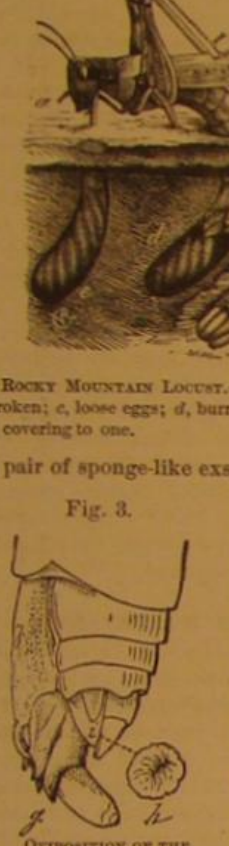
ROCKY MOUNTAIN LOCUST: Anal character of female, showing horny valves.

Fig. 2.

ROCKY MOUNTAIN LOCUST.—*a, a, a*, female laying; *b*, egg-pod partly broken; *c*, loose eggs; *d*, burrow showing oviposition; *e*, completed pod; *f*, covering to one.

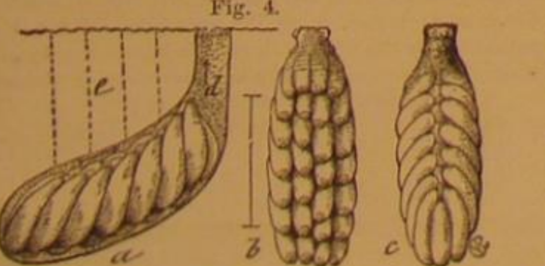
a pair of sponge-like exsertile organs (Fig. 3, *h*) that are normally retracted and hidden beneath the super-anal plate near the cerci (Fig. 3, *i*), a frothy mucous matter, which fills up the bottom of the hole. Then, with the two pairs of valves brought close together, an egg would be seen to slip down the oviduct (*j*) along the ventral end of the abdomen, and, guided by a little, finger like style (*g*), pass in between the horny valves (which are admirably constructed, not only for drilling, 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 elaborated, 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 narrower 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 a very excellent protection. (Fig. 4, *d.*)

Fig. 3.



OVIPOSITION OF THE ROCKY MOUNTAIN LOCUST.

Fig. 4.

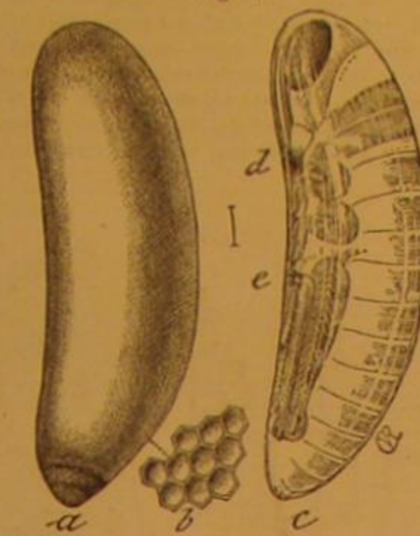


EGG MASS OF ROCKY MOUNTAIN LOCUST.—*a*, from side; *b*, from beneath; *c*, from above—enlarged.

PHILOSOPHY OF THE EGG MASS.

To the casual observer the eggs of our locust appear to be thrust indiscriminately in the hole made for their reception. A more careful 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 consistent 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, indeed, 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 the upper or head ends of the outer rows are necessarily bent to the same extent over the inner rows—*the eggs when laid* being somewhat soft and plastic. There is, consequently, an irregular channel along the top of the mass (Fig. 4, *e*) which is filled only with the same frothy matter which surrounds 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 removed.

Fig. 5.



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*, points where the shell is ruptured.

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 seen, by aid of a high magnifying power, to be densely, minutely, and shallowly 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 deeper 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 freezing; but the inner covering 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 frail that the mere swelling of the embryon affords means of escape; 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 a 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 subelastic prison. Nature accomplishes the same end in many different ways. She is rich in contrivances. Every one who has been troubled by it must have noticed that the shanks (tibiæ) of our locust, as of all the members of its family, are armed with spines. On the four anterior legs 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 antennæ 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 tips 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 filling in the neck of the burrow. (Fig. 4, *d.*) Once fully escaped from the soil, it rests from its exertions, but for a short 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 movements which freed it from the earth, and which now burst 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 first 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 struggling 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, except through the appropriate channel (*d*), where the soil is at all compressed. While crowding its way out, the antennæ 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 remarkable. Yet if, by chance, the protecting pellicle is worked off before issuing from the ground, the animal loses all power of further forcing its way out.

THE BRITISH IRONCLAD ALEXANDRA.

On page 258, we present a fine sectional view of a vessel that is now one of the strongest in the English navy. Judging 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 separated by 9 inches of solid oak. It will be seen, therefore, that against such weapons the sides of the Alexandra offer 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 were quickly destroyed. The ironclad of the near future must carry either the 40-inch plates which Sheffield makers have promised to roll, or else 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 newest and most important improvements in naval construction. She is a central battery ship, and is able to train four guns, including the two heaviest of her armanent of twelve, straight ahead and two straight astern. This capability is of the greatest 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 through the battery, showing the two gun decks. The sills of the ports of the lower deck are 9 feet, and those of the upper 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 thickness 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 feet; extreme breadth, 63 feet 8 inches; depth of hold, 18 feet 7½ inches; tonnage, 6,049; displacement, 9,492 tons; draught forward, 26 feet; indicated horse power, 8,000; speed per measured mile, 16 knots.

A MARBLE statue of Sir William Fairbairn has now been completed. The statue, 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 an 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 quiet energy characteristic of the man.

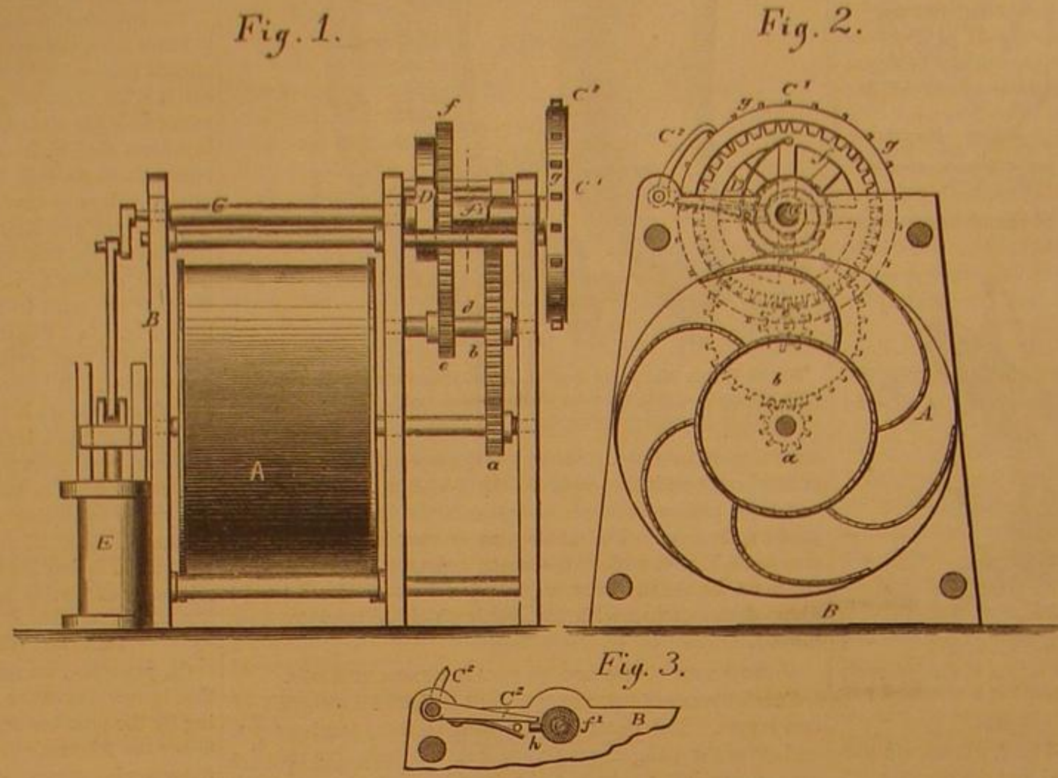
STATISTICS show that about 250,000 barrels of apples were exported from America last year to Europe. More than half this quantity was sent to England, and about 11,000 barrels went to St. Petersburgh.

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'*, loosely on the pump-operating crank shaft, C. A flywheel, C', 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, C², 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 wheel, *f*. The pin, *h*, bears on a spring-acted lever arm of the brake, so as to lift the same and admit thereby the turning of the crank shaft 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.

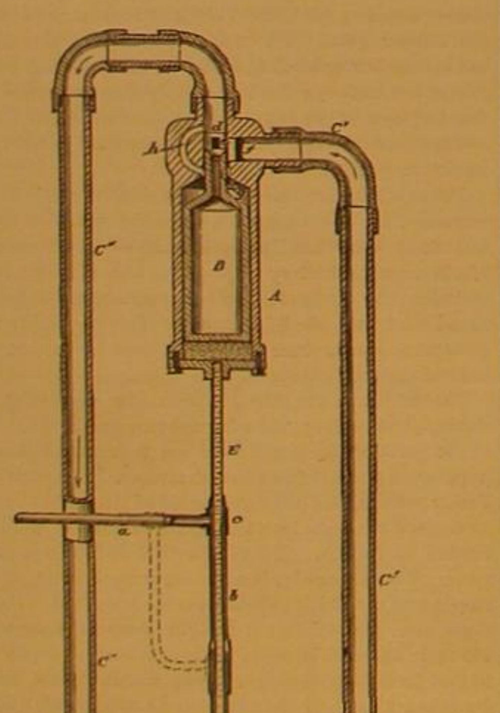
The power of the stream is thus utilized by being stored up by the spring, and intermittently applied to work the pump, furnishing thereby a supply of water to the house situated on elevated ground above.



RICHARDSON'S HYDRAULIC ENGINE.

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 engraving, 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 chamber, A, that contains the float, B. Upon the upper end of the float chamber, A, a valve seat, *d*, is formed, in which the supply ports, *e e*, are made, which connect with a semi-annular passage, *f*, provided in the upper part of the casting of the chamber. A valve, *g*, is formed upon the upper end of the float, B, which is cylindrical and beveled downward toward its center, forming a sharp edge, which removes deposits made by the gas upon the valve seat. A passage, *h*, connects the space above the valve seat with the chamber, A, for the purpose of equalizing the pressure on the valve, *g*. C is a gas supply pipe, that leads directly to the boiler furnace, and C' is a branch pipe leading to the supply ports, *e e*, of the regulator. C'' is a pipe leading from the gas regulator to the pipe, C. Stopcocks are placed in these pipes, by which the gas may be entirely shut off from the regulator, if 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, C' and C'', and the gas flows through the pipe, C', through the ports of the regulator and pipe, C'', 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 Trocadéro, 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. 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 are thereby destroyed. We would, however, again refer to linseed oil as a wash, as far more effective for insects, and it would, perhaps, do as well for moss and lichens. After all, these seldom come when trees are well cultivated. It is neglect that makes poor growth, and it is poor growth that makes lichens.

Great Eruptions.

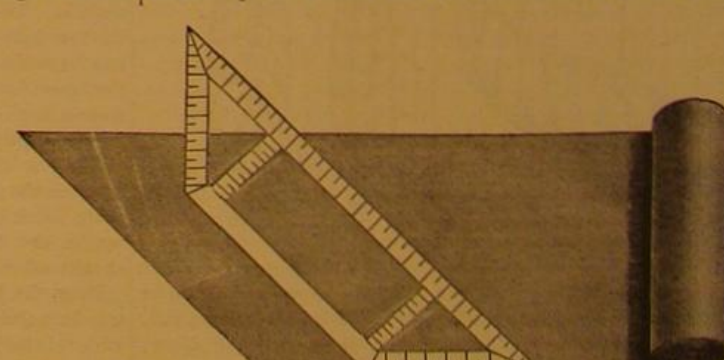
Two tremendous volcanic eruptions have lately occurred in the Hawaiian islands, which contain the most remarkable group of volcanoes in the world. Mauna Loa, which is 14,000 feet high, has great eruptions once in seven years, which are very energetic during the brief period over which they continue. On February 14, this volcano burst forth. During the preceding afternoon, a heavy cloud of black smoke had enveloped the top of the mountain, and in the forenoon 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 brilliant that all parts of the island were lighted up. This tremendous eruption lasted but a short time, having spent its force 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° to the selvage. A yard stick is suitably 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 3½ inches wide, a common width for trimmings, 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. Somes & Co., Springfield, Mass.

The Missouri Senate has passed a bill offering $10,000 reward 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 arrangement and effect of the main and local batteries. 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 small pieces of apparatus placed on shelves. These are all alike, with an exception that will be 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 automatically. 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 within 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 vibrating tongues of metal of different lengths—that is of such length as will give all the notes of two octaves. As often as any particular key is pressed down; and as long as it is kept down, the electric currents operate to make the corresponding metallic tongue vibrate. These vibrations constitute the music that the performer hears, but they are by no means the music that is heard at the other end of the line. As the tremulous tongues fly back and forth with a rapidity that defies vision, they open and close the circuit of the main wire. This, then, is all that is done so far. Each vibration is reproduced at a distance in successive waves of electricity.

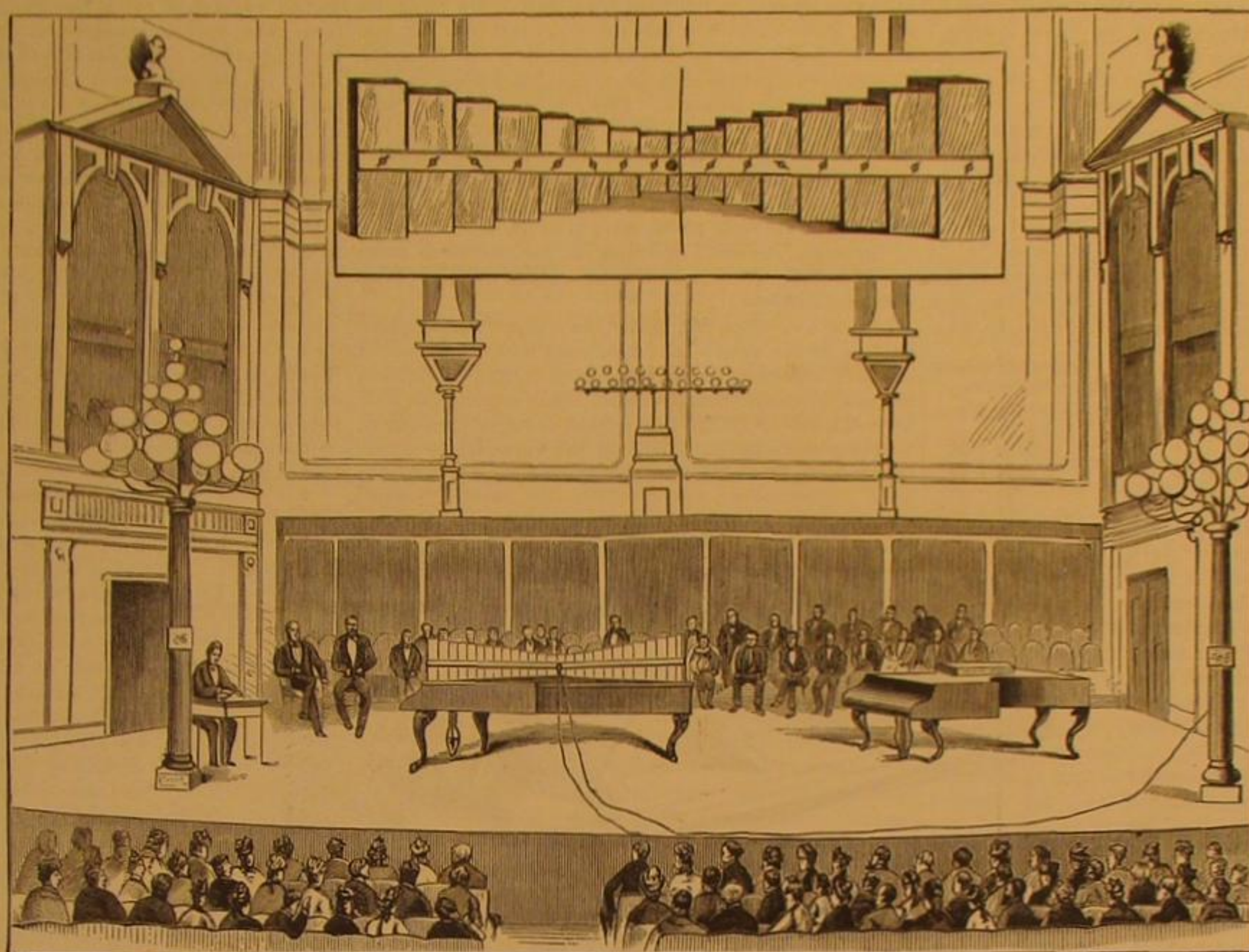


Fig. 1.—PROFESSOR GRAY'S TELEPHONE IN NEW YORK.

Just here it is necessary to explain a peculiar discovery that has made the telephone, as a musical instrument, possible. 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 at 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 wavelets corresponding to each note are carried safely and independently of those of all other notes. Following, then, these multifarious but separately cared-for elements of "Home, Sweet Home" to New York, we have to discover how they are received, sorted, and translated into air vibrations that may strike the tympanum of the ear. The wavelets are passed through sixteen pieces of apparatus, each consisting of an ordinary electro-magnet, C, having, instead of an armature, a steel ribbon, D, stretched in a metallic frame. This ribbon is tuned to vibrate at a particular pitch. Now, it is a fact, that when a piece of iron is magnetized it is increased in size very slightly, and when it is demagnetized it is restored to its original dimensions. This change is accompanied by a slight sound, supposed to be due to the arrangement and re-arrangement of molecular particles.

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, without 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 apparatus sorts out the wavelets of electricity and transmutes them into music. These sixteen pieces of apparatus in New York are each inclosed in an oblong sounding box, to increase the sound of the vibrating ribbons. A picture of these boxes, arranged in symmetrical order, is also presented herewith.

EXPORTS OF ICE.—The fine new ship C. C. Chapman, built at Bath, Me., recently cleared from Boston. Her cargo consisted of 2,200 tons of ice for Calcutta and 350 bales of drills for Madras. The bark R. R. Allen, which cleared from Boston in the same week as the C. C. Chapman, took 600 tons of ice for Havana. The same company have two other vessels loading with ice for export.

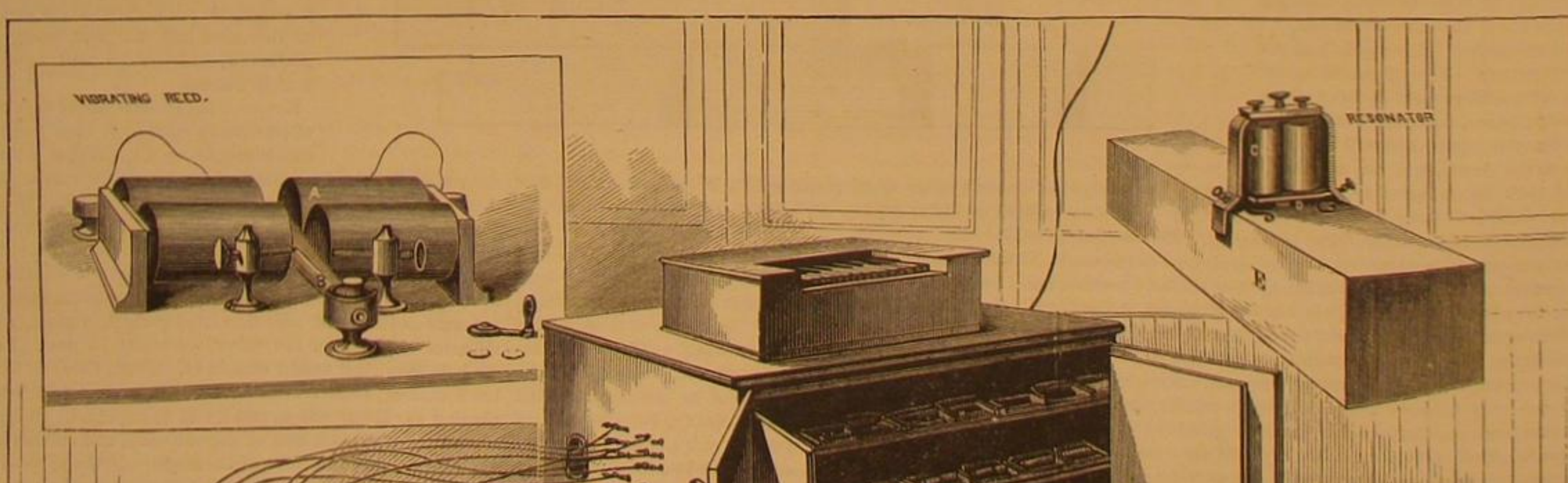


Fig. 2.—PROFESSOR GRAY'S TELEPHONE IN PHILADELPHIA.

[For the Scientific American.]

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 further 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 require 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 $\frac{1}{48}$ to $\frac{1}{26}$ 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:

	Angle of repose.	Friction in terms of the weight.
Metals on metals, dry	8½° to 11½°	0·15 to 0·2
Metals on metals, wet.......	16½°	0·3
Smooth surfaces, greased...	4° to 4½°	0·07 to 0·08
Smooth surfaces, best results.	1¾° to 2°	0·03 to 0·36

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 series of experiments which have led him to the conclusion that the friction between 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 under which a slide valve operates under the head of "metals on metals, dry," we are confronted at once with the question: For what reason shall we select the co-efficient as 0·15 in preference to the 0·2, or *vice versa*? If we class those conditions under any other of the head ings in the table, where are we to get a 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 a 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, depends upon the fit of the valve to its seat.

In Appleton's "Cyclopædia" occurs the following: "Two glass or metal 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 1½ 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 $\frac{1}{15}$ 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 chief 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 hemispheres, held together by the vacuum alone, fell apart."

Now whether Mr. Hill, in assuming the co-efficient of friction for slide valves to be 0·15, has assumed the valve to fit so closely to its seat as to induce the adhesion here referred to, I know not; but it is self-evident from the foregoing that, if the valves do not fit sufficiently closely to induce adhesion, the co-efficient will be less than if, from closeness 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 according 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 conditions, as existent in a slide valve, cannot be known, and certainly are never constant. First, then, beginning with scraped surfaces, is it not a fact that only a part of such surfaces are in contact, and what are we to presume fills or occupies the hollows of the scraping marks? According to Mr. Hill, they are under a vacuum; for he assumes the 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 weight. The sizes of the two finely fitted plates is 12 x 18 respectively. Their weight is about 20 lbs. each, their shapes being shown in Fig. 1.

Fig. 1.

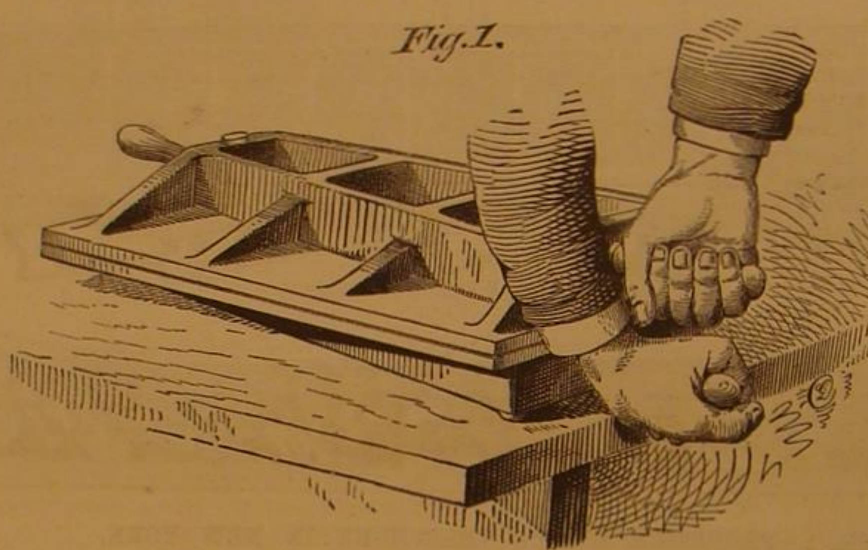
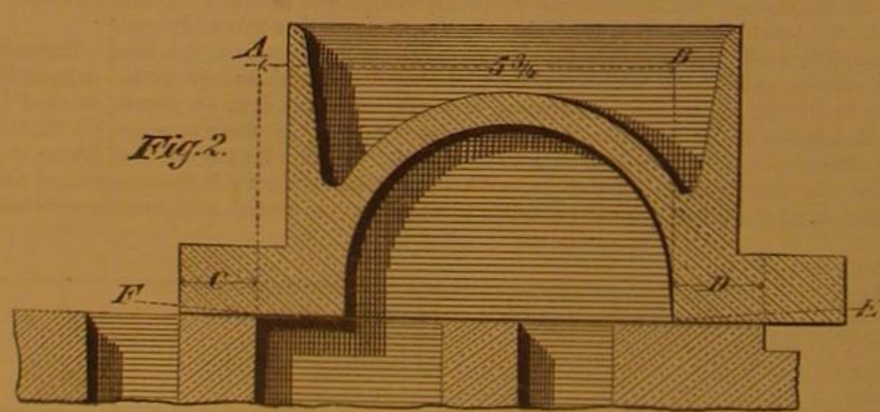


Fig. 2.



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 steamtight when under a steam pressure. Now accepting, for the sake of illustration, a co-efficient of friction of 0·15, 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 cleanliness 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 well 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 other, it has taken 341½ lbs. to slide one over the other (allowance being made for the weight of the top plate), as a certificate given by the Fairbanks Scale Company at the Centennial (which certificate now lays beside the plates) attests. From this we may proceed to test Mr. Hill's co-efficient of friction. According to his theory, every 15 lbs. required to slide the plate will represent 100 lbs. pressing them together; then the 341½ 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 $341\frac{1}{2} \div 15 = 22{\cdot}76 \times 100 = 2{,}276$ lbs. Now let us suppose that these plates have a perfect vacuum, of say 15 lbs. per inch, between them, and hence have the full atmospheric pressure of say 15 lbs. per inch upon them. Then the area of the plate (96 inches) multiplied by the atmospheric pressure (15) equals 1,440 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 pressure upon the plates, and that the other 836 lbs. necessary to make up the 2,276 lbs. (that a co-efficient of 0·15 assumes 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 *terms of the weight*, and not in terms of the combined weight and whatever adhesion the smoothness of the surfaces may induce. 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-efficient allowed by General Morin, the excess of the last two figures being accounted for in the fact that 0·2 is for an angle of repose, whereas my plates lay level), then we have as follows: Every 23·7 it requires to slide these plates represents 100 lbs. pressing them together; hence the 341·5 lbs. required to slide the plate, divided by 23·7, equals 1,440 (nearly), and this equals the allowed atmospheric pressure of 1,440 lbs. resting upon the plates. It is not to be presumed, however, that these plates are in perfect contact, and hence there is presumably air, to some extent, between them; and it is only reasonable to assume that, if they had, instead of about 15 lbs. per 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 proportion as the air was more perfectly excluded from between the surfaces: providing, however, that there were no elements tending to warp the plates out 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, however, there are several elements which preclude the possibility of the surfaces of the valve and the seat 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 this is supposing a good deal when we remember that some engine builders put in the valves just as 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 were 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 thickness of the valve, and on several other elements. 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 reheated (as experience demonstrates that it always does), and that, being heated to a given temperature, it would remain as close a fit to its seat as it was when cold. Then, just so soon as the temperature 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 ingresthrough 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 comes 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 amount 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 0·15, we should have 2,276 lbs. holding the plates together; and while allowing a co-efficient of 23·7, we should have 1,440 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 ½ inch thick in the body, and the ribs are each $\frac{1}{16}$ inch thick and 2⅜ 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 the 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 1½ x 17 inches, the bridges between ports 1 inch wide, the cylinder exhaust port 2½ 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 5¾ inches, as marked in the engraving, one way, and 17 inches the other =97·75 inches. Now supposing the steam pressure to be 130 lbs. per inch: then 97·75 × 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? The area of one bridge equals 17, the area covered under the valve flange at D equals 11 inches, and the amount of the valve flange overlapping the ends of the steam ports equals 15·5; 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. There 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 relieve the valve from its liability to spring from the 5,855 lbs. on the other side.

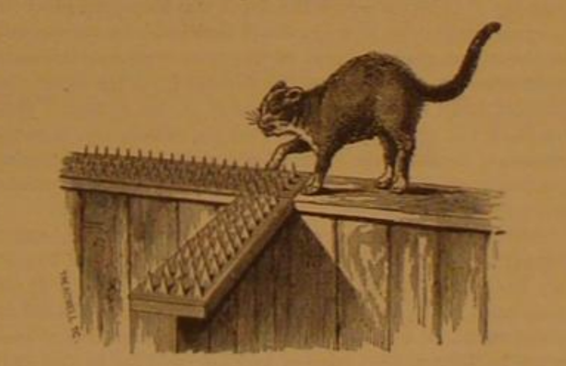
Theoretically, a valve will spring of its own weight; and that it will spring from the pressure which a man can put upon it with his hands, I have often found in facing valves up. For example, if, in trying the valve on the surface plate, the former is pressed in the middle by the hands to make the plate mark the face plainly, and the valve is fitted under these conditions to 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 instances 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 leaf [illegible] inch thick. There is yet another part of this question, however, which is found in practice to be of the utmost importance, 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 perfect fit, 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 seat face a groove at right angles to, and close to, the edges of the ports. To remedy this, a practice sprung up in in England, 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 engine 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 surrounding air at atmospheric pressure, let alone steam at a high 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 at 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 either in concert or partly counteract each the other, will depend upon the shape, size, strength, etc., of the valve. Isaac Walton said, in giving instructions how to cook a trout, "first catch your trout;" so it may be justly said, in calculating the friction of a slide valve, first find your pressure.

New York city. JOSHUA ROSE.

THE CAT TEASER.

No one who in the chill midnight air has hurled improper language 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 pleasant dreams," lulled by the distant wauls, mingled with the profanity of some one several doors away, both reduced to 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 the fence at the rear end of the yard, and for a short distance 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 protected, while the device may also be used for keeping cats away from flower beds.

Practical tests of the invention have shown that it is discouraging to cats in a high degree. Tom cats of exceptional 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 comfortably 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 Mediterranean—which has the curious power of spinning a viscid silk which is made in Sicily into a textile fabric. The operation of the mollusk is rather like the work of a wire-drawer, the substance being first cast in a mould formed by a sort of slit in the 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 foreign bodies. It employs the foot to guide the filaments to the proper place and to glue them there; and it can reproduce 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 through 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 amassed 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 rearing horses. His first invention was a plow, that had a large 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 modern eight-wheeled passenger car. His shop became famous, and he built a large number of locomotives, and in this way accumulated the greater part of his wealth. During the war, he devised a steam gun for the Southern army, but it was captured by the Federal forces almost immediately, and thus never used. It was not a formidable weapon. Since his withdrawal from locomotive building, 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 authorities 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 otherwise 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 comes 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 ocean 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 waters could be kept open during the whole year. In the narrowest portion, the width of the Straits is 8¼ 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 present time the price of cattle is commonly quoted "at boiling rate;" that is, the animals will fetch no more from the butchers than can be realized for their hides, horns, hoofs, tallow, etc., for exportation. In large establishments devoted to preparing these utilizable portions of the bullock, there was of course an immense waste when the ox went into the melting pot; but this loss is now in a great measure avoided by boiling the animal at once into soup, or concentrated 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 capable of holding upwards of fifty bullocks at a time. In seven hours, during which they are subjected to a pressure of steam of 15 lbs. per square inch, the bones and meat are reduced to a pulp. The steam is then condensed, and the tallow, which floats on the surface, drawn off. The pulp is removed and placed in a powerful press, which squeezes out 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-transparent, 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 other 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 conveyed electrically to Lincoln Hall in Washington, were distinctly heard on the relay used in the Press office, which had no connection 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 instrument.

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 department 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. There is 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 *cancellæ*. 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.'"—*New 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 something nice; thus a fictitious appetite is waked up, and before you know it you have eaten a hearty meal, to your own surprise, and perhaps that, or something else, of those at 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 health, 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 effort 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 was 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 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*, either the consequence of a like error at the outset of a task, or the penalty of attempting to compensate by intense effort for inadequate 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 purpose. 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 object 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 several times divided by the number of points at which the speed was taken gives the average speed of the water.

Now measure the depth at several equidistant points across the stream, *a*, *b*, *c*, *d*, *e*, *f*, (the diagram showing a cross section 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 contents of body of the water embraced in the section. Thus we have the quantity and its velocity, which are elements 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 a 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 divided by 33,000 equals 18·7 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 probable that in this sense alone electricity may be said to have a velocity. The early experiments on the 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 condenser or accumulator, and then discharging the latter through a delicate galvanometer. When the circuit is first closed, a minute interval of time is required before C will attain 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 acts being always the same, a nearly constant velocity is always imparted. The disk is divided into 500 equal parts. A movable index serves to regulate the angle through which 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 small telescope, when the disk was illuminated by half-second flashes of an induction coil. The force of the spring and the position of the trigger releasing it were adjusted until the right velocity was obtained. Recently a condenser was discharged through a known resistance for some interval indicated 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, Publishers, 15 Astor Place.

The author's principal object in the preparation of this work has been the desire to reduce what is supposed to be self-evident to the smallest possible 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 defined has been shown to be possible, the omission of the theory of proportions and substitution of the equality of fractions therefor, besides various other minor points, which tend to render 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 logical and connected view of the science, will, it is believed, enable him to master the same in shorter 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 constructor—would make such sad disasters as 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 that happy facility of producing works with say seventy-five per cent less formulas and heavy mathematics, then (and not until then) will their books "meet the daily wants of the practising engineer." If all practising engineers 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 the 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 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 clear and simple. 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 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 Americans.

From March 9 to March 22, 1877, inclusive.

Animal Pulp.—L. Coburn, Worcester, Mass.
Boiler Furnace, etc.—B. Hershey, Erie, Pa.
Cancelling Stamps, etc.—W. Morris, Richmond, Va.
Electroplating Wire.—W. Wallace, Ansonia, Conn.
Fish Plate, etc.—J. Eno, Council Bluffs, Iowa.
Gas Retort Process.—W. Karr, Frostburgh, Md.
Horseshoe Bars.—W. M. Greenwood *et al.*, Cincinnati, Ohio.
Lathe.—W. S. Cooper, Philadelphia, Pa.
Lime Kiln Flue, etc.—W. S. Sampson, New York city.
Making Ice, etc.—E. A. Gillet, New York city.
Making Steel.—S. Barker, Knoxville, Tenn.
Ribbon Holder, etc.—H. V. Dempster, Washington, D. C.
Ruling Machine.—W. O. Hickok, Harrisburgh, Pa.
Sack-Sewing Machine, etc.—W. Webster, San Francisco, Cal.
Smelting Furnace, etc.—G. H. Moller *et al.*, Plainfield, N. J.
Stop Valve.—E. Russell, New York city.
Tramway Car.—J. Stephenson, New York city.
Washer, Gasket, etc.—Vulcanized Fibre Company, Wilmington, Del.

Recent American and Foreign Patents.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED METHOD OF ATTACHING KNOBS TO SPINDLES.

William De Courcy May, Baltimore, Md.—The object of this invention is to provide a means for preventing the loosening and loss of the screw 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.

IMPROVED SADDLE.

Henry Ruwart, Jefferson City, Mo.—This invention embodies certain improvements in saddletrees designed to render the saddle convertible at will into either a gentleman's saddle, a lady's saddle, or a "muly" or harness 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, 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 connecting 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 spring is sufficiently rigid to support the thills, while it is also sufficiently flexible to permit of the required latitude of motion. All rattling and noise are obviated by the improvement, and the thills are readily attached and removed. To afford additional security, a ring may be added 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 constructed that it will be applied to the wheels by the operation of holding 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 device excellently adapted to its purpose.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion. If the Notice exceeds four lines, One Dollar and a Half per line will be charged.

Notes & Queries

G. H. will find a table of the electric conductivities of metals on p. 107, vol. 33.—J. H. will find the proper dimensions of boats in recent numbers of the SCIENTIFIC AMERICAN SUPPLEMENT.—A. W. G. will find a 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. L. S.'s query as to the telephone is answered on p. 191, vol. 36.—J. C. E. will find a recipe for a depilatory on p. 186, vol. 34.—W. H. J. will find on p. 344, vol. 32, a recipe for cement for marble.—C. E. will find on p. 283, vol. 30, directions for polishing 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 on spring power on p. 220, 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 find an article on impressions on the retina on p. 193, vol. 36.—G. H. W. can polish German silver by following the 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, vol. 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. will find an article on the use of compressed air as a power, for locomotive purposes, on p. 277, vol. 34.—G. E. D. will find directions for gilding picture frames on p. 90, vol. 30.—J. V. will find directions for gilding without a battery on p. 116, vol. 33.—C. E. B. will find, 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. B., 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 scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) H. S. asks: How can I make a platinum chain? How can I melt platinum? A. Pure platinum can only be fused by the aid of the oxyhydrogen blowpipe. 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, when the gases are properly proportioned, within a quarter of an inch of the mouth of the blowpipe.

(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 parts common soda (sal soda), 1 part pumicestone, and 1 part finely powdered chalk; sift it through a fine sieve, and mix it with water into a paste. Apply this to the stained parts of the marble; and, after a short time, wash clean with water.

(3) E. H. T. says: I found on the Old Millstone Hill, in Worcester, Mass., several fine specimens of fluor spar. I can find no account of its being found 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 iodine 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 a purple-red tint is observed, while in others there is no 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, and the conversion has been entire.

(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 increase in length 5h. 44m.; one half, 2h. 52m., is in the morning, the other in the evening. Taking it altogether, there is as much change at one end as the other; but the 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 does the number of minutes added to the day's length vary so? A. They appear to have a daily fluctuation because the seconds are not taken into account. They also have a regular increase or decrease, dependent on the earth's position in its orbit.

(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 a cold from another, under ordinary circumstances, by being 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 aqueduct water be used in place of rain water for making ink? A. Such water may be used if it is clear and not 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 driven in rock? A. Yes.

Is sulphur injurious to leather? A. Sulphur alone is not injurious.

A friend says that the saw does not possess any of the mechanical powers. I say that each tooth acts on the 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 arrangement is such that, when the vessel is inverted, the contents mix, and carbonic acid gas is produced. Would it keep therein six months under high pressure? A. 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 every 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 will experience no injurious effects. 2. Does the fruit exhale carbonic acid at night? A. Very little.

(14) J. C. K. asks: What is the diameter of a circle whose area is 1 inch? A. 1·1284 inches.

Is there a dictionary of mechanical and chemical words? A. Yes; but as new names are very often coined for new articles or ideas, it is not probable that dictionaries which have been published for some years will have them all.

Why does a circular saw make marks in the lumber at every revolution? A. Because some of the teeth are set wider than the others.

(15) C. R. asks: What is the difference in temperature between the steam and the water in a boiler, under 70 lbs. pressure? A. The difference, in general, is not more than 5° or 6° Fah.

(16) W. T. says: 1. I understand that, if the safety valve of a boiler be raised when the steam pressure 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 overheated plates. 2. In a small yacht boiler, would it be injurious to keep steam down by throwing small quantities of water into the furnace? A. It would be better to use a damper and cover the fire. 3. It is recommended to raise the safety valve to let the air out of 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 troublesome to expel. Considerable instruction as to the duties of an engineer is scattered throughout treatises on the steam engine, as well as through the pages of the SCIENTIFIC AMERICAN.

(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 regulator 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 ought to hold the balance of power. Am I right? 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 steam drops down to 50 lbs.), 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 promptly, within the limits of the variation in the power of the wheels.

(18) A. S. asks: What ingredients and proportions are used to produce the different shades of light so often used in theaters? A. We give below a table of the composition of the mixtures commonly employed for colored fires in tableaux, etc. These fires, however, should never be used within doors, as the gaseous products of some of them are extremely poisonous (see articles on pp. 84 and 171, vol. 36). The lime light lanterns and lenses of suitably colored glass have now been generally substituted for these fires, and give much better results.

	a Green	b Red	c Yellow	d Blue	e White
Chlorate of potash	32·7	29·7		54·5	
Sulphur	9·8	17·2	23·6		20
Charcoal	5·2	1·7	3·8	18·1	
Nitrate of baryta	52·3				
" " strontia		45·7			
" " soda			9·8		
Ammonium sulphate of copper				27·4	
Saltpeter			62·8		60
Black sulphide of antimony		5·7			5
Floury gunpowder					15

It is hardly necessary to mention that great care is required in mixing these materials, and that each should be pulverized separately.

(19) R. A. asks: Does the Dipper revolve around the North Star? A. No. The Dipper and North 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 once 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 asked: 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 twice 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;

$$\frac{100-(12\times 2)}{20}=3·8, \text{ and } \tfrac{1}{2}\sqrt{100\times 8·8\times 1·2}=\tfrac{1}{2}\sqrt{1056}$$

$=11·441+$, for the area.

(21) C. asks: What is the best cement for 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 before using.

(22) G. S. asks: What will take the smell out of porpoise oil? A. Agitate the oil with about 3 per cent of sulphuric acid, and then with 10 per cent of chloride of lime (hypochlorite of lime) while moderately hot. Finally wash thoroughly with hot water and allow to settle. This treatment will not completely deodorize the oil, but it will correct all rancidity.

(23) L. H. says: 1. I have an engine of ½ 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 I learn the signals of the steamboat whistle, such as the pilots use? A. We advise you to interview a boatman.

(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." 3. In a 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 ⅛, ¼, etc., pipe taps, I send you a table and rule for computation. The outside diameters are from Morris and Tasker's table of standard sizes.

Inside diameter.	Outside diameter.	Outside allowing for the taper.	Diameter at bottom of thread — size of drill in inches.
⅛	·405	·362	·298
¼	·54	·497	·401
⅜	·675	·632	·509
½	·84	·777	·654
¾	1·05	·987	·837
1	1·315	1·252	1·102
1¼	1·66	1·586	1·436
1½	1·9	1·826	1·676
2	2·375	2·301	2·085
2½	2·875	2·769	2·553
3	3·5	3·399	3·183
3½	4·	3·899	3·683
4	4·5	4·399	4·183

The taper used in calculating is that given by Pratt and Whitney, 1 inch to foot and the length of threads on ⅛ to ⅜ is ½ inch, ½ to 1 is ¾, 1¼ to 2 is ⅞, and 2½ to 4 inches is 1¼ inches. The rule for computing size of drills is: Subtract from the outside diameter (after allowing for the taper) the product of the pitch by 1·732, which gives the diameter at the bottom of the thread, or the size of the required drill.

(26) M. C. H. says: I am building a time regulator and want to make a mercurial compensating pendulum to beat seconds. The rod is to be of steel, and the bob a glass tube filled with mercury. At what height must the mercury stand in the tube to compensate correctly? A. You will have to determine the exact height by experiment. It will probably be between 6½ and 6¾ inches.

(27) G. W. J. says: I have been making a plain cylindrical boiler, without flues. It is 9 inches in diameter and 20 inches long, of No. 18 galvanized iron. The seam is lapped 1¼ inches, and riveted with 2 rows of iron rivets, 3/16 of an inch in diameter, 35 in each row, and the rows are ½ inch apart; the edges of the iron are soldered inside and out. The heads are of cast iron ¼ inch thick, with flange ¼ inch thick and ⅝ inch wide, to receive rivets. Each is riveted with 56 iron rivets 3/16 inch in diameter. Where is the weakest point, and at 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 upwards to the square inch, that the pressure is equal on all parts of the boiler. A friend claims that it is not. Who is right? A. The one who claims that the pressure is not the same on all parts of the boiler, is correct.

(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, will it not run the lever to work the bellows? A. No.

(30) I. says: An inventor of a steam boiler states that he has used his boiler for eighteen months with muddy water, and that on inspection he finds no 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 scale-forming impurities? A. These statements are not verified, in general, by experience.

(31) S. U. says: We have a cast iron sectional 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 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 prevent 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 impurities. 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 ⅓ the perpendicular 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 ½ inch inside diameter. How many inches shall I have to raise the mercury in it to equal 1 lb. pressure? A. Height of column 2$\frac{1}{10}$ inches. 2. How much mercury shall I use? A. Volume of mercury, about $\frac{4}{10}$ of a cubic inch.

(34) F. L. asks: 1. Could I boil about 45 gallons of linseed oil in a large copper vessel, by having the steam and the steam pipe running into the oil, or would the water from the condensed steam affect the oil? 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 or four coats of the varnish? A. The quantity would be amply sufficient. 3. Would linseed 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 1½ ozs. to the gallon? A. No. Boil the oil with the addition of ¼ lb. of borate of manganese (in powder), and about 5 lbs. of beeswax to the barrel, and apply to the cloth slightly warm. 5. Is it best to varnish the muslin once before it is cut, and once after the ballooon is made, to cover the needle 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 afterward. 6. Would the black gum waterproofs, that the ladies wear in damp weather, do for making balloons? A. The material will not answer.

(35) N. V. says: I have been trying to make ink according to the recipe on p. 250, vol. 34, Scientific American, and found that it washed off. I thought that perhaps there was too much of the sulphate of indigo, and I increased the quantities of nutgalls and copperas one half; but it still washes off. What is 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 of, as the ink as made by you from the recipe mentioned compares very favorably with the best inks of this character in the market.

(36) W. S. asks: In building a residence, is there anything that is of value as preventing conflagration from sparks on shingle roofs? A. There is an asbestos paint that is said to answer the purpose very well.

(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 blowpipe? A. It is not dangerous when used in suitably constructed blowpipe lamps.

(38) G. H., Jr., asks: 1. How would hard blue burnt brick, set endwise in cement mortar, answer for a public street wi h heavy traffic, if the brick resists a crushing power of 8,000 lbs. to the square inch? A. It is not resistance to crushing so much as resistance to impact that is required in a good paving material, and the latter quality is not possessed even by the hardest brick. The hammering process that the pavement of a 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 cement 1 inch thick under the brick, and ¼ inch all round the sides of them, built in arch shape? A. When the cement is once set, it would not be materially affected by temperature.

(39) R. C. asks: How many degrees of Fahrenheit does it require to hatch chickens' eggs? A. From 104° to 106° Fah. is the proper temperature. You will find an article on this subject on p. 849 of Scientific American Supplement, No. 54.

(40) B. A. asks: Can you tell us the best method of making concentrated lye from ashes? A. Collect the ashes of well burnt wood, place them in a suitable vessel, and leach with water for several days, with occasional stirring. Then transfer the clear liquid to 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, and pour off the liquid. This liquid constitutes common caustic lye. A lye may also be obtained by treating ordinary pearlash or carbonate of soda (sal soda) with lime and water, as stated.

(41) J. A. L. asks: How can I make a photographic camera? A. The simplest form is a box with a pinhole 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 optical part, these being arranged with diaphragms, rack and pinion, etc. The boxes (from the above simple form) have an endless variety of forms: the bellows, the swing front, the elevating front, 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 the plate has many modern improvements.

(42) E. D. F. says: I am constructing a filter of 11 pipes, made of cedar wood, packed very solidly 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 spring. I want to put a tank above the filter, square or oblong in shape. What metal shall I line it with, or of what material shall I make it? A. A cast iron tank would answer your purpose. Plates 18 by 18 inches and 18 by 9 inches are kept in stock for this purpose; they are provided with flanges around their edges, by means of which they are 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 the traps siphon? If so, what is it that causes the trap 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 gas, which forces itself through the water in the traps into the rooms of your house, let the main waste pipe extend without obstruction from the sewer up through the 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 waste pipe being only an air pipe, may be of much less diameter than the lower part, which it is necessary to have of larger dimensions.

(44) T. B. says: I recently had to put on a false valve seat on a locomotive. There had been one on before, but I put the new one on differently, leaving three of the old holes in the cylinder. I filled these with Babbitt metal hammered carefully; and I made the metal flush with the surface, put on the seat, and took all precautions to make a good job. When the engine went on the road she "blowed" badly, and continued to get worse, so much so that I had to take the seat off again; and when off, I found the Babbitt metal raised above the surface of the old seat fully $\frac{1}{16}$ of an inch. Two of the old holes were between set screws 4½ inches apart, and one between screws 2½ inches apart, and the two were considerably higher than the one. Is it possible for the metal to expand so much as to cause that seat to leak? A. No doubt the leak was caused by the expansion of the Babbitt metal.

(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 my 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 from it. Let the well be 3 feet diameter in the clear after it is stoned up, and provide at the top two lengths of well-curb, 3 feet high each, to keep out the surface water. The depth of the well will depend upon the depth at which clear water runs in the ground in your locality. You had better employ a professed well-digger, who will contract to dig your well and stone it up at a certain price per foot in depth. The cucumber pump is highly spoken of.

Minerals, etc.—Specimens have been received from the following correspondents, and examined, with the result stated:

G. H. M.—It contains pyrolusite (oxide of manganese).—H. B.—It is clay slate.—H. M. A.—It appears to consist 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 specimens.—J. L. R., Jr.—It is marmolite, a variety of serpentine. It contains silicate of magnesia, magnesia, a trace of iron, and water. It is of common occurrence. It has been employed in the manufacture of Epsom salts, and, when in large, perfect pieces, as material for ornamental vases.—W. H. C.—It is galena—sulphide of lead—a valuable lead ore. It contains about 80 per cent of available metal.

COMMUNICATIONS RECEIVED.

The Editor of the Scientific American acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Micro-Photographs. 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 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 the Gyroscope. By J. M. A.

Also inquiries and answers from the following:
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.—N. J.—A. B. C.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Inquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who rolls thin plates of spring steel, of large size and without flaws? Who makes castings to order? Whose is the best theodolite? Who makes the best recording pressure gauge? Who makes the best steam engine for running small machines? Who sells horse power pumps?" All such personal inquiries are printed, as will be observed in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

OFFICIAL.

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A complete copy of any patent in the annexed list, including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city.

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