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THE EAST RIVER BRIDGE.

The rapid progress made during recent months, in the construction of the great suspension bridge between New York and Brooklyn, indicates that no very extended time will elapse before its stupendous network will have bound the sister cities together. The fine engraving which we present below affords an excellent idea of how the grand work will look when it is finished, to an observer stationed in front of the new ferry house on the Brooklyn side. Each of the massive towers is to be 278 feet high, eight feet less than Trinity church steeple. Two hundred and twenty-five feet of the Brooklyn tower, and about one hundred and twenty feet of that on the New York shore, are thus far completed. Work on the anchorage located in James street, Brooklyn, at about 800 feet from the tower, is advancing and the masonry is already several feet above the ground. The New York anchorage will probably be commenced early in the spring. At the present time but a small force of workmen are employed, as the prevalent cold weather interferes with continuous labor upon the masonry.

The length of the great span, which is represented across the river, is 1,600 feet, and its approach on the New York side is to start from near the City Hall, and ascend gradually the intervening distance of 238 feet. The elevation of the

center of the bridge above the water will be 130 feet, and the roadway 80 feet wide. The view from the latter will be one of the finest in the world, both in beauty and extent.

It is believed that this thoroughfare will, when completed, command an independent travel equally great with the existing ferries, which will retain their own business; and that even these two immense means of communication will ere long be insufficient to accommodate the rapidly increasing demands of the multitudes yet to line the shores, so that the building of submarine tunnels will eventually become a necessity.

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VOLUME XXX, No. 5. [NEW SERIES.] *Twenty-ninth Year.*

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Contents:

(Illustrated articles are marked with an asterisk.)

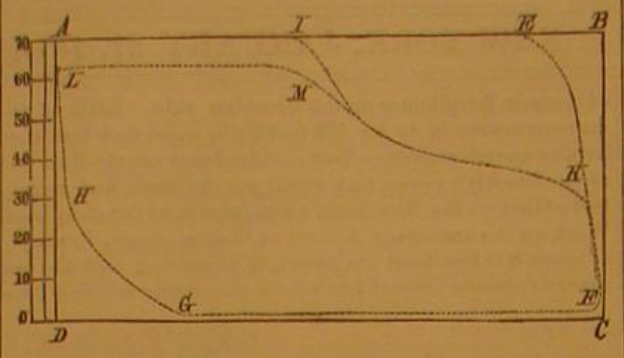
INDICATING STEAM ENGINES.

Questions from our correspondents, in relation to the power of steam engines, recur so often that we think it may be timely to devote some space to their general consideration. We are frequently asked what is the power of an engine of a given size, making a certain number of revolutions per minute, with a specified steam pressure. Most of our readers know that the horse power of an engine is equal to the mean effective pressure on the piston, in pounds, multiplied by the piston speed in feet per minute, and divided by 33,000. Hence those who send us queries of the nature mentioned above doubtless think that it will be an easy matter for us to determine the horse power. As a matter of fact, we suppose that very few of the answers we have rendered to these questions have been anything but rough approximation to the true solutions. We have been careful to hint as much, in working out each example; but perhaps it may be well to give a more definite explanation.

Referring to the rule for finding the horse power of an engine, it will be seen that the mean effective pressure on the piston is required. This, we believe, has never been sent to us. True, our correspondents give the pressure in boiler per steam gage, and sometimes mention the point at which the steam is cut off in the cylinder. They have never sent, however, to the best of our recollection, the amount of back pressure resisting the movement of the piston, the initial pressure of steam in the cylinder, the amount of steam and exhaust lead, and the point at which the exhaust cushion commences. We will endeavor to show how all these things affect the solution of the problem.

The following, taken from a back number of our paper, is a fair specimen of questions of this character: "What horse power has an engine of the following dimensions: Cylinder 9x16 inches, working at 63 revolutions per minute, with a pressure of 70 pounds to the square inch?"

Accepting our correspondent's statement as the correct one, we can readily represent the action of steam in the cylinder during the stroke by a rectangle, A B C D. Thus, while the piston is being acted upon by the steam, A B, 70 pounds above D C, on any convenient scale, will represent the steam or pressure line, the point, A, corresponding, to the commencement of the piston's stroke, and the point, B, to the end. When the piston has reached the end of the stroke, the exhaust valve opens, and the line, B C, represents the fall of the pressure from 70 pounds, per gage, to nothing. The piston then returns, and C D represents the pressure during exhaust. When the piston has returned to the starting point, the steam valve is opened, and the line, D A, shows that the pressure rises to 70 pounds again, for the next stroke. This, we say, is the graphical representation of the action of the steam, according to the data given by our correspondent. Our readers do not need to be told, however, that it is not usual to work engines in this manner, as it produces violent strains, and is far from being economical. The piston moves to and fro, and requires, of course, to be brought to rest before the direction can be changed. If it worked as represented in our diagram, the shocks that would occur each time the motion was reversed would be very severe. It is probable, then, that the exhaust valve commences to open, as at E, before the end of the stroke is reached. There will probably be some back pressure also, so that the exhaust line will be represented by F G, instead of C D. It is quite likely that the exhaust valve closes before the end of the return stroke, so that a cushion line, G H, is produced, and that the steam valve is set with lead, so



that it opens at H. It would appear, then, that perhaps a figure, A E F G H, may represent the action of the steam, instead of A B C D, and it will be seen that, if such is the case, the mean effective pressure per square inch will be considerably less than 70 pounds.

In the majority of engines, the steam valve has some lap, so that it is closed before the end of the stroke, and the steam is allowed to expand, producing an expansion curve, I K, on our graphical representation, in which case, A I K F G H, giving a still smaller mean effective pressure, will represent the action of the steam.

In general, the initial pressure of steam in the cylinder is less than the boiler pressure, from which it would appear that L M K F G H more probably represents the state of affairs, in our correspondent's engine, than A B C D.

Those who have followed us thus far will doubtless accept our original statement, that the best answers we can give to questions like the one under consideration will only be rough approximations. But it is possible to arrive at the truth, in cases of this kind. If a gage were attached to the cylinder, it would mark the varying pressure at different points of the stroke. The steam engine indicator performs this office admirably, recording the pressure at each successive point, thus forming essentially such a diagram as we have already represented. This is the only accurate method by which the mean effective pressure of the steam can be ascertained. The indicator shows, in addition, many things of interest and importance which our space will not permit us to consider at present. The importance of knowing the true power developed by an engine must be apparent to all our readers, and we need not enlarge upon it. The test of an engine with the indicator frequently discloses derangements and imperfections that could not be otherwise discovered. The indicator, however, is an exceedingly delicate instrument, and must be carefully manipulated to secure accurate results; hence tests of this character should be made by those who are truly experts.

We can readily perceive, from the numerous inquiries on the subject, that many of our readers realize the importance of knowing the power developed by their engines, and perhaps our remarks will be useful in showing them the means by which they can have their questions correctly answered.

DR. HENRY DRAPER'S RECENT DISCOVERIES IN SPECTROSCOPIC ANALYSIS.

In a recent number of the *American Journal of Science and Art*, there is an important paper on "Diffraction Spectrum-Photography," by Dr. Henry Draper, which is being reprinted in England, France, Germany, and Italy. Until quite recently, spectroscopic investigation has been conducted almost entirely by the aid of prisms; but the prismatic spectrum is far less suitable for exact inquiry than the diffraction spectrum produced by a grating of fine lines ruled on glass; because in the former case, the red end of the spectrum is contracted and the violet dilated, while in the latter the rays are presented in the true order of their wave lengths. Moreover, no two prisms give spectra that are exactly alike in the amount of this contraction and dilatation; and hence various observer have great difficulty in comparing their results together.

As all diffraction spectra are exactly alike, and, to use a technical term, they have no "irrationality of dispersion," it seems singular that prismatic observation has not long since been abandoned. But gratings have hitherto been very difficult to obtain; and, besides the spectrum produced by a grating is much fainter than that by a prism. Our distinguished townsman Mr. Rutherford has, however, constructed a machine which makes better rulings on glass than any heretofore produced, and it is with one of these that Dr. Draper has worked.

The main object of the present research has been to furnish a photographic map of the violet and ultra violet rays of the spectrum, to serve as a permanent reference map and to complete the great work of Angström, whose "*Spectre Normal du Soleil*" is unquestionably the most laborious and exact contribution to spectrum analysis made in recent times. Angström has, up to the present, failed in his attempts to do the very thing that Dr. Draper has succeeded in accomplishing so thoroughly. In many respects, indeed, Dr. Draper's work at the violet end of the spectrum exceeds in exactness that of Angström int he visible regions, as is well seen in the part between the fixed lines G and H, where the map of one observer overlaps that of the other. Many lines that Angström has omitted or misplaced are corrected by Draper; and in one place alone, 17 new lines are added.

By an ingenious device, the wave lengths of rays entirely invisible have been measured with an exactness exceeding that of those that are visible; and errors have actually been detected in some of the fundamental wave lengths of the standard test books.

The photograph which accompanies the paper is of beautiful definition and large size. If the whole solar spectrum were presented on the same scale, it would be about 10 feet long.

GAIL BORDEN.

Upon a shady knoll in the beautiful cemetery of Woodlawn near this city, in full view from the windows of the New Haven railway cars, stands a substantial family monument in granite, which at one time attracted the attention of the passing traveller by the peculiarity of the emblem by which it was surmounted. That emblem consisted of a milk can, cut of solid stone, representing in form and size the familiar utensil so commonly used here in our streets, for the transport and sale of milk. This was the chosen monument by which our friend Gail Borden, inventor and originator of the great industrial product now known as Condensed Milk, had desired to mark his last earthly resting place, when he should have been gathered to his fathers. The desire thus expressed was honorably characteristic of the individual. He was emphatically a man of the people; and although in process of time, by the success of his most excellent and useful inventions, he acquired great wealth, he ever regarded himself as one of the humblest of workers in the family of man; and the possession of riches never led him to put on aristocratic airs. He despised that sort of pride which makes some people ashamed of the humble origin of their progenitors, and wished that, in this respect, the very stones above his grave should teach a useful lesson. Surely they commemorate the truth that honest industry is better than titled birth.

Gail Borden was born in Norwich, N. Y., in 1801, his parents being New England people. In 1829 he removed to Texas, where he was always esteemed for his probity of character and earnest efforts for the public good. He was at one time a United States Surveyor, afterwards a newspaper conductor, then the Collector of the port of Galveston, when Texas was known as the Lone Star Republic. In 1853 he succeeded in producing Condensed Milk, as a permanent article of manufacture, which he accomplished by concentrating in vacuo. We well remember his early efforts in this direction, which were most persevering and arduous. The Patent Office for a long time refused to issue his patents, but finally yielded, and the new manufacture then received its first impulse. Mr. Borden's patents were obtained through this office. For over twenty years we enjoyed the uninterrupted friendship of this truly excellent man. Genial, kind-hearted, benevolent, his life was a most useful one and his memory blessed. He died on the 11th of January, 1874, aged 73 years, at Bordenville, Texas, where he had established a large factory for the production of concentrated foods, chiefly meats. He leaves a large and interesting family. His remains are to be brought to Woodlawn. The trustees of the cemetery have removed the granite milk can from his monument, as an infringement upon the rules of fastidious taste. But no one can blot out the record of his noble life, nor the splendid results of his long and useful labors.

Gail Borden was the inventor and first introducer, in merchantable form, of Condensed Milk. He may be said to have supplied the world with a new article of food. Medical authorities give it the highest place in the nourishment of the sick and the young. He lived to see the use of this most valuable product extended over the globe. Nearly all civilized nations, following his patterns and instructions, now have their factories for the supply of the article, which, as the years roll on, will be still more highly valued, while the work of its production will employ the industry of thousands of people. Gail Borden may be truly styled a benefactor of his race.

STEAM ON CANALS.

We have before us a report of the trial trips of the steam canal boat, William Newman, through the Erie canal, in the seasons of 1872 and 1873. We have also the report of Engineer Greene on the trials of 1872. His report on the trials of last season has not yet been received. The figures in these reports only confirm what has frequently before been shown by experiment: that it is not sufficient to put a good engine into a boat to ensure success; the boat must also be modeled to suit the engine. The ordinary canal boat, built in the form of a box in order to obtain great carrying capacity, cannot be propelled directly by steam power as cheaply as it can be towed. Thus it appears, from Mr. Greene's report, that the engine of the William Newman, in the trip made in 1872, developed an average indicated horse power varying between 30 and 35, to produce an average speed of 2·727 miles per hour. This same speed could probably have been effected by towing with from 3 to 4 horses, and it is easy to see that the steam power is much the most expensive. The power developed in the trial trip in 1873 is not stated; but from the data given, it probably exceeded 50 horse power, to produce a speed of 3·691 miles per hour. It is because such slow speeds are required on the canals that the inefficiency of this mode of propulsion is not at once apparent. If an ocean steamer only utilized about 12 per cent of the power developed by the engines, probably the vessel would not be large enough to contain the machinery that would be required to produce a speed of 14 knots an hour. It appears to

us that the prize offered by the Legislature has stimulated invention in the wrong direction. It is scarcely possible to give a canal boat the form required for a steamer, without seriously reducing the carrying capacity. It would seem better, then, to place the engine on a separate vessel, which could be properly designed, letting this vessel take the place of horses to tow the canal boats.

A YEAR'S INVENTIVE PROGRESS.

The following schedule indicates the progress of invention in the United States during the year 1873, and consists in a list of the number of patents issued by the United States Patent Office to citizens of each State and Territory, to foreign subjects, and to members of the Army and Revenue Marine Service. The table also shows the relative ratio of patents obtained to the population of each political division:

To citizens of	Number of patents.	Population to one to each	To citizens of	Number of patents.	Population to one to each
Alabama	43	23,185	Montana Territory	3	6,83
Arkansas	11	44,041	Nebraska	28	4,393
California	251	2,252	Nevada	19	2,236
Colorado Territory	8	4,983	New Hampshire	127	2,506
Connecticut	622	860	New Jersey	614	1,475
Dakota Territory	30	7,090	New Mexico Ter	1	91,874
Delaware	43	31,250	New York	2,826	1,551
District of Columbia	109	1,208	North Carolina	58	18,472
Florida	8	23,468	Ohio	832	3,203
Georgia	53	22,341	Oregon	19	4,785
Idaho Territory	1	14,999	Pennsylvania	1,639	2,148
Illinois	844	3,009	Rhode Island	167	1,201
Indiana	311	5,404	South Carolina	25	28,234
Iowa	246	4,854	Tennessee	105	11,986
Kansas	73	4,859	Texas	109	7,510
Kentucky	114	11,590	United States Army	8	3,750
Louisiana	26	7,512	U. S. Rev. Marine	1	
Maine	139	4,510	Utah Territory	8	10,848
Maryland	191	3,088	Vermont	87	3,914
Massachusetts	1,379	1,957	Virginia	76	16,120
Michigan	256	3,326	Washington Ter	6	3,992
Minnesota	110	3,997	West Virginia	42	10,524
Mississippi	55	15,053	Wisconsin	217	4,860
Missouri	288	8,975	Wyoming Territory	3	4,559

Total to citizens of the United States 12,371, or one patent to each 3,116 of the population. Total granted to citizens of foreign countries, 491. Grand total, 12,862, which includes reissues and designs, but not trade marks.

With reference to sectional distribution, the foregoing schedule reduces itself to the following;

Middle States	5,119	Territories and the District of Columbia	140
Western States	3,038		
North Eastern States	2,521	United States Army and Revenue Marine	9
Southern States	1,574		
Pacific States (Cal. & Oregon)	270		
Total	12,371		

By inspection of these data it is shown that, as compared with the number of patents issued in 1872, the aggregate of 1873 is smaller by 140 for citizens the United States, and by 31 for dwellers abroad. Considering numbers merely, New York stands first, with 2,826, and New Mexico and Idaho last, with but 1 each. Connecticut, however, fairly heads the list, as relative population must also enter into the calculation; her ratio is 1 patent to every 860 souls. The District of Columbia is next, with a proportion of 1 to every 1,208. Arizona and Alaska are entirely unrepresented, and New Mexico has but a single patentee for 1873 among her whole population of 91,874. The Southern States still present a low average; and in proportion to their population, fall behind all the rest of the country. A slight increase of four patents is noticeable over the aggregate of 1872. The list of States which show an increase over last year includes the following: Alabama, California, Iowa, Kansas, Louisiana, Maryland, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, North Carolina, Pennsylvania, Tennessee, Texas, and Washington Territory, also the United States Army. The remainder have decreased or else remained stationary.

It may be added as an interesting and perhaps significant fact that, in the four political divisions in which the least number of patents have been granted, the circulation of the SCIENTIFIC AMERICAN is the smallest; and in other States, the ratio increases in proportion to the circulation of this paper among its inhabitants. Thus in New York, the State having the largest number of patents, our patrons exceed those of any other State; while in New England and the West, whence, as the statistics show the most inventions emanate, the SCIENTIFIC AMERICAN has the greatest circulation.

PROCEEDINGS OF THE PATENT CONVENTION.

The Patent Convention, the call for which was recently alluded to in our columns, began its labors at Washington, on January 15th. Some two hundred delegates were present. The following is the organization:

President, J. M. Thacher; Vice Presidents, N. R. Graham, W. W. W. Wood, H. E. Towle, Miles Pratt; Secretaries, J. C. Bancroft, W. C. McIntyre, and C. F. Stansbury. The resolution of the Vienna Congress, declaring that the protection of inventors should be guaranteed by the laws of all civilized nations, for the reasons given, was adopted. The second resolution, declaring that an effective and useful patent law should be based on the principles set forth was modified by adding:

"A patent should be granted for a term of seventeen years, with a privilege of extension for the benefit of the inventor or his heirs for a further term of at least seven years." Several resolutions were offered touching upon the inventors' interests and the patent laws of the United States. C. M. Parks presented a resolution, recommending that Congress make use of the surplus fund of the Patent Office, now in the United States Treasury, for the erection of a suitable building in Judiciary square, for the exhibition of the models of inventions. This fund is stated to be over $1,000,000. Further reports in our next.

VERMIN KILLER.—Doré patents the use of the following mixture for the destruction of bugs, fleas, ants, etc., and their eggs: Bisulphide of carbon 80 parts; petroleum essence 20 parts. The liquid is to be applied to furniture, etc., by a brush.

PSYCHIC FORCE.

Some time ago we published an account by Dr. William Crookes, the distinguished scientist of London, editor of the *Quarterly Journal of Science, Chemical News*, etc., of his experiments and observations in connection with the phenomena of Spiritualism. We gave engravings of the special apparatus designed by Dr. Crookes for the purpose of detecting the fraud, if any existed, and of measuring the actual degree of invisible force that was alleged to be exerted. This apparatus consisted of a self-registering balance, which, to the surprise of the Doctor and his friends, went down before their eyes and registered a considerable degree of force, when the medium, Home, simply pointed his finger at the balance, but did not touch it. The force thus manifested was designated psychic force by Dr. Crookes. The publications of the learned Doctor attracted much attention at the time, and subjected him to the severest ridicule among the learned. He however promised to pursue the investigations and publish further reports. This he has now done, and announces his intention to give still further details. Most of the wonders which he now describes took place in his own house, and were witnessed by parties of friends, all of whom give concurrent testimony as to the actuality of what is stated.

These spiritual performances seem to involve something which, as Lord Dundreary would say, "no fellow can find out," and the Psychic Force theory of Dr. Crookes is perhaps as acceptable as any, while none of them tell us how the thing is done. None of the doings here recited surpass the tricks of the magician Hartz of this city—the box trick, for example, recently mentioned by us. The box is first tied up and sealed, then entirely folded up within a canvas sheet, and again tied and sealed, all being done by a committee of detectives before the audience. Into this box, in the course of two minutes time, Hartz then introduces a man, without disturbing the canvas envelope, ropes or seals. Other equally curious performances might be mentioned, which, we believe, have never been explained.

A correspondent of the New York *Tribune* says that, in classifying the various phenomena that have presented themselves to him in the course of his enquiries, Mr. Crookes refers, first, to the movement of heavy bodies, with contact but without mechanical exertion. This he states to be one of the simplest forms of the phenomena observed, varying in degrees from a quivering or vibration of the room and its contents to the actual rising into the air of a heavy body when the hands of the medium are placed upon it. These movements, and indeed most of the phenomena, are preceded by a peculiar cold air, sometimes amounting to a decided wind, sufficient to blow a sheet of paper about the room and to cause a lowering of the thermometer by several degrees.

The second class manifested themselves as percussive and other allied sounds; sometimes as delicate ticks; sometimes a cascade of sharp sounds, as from an induction coil in full work; detonations in the air, sounds like scratching, twittering as of a bird, etc. The third class of phenomena consists in the alteration of the weight of bodies. The fourth class, namely, the movement of heavy substances when at a distance from the medium, he has seen in many instances. An empty arm chair, at his request, moved to where he was sitting, and then slowly back again, a distance of about three feet. He has seen the movement of a heavy table, and chairs turned with their backs to the table, about a foot and a half off, each occupant kneeling on his chair, with hands resting on the back, but not touching the table. The fifth class is that of the raising of tables and chairs off the ground, without contact with any person.

The sixth class is that of the levitation of human beings, which has occurred in four instances in his presence. He has seen Mr. Home raised completely from the floor of his room in several instances. The accumulated testimony, establishing Mr. Home's levitations, Mr. Crookes considers overwhelming: and he thinks it greatly to be desired that some person, whose evidence will be accepted as conclusive by the scientific world, shall seriously and patiently examine these alleged facts. The seventh class of phenomena consists in the moving of various small articles without contact with any person, which he has very frequently observed, and where there could be no suspicion of trickery. He thinks that when he is in his own dining room, seated in one part of the room, with a number of persons keenly watching the medium, the latter could not, by any trickery, make an accordeon play in his (Mr. Crookes') own hands, when the keys are held downward, or cause the same accordeon to float about the room, playing all the time. He thinks it impossible to introduce machinery which shall wave window curtains; pull up Venetian blinds eight feet off; tie a knot in a handkerchief and place it in a remote corner of the room; sound notes on a distant piano; cause a card plate to float about the room; raise a water bottle and tumbler from the table; make a coral necklace rise on end; move about a fan so as to fan the company, or set in motion a pendulum when enclosed in a glass case firmly cemented to the wall. The eighth class is that of luminous appearances. He has seen a solid self-luminous body, of the size and nearly the shape of a turkey's egg, float noiselessly about the room, being visible for more than ten minutes, and striking the table three times, with a sound like that of a hard solid body, before fading away. He has seen a self-luminous crystaline body placed in his hand by a hand which did not belong to any person in the room, and a luminous cloud floating upward to a picture. In the daylight he has seen a luminous cloud hover over a heliotrope on a side table, break off a sprig, and carry the sprig to a lady; and on several occasions he has seen a similar luminous cloud visibly condense to the form of a hand, and carry about small objects.

The ninth class consists of the appearance of hands, either self-luminous or visible by ordinary light. In one case a small hand rose up from an opening in the dining table and gave him a flower. The hands and fingers do not always appear solid and life-like, sometimes indeed seeming like a nebulous cloud, partly condensed in the form of a hand. He has more than once seen first an object move, then a luminous cloud appear to form about it, and lastly, the cloud condense into shape and become a perfectly formed hand. At this stage it was visible to all present. Sometimes it was life-like and graceful, the fingers moving and the flesh apparently as human as that of any person in the room. At the arm or wrist it became hazy, and passed off into a luminous cloud. To the touch the hand appeared sometimes icy cold and dead, at others warm, grasping his own with the firm pressure of an old friend. In one instance he retained one of these hands in his own, firmly resolved not to let it escape. There was no struggle, no effort to get loose, but it gradually seemed to resolve itself into vapor, and faded in that manner from his grasp. The tenth class comprised direct writing, exhibited sometimes in darkness, sometimes in light, sometimes without any apparent agency, at others through the medium of a hand. The eleventh class embraces the rarest phenomena, namely, those of phantom forms and faces, which he witnessed in a few instances only. The twelfth class covers phenomena that seem to point to the agency of an exterior intelligence, other than that of the medium or some person in the room. Although the hypothesis has been suggested that the medium is the source of this intelligence, by those who think they see in this an explanation of many of the facts, yet Mr. Crookes has reason to believe that, in certain instances at least, they result from the agency of an outside intelligence not belonging to any human being present.

SCIENTIFIC AND PRACTICAL INFORMATION.

EXTRACTION OF QUICKSILVER AT NEW ALMADEN, CAL.

The mineral is treated as at Idria, that is, it is roasted in great cylindrical furnaces in which it is placed between successive layers of wood. The mercurial vapors are condensed in walled chambers. The presence of lime in the minerals greatly facilitates the disengagement of the metal. 4,400,000 pounds of mercury are thus yearly obtained at an expense of about $27 per 100 lbs. At Almaden in Spain the annual product is 2,200,000 ounds, costing from $90 to $180 per 100 pounds.

A NEW USE FOR INFUSORIAL SILICA.

Infusorial silica has been strongly recommended for surrounding ice, ale, and beer cellars, fireproof safes, steam boilers, and powder magazines. A firm in Germany have recently made a series of experiments on a large scale, and they assert that the use of this earth has reduced the melting of ice in a cellar during the summer from 23,500 to 10,000 pounds. This material is not inflammable, and is not in the least affected by the hottest fire and it prevents the entrance of rats and mice.

ELECTRIC DISCHARGES IN AIR.

By allowing a series of sparks from an electromagnetic induction apparatus to be discharged between platinum electrodes in perfectly dry air, Böttger noticed the formation of yellow vapors; and after the lapse of a few minutes, nitrous acid was recognized by the smell. If the sparks are passed through very moist atmospheric air, or if the sides of the glass vessel in which the experiment is conducted are moistened with distilled water, and time is allowed to collect at the bottom, no yellow vapors are formed; but the air, in a few minutes, acquires the characteristic odor of ozone, while in the water the presence of hyponitric acid can be detected. Iodide of potassium and starch paper, the test in common use for the detection of ozone in the air, is thus shown to be an untrustworthy reagent, as it must in many cases turn blue by nitrous acid. It behoves meteorologists, now that their attention has again been directed to these facts by Professor Böttger, to ascertain the exact condition of moisture under which the acid is produced, and to establish a process for the estimation of ozone, which shall be of absolute certainty.

Dr. Dotch of New York, who has for years occupied himself with the artificial generation of ozone, states that strips of paper saturated with the tincture of guaiacum afford a more sensitive and certain reagent or test for the presence of ozone than either the iodide of potassium and starch or paper containing protoxide of thallium; and that such an ozonometer can be relied on to show at least 10 gradations or shades.

SCIENTIFIC GHOULS.

The tomb of Petrarch was recently opened on the occasion of the centenary of the poet. The bones were found in quite perfect condition and of an amber color; other than which, we fail to note a single fact of the slightest interest in the long account of the ceremony published by a foreign contemporary. It strikes us that the spectacle of a body of scientists, calling themselves the "Academy of Bovolenta," breaking open the grave of a great man, pawing over his bones, and glaring at his dust through their eyeglasses, with apparently no other object than to make him share his coffin with a bottle contain' list of their names, must be refreshingly idiotic.

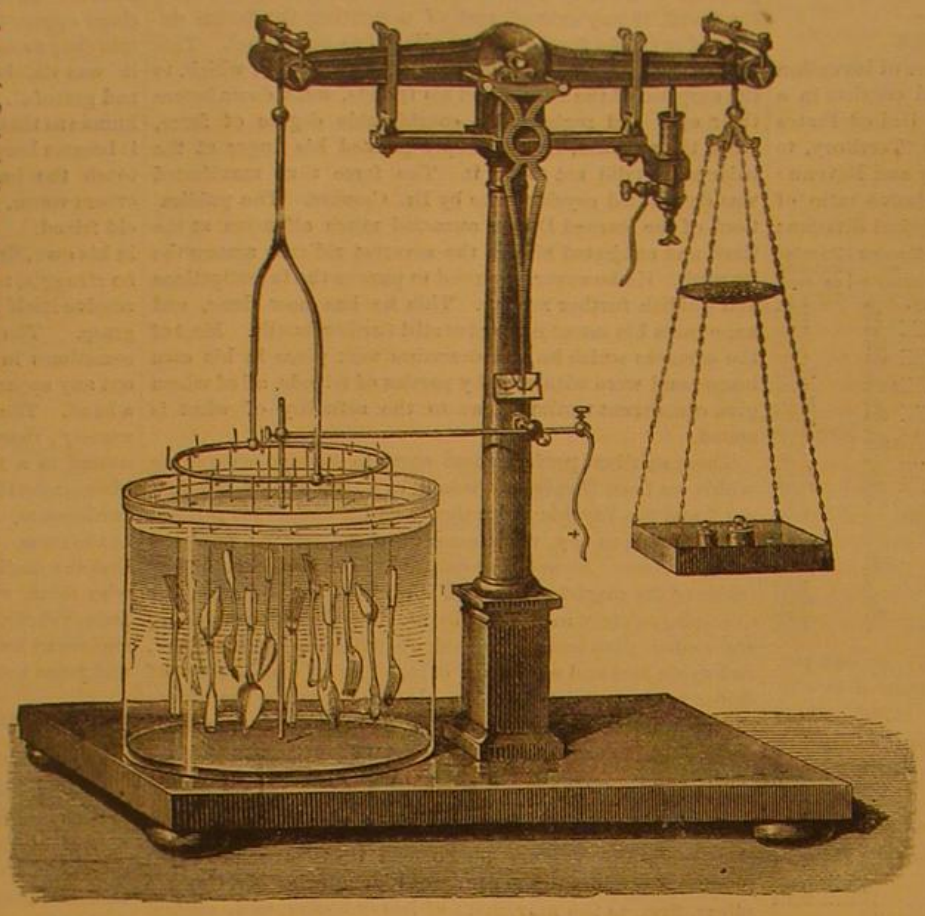
OZONIZED WATER.

Ramelsberg states that some of the substances sold as ozonized water owe their action to the presence of chlorine. Behrens and Jacobsen, on the other hand, find that some ozonized water is only a dilute solution of hypochlorous acid.

ELECTRO-PLATING BALANCE.

In the operation of electro-plating with gold or silver, a convenient means of regulating the exact amount of metal to be deposited on the articles is afforded by the automatic apparatus herewith illustrated, the invention of M. Roseleur, of Paris.

The objects are suspended in the bath, as shown, from one arm of a scale beam. A horizontal rod, fixed to the standard, supports at one extremity the soluble anode in the bath, and at the other connects with the positive pole of the battery. The opposite arm of the beam carries two scale pans, in the upper of which is placed a weight sufficient to produce equilibrium in the apparatus. In this position, the current does not pass, since the rods carrying the objects which form the negative pole are not in connection with the battery. But if in the lower pan of the balance are placed weights, corresponding to the amount of precious metal which it is desired shall be deposited, the equilibrium is destroyed. Necessarily the beam descends to the right, and, at the same time, plunges a metallic point into a cup filled with mercury which is in communication with the negative pole of the battery. The circuit being thus established, the operation progresses and continues without necessitating attention, until a quantity of the anode is deposited on the objects, of sufficient weight to cause equilibrium with the weights in the lower scale pan. The beam then becoming once more horizontal, the point is withdrawn from the mercury, the current is broken, and the action ceases.



ROSELEUR'S ELECTRO-PLATING BALANCE.

Fecundation of Vegetables.

M. Beer announces that he has put Hoolbreuk's process for the fecundation of vegetables in successful practice in the Botanic Garden of Vienna.

This process, which, it would seem, achieves important results, consists simply in touching the extremity of the pistil (the stigma) of the flower, just before it blooms, with a pencil dipped in honey or, better still, with honey mingled with the pollen of the same plant on which the operation takes place. The process has succeeded admirably, it is stated, on fruit trees, and even on certain particular branches of trees which had never borne. On the portions thus treated, fruit formed in natural course, while other parts remained in their normal condition.

THE YAMA-MAI, OR OAK TREE SILKWORM.

The Yama-mai is a species of silkworm common in Japan, which derives its sustenance from the leaves of oak trees. It has recently been introduced in Europe with considerable success, and is readily acclimated. In Austria, it is stated that Baron Bretton has obtained from a third generation 4,000 cocoons and 300,000 eggs. Our illustration, for which we are indebted to *La Nature*, shows the worm fully developed and in its natural size, the young enlarged (1), and also the egg considerably magnified (2). The egg is round and slightly flattened in form, of a brown color, more or less dark, and is covered with black granules. Its greatest diameter is 0·09 inch, and its thickness varies according to the state of incubation. As soon as the young worm emerges, it rapidly attains, owing to its contact with the air, a size greater than it had in the egg. In a short time it grows to a length of 0·21 inch, as indicated in the lower portion of our engraving. The head, first thoracic segment, and the legs, are of a reddish mahogany tinge, without spots, and the rest of the body is a golden yellow, the color of gamboge. All the segments, from the second to the eleventh, are traversed by five longitudinal and sharply distinguished black lines. At the end of the first age, which lasts sixteen days, the caterpillar, after its change of skin, is 0·45 inch in length and of a subdued green color, slightly yellowish underneath. At the third age, after a second change of skin, the length increases to 1·1 inches, and the green color becomes brighter. Subsequently, during the fourth age, the body grows to 2·7 inches, and finally to 3·2 inches, when it becomes fully developed. The color at this period corresponds very closely to that of the leaves on which the worm feeds.

The caterpillar now begins its cocoon, uniting two leaves with several threads, which are, in turn, secured to branches. Its nourishment consists in the tenderest branches, contrary to the ordinary habits of other worms. Finally, it ejects a large drop of transparent liquid and begins to spin. The chrysalis, which is the sixth age of the caterpillar, is contained in a closed cocoon. In order to open the latter, a reservoir of liquid is supplied at the rear end, which fluid has the property of softening the silk, so that the butterfly can readily break its way out. The cocoon strongly resembles that of the ordinary mulberry leaf silkworm, and the raw silk is readily mistaken for the work of the latter.

After a repose of fifty days the butterfly appears, and is of a bright golden yellow tinged with orange on the wings and body. The head is reddish, with light colored antennæ, and the under sides of the wings are brown with gray spots.

The importation of silk worm eggs from Japan to Europe is now in extensive progress, and it is an interesting fact that, in place of transporting them *via* the Isthmus of Suez, as heretofore, the transcontinental route is preferred. The first shipment ever thus made, consisting of nine tuns of eggs, valued at $200,000, recently arrived at San Francisco, from Japan, and were dispatched in a freight car to the Atlantic coast for transmission to Milan, Italy. They were packed in leaves, in layers, in airtight tin boxes, which, in turn, were covered with matting. The interior of the car was kept below the freezing point, and light carefully excluded.

THE YAMA-MAI OR OAK TREE SILKWORM.

A variation of seven degrees of temperature, it is said, would be sufficient to kill the germs. By this route the time required to reach Milan, from Yokohama, is forty-two days; while, by the passage through the Indian Ocean and the Suez canal, it could be effected in thirty-nine days. The number of transhipments would be the same in both cases; but the American route passes through temperate latitudes, while the other would expose the eggs to the extreme of tropical heat.

A SOLUTION of pearlash in water, thrown upon a fire, extinguishes it instantly; the proportion is 4 ounces, dissolved in hot water, and then poured into a bucket of common water.

Preservation of Vegetables by Drying.

The vegetable designed to be acted upon is first picked and washed, then placed in a large drying room, fitted with shelves and sieves for the spreading, shaking, and turning of the vegetables during the drying, and supplied with dry air at a temperature of from 95° to 100° Fah., and from which the moist air is discharged through the chimneys. After this they are subjected to pressure, formed into tablets of a certain size, wrapped in tin foil, and then packed in tin cases for preservation and for sending away. To prepare this for use, it is only necessary to steep it for one hour in warm water, and then cook the same as fresh vegetables.

The following is an extract from the Annals of the Central Horticultural Society of France: "It appears that there is established in Paris, at No. 5 Rue Marbœuf, under the direction of Messrs. Chollet & Co., a manufactory for the preparation, by the process of M. Masson, of vegetable substances, with which the French navy and commercial marine are furnished. The Horticultural Committee pronounced the opinion that the desiccating process of M. Masson preserves vegetables without altering their constitution, and reduces them to a small bulk without impairing their flavor or nutritive qualities. M. Masson's processes are applied with entire success to most vegetables and several fruits. Thus all cabbages, spinach, parsley, cress, chervil, succory, and sorrel, are dried and pressed to a very small volume. It is the same with carrots, turnips, parsnips, celery, salsify, and viper's grass, which are cut in thin slices and into small pieces, to make Julienne. Cauliflowers, Brussels sprouts, asparagus, and string beans, in order to resume their natural appearance, should not be pressed. Potatoes are perfectly preserved in thin slices. Peas and beans, in a green state, are succeeded with very well. Lastly, various fruits, and especially apples and pears, in slices, are also dried, and keep perfectly."

Charcoal and Tar as a Surgical Dressing.

The London *Lancet* strongly recommends the use of a mixture of charcoal and coal tar, containing 33 per cent of the latter, in pulverized form, as a dressing for wounds. The powder exercises no irritative action, and is easily removed by lotions of cold water. The charcoal absorbs gases due to fermentation, coagulates the albumen, and prevents decomposition, in this respect materially aiding the action of the carbolic acid contained in the coal tar. For wounds which cannot bear the contact of the powder, 100 parts of pulverized coal tar are macerated for some hours in 400 parts of rather weak alcohol. The solution is said to be very efficacious.

Salt in Sickness.

Dr. Scudder remarks: "I am satisfied that I have seen patients die from deprivation of common salt during a protracted illness. It is a common impression that the food for the sick should not be seasoned, and whatever slop may be given, it is almost innocent of this essential of life. In the milk diet that I recommend in sickness, common salt is used freely, the milk being boiled and given hot. And if the patient cannot take the usual quantity in his food, I have it given in his drink.

This matter is so important that it cannot be repeated too often, or dwelt upon too long.

The most marked example of this want of common salt I have ever noticed has been in surgical disease, especially in open wounds. Without a supply of salt the tongue would become broad, pallid, puffy, with a tenacious pasty coat, the secretions arrested, the circulation feeble, the effusion at the point of injury serous, with an unpleasant watery pus, which at last becomes a mere sanies or ichor. A few days of a free allowance would change all this, and the patient get along well."

New Method of Preparing Aluminum.

The oxide of aluminum is first prepared by any of the processes now in use, either from kaolin or clay. It is then mixed with wood charcoal in the proportion of 40 parts charcoal to 100 of alumina, and heated to a red heat. While still hot, the mass is placed in retorts heated to dark redness, and chlorine gas is passed over it from a gasometer. The volatile chloride is condensed in the receiver, and afterwards decomposed by the battery; the chlorine which is set free is returned to the gasometer to be used over repeatedly. Garneri employed a magneto-electric apparatus.

HYDRAULIC ENGINEERING EXTRAORDINARY.

An iron conduit has recently been constructed which, according to the *Mining and Scientific Press*, sustains the greatest water pressure in the world, namely, 1,720 feet, or 750 pounds to the square inch. It carries the water supply of Virginia City and Gold Hill, Nevada, from Marlette lake, situated at an elevation of about 1,500 feet above the former town, over a valley seven miles in width, the sides of which are steep and precipitous, and through a route presenting engineering difficulties of unusually troublesome nature. The most awkward feature of the undertaking begins at an elevation of 1,885 feet above the track of the Virginia and Truckee railroad, at a point about two miles west of Lake View Toll House, and thence follows by an easterly course the crest of the spur from which it starts: crosses the valley, at the toll house referred to, and gradually ascends to its outlet end, making the entire length 37,100 feet. The water at present is taken from Dall's Creek by an 18 inch flume four miles long, to the inlet, or western end of the pipe. From the outlet or eastern end of the pipe, the water is conveyed through a flume of the same size, nine miles long, into Virginia and Gold Hill, where it connects with the present city pipe system. In the future the water from Marlette lake will be conveyed to the inlet of the pipe, and be added to the supply from Dall's Creek.

All the iron pipe used is coated, inside and out, with a mixture of asphaltum and coal tar, thoroughly boiled together, each separate piece being plunged and rolled about in a bath of this mixture for from seven to ten minutes before being shipped to its destination. The average diameter of the pipe is 11½ inches, and its entire weight about 700 tuns. Nearly one million rivets were used to manufacture it, and some 35 tuns of lead were required in making the joints. At the point of heaviest pressure the iron is No. 0 thick, and is hot riveted with five eighths inch rivets, there being a double row on the straight seam and a single row on the round seam. The pressure gradually decreases as the ground rises to the east and west, and the iron decreases in thickness from five sixteenths to one sixteenth of an inch toward both inlet and outlet. But on its course to the outlet, it having to cross a great many spurs and sags, the iron varies of course according to the pressure.

The inlet has a perpendicular elevation above the outlet of 465 feet, but just now only 300 feet is used, as this head will supply ten times as much as the two towns have heretofore had. This head carries into Virginia about 2,000,000 gallons every 24hours; and by increasing the head to its fullest capacity, the supply can be increased to 2,350,000 gallons per day.

Fig. 1 will convey an idea of the country over which this undertaking was carried out as it shows the profile of the pipe. The remaining engravings represent various ingenious plans adopted in the construction. Fig. 2 shows a lead joint in detail, said to be perfectly tight and safe. One of these joints is made between every two lengths of pipe of 26 feet 2 inches in length each; *a* is a wrought iron collar, always one sixteenth thicker than the thickness of iron in the respective pipe, leaving a play of three eighths of an inch between the inside of the collar and the outside of the pipe. The collar is five inches wide. *b* is the lead which is run in and caulked up tight from both sides three eighths inch thick; C is a nipple of No. 9 iron, riveted in one end of each pipe.

Fig. 3 shows the method of tightening leaky joints. At A is the clasp the application of which, for forcing back the lead where it works out on account of the longitudinal expansion and contraction of the pipes, is clearly evident. A clamp is used to keep the lead afterwards in place. Fig. 4 is the elbow used for making short curves in the line of the pipe around rocky bluffs, through sharp cañons, etc. At B are angle irons riveted on the pipe on the outside of the curves which, by means of iron straps, are connected with the corresponding angle iron on the next pipe. Fig. 4 shows the manner in which the pipes and elbows were strapped together, wherever the curve was sufficiently short to require this precaution against an outward movement. The iron strap is put on the outside of the curve to strengthen the pipe. Fig. 5 shows the self-acting air or vacuum valve, used at each high point on the line of pipe. When the water is on, the valve, A, is kept wide open; the small valve, C, is shut, while the valve, B, is shut by the pressure. If any air accumulates in the pipe, on the elevation where this air cock is placed, it is occasionally blown off, by opening the cock, C. Should a break occur in the main pipe line at a point lower than the air cock, and within its district, the valve, B, falls down and admits the air into the main pipe so as to prevent a vacuum. Should the valve, B, get out of order, the valve, A, is shut, and the other valve, B, taken off and repaired. After a break on the main line is repaired, and the water let on again, the valve, B, being down or open, the air rushes out at B, its stem being weighted by the weight, D, so as only to close when the water begins to escape.

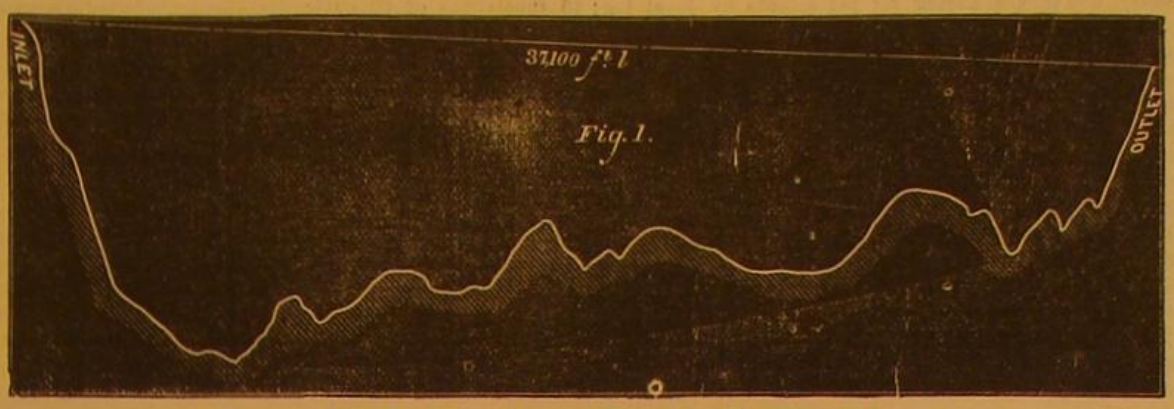
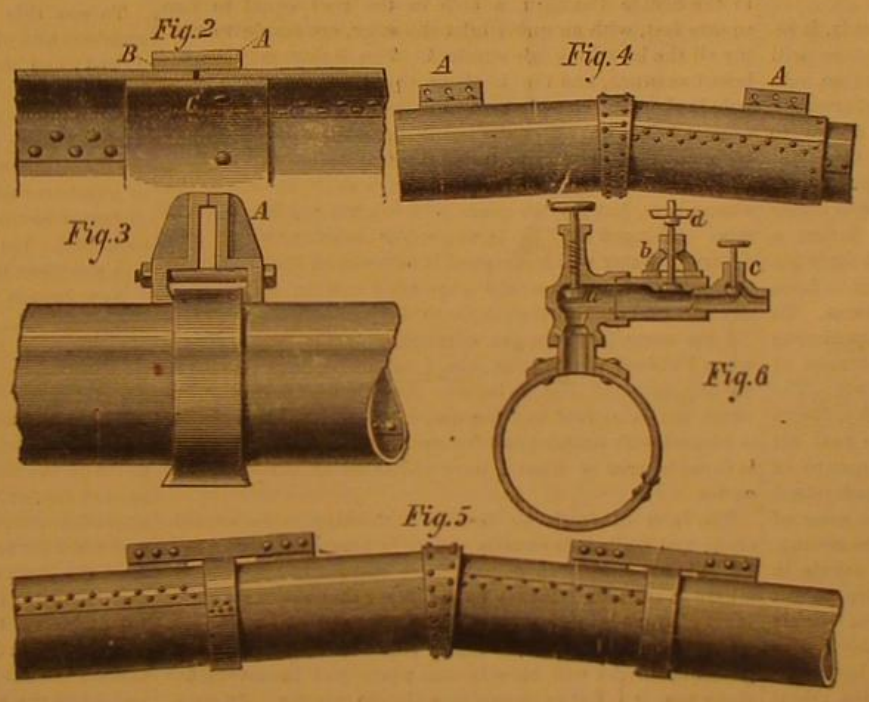


Fig. 1.

HYDRAULIC ENGINEERING IN NEVADA



HYDRAULIC ENGINEERING IN NEVADA.

From the time of commencing the manufacture of the pipe until the water ran into Virginia City, only five months elapsed, ending in August last. The Risdon Iron and Locomotive Works constructed the pipe, and the credit of the accomplishment of the undertaking is due to the engineer, Mr. Herman Schussler.

It is difficult to say which characteristic of our Western engineers is the more remarkable, the courage with which they attack the most stupendous and difficult problems, or the promptitude and celerity with which they carry out their ideas. There is a great future for a country which produces such men and such achievements.

THE CANOPUS STONE.

Hitherto, almost the only guide for interpreting the hieroglyphics with which the monuments of Egypt are covered has been the Rosetta Stone, brought to England by the British army, after the expedition of 1801, and now in the British Museum.

But this is in every way inferior to the stone of Canopus. Half the lines it contains are incomplete, in consequence of the stone being broken and the fragments lost; and of the remaining lines many are defaced or illegible; whereas the stone of Canopus is almost as perfect as on the day it left the sculptor's hand. This inscription was accidentally discovered about seven years since at the southwest corner of Lake Menzaleh, one of the lagoons on the coast of Egypt; and on the old Tanitic branch of the Nile are the ruins of San, the Zoan of Scripture It is a place very little visited, being remote and not easy to reach. But to judge from the numerous obelisks, statues, and remains of temples still existing there—especially that of Rameses II.—San must once have been a place of much importance. About five years ago a portion of the west wall of the temple of Rameses fell, and exposed the corner of a stone covered with Greek characters. in this state the inscription remained some time; at length its value was perceived, and it was removed to the Viceroy's museum at Boulac. It is of fine grained limestone, of light gray color, about seven feet high, two and a half feet broad, and the same deep, and bears three inscriptions, each on a separate side, in hieroglyphic, in Greek, and in the Hieratic (or Egyptian) characters.

It is a copy of a decree made in the ninth year of the reign of Ptolemy III. (Ptolemy Euergetes) by the priests of Egypt, assembled in solemn conclave at the great temple of Osiris, in Canopus. which is called, in the decree, the "Temple of the Euergetæ."

Of this magnificent temple not a fragment now remains; indeed, its very position can only be conjectured. As to the town of Canopus itself, the visitor may trace its site by the high mounds of rubbish over it. It was built on a high promontory (a little to the west of the bay of Aboukir), about fourteen miles to the east of Alexandria. For many years past, nothing of its buildings above ground could be seen, and lately the very foundations have been dug up to provide stone for the fortresses now building on the spot, by order of the viceroy, Ismail Pas'ha.

The position of Canopus, on one of the large canals or mouths of the Nile, and on the highest ground to be found for many leagues along the coast, must have made it healthy and pleasant; and it was a very flourishing, but, at the same time, a most dissolute, city. There was an open space, planted with trees, in front of the temple. On either side of it were altars belonging to the temples of the first order. After offering sacrifice upon these, and performing the necessary ceremonies for the apotheosis of Berenice, the assembled priests made the decree recorded on the stone.

One of the most remarkable points in this decree is the assigning Divine honors to a living person.

To the Egyptians, not the least esteemed prizes of their King's victory, were the images of their gods, which Cambyses, the Persian conqueror of Egypt, had carried off; and in gratitude for their recovery, his subjects conferred upon Ptolemy the title of Euergetes (the benefactor).

It praises the King's great care for the sacred animals, especially for the worship of Apis and Mnevis.

After setting forth the merits of their rulers, and proclaiming the extraordinary honors to be offered to them, the priests established a fifth priestly tribe, for no other apparent reason than because the king's birthday was the fifth of the month Dios. And then they pass on to the real business of the meeting.

In addition to the three monthly festivals of the Euergetæ, on the 5th, 9th, and 25th days, "decreed in a former proclamation," they ordain that a general public festival for five days shall be held every year, in honor of the Euergetæ, commencing on the day "on which the star of Isis rises," "which in the sacred writings is considered New Year's day." Now in this 9th year of the reign of Euergetes, the rising of "Sirius" occurred on the 1st of Payni (July 19th) and they decided that this 1st Payni, reckoned according to the common computation, should be the first day of the Euergetan festival for four years. And that every fourth year, one additional day (besides the usual five intercalary days) should be kept as a public festival in honor of the rulers; thus introducing on every fourth year six instead of five intercalary days.

By the former of these two provisions, the priests introduced the Sirius year of 365¼ days, in place of the common year of 365 days; and by the latter means, placing their reform under the protection of the monarch, they provided for the surplus six hours in every year, while by making the extra intercalary day a general festival, "both in the temples and throughout the whole country," they kept it in the people's memory.

The inscription does not inform us in what year this sixth intercalary day

THE CANOPUS STONE.

was first to be kept, but it is natural to suppose that the new arrangement would be brought into force as soon as possible, that is, in the then existing year.

It is probable that this reform of the calendar was not effected without much opposition. It lasted through the reign of Ptolemy III. But in B. C. 222-1 he died; his son Ptolemy Philopater succeeded him, and then this sixth intercalary day was no longer kept. There seems to have been a reaction Sirius the year was no longer observed, and the common year, of 365 days only, again prevailed. The old irregularities gradually became apparent; and the reform, which in consequence became necessary, was effected during the reign of Augustus in the year B. C. 26.

The latter part of the inscription recounts the honors decreed to the deified Princess Berenice. Her statue is to be placed in the great temple at Canopus, near the statue of Osiris. In all temples of the first and second orders, a statue of her, made of gold and adorned with jewels, is to be kept in the adytum; a four days' festival in all the temples is to be kept in memory of her, beginning on Tybi 17th (March 7th), the day on which the mourning for her ceased and her apotheosis was decreed. On the festivals of the other divinities her image is to be carried in the procession. Hymns are to be sung in her honor, and regular rations given to the maiden daughters of the priests who do service to her.

Lastly, the presiding high priest in each temple, and the temple scribes, are charged to set up in every temple of the first, second, and third order, and in the most conspicuous place, a copy of the decree, carved in Hieroglyphic, Egyptian and Greek characters, on a pillar of stone or brass.

Out of the many copies that must have existed, this is the only one hitherto discovered.

Correspondence.

The Ventilation of the United States Senate Chamber.

To the Editor of the Scientific American:

Allow me a few words of comment on the article on ventilating the Senate Chamber in your issue of December 13, 1873:

Ventilation is a very simple thing; and to secure it, it requires only to be not prevented or obstructed. Nature will ventilate any apartment if it is only allowed to do so. As easily as a man draws his breath, so will an apartment, crowded or not, ventilate itself if it be allowed a throat to do it with. To devise fans, steam engines, exhausts, or injectors to ventilate the senate or other house, is only foolishly trying to help Nature to do work which she can better do without help. It would be no more absurd to invent a whirligig to put into a man's mouth to help him to draw his breath than it is to devise an injector and an exhaust to force in pure and draw out impure air to and from a room. To help a river over a waterfall is not more preposterous than, by moving apparatus, to accelerate the entrance of fresh and the exit of foul air from a crowded hall. The same force which makes the water descend, gravity, forces cold air under hot air and makes it ascend. If the foul air of a crowded hall could be seen and handled, the nature of its movements would have been long ago as well understood as those of water. Supposing foul air were the color of dense smoke, it would be seen to accumulate at the ceiling. If it could be seen that it always tended upwards, a hole in the roof would be the natural result of the desire to get quit of it. The amount of haziness regarding this simple matter in the minds of scientific men is unaccountable. The thousands of pounds and the amount of abortive invention spent on the ventilation of our Parliament Houses might make the angels weep, and all for what? To force atmospheric air to obey a law of its nature, which it cannot of itself disobey. As the sparks fly upwards so will heated air, if it is not restrained; and herein consists the whole secret of ventilation. It needs no device to float a cork; neither does it need any machine, fan, steam engine, exhaust, or injector to purify the air of the Senate House. All that is strictly required is an entrance for fresh air below, and an exit for foul air above. These provided, ventilation will work in spite of all the wrong headed theories of the *savans* and without the well meant but useless inventions usually erected to assist Nature. If these holes are large enough, no hall need be either impure or oppressive. If the place be half filled, the supply of pure air will be enough. If crowded, it will be augmented to meet the larger demand. Every person who enters is a machine to make the current inwards and outwards work more vigorously; and every one who leaves deducts from the demand and the power to supply. The atmosphere is a nicer balance than ever man made, and vibrates to a counterpoise infinitesimal beyond his conception. It is a comfortable as well as an undeniable fact that the objects which require ventilation are the very means to create it. Fires, lights, and man himself, if they consume pure air, also heat it, causing it to ascend and give place to a new supply, which in turn is consumed, heated and pushed upwards. This process, which is never ending, is simple, admirable, exact, and complete. It requires no assistance, has worked from the beginning of time, and will work, though there be neither *savan* nor machinist in existence.

If our halls, like the ancient Greek, were without roofs, ventilation would cause us no thought. The foul air from our lungs and bodies would ascend right into the air, and a fresh supply would come down to us through the same opening. But our houses and halls are ceiled, and the currents are prevented taking their natural courses. Even in a ceiled chamber, if an open space be left large enough, the ascending and descending currents through it would supply all the ventilation required by a crowded assembly. But it is more convenient, as the modern fashion of buildings is and as our climates require, to admit our fresh air at the lower part of our houses instead of at the top. By this mode a smaller opening in the roof suffices. A very much smaller opening is needed than many would suppose. And here I beg to take exception to a statement in the article referred to. It is there said that the machinery injects 25 cubic feet of air per minute for every man of 1,200 assembled, or it is capable of doing so. This quantity is ridiculously overdone. A man does not consume even one foot of air per minute by breathing; 15 inhalations of 60 cubic inches each make only 900, and a cubic foot contains 1728. Take man by man in an assembly, half a foot per minute is all each will consume. One can inhale through a half inch tube more air than he requires. Even a quarter inch one will not oppress him much. I speak of a round tube, but, if you will, take a square one. Of this a square foot will represent 576 persons' breathing area, and will admit air sufficient to supply that number. It may be said the velocity of air into a crowded chamber is not so great as that of the air through the tube when one breathes by it. But it is to be remembered the air is passing into the lungs only half the time, while the inward rush to supply an assembly hall is constant. The fact is the current inwards and outwards in a chamber, ventilated in the natural way which I indicate, is quite as fast as the current in and out of a man's windpipe.

But in an assembly hall at night, the lights must be supplied with fresh air as well as the occupants. I need hardly mention fires, as it is not usual to have them in such places. If they be used, they also must have their supply of air, and they will take an amount of inlet for themselves, equal to the united areas of their chimneys. I suppose there are no fireplaces in the Senate Chamber; but a crowded hall gets heated, and an extra supply of air is demanded on that account. If such is the case, it calls in its own supply. The velocity both inwards and outwards increases and the temperature falls. If the air of a hall be pure, heat is not so oppressive. It is impure air that exhausts and makes people pant. Taking your estimate, 1,200, as the usual number in the Senate Chamber, a hole in the roof equal to two square feet, with an under inlet the same, are ample to supply all the breathing air required. The lights may be allowed as much, and the heat an equal space. As a large hole is about as cheaply made as a small one, and as plenty of outlet does not affect the people below, the openings may be made double or even treble the size mentioned without fear of inconvenience. These openings must be free to the atmosphere, but may be made with louvres to keep out the rain. A hinged skylight is as good as anything else. As a cistern of water will be emptied if any sort of hole be driven through the bottom, so will a crowded hall be refreshed if any sort of hole is driven through the roof.

I am sorry I did not get admission to the Senate House when I visited Washington, else I might be more precise in my suggestions. But I believe that there is a ceiling between the outer roof and the audience, and that this ceiling is pierced with ornamental fretwork, and that the piercing is equal in area to what I have indicated as necessary for outlet.

The inlet of fresh air is the next thing to be considered; and while it is equally simple in principle as the outlet, it is not exactly so in practice. The outlet may be anywhere in the roof. It may be far larger than really required. It may be one large opening, or it may be many small ones. The inlet must be a great many small openings, or a disagreeable current will blow in one place and inconvenience those near it. But even this is a simple matter. An opening in the masonry under the joists of the floor, communicating with the outer air, will allow a fresh current to rise through small gratings in the passages between seats. Or if the corridors have proper air holes, a supply to the main chamber may be got from them by slits above the doors. Or air may be let in along the channel where lie the heating pipes and allowed to find its way to the chamber through small grate work along the base of the wainscoating. The modes for small inlets are endless. And let me say the united areas of the divided inlets need not be so great as those of the outlets, because they are supplemented by chinks of windows, thresholds of doors, etc. I would impress on all objectors that no inconvenience from the currents will be felt, if an inlet area of 8 or 10 feet be properly scattered over a room of the size of the Senate Chamber.

Allow me a few words on the long pipe proposed, to suck the air from the park 220 feet off. I do not know what purer air people would wish than that at the Capitol. It blew on me as fresh as mountain breezes. It is all people have to breathe who are walking outside; and if those inside get the same, what else do they want? One undeviating law of air currents is that they always take the shortest available cut and depend upon it, the ventilating air of the Senate house will never run through a long pipe if it can get in at an open door nearer its work. The whole thing is of a piece with the London delusion, and indeed is a counterpart of it from beginning to end.

Paisley, Scotland. WM. MACKEAN.

To the Editor of the Scientific American:

I have read an article in your issue of December 13th, 1873, on the above subject, and I understood the difficulty (remedied by the charges described) to be the want of sufficient area, and the proper arrangement of the air passages from the old fan to the Senate Chamber. Unless there is some mistake in your explanation, there was, in my opinion, no necessity for the new fans, engine, and the two air shafts, which in all probability occasioned a large expenditure. I venture my opinion on these grounds: You say that the capacity of the old fan was 80 revolutions per minute, discharging 500 cubic feet of air at each revolution, making in all 40,000 cubic feet of air per minute; and that in consequence of the defect, it was producing but one fourth of the ventilation that it had the capacity to furnish. As you state the capacity of the new fans to be 30,000 cubic feet per minute, it appears there was at least no want of capacity in the old fan, and that in comparison with forced ventilation, there is no advantage in ventilating by exhaustion. In my opinion, Mr. Hayden selected a very indirect, as well as an extravagant method of remedying a very simple matter.

CHICAGO.

Mental Arithmetic.

To the Editor of the Scientific American:

The young mechanic who hopes to excel in his chosen trade should endeavor to become skillful in mental arithmetic; and at the last analysis, all computation is strictly mental, the figures employed being only tallies to record results. I will give a table illustrating the theorem that the product of any two numbers is equal to the square of half their sum less the square of half their difference, that long practice proves to be a useful method of multiplication:

$$6\times6=36=6^2$$
$$7\times5=35=6^2-1^2$$
$$8\times4=32=6^2-2^2$$
$$9\times3=27=6^2-3^2$$
$$10\times2=20=6^2-4^2$$
$$11\times1=11=6^2-5^2$$

This theorem may be expressed algebraically, thus: $(a-x)\times(a+x)=a^2-x^2$, and numerically as in the table.

Suppose it is required to multiply 53 by 47. Half their sum is 50, the square of 50 is 2,500, and the answer sought is that sum less $3^2=9=2,491$. In practice, such an example can be solved almost instantaneously. If 47 times 54 were required, proceed as in the example and add 47 to the product.

To use this method, considerable knowledge of square numbers and of some of their remarkable properties is required; and the careful study of difference series will be beneficial. This study has proved an excellent means of initiating pupils into the mysteries of square and other roots, enabling them to become proficient in a short time. There are many similar things in the curious and wonderful science of numbers that, like the magic squares given in your issue of December 20, 1873, are of far more value than is generally supposed. Let some one arrange them in a suitable form and put them into the hands of the Yankee boy.

New Britain, Conn. F. H. R.

The Relative Attraction of the Earth and the Sun

To the Editor of the Scientific American:

The semidiameter of the earth is, in round numbers, about 4,000 miles, and that of the sun 425,000 miles. An object situated on the surface of the earth will, therefore, when turned toward the sun, be 22,874 times farther from the center of solar attraction than it is from the center of terrestrial attraction; and when turned from the sun, it will be 22,876 times as far from the sun's center as from the earth's center. Now as the strength of attraction varies inversely as the squares of the distances, the pull of the earth's mass will be $22,874^2$ times as great (on a body on the surface of the earth turned toward the sun) as the pull of an equal solar mass will be; and when the object is away from the sun, the pull of the earth will be $22,876^2$ times as great as the pull of an equal solar mass. But, as the sun's mass is estimated to be 215,000 times as great as the earth's mass, the total pull of the sun on an object in the two supposed situations will be: $\frac{315,000}{22,874^2}$ and $\frac{315,000}{22,876^2}$ times that of the earth.

$\frac{315,000}{22,874^2}=\frac{315,000}{523,176,276}$ and $\frac{315,000}{22,876^2}=\frac{315,000}{523,211,376}$ or $\frac{1}{1,660,877}$ and $\frac{1}{1,660,688}$.

Now if the foregoing estimates be correct, there must be, in certain situations, a sensible difference between the weight of a given mass when on the surface of the earth in the direction of the sun, and the weight of the same mass when the earth has turned it away from the sun. This could be verified by experiment.

Let the place be at the equator, and the time of the experiment be one of the equinoxes. Suppose scales to be constructed of the capacity of several tuns and of the utmost possible delicacy. Now let us try our experiment with a weight of 10 tuns. Its weight at noon will be 10 T$-\frac{1}{1,660,877}$ of 10 T. and its weight at midnight will be 10 T. $+\frac{1}{1,660,688}$ of 10 T. or: Noon weight = 20,000 lbs.—12 lbs. 10 drams = 19,987 lbs. 15 ozs. 6 drams. Midnight weight = 20,000 + 12 lbs. 8 drams = 20,012 lbs. 0 ozs. 8 drams, making a difference between the noon weight and the midnight weight of 24 lbs. 1 oz. 2 drams.

If astronomers have miscalculated the relative masses of the sun and the earth, will not this experiment indicate the fact? And if we experiment in the same manner with the moon's attraction, may it not lead us to modify our statements of relative masses still further? And, moreover, may it not lead to a reconstruction of our tables of distances? If the principles set forth herein be correct, would not such an experiment be as worthy the interest of the great powers as are those expeditions of observation, so munificently aided, to

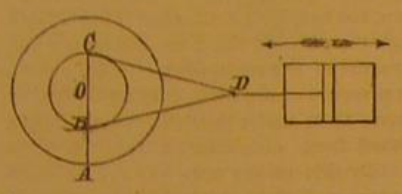
make the transit of Venus and the total eclipse of the sun contribute to our stock of astronomical knowledge?

Brownville, Neb. W. B. SLAUGHTER.

Adjusting Journal Boxes Horizontally.

To the Editor of the Scientific American:

Apropos of recent suggestions for taking up the wear of journal boxes, permit me to say that there is a common error among machinists to the effect that the wear upon the side of the main journal box nearest the cylinder is double that on the side opposite. Strange to say, the same idea is advanced as a theorem in a work on machine drawing, recently published by a noted writer on graphics. Some machinists, again, think that the wear is equal on each side of the center. The following is a demonstration of the true case:



The diagram being the skeleton figure of a locomotive or stationary engine, let A, the point of traction on belt or rail, be taken as the axis of moments.

Let P = pressure on piston, let x = pressure on front of box at O, let y = pressure on back of box at O, let R = radius of wheel, and r = radius of crank. With crank pin at C, we have $x = \frac{P \times (R+r)}{R}$ by equaling moments. With crank pin at B, we have $y = \frac{P \times (R-r)}{R}$. Whence $x \div y = \frac{P(R+r)}{R} \times \frac{R}{P(R-r)} = \frac{R+r}{R-r} = 1 + \frac{2r}{R-r}$, by performing division

But if $x = 2y$, then $x \div y = 1 + \frac{2r}{R-r}$ must equal 2; whence $\frac{2r}{R-r} = 1$ and $2r = R - r$ or $R = 3r$. That is, the pressure on the front of box is double that on the back of box only when the radius of the wheel is three times that of the crank.

Or in a locomotive, let P, x and y be as before, and T = train resistance. Then going forward, with crank at C, $x = P + T$; or with crank at B, $y = P - T$, whence $x \div y = \frac{P+T}{P-T} = 1 + \frac{2T}{P-T}$ which, as before, is equal to 2 only when $P = 3T$.

The wear on both sides of the box will be equal only when T = O. The wear on the front box will always therefore be practically the greater, but not necessarily twice as great.

Since the wear is proportional to the pressure, the formulæ $x \div y = \frac{R+r}{R-r}$ and $x \div y = \frac{P+T}{P-T}$, may be used to determine the relative thickness of the two sides of the box.

Notwithstanding the weight of the engine throws the point of greatest wear towards the top or bottom of the box, the fact of unequal wear, proved above, shows the necessity of making the boxes adjustable horizontally, as suggested by your correspondent. W. L. C.

Lehigh University, Bethlehem, Pa.

Animal Electricity and Magnetism.

To the Editor of the Scientific American:

Among the components that make up the whole of man's vital parts, animal electricity and magnetism are of prominent importance. Their existence has long been known, but almost all else in regard to them seems mystery.

Air when taken into the lungs gives up a portion of its oxygen, which passes into the blood, and, when expired, is converted into carbonic acid gas. The latter gas amounts to about three and a half per cent of the whole expiration. In the process a combustion takes place, wherein a portion of the oxygen combines with the blood, and another portion with carbon, to be exhaled as carbonic acid gas. I presume that this combustion or transformation is the cause of animal heat. But this is foreign to the present subject. Faraday discovered that oxygen was the most magnetic of all gases, holding the same place among gases that iron does among metals. When reduced to proportions and figures, if 17·5 represents the magnetism of oxygen, air would rate 3·4, while carbonic acid gas is diamagnetic and would be represented by 0·0. The amount of carbonic acid gas taken into the lungs with air is quite small, but from each healthy person sixteen cubic inches are exhaled per minute, or twenty-three thousand cubic inches per day. As this gas is composed of carbon one part and oxygen two parts, it follows that about fifteen thousand three hundred and thirty-two cubic inches of oxygen, charged with magnetism in the proportion above stated, has the total amount of magnetism daily eliminated from it by the vital organs of each individual. What becomes of this magnetism thus extracted from the oxygen of the air? It enters the lungs; it does not go out again. The sequence is beyond question: it is taken up by the organism and remains there to be used in the vital forces. Thus in the life-giving gas, not only is to be found the property of supporting life, by purifying the blood and furnishing heat for the body, but, also, the magnetism that performs an important, but a far more subtile part. An atmosphere of pure oxygen, if supplied to the lungs, increases the heat, magnetism, and electricity of the body, by the conversion of a much larger proportion of oxygen into carbonic acid gas, and quickens life to such an extent as to cause death from exuberance. When an absence of oxygen from the blood has almost caused a cessation of magnetic and electric currents in the body, an injection into the circulation of blood charged with oxygen will cause their instant return; and just in proportion as carbonic acid gas is exhaled from the lungs, do we find a supply of these fluids remaining.

I have referred to animal electricity and magnetism as identical. In vital economy I believe them to be so in source of supply; and while manifestations of one may be had without the apparent presence of the other, yet there is so much to join them together, and so little to separate them, that the day of doubting their identity, in this respect, has about passed. Oxygen and ozone are the same, and yet how different! Are not both different conditions of the same thing? JOHN HILL.

Columbus, Ga.

THE SILVER MINES OF PERU.

BY PROFESSOR JAMES ORTON.

Peru was conquered and explored by the early Spaniards under the belief that it was *El Dorado;* but there are no famous mines of gold in the Republic save those of Carabaya. It better deserves the name of *La Plata,* for its Andes are threaded with silver. The annual yield of Peruvian silver, however, is decreasing, owing to mismanagement. A thorough scientific survey of the country is needed, and then a judicious system of mining. We are confident this will reveal

> "Rocks rich in gems and mountains big with mines,
> That on the high equator ridgy rise."

The most famous silver mines in South America, after those of Potosi, are the mines of Cerro de Pasco, sixty leagues northeast of Lima. They are situated on the Atlantic slope of the Andes, over 13,000 feet above the sea, where the prevailing rock is conglomerate. The silver, discovered by an Indian in 1630, occurs in the native state; also as sulphuret mixed with pyrites, with *cobrizo* (a carbonate of copper and lead, with sulphuret of copper), and with oxides, forming what are known in Peru and Mexico as *pacos* and *colorados.* The ore is treated to salt and mercury, but so rudely that generally one pound of mercury is lost to every half pound of silver extracted. Fortunately, Cerro de Pasco is only 200 miles from the celebrated quicksilver mines of Huancavelica. According to Herndon, the ore yields only six marks to the cajou. (A mark is eight ounces, and a cajou is three tuns). A representative specimen in our possession contains 0·004 of silver. During the last two centuries and a half, the mines have produced about $500,000,000. The annual amount of ore mined has been 50,000 cajous, yielding an average of four and a half marks, the amalgam containing 22 per cent of silver. Just now, work has nearly ceased, owing to the inadequate means of drainage. But at Cerro de Pasco, as at other places, it has been found profitable to re-work, by the improved modern method, the tailings left by the old Spanish miners.

Hualgayoc, fourteen leagues north of Cajamarca, has long been celebrated for its rich mines; but it is also afflicted with a plethora of water. There are many good mines in the vicinity of Lampa and Puno on the borders of Lake Titicaca; those of Manto, Salcedo, Chupica, and Cancharani were famous in Spanish history. The ores of Huantajaya near Iquique yield from 2,000 to 5,000 marks to the cajou. Masses of pure silver have been found on the surface of the plain, one weighing 800 lbs. Rich deposits occur also in the province of Cailloma, north of Arequipa; and at Yauli, San Mateo, and other localities near the Oroya Railroad. Extensive veins have been recently discovered at Chileta, the terminus of the Pacasmayo railroad, the ore assaying from $60 to $200 a tun.

But the most numerous and promising silver mines of Peru are, without doubt, located in the department of Ancache, just north of Lima; not because it is a richer region than the eastern cordillera, but because it is the only district which has been scientifically explored. This has been done by the accomplished naturalist, Professor Raymondi, under the patronage of Mr. Henry Meiggs. The report just published at Lima contains assays of specimens from the most valuable mines in which the silver occurs. It appears: (1) That silver is not very common in the native state. (2) That the minerals richest in silver are pyrargyrite ("rosicler" or ruby silver) and stephanite (brittle silver glance). (3) That the greater part of the silver, however, is extracted from tetrahedrite, galena, and many mineral oxides (*pacos* or *colorados*). The pacos richest in silver ore are those which result from the oxidation of stephanite and pyrargyrite; the poorest are found in great part of oxide of iron, in which the silver is minutely disseminated in the native state. (4). It is worthy of notice that the silver ores are constantly associated with antimony. Even the galenas having a cubical structure always contain a small percentage of antimony.

New Houses.

The coincidence of a man's moving into a new house and dying soon after has frequently been a subject of remark, and there is an avoidable cause—the house is moved into before the walls and plaster and the wood are sufficiently dried. Sometimes the cause of death is the poisonous character of the water conveyed through new lead pipes. No water for drinking or cooking purposes should be used in a building supplied with new lead pipes, in whole or in part, for at least one month after the water has been used daily; this gives time for a protecting coating to form on the inner surface of the pipes, when their chemical change from contact with water generally ceases.

But the damp materials of the house have the most decided effect, especially on persons over fifty years old or of frail constitutions; whereas if the person were in the full vigor of life and health, not even an inconvenience would be experienced.

In building a new house, or on going to live in another locality where the water supply is not far from the house, it should be ascertained with the utmost certainty that the spring or well is higher than the privies or barnyards. Insidious and fatal forms of decline and typhoid very often result from persons drinking water which is drained from the localities named.

The safest plan, and the only safe plan for furnishing dwellings with the most healthful and unobjectionable water, is to have a watertight cistern, and let the water from the roof of the house or barn, or other outhouses, be conveyed into it through a box of sand several yards long, this box to rest on a board, or cemented bottom and sides, so that no outside water could not get into it.—*Hall's Journal of Health.*

Solvent Powers of Water.

Water is a physical rather than a chemical agent in bleaching and dyeing; it is the vehicle which carries the chemical substance to the cloth to be operated upon, or which removes the matters necessary to be removed from it. When a substance is mixed with water, it may either be dissolved by it, and disappear, as salt does; or it may remain in suspension, as chalk does. Nothing is considered to be actually dissolved in water if it can settle out again, or if it will not pass with the water through a filter made of paper or calico; thus to talk of dissolving ground chalk in water is incorrect, for if allowed to stand it would settle out; or, if the mixture were filtered, the water would pass clear, while the chalk would remain upon the calico; but blue vitriol (sulphate of copper), for example, does really dissolve in water, and the liquor all filters through together; to deprive the water of the blue vitriol would require chemical means different in kind from filtration. Water, therefore, dissolves some substances and not others. Water does not dissolve the same quantity of all soluble substances; of some it can dissolve its own weight, and more; of others a small portion; and of some extremely little. As a rule, hot water dissolves more than cold, and more quickly than cold: but, upon cooling, the excess mostly falls out as crystals. This point deserves notice, for a liquor, which is of right strength when a little warm, may be too weak when it becomes cold; left in a carboy, for example, in a cold place, because the salt crystallizes out; this is the case only with those salts that are but sparingly soluble, as chlorate of potash, cream of tartar, sulphate of potash, etc. The crystallizing is sometimes troublesome in steam colors which, right enough when freshly made, become filled with small crystals, and rough on the machine; it is felt in the case of an ageing liquor, which contains chlorate of potash as an active agent, which, crystallizing out, leaves the liquor weak and not able to do its work. As a usual thing, the drug room upon a printing or dyeing works should be cool, but there are some liquors better in a moderately warm place; brown vitriol, for example, in winter time is apt to go solid in the carboys, if kept in an exposed place.—*Am. Tex. Manuf.*

Sir Richard A. Glass.

Sir Richard Atwood Glass died recently at Southampton, aged 53. It was at his factory that 1 250 miles of the first Atlantic cable of 1866 was wholly constructed, under the direction of Mr. Glass, who, on the successful completion of the undertaking, after ten years of unremitting labor, received the honor of knighthood. He retired from the company in 1867, and afterwards became chairman of the Anglo-American Telegraph Company. He was for a short time a member of the House of Commons.

The Detection of Death.

The late Marquis d'Ourche, one of whose friends was buried alive, left a sum of 20,000 francs ($4,000) to the French Academy of Medicine, to be given to the inventor of a simple process of ascertaining when death has really occurred, and a further sum of 5,000 francs to be awarded to the discover of a scientific method of verifying death. Altogether 102 essays were sent in for adjudication. Most of the papers contained such absurd suggestions that the list was practically limited to 32 competitors. The large prize was not awarded, but the 5,000 francs were divided between four competitors. No new facts, likely to enlarge the domain of forensic medicine, have been elucidated by these investigations.

MESSRS. MACNAUGHT, ROBINSON, & CO., of Southwark, London, England, have sent us diagrams of a most complete system of wrought iron girders for building purposes, made by them and kept constantly in stock. Their sections are cheifly of the double T form, and range from 2 to 6 inches in width, and from 3 to 14 inches in hight. The list also includes flitch plates, bolts, nuts, washers, etc., an arrangement very convenient for builders, who by consulting the chart can ascertain the approximate cost.

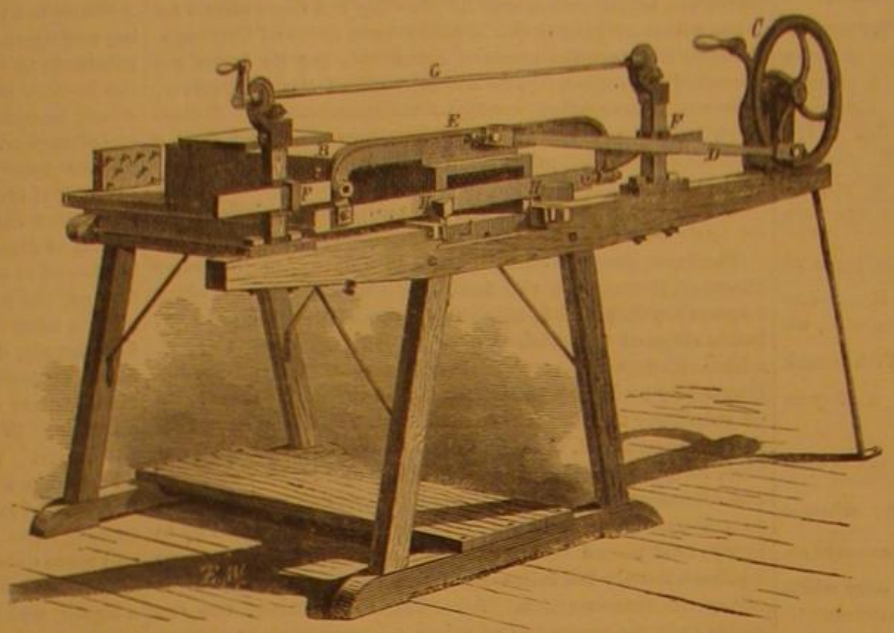
WE have received from Messrs. Goodnow and Wightman, of 23 Cornhill, Boston, Mass., an illustrated catalogue of tools, lathe attachments, and machinists' supplies, which provides for nearly all the possible wants of model makers and experimenters in mechanics. The line of small gearings is extensive and complete, and the book describes several new gages and combination tools, of value and interest to all inventors and amateur mechanics.

A NEW APPLICATION OF GYPSUM.—Gypsum mixed with 4 per cent of powdered marshmallow root will harden in about one hour, and can then be sawn or turned, and made into dominoes, dice, etc. With 8 per cent of marshmallow, the hardness of the mass is increased, and it can be rolled out into thin plates, and painted or polished.

IMPROVED PATENT CANDY CUTTER.

This machine is intended for cutting "beefsteak" and other candies in which nuts, etc., are intermingled, and which are cut from a loaf-like mass into slices while warm. The apparatus consists of a knife reciprocating to cut the candy, and provided with means of constant lubrication to prevent the adhesion of the warm candy, and to cause it to cut more freely.

The frame supports a table and a beam, on which the operating parts are mounted. The candy is made into a long loaf-like mass, with nuts, etc., and placed on a long movable board, A, and against a block on its back end. This board is fed up under the knife as slice after slice is cut off. The box, B, incloses the candy on the sides to hold it in place and in shape, and remains stationary, while the candy and its supporting board is moved up. The wheel, C, is turned by a hand crank, and rotates a smaller wheel having a fly wheel on its shaft. This fly wheel has a connecting part, D, from a bearing on its rim to one on the knife frame, E, to drive the knife back and forth to cut the candy. The knife frame has guide bars at its ends playing back and forth in bearings, F, on posts attached to the beam, as shown. The bearings move up and down on the posts, and the latter are hollow, with one side open. The bearings connect with vertical screws within the posts, so that they may be raised or lowered by turning the screws, to feed the knife as it cuts. These screws have bevel pinions on their top ends, gearing with bevel pinions on the shaft, G, which extends over both posts. The shaft is turned by a hand crank, to raise or feed the knife on the candy, regularly at both ends. The edge of the knife moves through boxes on each side of the candy, which contain sponges saturated with oil, for lubricating as above noted. These boxes are borne by arms from bearings, so that they will move up and down with the knife and keep the lubricator to its edge. The board, A, is moved up by pinion and rack underneath, not shown, with suitable arrangement for gaging its feed, to regulate the thickness of the slices uniformly.



QUINN'S PATENT CANDY CUTTER.

This machine has been in use in the shop of J. Essig, candy manufacturer, Keokuk, Iowa, for the past six months, and, we are informed, has given perfect satisfaction.

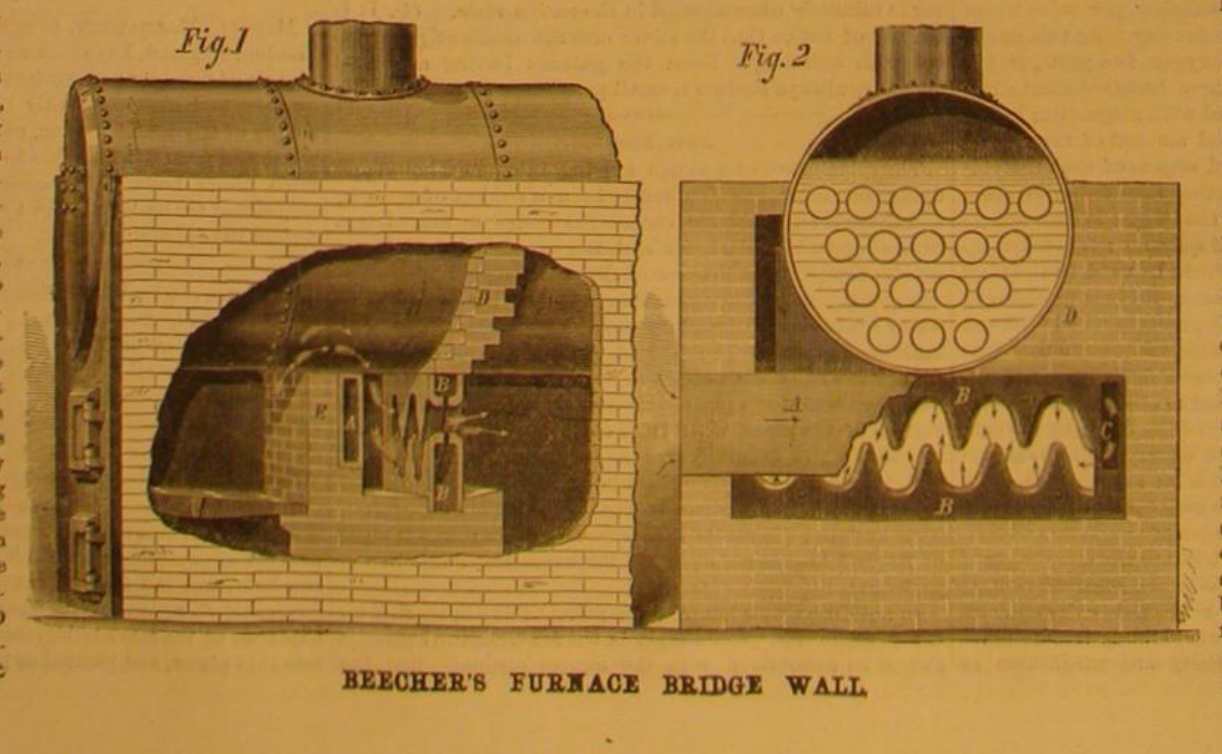
For further information and purchase of patents and rights, address the patentee, Francis Quinn, Keokuk, Iowa. Patented October 1, 1872, and October 14, 1873.

IMPROVED FURNACE BRIDGE WALL.

The invention which we illustrate herewith is a bridge wall, constructed so as to produce the same action on the flame as the flat wick does in the lamp, namely, forming it into a thin sheet or, rather, breaking the flame into thin sheets, thus preparing the flame before charging it with currents of air, so that the latter can penetrate every portion. The result is claimed to be nearly perfect combustion.

Fig. 1 is a side elevation of a boiler set in brick work, of which a portion is removed, showing an end view of the bridge wall in position. Fig. 2 is a vertical section taken through the bridge wall, back of the fire box. A is a conduit or pipe, having its outer end on the outside of the brick work, and extending across the back of the fire box, entering into the conduits, B B, at the opening, shown at G, Fig. 2. This pipe, A, is for the purpose of conveying the air and also heating it before entering the conduits, B. It is protected from the direct action of the fire by the brick work shown at E, Fig. 1. B B represents two air conduits arranged in a vertical plane passing longitudinally under the boiler. The portions which are exposed to the gases or flame present waved surfaces, and are so arranged in relation to each other as to form a ziz-zag or serpentine flue, through which the flame or products of combustion are compelled to pass on their way out of the fire box. It will be noticed that the top and bottom of the zig-zag flue terminate nearly in a point. In this portion of the conduits are perforations or a continuous slit for the admission of air, striking the flame crosswise, in fact in every direction (as shown by arrows in Fig. 2), on its way through the zig-zag flue. It will also be noticed in the form of this flue that a direct line is avoided. The object of this is to cause the flame, when it strikes the flue, to be completely broken up into thin sheets, and thus prepared so that the air can penetrate every portion. At the same instant, therefore, that the flame is broken up, it is thoroughly charged with cross currents of heated air in every possible direction, producing combustion of the gases before entering the stack. C is an opening into the side of the gas burner, where the connection is made with the pipe, A. D shows a wall closing the connection between the after part of the boiler and fire box, compelling the products of combustion to pass through the zig-zag flue. The inventor states that this bridge wall has been thoroughly tested, and that the advantages gained by its use are, first, a saving of 25 per cent of fuel; second, the benefit of the coke or solid part of the coal, which, under the present construction of furnaces, it is claimed is wasted; third, all the sooty matter is consumed before reaching the stack, and also all the gases, so that but a very small portion of the heat escapes.

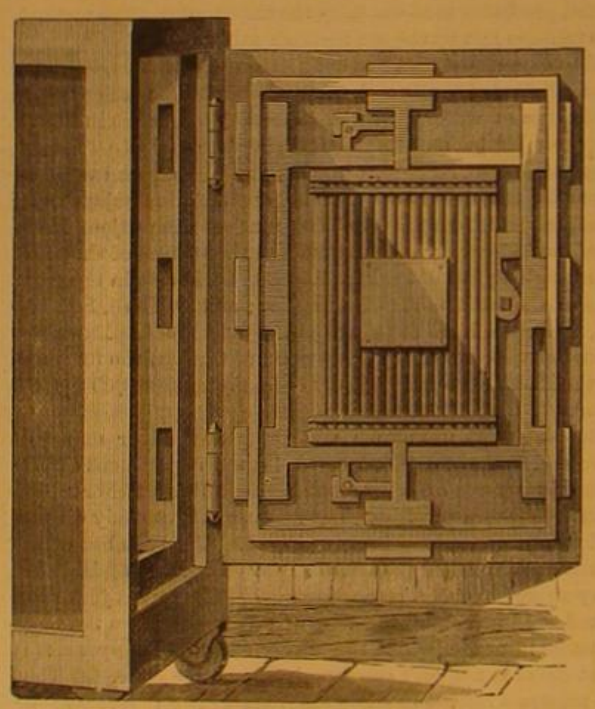
The improvement is further claimed to be efficient and durable, not liable to get out of order, and to require no attention after being set in its place. It can be applied to both locomotive and marine boilers. For further particulars address the inventor, Mr. W. F. Beecher, 83 Seneca street, Cleveland, Ohio.



BEECHER'S FURNACE BRIDGE WALL.

THE BAFFLE DRILL-PROOF SAFE.

An ingenious contrivance has recently been patented by Mr. Henry Geering, of Birmingham, England. Experience



has shown that a skilled thief, as a rule, by boring a number of holes through the chilled plate to which the lock of a safe is attached, invariably succeeds in removing the lock bodily, and the safe, with its contents, may then be dealt with at leisure.

The present invention is designed to prevent this, and it consists in the arrangement, at the back of the door and in front of the lock, or at any other required part of the safe, of a series of cylindrical steel rods, free to turn in a frame or bearing pieces. These rods are arranged side by side, and as near together as is compatible with their perfect freedom of motion, excepting immediately in front of the key hole in the door, at which part a space is left for the passage of the key to the lock. One or two series of rods may be used. Where two are employed, the axis of one of the series may cross the axis of the other series, or be placed perfectly parallel with it at pleasure. The patentee provides flat or angular rotating bars, which may be employed instead of cylindrical steel bars. The practical effect of the use of these steel rods is simply this: When the door of a safe or strong room is provided with the invention, the burglar's drill, after it has drilled through the plate of the door, comes against one or more of the rotating steel rods, which, under pressure of the drill, turn on their axes and move from under the drill, which is thus prevented from obtaining a bearing upon them. By this means access to the lock, for the purpose of picking or destroying it, is prevented. Where still greater security is desired, a plate of hardened steel or chilled iron is fixed in front of the steel rods. This plate is pierced with angular perforations, or armed with ribs or projections on the face turned towards the outside of the safe; and in use these perforations or ribs intercept the drill of the burglar, which is either broken or so much injured in contact as to be almost inoperative before it can reach the steel rods. At a public trial, says *Hardware, Metals, and Machinery*, a number of hard steel drills were put through the iron and steel plates with a pressure of from 12 to 15 cwt. behind the drills; but when the latter touched the revolving steel rods, they failed to bite, and were in nearly every case broken. Beyond this, the clicking of the revolving rods, when touched by the drills, was quite loud enough to raise an alarm sufficient, in ordinary cases, to frustrate any burglarious enterprise.

On Some Metallic Spectra.

M. LECOQ DE BOISBAUDRAN.

(1). Lead. When the induction spark from an electric coil passes between two electrodes of lead, the spectrum consists merely of narrow lines; when the electrodes get covered with oxide of lead, there are the numerous characteristic bands, and some of the lines then disappear, while others retain their brightness. The action of the condenser is almost exactly opposite to that of oxidation; it intensifies the lines, and, where they are extinguished through oxidation, the condenser restores them. (2). Chloride of gold. In a gas flame, this gives magnificent bands crossed by slightly nebulous lines, extending from yellow to blue green. With the spark in a solution of $AuCl_3$, the spectrum consists of green bands, and a certain number of narrow lines, distributed between red and violet. The relative brightness of the lines varies according to the mode of operation. The author points out changes undergone by the lines δ 506·3 and δ 523 when one modifies the degree of dilution, the length of the spark, or the direction of induced current. (3). Thallium. The salts of thallium in a gas flame give, besides the bright green line δ 534·9, another, faint and nebulous, having for wave length 568·0. It seems to belong to thallium, for its relative intensity is maintained with various salts of thallium carefully purified. (4). Lithium. From theoretical considerations, the author was led to expect the probable existence of a new line in the spectrum, having 413·0 for wave length. He obtains merely a trace of this line on passing the induction spark in a solution of LiCl, but it can be easily had with the spark in Li_2OCO_2 at red heat. Two series of measurements gave 412·9 and 413 for the wave length.—*Comptes Rendus—Chemical News.*

Practical Science as a Trainer.

Professor Williams, in an interesting article in *Nature*, relasting to remarkable practical achievements of Count Rumford, says: The main interest of the career of this wonderful man appears to me to lie in this, that it affords a magnificent demonstration of the practical value of scientific training, and the methodical application of scientific processes to the business of life. I have long maintained that every father who is able and willing to qualify his son to attain a high degree of success, either as a man of business, a soldier, a sailor, a lawyer, a statesman, or in any responsible department of life, should primarily place him in a laboratory, where he will not merely learn the elements of science, but be well trained in carrying out original physical research, such training being the best of all known means of affording that discipline of the intellectual powers upon which all practical success depends.

OVERHEAD STEAM CRANES FOR DOCK PURPOSES.

The Middlesbrough docks, Yorkshire, England, which have recently been made by the North Eastern Railway Company to accommodate their greatly increased shipping traffic, possess many points of interest and novelty, prominent among which is the system of steam cranes employed, a system which we illustrate herewith.

It was found that no fixed crane could be kept constantly employed at Middlesbrough on account of the great variation in the length of the ships, steamers, etc., while, furthermore, as the total area of quay room would be, in the first instance, somewhat limited, the space occupied by a fixed crane would be attended with serious inconvenience. The same objection existed to the adoption of the ordinary construction of portable cranes, involving a separate line of rails for them to travel on. There was also the further condition that the cranes must be capable of loading and discharging vessels, the sides of which were 15 feet to 20 feet above the level of the quay, as rapidly as lighters, which would frequently be 20 feet below the quay level, and that in both cases the driver should have a clear view of his work. Under these circumstances it was decided to state the leading conditions to various manufacturers of cranes, and invite them to give tenders and prices for what appeared to them best adapted to fulfil these conditions. The design adopted, says *Engineering*, to which we are indebted for the engraving, was that sent in by Messrs. Appleby Brothers, of London; this design, as will be seen from the engraving, consisting of a traveling staging or gantry, on which is mounted a steam crane of the same construction as that sent by the firm to the Vienna Exhibition (see page 95 of our volume XXIX.), and which is in successful use at so many of the docks and harbors in England and on the Continent.

The traveling staging of each crane has a span of 23 feet, center to center of rails, one of the latter being laid close to the edge of the quay, and the other in the 6 feet between rails. The clear hight is 17 feet 6 inches, which allows the uninterrupted circulation of locomotives and all kinds of rolling stock on each of the two lines of rails which are spanned by the gantry. The traveling wheels are 12 feet, center to center. The framing is composed of a pair of timber uprights, braced and strengthened by cast iron brackets, and two wrought iron plate girders, which are connected to the timber uprights by four wrought iron plate brackets, strengthened with angle irons. A strong carriage, with the necessary roller path and brackets for the gear required to transmit the traveling motion, which will shortly be referred to, is firmly bolted at the extreme end of the girders nearest to the dock, while the girders are planked over so as to form a store for coal and water. The crane, and the whole of the substructure, is designed for a working load of 3 tuns at the maximum radius of 21 feet from center of crane post to the plumb line of the lifting chain, while the crane itself is, as has already been stated, of precisely the same construction as those which have given satisfactory working results elsewhere, with apparatus for altering the radius by steam from a maximum of 24 feet to a minimum of 14 feet.

The traveling motion is transmitted from the crane engines by suitable gear and shafts to the traveling wheels, and warping drums or capstans are fitted on a countershaft on the inner side of each frame, so that these warping drums can be driven independently of the traveling wheels. This simple addition is found to effect a very large saving in manual labor and time.

Another great advantage which has been demonstrated by practice is that the cranes can be so readily concentrated at any point where they may be required; and indeed, as is shown in the engraving, three of these cranes are brought to load a long screw steamer having three hatchways; this is evidently a most important consideration with owners and shippers, especially under circumstances which so frequently arise where great dispatch is essential. Or two cranes can be brought together for any exceptional heavy lift. The cranes were tested with the maximum working load of 5 tuns, and subsequently for speed, when each crane delivered 50 tuns per hour from the trucks into the steamer's hatchway.

The arrangement we have described may be modified with advantage under some conditions by making the crane portable on its gantry, so that it will travel from end to end, all the other motions being retained, and the traveling motion in that case being transmitted through a square shaft with tumbler bearings. This construction is especially valuable for use on a jetty where vessels lay on each side; to suit these conditions, the gantry is made to span the whole width of the jetty, and to travel over the ordinary lines of rails and roadway. Another modification of the system consists in having the crane fixed on an ordinary overhead traveler gantry, or it may be made to travel across the gantry; in such a case the fixed staging may be constructed of square timber, or of columns and girders; this class of traveling crane has been rather extensively used in the construction of public works and large buildings.

OVERHEAD STEAM CRANES AT MIDDLESBROUGH DOCKS, ENGLAND.

It might at first sight appear that the road to carry these cranes must be of unusual strength, but on further consideration it will be seen that this is not absolutely necessary, because the base obtained is so large that there is comparatively little strain on the road, in fact, probably no more than on a line of rails of the ordinary gage, carrying a portable crane of the usual type, working the same loads at the same radius. Several of these cranes have been in successful operation for some time past, and a number more are in course of construction for the Middlesbrough Docks.

The system, evidently, has great advantages under the conditions above named, as well as for working in crowded railway stations, or in stone quarries, timber yards, etc., and it appears singular that an arrangement at once so simple and efficient should, until now, not have been brought into more extensive use, especially for dock and railway traffic.

Sumac.

Sumac is largely used in tanning the finer kinds of leather, especially in the manufacture of the hard grained moroccos and similar goods. It is also employed as the base of many colors in calico and *de laine* printing. Probably the consumption of this article throughout the country for all purposes aggregates more than 20,000 tuns, of which about two thirds are imported from Sicily, not because just as good sumac cannot be grown in this country, but because, until a few years ago, our people did not know its value, or in what way to prepare it for the market. The sumacs of Virginia, Maryland, and Tennessee in particular are said to be the best in the world, and even their worst varieties have been officially pronounced by experts to be better than any imported from Sicily.

Almost every farmer has a clump of these bushes. They are called by some "shoemake," by others "red shoemake." Probably many farmers may have tried to kill them by cutting down. If they have, they know how difficult a task it is. It grows like asparagus, all the better for being cut; and when once started upon a lot and cut close once a year, it is as easy to cut as corn fodder.

The only trouble is in curing it properly. This must be done with all the care that is bestowed upon tobacco or hops. Exposure, after cutting, to a heavy dew injures it, and a rain storm detracts materially from its value. It is cut when in full leaf; and when properly dried is ground, leaves and sticks together. An acre in full bearing will produce not less than three tuns; and when fit for market, it is worth from eighty to one hundred dollars a tun. The "manufacturers," as the curers are called, pay one cent a pound for it in a green state.

A sumac mill costs about $3,000. The Commissioner of Agriculture gave an outline of a mill in his report for 1869. If thirty farmers would unite in an effort to establish a sumac mill, each planting out a few acres, says the *Ohio Farmer*, we have no doubt the enterprise would prove far more remunerative than either corn or wheat, and be the means of inaugurating a new enterprise in their State. There is no danger of an overstock. The demand is daily increasing, for hemlock is growing scarce, and every day new tanneries and dye houses are going into operation.

The Commissioner of Agriculture advises to plant in rows in order to cultivate between, either by seed or cutting of the roots. We should advise cuttings by all means, as sumac is as tenacious of life as the blackberry or horse radish. It will never need but one planting, and the crop can be gathered any time from July to the time of frost. If it is cut later in the season, and annually, the leaves and the stocks can be ground together. If the cutting is delayed until the stock has formed into solid wood, the leaves must be stripped from the stock, and the stock is thus wasted. It is doubtful if anything is gained in the weight of leaves after the middle of July, at which time almost every tree has completed what is called "first growth" for the season. An auction sale of 1,406 bags of Sicily sumac, damaged on the voyage of importation, recently took place in Philadelphia, and will serve to indicate the value of the article: 102 bags sold at $53 per tun; 37 bags sold at $45; 178 bags at $72; 200 bags at $59; 221 at $66; 531 at $49, and 137 bags at $30 per tun.

ARTIFICIAL ALIZARINE.—Messrs. Lucius and Brüning oxydize anthracene by a mixture of nitric acid and bichromate of potash; the anthraquinone thus formed is boiled with nitric acid, whereby nitrothraquinone is formed; this is then treated with an alkali, and the alizarine formed precipitated by an acid. Purpurin is contained in the product thus formed, for which reason the dye thus produced is said to be superior to that made in other colorf actories.—*Reimann's Färberzeitung.*

E. L. C. says that the experiment in the wear of gold coin, reported in our issue of January 17, was not conducted in a manner to produce a correct result, as the gold coins used were heavier than the silver ones, which of course would cause greater wear on the gold. The correct way to test them would be to take a gold coin and a silver one of the same weight, regardless of size; then weigh out 20 pounds of each, and proceed in the manner described.

KANGAROO AND ALLIGATOR SKINS.—The hides of kangaroos are imported in considerable quantities from Australia to San Francisco, where they are tanned. They give a leather quite thin, much more supple than calf skin, and yet less permeable to water. Alligator skin from the South has been used for some time in this city for the manufacture of heavy boots for winter wear.

THE use of Epsom salts is found to give brighter tints to certain aniline colors, especially primula and methyl violet. Sulphurous acid is also beneficial for these colors, the tints being brighter and less readily rubbed off.

SAFFRANIN.—If mixed with strong sulphuric acid, this dyestuff developes a fine blue tint, becoming emerald green by addition of a little water. By suitable additions of water and acid, nearly all the prismatic colors can be produced.

IN some recent experiments on the droera, it was found that the leaves could reach round and catch a fly anywhere within half an inch of the plant. The flies have to be tied, as it takes the leaves about an hour to get round.

DECISIONS OF THE COURTS.

United States Circuit Court---Southern District of New York.

PATENT GRAIN AND GRASS HARVESTERS.—CYRENUS WHEELER JR., *vs.* CYRUS H. MCCORMICK.

[*In Equity—Before Woodruff, Judge.*]

A patentee may maintain a suit at law upon his patent in his one name, although he is under a contract to assign it to others, if it has not been executed.

But equity regards that as already done which the patentee has agreed to do, and requires that the proposed assignees be made parties to a bill in chancery brought against infringers.

If the other parties to such a contract release to the patentee all their interest in the patent, he may maintain a bill in his own name for all subsequent infringements, but not for those committed previous to the release.

Neither can he recover damages for any infringements committed after he has sold and assigned the patent.

The pendency of a suit upons patent in one district is no bar to the prosecution of a suit upon it in another, whatever may be the effect of a recovery in such foreign suit.

A patent covers only the devices which are claimed, although others are described by way of explaining them or illustrating the way in which they operate.

When a patent is reissued in several divisions, no one of them is void, because they every one describe all the mechanism shown in the original, provided the claim in each is for a different device, which is clearly described, and there is no conflict between them.

An inventor may claim in one patent a combination of devices when they are so connected as to operate in a certain way; and in another he may claim in combination with some of those devices another one especially by means of which the operation so described is produced.

An inventor may have distinct patents for several distinct devices, although he might have included them all in one, making a separate claim for each device.

Although a patent has expired and the device covered by it can be used only in connection with other devices embraced in a patent still in life, the latter devices cannot be used without the consent of the patentee, though in connection with the first.

WOODRUFF, *Circuit J.;*

On the 5th of December, 1854, the complainant, Cyrenus Wheeler, Jr., received from the United States a patent for an improvement in grass and grain harvesters, for which he had made application March 16, 1854. On the 7th of November, 1859, he surrendered his patent for the purpose of obtaining reissues thereof in divisions, and on the 3d of January, 1860, the patent was reissued in seven divisions, numbering 875, 876, 877, 878, 879, 880, and 881. Of these the reissue numbered 876 was surrendered on the 6th of April, 1867, and on the 14th of May thereafter was again reissued, numbered 2,610.

On the 6th of February, 1855, another patent was granted to the complainant for an improvement in grain and grass harvesters, which was also afterward surrendered and reissued June 5, 1860, and again surrendered and, on the 28th of May, 1867, was again reissued, numbered 2,632.

For the alleged infringement of the reissued patents numbered 875, 877, 878, 879, 2,610, and 2,632, this suit is brought.

The answer sets up probably as many grounds of defense as the ingenuity of counsel could suggest. It denies that the complainant invented the devices originally patented, and denies that a machine constructed in accordance with his patents is a practicable machine, or has any useful or patentable quality. It denies the validity of the several reissues on various grounds; avers that other parties were at the time interested in the patents, and that the complainant surrendered them, and obtained reissues without their authority, consent, or concurrence; and alleges that the reissues were obtained without any legal or justifiable grounds therefor; that they embrace devices not shown in the original patent, specifications, drawings, or models and which were not of the complainant's invention; that some of the reissues are for the same devices patented in others; that one of the reissues has expired, without extension, which included all the distinctive peculiarities shown in the original patent. It objects that other persons are jointly interested with the complainant in the patents, and that the suit is defective for want of the presence of such persons as parties. It denies the validity of the extension of the patents beyond the term for which they were originally granted. It avers the commencement of a suit in Illinois by the complainant against the defendant and another, for infringing the same patents on the 8th of May, 1869, which is still pending. It denies infringement by the defendant at any time since January 2, 1860, or that he has made or sold within the southern district of New York any infringing machines.

The defendant has moreover interposed a supplemental answer setting up, as a partial defense, that since this suit was commenced—to wit, on the third day of July, 1872—the complainant, Wheeler, sold, assigned, transferred, and set over to Cornelius Aultman all the right, title and interest, he, the said Wheeler, then had in the several letters patent and patent interests in the bill of complaint herein mentioned and therein set forth, as the property of the said Wheeler. This assignment and transfer the defendant relies upon as a partial defense—that is to say as a bar to any decree for an accounting to or with the complainant for any profits arising from infringements committed after the date of the said assignment, and as a bar to the granting of any injunction herein upon the prayer of this complainant.

Possibly in the defendant's answer some other grounds of defense were suggested, but not all of the supposed defenses were insisted upon on the hearing.

1. The objection founded upon want of necessary parties rests upon two agreements, one of which goes, as is claimed, to the right of the complainant to maintain this suit without joining other parties. That agreement was entered into by the complainant Wheeler and others of the first part, and Cornelius Aultman and others of the second part, on the 27th of December, 1860, to continue in force for ten years. It is the same agreement that was urged as a defense as against Aultman in the suit of Aultman *vs.* Holley *et al.* It is called in that suit and in this the "consolidation contract." In deciding the case of Aultman *vs.* Holley, at this present term, I have considered the same objection which is now urged here, and held that that agreement did not disable Aultman to maintain a suit in his own name, upon his patents included within the scope of that agreement. The same reasons apply to the present complainant, and my opinion in that case on this point must be taken as my opinion in this case, and may, if either party so desires, be inserted in this place, *mutatis mutandis*, as part of this opinion.

The other agreement was entered into by and between Wheeler, the complainant, and Henry Morgan, Allen, Mosher and others, on the 25th of October, 1859. It recites that he had theretofore entered into certain agreements with the others, relating to his patents for harvesters, and in it he agrees to obtain a reissue of his patents, and that upon obtaining such reissue he will execute to such several other parties assignments to convey to them undivided shares or interests in all said patents now held by him, and all reissues and renewals and extensions of the same; to the said Morgan, one fourth; to other of the persons named, one fifth; to others eighteen one hundredths; and to another, seventeen one hundredths; so that the said several parties shall become joint owners thereof (certain specified States excepted); that the income derived from the excepted States shall be divided in like proportions. Among other numerous detailed provisions showing the considerations moving between the parties, is one that Wheeler and Morgan, when the reissues have been obtained and the deeds of assignment are executed, are authorized to make sales of territorial rights, give licenses, to prosecute for infringements, compromise and settle claims for infringements, etc., they to render accounts, etc., to the others, and pay to the several others their proportionate share.

By a supplement another firm was admitted to share, with one of the firms who were included in the agreement, certain of the advantages secured thereby.

The defendant, in his allegation of defect of parties, names a part only of the persons with whom his agreement was made, and on recurring to the consolidation contract it appears that he has only named those who were parties to that contract also. This makes it quite apparent that the objection in the answer refers only to the consolidation contract, and has no reference to the agreement of October, 1859; nevertheless, I cannot say that an objection in the answer that Morgan and Mosher and some others specified are necessary parties does not warrant the production of this agreement of October, 1859, and any claim in respect to the specified persons which that agreement will sustain. It cannot be denied that that agreement made them equitable joint owners of the patents ow in question with the complainant Wheeler. When the reissues were obtained it was the plain duty of Wheeler to make and deliver to the others such assignments as the agreement provided for, and such as would have invested them with the legal title jointly with himself, until then Wheeler might have sued at law upon his legal title for the joint benefit. In equity, their title was (in the absence of any proof of a release, reassignment, or of a rescission of the agreement) as clear as his was at law. To this extent equity would regard that as done which ought to be done, and in equity their equitable title and immediate right to share the proceeds of a recovery made them necessary parties to a suit to recover for and to restrain infringements, if that objection is raised.

True, the complainant testifies that this agreement, "as far as the transfer of interest in the patents, as called for in that writing, was never acted upon." This is not sufficient to avoid the effect of the agreement; it does not show that any change was made in the relations of the parties to the reissued patents.

Their equitable titles in the shares, severally stipulated to each, became vested upon the procurement of the reissues, subject only to an accounting with certain of the parties mentioned. To vest the legal title it was necessary that the agreement should be "acted upon," but the parties, without action, could suffer Wheeler to retain the legal title and rest on their equitable rights. Proof that the agreement, in so far as it called for a transfer of the legal title, was not acted upon, does not show that it was in any manner defeated, or that it was rescinded, or that anything occurred to interfere with or interrupt its full force and effect in equity; while, on the other hand, the express admission by the complainant, in his testimony, that other writings were executed, not followed by showing what those writings were, leaves the defendant at liberty to insist upon the full force of his objection, and to presume that, had the complainant produced those writings, the equitable title of those absent parties would not be less clear.

It is, however, proved that on the 8th and 9th of July, 1868, releases were executed to the complainant by Morgan, Mosher, and certain other persons, who, by express stipulation herein, are admitted to have then been the owners of all the interest of the parties to the said agreement in question, excepting, of course, Wheeler himself. By these so called releases the parties sell and relinquish to the complainant, his heirs and assigns, any and all the right, title, and interest, which the parties thereto can or may have, or claim either in law or in equity, in or to said patents, and any reissue or extension of the same by reason of any agreement, contract, or understanding previously had with them or those whom they represent; to be had and held by the said Wheeler and his legal representatives to the full end of the term for which said Letters Patent are or may be granted.

This operated to vest in Wheeler the equitable as well as the legal title. In respect to subsequent infringements, his right to sue in equity as well as at law was unembarrassed.

This, however, leaves to the defendant a partial defence to this suit, which was commenced on or about the 30th of June, 1870. As to infringements and profits from infringements accrued prior to those last named releases, the objection remains, and on that ground the defendant now insists that if the defendant be decreed herein to account, such accounting shall not go back to an earlier date than July 8, 1868.

The complainant urges that this release of the equitable interest in the Letters Patent carries with it their interest in then existing claims for infringement. I think not; no such intention is expressed; the words used have no such import nor implication.

These releases, in that respect, are not unlike the instrument which, pending this suit, the complainant has executed to Cornelius Aultman, and which the defendant has set up in his supplemental answer. The only difference is that the former transfer the equitable title, and the latter both the legal and equitable title. If the latter were construed to embrace all claims to antecedent profits arising from infringements, it might be claimed to defeat the suit altogether. I must, therefore, hold the objection, for want of parties, valid to this extent—viz., that the complainant, if entitled to a decree, notwithstanding other alleged defences, cannot require the defendant to account in this suit for profits arising and accruing from infringements prior to July 8, 1868.

2. Upon the merits I shall not attempt to go into all the details of the arguments most minutely and very ably addressed to this case by the respective counsel. In one form or another they have, nearly all of them, on a like question, been under consideration in other cases heard and decided in this court between other parties. (See Wheeler *vs.* The Clipper Company, 10 Blatch. R., 181; Aultman *vs.* Holley *et al.*, at this present term.)

The patentable nature of the invention described in and secured by the original patents granted to Wheeler, December 5, 1854, and February 6, 1855, and the practicability of the devices patented and their utility I deem unquestionable. The contrary, though set up in the defendant's answer, is not insisted upon by his counsel.

That the reissues here in question are not invalid on the ground that they include devices not shown, described, or indicated in the original patents, their specifications, drawings, or models, has also been heretofore held, and I find no reason to change my opinion on that point.

Though alleged in the answer no ground is shown for holding the extension of the patents invalid or void.

The pendency of a suit in Illinois against the defendant and Leander J. McCormick, set up in the answer, is no bar to this suit, whatever operation, if any, a recovery here may have upon a final recovery there.

3. The invalidity of the reissues in question is most strenuously urged by the counsel for the defendant on the ground that they are several patents for the same alleged invention, and not several patents for distinct and severable parts of the invention described and shown in the original patent.

This is most elaborately and ably argued. I do not understand that the counsel for the complainant contests the legal principles urged in support of this branch of the defense. The contest is rather whether there is any foundation of fact upon which it rests; whether, according to a just construction of the several reissues, they are not in fact for severable parts of the aggregate invention included in the original patent.

I think the arguments of the defendant's counsel have not sufficiently kept in view this idea; where a patentee, having patented an aggregate of several devices, is permitted to surrender his patent and receive new letters patent for the several devices included in it, it does not follow that his new specifications may not be identical in their description of each and all of the devices included in the original aggregate patent. It is the patentee's selecting out of these devices some or one, being separable and capable of use as a distinct device or devices, and making that or those the subject of his specific claim that determines what is covered by each reissue. The description of an entire machine may be convenient and sometimes necessary in order to show the adaptation of the separated device to a useful purpose, and illustrate, not its construction alone, but its application, in one practicable mode, to the purpose for which it was designed. Such a description may be given, but that does not make the patent cover all that is included in the description.

In this case, then, it was competent for the patentee to amend his original specification, so as fully and minutely to describe all that was shown in the original or in its drawings or model, and receive patents for each separate device shown therein, or separate and severable combinations of devices, capable of distinct use, and, while such specification might be annexed *in totidem verbis* to each reissued patent, define and claim in each such separable and distinct part of his original aggregate invention; the specification in each case showing, as it should, the construction of each separate patented device or combination of devices, so as to give the required information to the public, and illustrating the application of each device or combination to actual use in the construction of an aggregate machine.

This does not make one reissue include all that is described in the specification. All that is included in a specification is not necessarily included in the patent. What is claimed in and secured by the patent is secured not only when used in the mode illustrated by the description of other devices with which it may be used in the specification, but it is secured against its use in connection with other devices of an entirely distinct character.

For example, in reissue numbered 2,610, the patentee claims, in combination with a harvester frame that is free to vibrate about a gear center, a laterally projecting finger bar, so hinged to one end or corner of said frame as to permit the finger bar at each end to follow the undulations of the ground over which it is drawn. This claim, read in connection with the specification, refers to and is confined to a special class of harvesting and mowing machines—viz., those in which the rise and fall of the finger bar are effected by a vibration of the frame of the machine around the gear center, and the hinging of the finger bar to one end or corner of that frame, so that it may rise and fall with it. It is the use of a laterally projecting finger bar in connection with such a frame, and hinged thereto, and also hinged so as to permit the rise and fall of either end, which is the subject of this patent. In comparison with this, take either of the claims say the first in reissue, numbered 875:

In combination with the hinged bar H and the finger bar, the intermediate shoe M hinged to said bar H, substantially in the manner and for the purpose set forth.

Here is a limited claim to the shoe confined to its connection with the oscillating bar H and the finger bar, in the manner pointed out in the specification. It is clear that the claim in number 2,610 might be infringed without the employment of this specific combination, and it is equally clear that the claim last above recited would not be infringed by the use of the shoe M in any other manner or combination than with the oscillating bar H, mentioned therein.

It is true that the devices specified in each claim may be so used as to infringe oth, but one may be used, and may infringe one of the claims and not infringe the other. As already suggested, the fact that the specification in each patent described the whole is not material. This is illustrated where there is but one patent, and of course but one specification; and yet the patentee, by his several claims, separates the devices, and, as may be lawfully done, claims the whole as an aggregate, and each separately.

A like comparison, instituted in reference to the other several claims in these reissues, leads to the same conclusion. In some the several and separate character of the devices is more plainly apparent than in others; but I think they are none of them liable to the objection that the complainant has taken more than one patent for the same device or combination.

In a certain sense it may be said that a patent for a combination of several new devices includes them all; but this does not forbid the patentee from claiming the combination, and also claiming the several devices which enter into it, if he be the inventor of each, and they are useful by themselves or in other combinations.

It is not to my mind very clear that the complainant might not have secured all to which he was entitled by reissuing his original patents, and claiming separately therein each device, or combination of devices, which he has claimed under several reissues. But the law permits him to divide his patent, and I find no sufficient ground for pronouncing the reissues invalid.

A ground of defence, depending substantially upon the point last considered, arises out of the fact alleged in the answer, that reissue numbered 880, which was founded upon the original patent of December 5, 1854, has not been extended. The term of the original patent, and of course the term of this reissue, expired December 5, 1868; whereupon it is claimed that inasmuch as the invention patented by that reissue became, on the expiration of the term, public property, and the defendant therefore became entitled to use it, first, that the defendant is not liable for any infringement since that time by the use of anything included in that patent; and, secondly, that that reissue does in fact embrace within it the devices included in the other reissues, and so the defendant is not liable at all, or, if at all, he is not liable unless it be for infringements prior to that date. In the first place, the defendant is not sued for violating any rights secured to the complainant by the reissued patent 880. In the next place, the whole proposition fails if reissue numbered 880 embraces only a distinct and separate device not included in the other reissues, so as to be free from the objections already considered. I will not enquire whether that reissue was invalid, either as not embracing a patentable invention, or because the device which was the special subject of that patent was not new, or not the invention of the patentee. Nor will it be necessary to inquire whether the complainant is at liberty to allege the invalidity of that patent on any ground in order to avoid the conclusion sought to be drawn from the expiration of its term.

I am of opinion that nothing fell into the public domain, on the expiration of that patent, except the special device claimed in it, and that the patent did not include the device embraced in the other reissues upon which this suit is brought.

Bearing in mind that a patent includes no more than the patentee claims therein, it will be seen that although, as in other reissues, the specification gives a full description of the device, and of other devices which illustrate its application to use, the claim thereupon is:

The use of two hinges substantially as described, whereby the finger beam may be folded to the main frame, in the manner substantially as set forth.

Waiving, as before, the question of the validity of this patent, it is manifest that the devices claimed in the other reissues do not necessarily permit such folding of the finger beam to the frame. They, or some of them, provide for the rise and fall of the finger beam at either or both ends, and for its oscillation, so as to elevate or depress the points of the fingers, but neither of them describe a construction or use adapted to this folding of the finger bar sidewise against the frame. That is only described and provided for in the specification of this reissue 880, and it is doubtful, at least, whether the machine, as described and shown in the original patent, had any such capacity. Be that as it may, the special feature, not included in the other reissues, and in nowise essential to the operation of the devices which are therein patented, is pointed out in the specification of reissue 880, and it is the special location of the hinge by which the shoe or socket piece is hinged to the oscillating bar. The device consists in so extending the place of that hinge sidewise towards the inner or grain side of the machine as that it may clear the frame when turned or folded. All the other functions of the oscillating bar, mentioned in other reissues, might be effective, and the finger bar might rise and fall at either or both ends in actual use for mowing, and, so far as desired, in reaping, without this capacity of folding to the side of the main frame. This special location sidewise of the frame admitting of such folding, is the specific device covered, or sought to be covered, by this reissue, and whether such mere location involved any patentable quality or not it does not in itself so include the other devices that the termination of the exclusive right to employ the specific location involves also the right to use the other devices. Such location, if patentable, might be suggested by a third person, not the inventor of the other devices. If he had the right to use such other devices he might employ them in his new location. If not, his patent would be of no value, it being merely an added improvement to what was patented to another. In short, the devices included in the other reissues do not necessarily include this capacity to fold the finger bar against the side of the frame, and the special right to extend the location of the hinge inward, so as to clear the frame, and so permit or enable the finger bar to be thus folded, may, as an improvement, be vested in another inventor, who, nevertheless, cannot use it on a machine constructed within the other patented devices without infringing the patents therefor. Such a location of the hinges, whereby the hinged finger bar may be folded to the side of the frame, may be applied to machines not involving the use of the other patented devices, and the right to use such a location may have become free to the public, and yet without involving the right to use such other devices.

For general illustration, suppose separate patents for several devices, all of which are useful in constructing an aggregate machine—the expiration of one of the patents makes the specific device therein patented public property. But while that will warrant the use of that device in any other connection, it will not warrant a use thereof in connection with the other patented devices, unless any use thereof necessarily involved the use of such devices; nor even then, except upon the ground that there is one patentee of both or all, who, in giving the use of one to the public, necessarily gives all that is essentially necessary to make that use available. Not only so, a device may be patentable and may become public property, either by expiration of a patent or by abandonment to the public, which is useful and valuable, which, nevertheless, cannot be used except in connection or combination with other patented devices. In such cases, it cannot be used by permission of the patentee of such other devices, whether he be the former patentee of such first named device or a third person. This exhibits the condition of the device patented in the reissue 880, even if it were conceded that it could not be used otherwise than in connection or combination with devices included in the other reissues, while, if it is susceptible of use in connection with other modes of hinging the cutter bar, which would not include the devices claimed in such reissues, the result more conclusively follows that the expiration of that patent forms no justification for infringing the other reissued and extended patents.

5. The question of the novelty of the invention claimed by the complainant, and whether he was the first inventor, was very elaborately discussed in this court by the counsel defending the case of Wheeler *vs.* The Clipper Company (10 Blatch. 181), upon the same proofs which are represented in this bearing on those questions. The influence of the same prior patents, applications for patents, inventions, attempted inventions, experiments, and failures, upon the inventions of others, was discussed in that case, and also in the case of Aultman *vs.* Holley, decided at this present term, and to some extent also in Kirby & Osborne *vs.* The Dodge and Stevenson Company, in the northern district of New York. Those questions have again been most elaborately reviewed on some alleged new aspects of the questions considered, and I have endeavored to give to the views of counsel not only a patient but careful attention, and I am constrained to the same conclusion in this case as is stated in the former cases; and what is stated on the subject, without a discussion of each patent, invention, and experiment in detail, in Wheeler *vs.* The Clipper Company, and Aultman *vs.* Holley, must be taken as my opinion in this case.

6. As to infringement by the defendant, the resistance of the charge depends very largely upon an impeachment of the complainant's title as inventor of the several devices employed by the defendant. So far as the denial of any infringement of the complainant's exclusive rigats depends upon that impeachment, what has already above been said sufficiently overrules it. In relation to the specific claims infringed, much that was said in the Clipper case is applicable to the defendant's machine. The infringement seems to me very clear. It includes and, in substance, uses the devices embraced in the third and fourth claims of reissue 875, and probably at least one other, but only the infringement of the third and fourth was urged by the counsel for the complainant; also, what is embraced in the claims in reissue 877, the claims in reissues 878 and 879, and 2,610, the first, fourth, fifth, sixth, and eighth claims in reissue patent numbered 2,632. The testimony of the expert, Mr. Renwick, is full and explicit, that the defendant's machine contains all these devices or combinations. My conclusion upon all the proofs is in conformity with his testimony to that effect. The witness also testifies that the defendant's machine contains also substantially the same combination described in reissue 2,632, and referred to in the third claim thereof; but as the counsel for the complainant, in his printed argument submitted, expressly states that the claims in this patent alleged to be infringed are the first, fourth, fifth, sixth, and eighth. I confine the decision to those claims.

Without further detailed discussion of the numerous points and arguments most ably presented by the counsel in this case, I must content myself with saying that, after a laborious examination of the case, I am of opinion that the complainant is entitled to a decree in conformity with the foregoing opinion, declaring the infringement and directing an account of profits; but for reasons above stated that account must begin with the date of the releases from Morgan and others, July 8, 1868, and inasmuch as the complainant has, since the filing of the bill in this case, and on the 3d of July, 1872, assigned and transferred all his right, title, and interest in these patents to Cornelius Aultman, as alleged in the defendant's supplemental answer, the account must terminate with the last named date, after which the complainant has no interest in the profits of the defendant's infringement, and no interest to be protected by injunction. The usual reference will be made to take such account, and the amount reported must be decreed to the complainant with costs.

George Harding, for complainant.

Henry Baldwin Jr., and Charles F. Blake, for defendant.

Recent American and Foreign Patents.

Improved Type Writing Machine.

John Galloway, New York city.—There is a roller, of sufficient size to receive a sheet of the paper to be used, and covered with cloth. This is mounted on a horizontal shaft which revolves in bearings attached to the frame. The paper, in connection with the colored paper or cloth from which the color is obtained for the impression, is rolled around the roller, and its edges are secured by a clamp. To the inner end of the roller is attached a spiral thread, which works between the pins of a shaft, so that the roller may be moved longitudinally upon its shaft at the same time that it is carried around thereby. By suitable means, the teeth of the shaft may be turned down out of gear with the thread, so that the roller may be pushed back at once, when required. By suitable construction the roller is rotated by the upward movement of the forward parts of the frames, the downward movement of said parts raising a push pawl one tooth. A pawl, which is pivoted to the frame, has its engaging end resting against the teeth of the wheel, to prevent said wheel from being turned back by the friction of the pawl as it is raised. A long block or hand piece is perforated longitudinally to receive a slide upon the forward bar of the movable frame. Upon the inner side of the forward end of the sliding block is formed an arm which projects through a slot in a plate, the ends of which are secured to the side bars of the frame. In the plate, at the upper and lower edges of said slot, are formed notches, and the free end of the arm is so formed that it may fit into the upper or lower notches, according as it is inclined upward or downward. Upon the top of the slotted part of the plate are formed the letters of the alphabet, the nine digits, a comma and a period, which characters are arranged in two rows, one row corresponding with the upper and the other with the lower row of notches. Upon the lower side of the sliding block are formed two rows of raised type corresponding with the characters, and which project at such an inclination that, when the arm is in the notch of either the upper or lower row of notches, the corresponding row of types will be in proper position for making the impression. In using the machine, the paper is placed upon the roller and the block is grasped with the hand, and is moved to bring the arm successively into the notches corresponding to the letters of the word to be formed upon the paper. As the arm is brought into each notch, the block is forced down, and the letter is printed upon the paper. At the end of each word the roller is caused to rotate twice the usual distance, and thus forms a space between the words.

Improved Safety Attachment for Car Trucks.

George C. Offen, Portland, Me.—The rollers are about three times as wide as the truck wheels, and are provided with short side flanges, and turn in bracket-shaped bearings, which are pivoted in suitable manner to the cross piece, to keep square on the track in case the truck is thrown off the track. They are hung at such hight above the track that they just clear the same, the flanges keeping them on the track when thrown into use. The rollers may be connected suitably to the engine, to notify the engineer when the wheels are off the track. On the damaging or detaching of any wheel, they carry immediately the truck, taking the place of the wheels, and may prevent damage and accidents.

Improved Lock.

Herrmann Stein, New York city, assignor to himself and Herman Dale, Brooklyn, N. Y.—This invention consists in a revolving tumbler which acts directly on a recessed bolt, and is retained in opened or closed position by a disk-shaped spring plate with projecting teats. The small slots or recesses for the key prevent the introduction of wires of sufficient strength to overcome the strong pressure of a plate on the tumbler, so that the lock cannot easily be tampered with, while the direct action of the tumbler on the bolt prevents the forcing back of the same by a chisel or other implement.

Improved Burglar Alarm.

Henry L. Brown, Middletown, Conn.—The object of this invention is to provide simple and convenient means for detecting burglars when entering buildings; and consists of an alarm movement and bell, in combination with a wire or cord and gas burners, so arranged that, in the act of opening the door or window with which the alarm is connected, gas is turned on, a flame is produced, and the alarm given. A wire or cord is attached to an arm in the wall and to a second arm, which is attached to and projects from the escapement shaft of the alarm movement. The alarm movement is wound up by means of a key on the main shaft, and is held and prevented from giving the alarm by the wire. This wire is attached to the vibrating escapement shaft by a crank, so that the movement is held stationary by it. When this wire is broken or parted, the alarm is given. A gas pipe is connected with the service pipe, and the burner on the end thereof is supplied with a small jet of gas, which is ignited when the alarm is set for use. When the door is opened a bar is drawn back, a gas cock is turned, which admits of a flow of gas through a pipe to a second burner. The two burners are so formed and placed so near each other that the gas which escapes from the second burner is ignited by the flame from the first burner. The former gives a full flame, which envelopes the wire and, in a few seconds, burns it off, and allows the alarm movement to vibrate the hammer and give the alarm.

Improved Machine for Printing Oil Cloth.

William E. Worth, San Francisco, Cal.—This invention consists of a vertically moving press for carrying the printing block and pressing it on the cloth. The block is mounted on a frame carrying a platform for the operators, and shifting laterally on another frame, which shifts forward and back over the printing floor, whereon the cloth to be printed is laid. The principal frame is provided with mechanism for shifting it, and both frames are capable of having their movements arrested by steps, so that the prints will match properly.

Improved Bench Plane.

George W. Huber and Aaron E. Flickinger, Norwalk, O.—The object of this invention is to construct a plane, which is light, handy, and easily adjustable to any thickness of shaving without the use of a hammer. It consists in the firm mounting of the plane iron between a cap piece with connecting clamping bolt and set screw, and a supporting shoe, which is pivoted to the sides of the base piece, and adjusted, together with the plane iron by a conical eccentric pivoted to the base.

Improved Saw Gumming Machine.

Henry Baughman, Dorn's Gold Mine, S. C.—In this invention an emery or vulcanite gumming wheel is used. The tool overhangs an oscillating frame at one end, so as to be presented to a circular saw by means of two handles. An eccentric dog regulates the depth of the cuts in the saw by the tool by coming against the side of the frame. It can be set for cutting deep or shallow notches by turning it on its pivot. The tool is driven by a belt operated by any suitable driving mechanism. The contrivance for holding small circular saws consists of a clamp and center pin fitted on a slotted bar which is detachably connected to the frame. The clamps slide along the slotted bar through which the center pin passes, and are secured at any point for saws of any size by nuts on the center pin screwing all fast. There is a bar with a gage screw for controlling the edge of the saw by being screwed fast during the operation of the gumming tool. It is released to shift the saw. A stop button is employed to engage with the frame and hold the securing frame when gumming straight saws, which are moved up to it instead of moving the tool down to the saw, as when gumming round saws. The saw frame is weighted, so that the end on which the tool is mounted is borne upward.

Improved Gauntlet Glove.

Frederick Farrant, Gloversville, N. Y.—This invention consists of a novel construction of the wristband of a gauntlet glove, of two or more pieces, contrived to arrange one or more pinked or otherwise ornamented edges of the material of which the glove is formed, around the band at the middle, to make a more stylish finish than is afforded by the plain surface of a band composed of only one piece.

Improved Culinary Tongs.

Alfred Greenleaf, Brooklyn, N. Y.—This is a pair of wire tongs of which the middle part of the lower prong is bent upward above the other and has a coil formed on it to give it elasticity so that the points are held closely together. A thumb piece is affixed to the bend, by pressing down which the prongs are forced apart.

Improved Device for Converting Motion.

Joseph P. Taylor, Hudson City, N. J.—This is an improved apparatus for applying motive power for propelling machinery, and for other purposes, by a pendulum lever connected with a rotating wheel, a continuous rotary motion being produced by means of a ratchet wheel and two ratchet pawls. The wheel and the ratchet are revolved on a central shaft, and the pawls are carried one to the right and the other to the left, by the oscillation of the pendulum lever, and alternately drop into gear with the ratchet by their own gravity and rotate the wheel. They are thrown out of gear with the ratchet wheel at the completion of each stroke by means of weights. An impulse is given the pendulum lever by means of a cord attached at the bottom.

Improved Automatic Railroad Signals.

Jane D. Evans, West Chester, Pa. executrix of Henry S. Evans, deceased.—This invention is an improved device, by the use of which railroad trains will be enabled to set the signals automatically as the train approaches and leaves a station, a crossing, a curve, or other place requiring care. Posts are set upon each side of the dangerous place, and in such positions that the signals attached to said posts may be readily seen from such a distance as will enable the engineer to readily stop his train before reaching said point. The signals are pivoted to the posts and are connected by chains which are attached to the rotating part of said signals, so that each signal may be operated by and from the other. As a train passes in the opposite direction, a projecting wheel placed upon a journal extending from the side of the engine strikes and presses down inclined bars arranged upon the other side of the track, which bear down upon the ends of levers, which are pivoted to the ties, and the inner ends of which are jointed to the inner ends of other levers, which communicate with the chains which work the signals. The inclines when relieved from the downward pressure of the car wheels are again raised to their former position by coiled springs placed beneath them in recesses in the ties.

Improved Ventilating Car Window.

Charles B. Knevals, New York city.—This invention consists in a horse-shoe-shaped plate, provided with stop flanges upon the ends of its arms and perforated. It is secured to the lower part of the casing around the lower pivot of the sash, and with its circular part inward and its ends outward. The flanges serve as stops to limit the movement of the window upon its pivots. With this construction, the forward side of the sash, whichever end of the car moves forward, is swung inward, so as to form front and rear openings between the side bars of the said sash and the frame. The inclination of the window not only ventilates the car by causing a movement in the air, but the window serves also as a shield to prevent cinders and dust from entering the car, which cinders and dust strike against the inclined surface of the window and are projected outward. Small bolts are secured to the bottom bar of the sash upon the opposite sides of its pivot, and in such positions that their lower ends may enter holes in the side bars of the plate and thus lock the sash in place when adjusted.

Improved Washing Machine.

Moses L. Hawks, Kinderhook, Mich.—This invention has for its object to improve the construction of the washing machine for which letters patent No. 140,625 were issued to same inventor, July 8, 1873. The journals of a large roller are held down by the half bearings which slide up and down in the slots of the standards. The half bearings are rounded off to receive the rubber bands. The journals of two inner small rollers revolve in bearings in the standards, and the journals of two outer small rollers, all four being below the large roller, pass through short curved slots in the standards and revolve in bearings in the ends of the cross bars, which are placed upon the outer sides of the standards. The upper parts of the rubber bands are whole, but their lower parts are split. The improved construction allows the outer lower rollers to yield more readily as the clothes are entering and leaving the machine, and prevents the tendency to press the rollers out of position. The cross bars are connected and held in place against the outer sides of the standards by the wires, the ends of which are attached to the ends of the said cross bars. The wires pass across the edges of the standards, and, at the inner side of said standards, are bent twice at right angles, so as to pass beneath the outer small rollers, and thus be out of the way of the clothes.

Improved Car Coupling.

William Charles Brooks, Stoneham, Pa.—The upper part of the drawhead comprises the top and two sides, between which is a hollow longitudinal space, in the lower part of which is the other part of the drawhead, which is pivoted to the sides at its middle part. At the inner end this lower portion has a spiral spring arranged with it, so as to force the front end up and press a coupling link, which has a hook on the upper side, up into a notch behind a corresponding hook on the lower surface of the top side of the drawhead. The two parts of the drawhead are beveled at the front end to form a bell mouth to guide the end of the coupling link into the space at the front end when the cars come together. The link forces the front end of the lower part down sufficiently for its hook to pass hooks on the under side of the top of the drawhead, and the spring instantly forces it up again, and holds it so as to keep the hook of the link in connection with the hook of the drawhead. To disconnect the hooks a push pin and a lever are arranged with the drawhead and link and provided with a spring to hold it up. The push pin is arranged above the link, so that, by being pressed down by the lever, it will press the link and the lower part down so as to disconnect the hooks. The lever will extend to the side of the car, where it can be reached to uncouple the cars without going between them.

Improved Umbrella.

James H. Dugan and George Moncrief, Stoneham, Mass.—This invention consists of an arrangement of an umbrella top, so as to revolve upon the handle to relieve it when strong gusts of wind blow against it quartering, or when the top strikes against other umbrellas or other objects in crowded places. The said arrangement consists of a notched revolving ring for the ribs, between two collars on the handle, and a revolving notched ring on the runner, also between two collars.

Improved Portable Fire Extinguisher.

Isaac C. Andrews, New York city.—There is an inner bucket for containing the acid, in the opposite sides of the lower part of which are formed V shaped notches to receive pins formed upon the inner sides of the arms of the bow or U shaped bar. The ends of the arms of the bow pass up through stuffing boxes in the cover, and their ends are secured to the ends of the yoke. Upon the lower or inner side of the cover is formed a stopper, which fits into the mouth of the acid bucket. The bottom of the acid bucket is recessed to receive a loop, which is connected with the bow by a short chain. To the upper or outer side of the cover is rigidly attached the end of a rack bar, which passes up through a longitudinal slot in the yoke, in which slot is pivoted a lever, upon the lower end of which is formed a segmental gear wheel, the teeth of which mesh into the teeth of the rack bar, so that by operating the lever ratchet the bow may be lowered or raised. Upon the inner sides of the arms of the bow are formed toes which, as the said bow is lowered, strike against the upper edge or mouth of the acid bucket and push it off the stopper. This allows the bucket to slip over, and as it approaches a horizontal position the peculiar form of the sockets allows it to escape from the bow, and it drops, bottom upward, into and hangs suspended in the alkali solution in the middle of the lower part of the outer or alkali vessel. The rapidity of descent of the bucket causes it to carry the greater part of the acid with it, which acid is thus discharged in the midst of the alkali solution, with which it thus becomes thoroughly and evenly mixed, the swinging motion of the suspended bucket greatly assisting the mixing.

Improved Button Holder.

Minor J. Cooper, New York city.—The holder consists of two plates of metal which are forked at one end, the space between the prongs being V shaped. One of these plates has grooves on the inner edges of the prongs, which grooves receive the buttons. This V shape of the openings adapts the holder for buttons of different diameters. The cloth passes in between the two plates, and is pressed upon the buttons by the prongs of back plate as the two plates are pressed together or toward each other when the holder is in use by the fingers of the operator. The button is then sewn on with a needle and thread, in the usual manner. The advantages claimed are that the fingers are not exposed to the needle, and the sewing on is performed with much greater ease.

Improved Machine for Shaping Brush Woods.

John Ames, Jr., Lansingburg, N. Y.—Through a hole in the bench or table of the machine passes a vertical shaft, upon which is formed a spiral cutting edge. To the upper side of the forward edge of the base plate is attached a flange of such a hight as to afford space for the bristles of the brush, so that the said bristles may serve as a guide in placing the brush. The brush is held securely, while being operated upon, by the plate, which rests upon the back of the brush, and its forward edge is made of the exact form to be given to the edge of the brush, so as to firmly support the said brush while being operated upon. A cam is made to press against the base plate, so that the brush may be securely clamped in place. The part of the plate opposite the cutter is further supported against the upward pressure of said cutter by a ring guard through which the cutter passes, and which is supported in place adjustably. By this construction the brush is shaped with an upward cut toward the back of the brush, which leaves the edge around the bristles perfectly true and smooth, the trifling sliver ing that may be made being around the back of the brush, where it can be readily worked out.

Improved Cotton Seed Planter.

Zimri Carter, Line Creek, S. C.—This invention is an improvement in the class of planters having a furrow opening plow and covering devices arranged, respectively, in front and rear of a hopper, from which the seed is centrally discharged as the machine advances. The improvement relates to the arrangement of plows or shovels in rear of a centrally discharging hopper, whereby one distributes or disperses the seed after being deposited in the furrow, and the others cover it.

Improved Machine for Removing Snow from Roadways.

George Hart, Tarrytown, N. Y.—This invention consists of a small locomotive engine, which is surrounded at the sides by a casing, with inclined endless belts with buckets, which take up the snow from rotating brushes or wings and convey it over connecting chutes to a separate tank, where the snow is melted by steam connecting pipes and the direct application of heat. The different parts which come in contact with the snow are heated by steam from the boiler, to prevent the clogging of the machine and insure a rapid delivery of the snow to the tank.

Improved Skate.

James A. Whelpley, Dartmouth, N. S.—The runner has standards formed together with it, and projecting upward from the upper edge, for the support of the heel plate, sole plate, heel clamp, heel dog, and toe clamp. The toe clamp and heel dog are mortised to fit on their standards so as to slide freely back and forth, and they extend down to the upper edge of the runner, and have a thumb nut screwed on the lower extremity, so as to cramp and bind them fast at any point by screwing the nuts down on the runner. The sole plate and heel plate are also notched a little to receive projections and lock together with them when said plates are connected to the runner. Said plates have a strong semicircular brace attached to the under side, and these braces are engaged with the standards by entering longitudinal notches, when the plates are placed on, sprung down, and moved endwise. At the same time the notches of the plates and the projections lock together. The standards also have a projection passing entirely through the plates, to secure them against lateral movement. There is also a vibrating heel piece, clamped by means of a pendant shank and a cam lever. The latter has a slot and a projecting point, in combination with the shank of the heel piece, provided with an incline, to operate the same. It will be seen that all the several parts of the skate can be cut or formed in the shapes required by the dies by which they are punched out of the plates of which they are formed, and that the only fitting necessary besides the smoothing and polishing is a little bending of the clamps and dog, the fitting of the nuts, and the fastening of the braces to the plates.

Improved Water Closet.

John F. Neilson, New York city.—A round valve in a water chamber is opened by a lift handle, when all the water and other matter are discharged from the basin and elbow pipe through the valve seat. A float then sinks in a second chamber, carrying with it a valve which opens the supply pipe and admits water through to the basin, thence through the elbow to the chamber first mentioned. On releasing the handle the round valve resumes its former position, having sufficient weight to carry it to its seat. Water now gradually enters and raises the float and closes the supply pipe. To avoid overflow, a third chamber and an intervening piston that works between the valve and float are used. This greatly lessens the chances of sticking, but will not always prevent it. To provide an outlet to meet this contingency, a piston on the same rod that carries the round valve is employed. This piston not only serves as a guide to cause the valve to pass perpendicularly to its seat; but as soon as the water reaches it, it will be lifted and carry with it the valve, thus opening an outlet for the surplus water, and preventing an overflow.

Improved Spinning Mule.

Thomas Houlding, Ipswich, Mass.—This invention consists of a shaft extending the whole length of the carriage of a spinning mule or jack, and gearing at each end, by a toothed flanged pinion, with a kind of toothed chain, stretched from end to end of the carriage track, and prevent one end from over running the other. The chains are adjustable in their supports at the ends, as may be needed from time to time, to adjust the carriage.

Improved Corn Sheller.

John Marshall, Cordova, Ill.—The corn to be shelled is placed in the hopper, from which it is fed to an endless apron or elevator, which consists of a wide belt provided with cross slats, and passing around rollers pivoted to the frame work of the machine. From the upper end of an elevator the corn falls into the space between a cylinder and concave, where it is shelled. The cylinder is cast hollow, and with its shell is about half an inch thick, and revolves in bearings upon the frame work of the machine. In the shell of the cylinder are formed a number of pairs of holes to receive the shanks of ribs. These holes are arranged in rows, longitudinal with the cylinder, and in such a way that the ribs of one row may be opposite the spaces between the ribs of the adjacent rows. The ribs are made of steel or wrought iron, are half round in form, and are provided at their ends with shanks projecting at right angles from their flat sides. The concave is made of cast iron, in sections, with semi-cylindrical ribs upon their inner or concave sides. The sections are arranged about a quarter or three eighths of an inch apart, and their edges have oblong or oval notches formed in them, which are so arranged that the notches of the adjacent edges may alternate with each other. It will be seen that while the said notches supplement the function of the parallel spaces between the sections in aiding the ready discharge or escape of the shelled corn downward, their form and size are also such as to prevent the cobs taking the same course.

Improved Fish Grappling Spear.

Jonah W. Knapp, Cross River, N. Y.—The spear hooks are jointed together and provided with springs, which are bent when the hooks are opened, and held by the toggle joint until the latter is sprung, and then close them with sufficient force to secure the fish. The springs are jointed to the stock instead of being permanently attached as they have always been arranged, so that the hooks can be released from the power of the springs, to facilitate the opening and setting of them. One of the hooks is connected with sliding sleeves on the stock by a rod and wires passing up and down on the rod and over a pulley, and communicating with slides; so that by the sliding of one sleeve toward the spear hooks, and the other sleeve toward the top of the handle, the rock lever will be turned around to open and reset the hooks; and by moving the sleeves in the opposite directions, the lever will be turned back again to free the connecting rod so that said rod will allow the jaws to close when tripped, also to subject the springs to the required tension for actuating the hooks, which is effected by the action of a cam on one of said springs. The springs are arranged in a clip to which a rock lever and cam are pivoted; and the form of the rock lever and the connection of the rod with said lever are such that, during the first part of the movement of said lever in the direction for opening the hooks, the tension of the springs is so lessened that when the opening of the hooks begins the springs have but little power to resist it, thus making it so easy that it can be readily effected. This clip has a set screw which acts in conjunction with the cam for producing and varying the tension of the springs; and the clip is made adjustable forward and backward on the stock along the springs, also to vary the tension.

Improved Corn Dropper.

Robert M. Bowman and William H. Bowman, London, Ohio.—This invention consists of a hopper bottom having a hole for dropping the grain into it, with a supplementary slide for closing the hole arranged on its under side. The bottom is constructed to slide forward and back to bring the hole under the grain in the hopper, and then move it beyond the cut-off to the place of delivery. At the same time, the hole is opened by carrying the supplementary slide against a stop, which holds it against moving with the hopper bottom as soon as the hole has passed beyond the cut-off. The bottom continues its motion as far as the width of the hole, and then goes back for another charge, the supplementary slide being closed during the back movement by a spring. The arrangement is designed to prevent the choking and clogging common to most droppers in use.

Carbonic Acid Gas Generator and Soda Water Fountain.

Friederick W. Wiesebrock, New York city.—The first invention is an improved apparatus for generating carbonic acid gas for charging soda fountains, and for other uses, which shall be so constructed that the operator can discharge any desired amount of acid into the generator, as may be required, and know exactly how much remains in the acid chamber, and which can be operated without an agitator. To facilitate and insure the thorough intermingling of the acid and marble dust, cross bars are extended across the middle part of the generator, and have their ends secured to the shell of the said generator. The dome or gas chest is connected with the generator by one or more pipes, and in the top or cover of the dome are formed two openings. One opening is closed with a screw cap, and the other is connected with a pipe which leads down at one side of the dome and passes through or is connected with the hollow gudgeon of the receiver, so as to conduct the gas to the washer without being disturbed by the oscillation of the generator. The acid chamber has gudgeons formed upon its sides, which work in bearings in the sides of the dome. One of the gudgeons projects and carries an index finger which moves along an index plate on the side of the dome, and thus indicates the exact amount of acid that is poured out of said chamber. In the upper side of the acid chamber is a hole which, when the generator stands at rest in a horizontal position, is directly beneath one of the dome openings, so that the acid poured in through the said opening may flow into the acid chamber. By this construction, the contents of the generator will be thoroughly intermingled, by simply oscillating the said generator, which movement does not affect the acid chamber, which swings upon its pivots and is kept right side up by gravity. This construction also enables the generator to be turned into a vertical position, so that the refuse can be readily discharged without its being necessary to retain sufficient gas in the generator to blow out the said refuse, as is the case with the ordinary apparatus, thus effecting a great saving of gas. The same inventor has also devised an improvement in fountains for soda water, etc., in which the cylinder has a removable bottom, with a downward flange. There are hoops around the cylinder, and a lining; and an overlapping cover, a discharge pipe, and a discharge cock are also provided. The lining is made to loosely fit the cylinder, and is held to the cover and to the discharge tube by flanged nuts. The bottom is attached to the lower end of the cylinder by means of a peculiar base piece, hoop, and screws, so that it may be readily detached. When the bottom pipe and nut are removed, the lining and nut may be taken out. By making the fountain in this manner, it is claimed, the expense of the cylinder is greatly lessened, and all needed repairs to the lining easily and cheaply made.

Improved Railway Car Brake.

Luther Adams, Mattoon, Ill.—A friction disk or wheel having a notch is the chief medium for bringing the brake mechanism into action. This disk is mounted on journals in the bifurcated end of a plate which is hinged to a cross bar or timber. A spring is attached to said plate, and has a hole in its free end to receive a rod which forms the short arm of a bent lever. This last extends above the platform, and is pivoted thereto so as to be easily accessible. A spring also holds the disk out of contact with the axle. When it is desired to apply the brakes, the lever is operated to depress the spring plate, and thus bring the disk to come in frictional contact with the axle, which causes it to revolve one half a revolution, or until the axle enters the groove or notch, when the disk will remain locked until the pressure on the spring is relieved. This movement of the disk upon its axis applies the brakes, since it winds up the chain, which is secured in a circumferential groove of said disk, and extends back and connects with one end of a bar that is pivoted to the brake beam. By suitable mechanism, the action of the friction wheel is made automatic.

Improvement in Heating Air and Supplying Boilers therewith.

George E. Hibbard, Fond du Lac, Wis.—There is an air holder on the top of the boiler, near the smoke stack, into which air is forced by one or more air pumps, worked by the engine and connected with it by pipes. A pipe, with a check valve, connects this holder with a heating coil in the space, at the front, from which the hot air and exhaust steam escape. This coil is continued from the bottom of the space to the top of the boiler, where it connects with a pipe inside the boiler, which extends back into the steam dome, and discharges the air into the throttle pipe. The cold air is condensed to the extent of the boiler pressure, when it passes the check valve by the pumps, and what is gained afterward by the expansion is utilized as working force in the engines. In case air brakes are used on the cars, it is proposed to take the air for working them from this holder by a pipe, and thus utilize the same air pumps for supplying them. By the use of expanded air in connection with the steam, it is claimed that a large measure of heat which is otherwise wasted is utilized, thus economizing about twenty per cent of fuel.

Improved Dust Pan.

Orlando C. Forsyth, Jr., Newburgh, N. Y.—This invention is a dust pan provided with a handle made of wire bent at the middle to form an oblong end loop, next twisted together, then bent laterally and downwardly to support the rear of pan, so as to form legs of such a length as to support the pan in proper position for the dirt to be swept into it, and which will at the same time prevent the dust pan from being pushed back by the broom when sweeping the dust into it.

Improved Meat Holder.

Sarah Beissel, Shamokin, Pa.—This invention serves to hold meat while the same is being cut. It consists of a board clamped by set screws to the table and carrying two upright adjustable rollers between which the meat is placed. Vertical screw bolts also support a concave cross bar, which, on being forced down upon the meat, holds the same firmly in place.

Improved Car Mat.

John O'Neill, Brooklyn, N. Y.—The floors of street cars are usually covered with a wooden grating, made in sections, called car mats. As these mats are now made, the slats or bars are made to run all in one direction, either longitudinally or transversely with the car. The present invention consists in forming each separate section with groups of slats, arranged at right angles with each other, thereby, it is claimed, greatly strengthening the mat and rendering it durable.

Improved Till Alarm.

John F. Baldwin, Nashua, N. H., assignor to himself and Miles Alarm Till Manufacturing Company, Providence, R. I.—The receptacle in which the bolts and levers are placed and work consists of a box, the front and sides of which are cast in one piece, and the rear side of which is closed by a guide plate. Bolts are arranged so that their bodies fit into an upper chamber of the box, and their tops project in front and rear to rest upon the upper edges of the box and guide plate. The lower ends of the bolts are inclined and rest upon the upper ends of the one armed levers which have their fulcrum in the guide plate. By suitable construction, when the lower parts of the one armed levers are held back by springs, their upper ends are inclined to correspond with the inclined lower ends of the bolts. When the bolts are so arranged that the inclination of their lower ends may correspond with the inclination of the tops of the levers, the forward movement of the lower ends of said levers will raise the said bolts; but when the bolts are reversed, the forward movement of the lower ends of the said levers will lower them. By other construction, when all the bolts are down, lugs, when the drawer or till is drawn outward, will pass out beneath other lugs; but should the till or drawer be drawn upon without all the bolts being down, the first lugs will strike against and cannot pass the others. There is other apparatus so arranged that, when the drawer or till is drawn upon without all the bolts being down, a lug releases a lever from a ratchet and sounds the alarm.

NEW BOOKS AND PUBLICATIONS.

A SELF-MADE WOMAN: or Mary Idyl's Trials and Triumphs. Price $1.50. New York: S. R. Wells, 389 Broadway.

This little tale is one of an unexceptionable moral tendency, in which the value and importance of the publisher's specialty of hygienic treatment is thoroughly displayed.

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STATISTICS OF THE WORLD, containing the Area, Population, Debt, Revenue, Expenditure, etc., of All Countries. By Professor Alexander J. Schem. Issued Semi-Annually. Price 50 cents. New York: G. J. Moulton, 103 Fulton street.

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[Compiled from the Commissioners of Patents' Journal.]

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ANSWERS TO CORRESPONDENTS

W. P. D. will find a recipe for a transparent cement for glass on p. 27, vol. 30.—W. H. P. will find the description of a paste that will not sour on p. 290, vol. 28.—M. M. F. will find the explanation of the gravity clock on p. 58, vol. 30.—E. R. R. D. should see our advertising columns for book publishers' names.—J. Mc. can repair his waterproof suit, if it be made of rubber cloth, by following the directions on p. 155, vol. 26.—S. H. Jr. should see p. 349, vol. 26, and p. 33, vol. 27, for directions for utilizing old rubber belts.—C. P. should read the directions on p. 408, vol. 24, for destroying moths.—P. H. R. should consult a qualified medical man, and beware of nostrums.—A. S. will find directions for destroying red ants on p. 122, vol. 27.—P. can mount his chromos by the process described on p. 154, vol. 27.—S. H. S. will find a recipe for a waterproof and fireproof cement on p. 241, vol. 27.—G. W. H. will find an answer to his query about American and foreign inventors in our editorial columns of this issue.—A. F. will find information about gas engines on p. 33, current volume.

B. F. P. asks: 1. Is it an easy thing for burglars to turn the key, if left in the lock of a chamber door, from the outside? 2. If so, can they pick a lever lock, if the key is taken out when the door is locked for the night? Which is safest? A. 1. Yes. 2. Yes. Perhaps the latter may be somewhat the safest, though neither of them would be likely to give much trouble to an expert burglar.

D. R. H. asks: In the case of two steam fire engines, one on a level and one at the foot of a hill, with the hose (2 lengths, or 100 feet) in the first case being level and in the second being laid up the hill, and the water gages on the engines showing each 160 lbs. to the square inch, is there any more pressure on the inch in the hose laid up the hill than that laid on the level ground? A. We suppose not.

C. W. Jr. asks: Is there any special cause producing storms at the time of the autumnal equinox? A. We think not.

F. M. H. asks: Which of the three methods would be best for keeping the ceiling over the smoke stack of a 15 horse power boiler from heating? The pipe is about 15 inches from the ceiling, and runs horizontally with it for 9 feet. 1. Nail a piece of tin tight to it. 2. Have it hung on wires about two inches from it. 3. Have a pan made and have it hung on wires about 6 inches from the ceiling and keep it full of water. 2. What is a good treatise on steam heating? A. 1. Probably the last method is the best. 2. Box on "Heat." See our advertising columns for booksellers' addresses.

W. A. B. asks: 1. Will silver coin answer for anodes in electroplating, that is, without taking out the alloy? 2. Has the United States nickel coinage any alloy in it? 3. I had some old gold, and tried to separate the alloy from it by the moist method. I dissolved it in strong nitric acid, and then tested for silver, but there was not any. I then poured off the supernatant liquor, which contained copper, and found a brown precipitate remaining. Then I added *aqua regia*, but it would not dissolve the precipitate. Why is this? How can I make chloride of gold of it? 4. I wished to make a plating solution for rubbing on with a sponge, according to a formula in an electroplating manual: I first took some pieces of pure silver (worn anodes) and dissolved in nitric acid and water. When dissolved, I evaporated. I dissolved the resulting crystals of nitrate of silver in rain water. Then (as per manual) I threw in a few crystals of hyposulphite of soda. A brown precipitate was formed, which eventually turned black. I threw in an excess of the hyposulphite to dissolve precipitate, but it would not dissolve. Why is it so? How can I make it into solution? 5. Having a quantity of copper wires coated with silver (slinging wires) I dissolved them in nitric acid, then diluted it with rain water, and precipitated with pieces of copper. I poured off the supernatant liquor. A white mass remained. How shall I make nitrate of silver out of this, in order to make silver solution? 6. Could you tell me how to test the strength of my batteries by some simple contrivance that I could make myself? A. 1. Yes. 2. The nickel is alloyed with a certain proportion of copper. 3. The material you dissolved in nitric acid was not gold. The only acid solvent for gold is a mixture of nitric and hydrochloric acids, and the solvent in this case is the nascent chlorine which is liberated, forming chloride of gold. 4. Ammonia will dissolve the precipitate. 5. The white mass which remained was metallic silver, thrown down by the copper from the silver solution. This will dissolve in dilute nitric acid, forming nitrate of silver. 6. Consult some good work on electricity.

F. H. asks: What is the proper rule for reducing logs to cord measure? A. A rule frequently used is as follows: Multiply the square of one fifth the girth of the small end of the log, in feet, by twice the length in feet, and divide the product by 128.

F. E. C. says: I wish to be a machinist. 1. What branches should I study in addition to arithmetic and algebra? 2. I am now 16. When will I be old enough to enter a shop? 3. Will I have to serve as an apprentice? If so, how long and on what terms? A. 1. You should know something about drawing. 2. We think you are old enough now. 3. Arrangements are different in the various shops, and we advise you to make some inquiries from their proprietors.

W. McC. asks: Can you suggest a substance to be used in the manufacture of corundum wheels that is better than shellac, as adhesive as that material, but harder, and such as will render the wheels capable of being used both wet and dry? A. Such wheels are made, to be used both with oil and water. We believe the process of manufacture is patented.

J. C. S. says: I have an engine 6 inches bore by 10 inches stroke, now running 100 revolutions per minute, and doing about 3 horse power of work. At what speed should it be run to do that amount of work with least steam, at 20 pounds pressure, the driving pulley being changed to suit the speed of the engine? Probably the faster you can run it, without injury, the better.

W. & B. ask: Will three fans blowing into a common receiver, to supply blast for puddling furnaces, be as effective as the same three fans blowing through separate pipes? A. We suppose so, if application of blast is similar in both cases.

S. says: 1. I have a blank in which I wish to cut teeth for a gear. The diameter is ¼ inch. I want the teeth to be small. The gear is to work in a rack not yet made. Can you give me some simple method of obtaining the number of teeth, etc? I should like an even number of teeth to the inch. 2. How do you calculate how many threads to the inch to cut a worm to run in a gear? A. We advise you to study some standard work on gearing. "The Engineer's and Machinist's Assistant," will give you full information on the subject.

W. E. C. asks: Why is it that when a piece of steel with a hole in it has been hardened and annealed, it is necessary to bore the hole out, as it has contracted in the process? A. We suppose that the steel, when hardened, contracts more than it afterwards expands, when annealed. As the nature of hardening is not understood, it might be difficult to give a precise reason for this.

H. C. asks: 1. What will be the difference in the work of a pump, the perpendicular hight being 18 feet, if I work it through a slanting tube 44 feet long, to the same level? 2. Has there been a patent taken out for a roof tile? 1. The difference would be that due to the friction of the water in the pipe, caused by its increase of length. See article on "Friction of Water in Pipes," p. 48, vol. 29. 2. We think there have been a number of patents for roof tiles.

C. H. S. says: I find the following memorandum: "Grade, 374½ feet in 1¼ mile; 2 cuts, one 96 feet, one 140 feet." This refers to the inclined plane of the railway at this place, which is built nearly as straight as a line can be drawn; and at the above gradient, the cuts referred to are through solid carboniferous limestone, which is a great curiosity to many. I saw in the SCIENTIFIC AMERICAN, a few weeks since, an account of the railway over the Alps, in which you state that they use a third rail, which is notched, and into which a toothed wheel, on the engine, works to aid the ascent. That plan was used here until about four years ago, and was invented (or claimed to be) by a resident of this city, a master mechanic in one of the machine shops here. I am not sure, but am under the impression, that he had a patent; if so, its date was about 20 years ago, as that is about the time it came into use here. A. We think this idea is quite an old one, and we aid nothing to give a contrary impression.

P. C. asks: 1. What is meant by mean pressure on the piston of an engine, and how is it calculated? 2. How many inches in cylinder are allowed to a horse power in manufacturing an engine? 1. The average pressure during the stroke. It must be determined by experiment. 2. It depends on intended pressure and piston speed.

J. W. K. says: I want to run kerosene through a gas pipe. What cement shall I use on the joints? Red or white lead, or our ordinary cement, will not stand it. A. You will probably have to make face joints, without cement, or you might use solder at each joint.

J. F. M. says: I wish to build an engine with a two inch cylinder, with stroke of 18 inches. 1. Can I get a piston speed of 300 feet per minute, with suitable connections? 2. Can I use a direct acting valve, moved by the piston, using no crank or shaft, only the reciprocating motion of the piston rod? 1. Yes. 2. Probably not with safety.

S. K. S. asks: How is the storm glass (referred to on page 234, vol 29) made? 2. How do you find the horse power of a double cylinder engine? The cylinders are set so as to act on the crank shaft at right angles. 3. Is the number of revolutions the number which the engine makes while doing its usual amount of work? A. 1. The best form of storm glass is that of a thin glass tube about 12 inches long and ¾ inch diameter, filled ¾ full of the following liquid: Camphor 2 drams, niter 1¼ drams, sal ammoniac 1 dram, proof spirit 2½ fluid ounces; dissolve. The top should be covered with a brass cap with a very small hole through it, or tied over with bladder. 2. Find the power of one cylinder by the process frequently given in these columns and multiply by 2. 3. Yes.

G. M. asks: 1. What is the best process of photographing on wood for engraving? 2. How is wood best prepared for pencil drawing? 3. Which is considered the best, a photograph on wood or a pencil drawing, to engrave from? 4. When types or stereotypes are cast, is compression used to get a perfect cast. A. 1. Consult some good work on photography. 2. The surface is whitened with chalk. 3. A pencil drawing is considered the best to engrave from. 4. We believe not.

M. M. asks: 1. Do bones lose any considerable portion of their value as manure, by being reduced with caustic alkali? I notice that the steam escaping from them while boiling appears to have the smell of ammonia. 2. When bones are reduced with sulphuric acid, a pungent vapor is discharged. What is that vapor, and is it injurious to inhale? 3. If 100 lbs. of bones are reduced with caustic alkali, and 100 lbs. with sulphuric acid, which (not taking into account the manure value of the alkali) will possess the greater value as manure? 4. Are the hoofs of animals as rich in fertilizing properties as the bones, and how can they be reduced to a condition suitable for use as manure? A. 1. The action of the alkali will be such as to dissolve or decompose the organic matter of the bones. 2. This is carbonic acid gas, from the decomposition of the carbonate of lime in the bones by the sulpauric acid. 3. The valuable constituent of bones is phosphate of lime. A portion of lime is removed from this by the action of sulphuric acid, converting it into a superphosphate which is soluble in water. 4. No. They can be chopped up fine and mixed with compost.

J. L. E. asks: How can I remove white paint from a black alpaca garment? A. Rub on to the spot a mixture of fuller's earth and soft soap, made into a paste with spirits of turpentine.

C. W. C. asks: 1. Was not H. B. M. ship Captain, which foundered in the Bay of Biscay 3 or 4 years ago, the first turret ship on the Coles system? 2. Was she not a new ship? 3. About how many men were drowned? A. 1. We think so. 2. Yes. 3. Somewhat over 400, we believe.

E. S. asks: 1. Is there any possibility of polished silver corroding so as to become a non-conductor of electricity, by being buried in the ground, exposed to weather, or by any other treatment? 2. Can hard rubber be turned into nuts having threads cut, etc., and will they be strong enough to turn with a wrench? 3. How are platinum points fastened to sounders? 4. Can platinum be worked into strips and riveted or soldered to wires, and will it become corroded so as to impair its conducting powers under any circumstances? A. 1. We think not. 2. Probably it can. 3. By the use of solder. 4. It can be, and we do not think it will lose its conducting power.

R. asks: Will it be safe to use, for dyeing, the steam generated in a boiler that contains a compound for removing scale? A. We think it quite likely, but could not answer positively without knowing more particulars.

C. B. R. says: 1. The rain water taken from our brick tank is quite hard. The tank is lined with Portland cement. What is the probable cause, and what will help it? 2. I am now using an engine, the cylinder of which is 16 x 8, making 60 revolutions. I want about double the power. What would be the best dimensions for a new cylinder? I want the shafting to run faster to do away with so much countershafting and to use smaller pulleys. Which would be the best for a 52 inch boiler, 3 inch tubes or two large flues? A. 1. We cannot answer this question without knowing more details. 2. You could readily get double the power from the present engine by running it twice as fast. Both styles of boilers that you mention are good. If you have plenty of room, the flue boiler may be desirable on some accounts, especially if you use hard water.

E. F. J. asks: If a cannon on the stern of a ship be fired at a target fixed on the bow, the ship moving forward as fast as the ball travels, can the target be hit, as it is moving as fast as the ball? A. We think so. There are several interesting questions involved in the solution of this problem, and we should be glad to hear from our readers.

A. J. D. asks: What is your opinion of the following plan for a dry house for drying timber? My factory is 100 feet long, and 2 stories high, the boiler being in the west end, and the chimney going up through one corner of building. My idea is to put a drying room in the second story, 12 feet wide x 8 feet high x 100 feet long, and connect with the chimney, just on the second floor, a brick flue and build it horizontally to the east end of building, then turn it into dry room at the bottom, the heat from the furnace to pass through this flue into the drying room, and into a flue leading back into the chimney again. The main difficulty is to prevent sparks from passing through into the dry house and setting fire to the lumber or staves. Do you know of any plan by which that can be prevented? A. Your idea does not strike us very favorably. It would be difficult to secure perfect immunity from sparks, and probably you would seriously injure the draft in your boiler.

H. & C. Co. ask: How can we best ascertain the horse power of an engine? A. Multiply mean effective pressure in lbs. during stroke, by piston speed in feet per minute, and divide the product by 33,000.

J. B. E. asks: 1. Who will, on application, examine me and, should I pass examination, give me such papers as would certify that I am a competent engineer? 2. Are ¾ inch common iron braces in a cylinder boiler strong enough to stand a pressure of 120 lbs., provided that each brace has a surface of over 9 square inches to brace. A. 1. The supervising inspectors appointed by the Government grant licenses to those who pass satisfactory examinations. 2. We think such bracing is insufficient.

E. J. H. asks: If water be applied to a wheel made upon the principle of some of the rotary steam engines, could a better percentage of power be obtained than from the present improved turbines? A. It seems probable that the turbine wheel will give better results, judging from experience.

J. W. F. asks: Please give me a correct rule for estimating the horse power of a high pressure engine, and also for estimating the amount of horse power in a boiler. I have tried four different rules, but I get different answers, that vary very much. The engine has a diameter of cylinder 12 inches, length of stroke 30 inches, average pressure of steam 80 lbs., revolutions 80. The boiler is 16 feet long and 4 feet diameter, with 52 two and three quarter inch tubes. Will increasing the number of revolutions of the engine increase the horse power? I tried your rule as given to M. C. in No. 8, vol. 29, but was not sure I was right. A. Area of piston $12 \times 12 \times 0{\cdot}7854 = 113{\cdot}1$ square inches. $80 \times 5 = 400$ feet piston speed per minute. Horse power $= (113{\cdot}1 \times 80 \times 400) \div 33{,}000 = 109{\cdot}37$. This solution supposes that the mean effective pressure in the cylinder is 80 lbs. per square inch, which is probably untrue. An increase of speed, other things being equal, increases the horse power. In regard to the horse power of a boiler, it has many different meanings. In some cases a boiler of one horse power designates a boiler that furnishes steam enough to produce one horse power, when used in an engine; others employ the term to distinguish a boiler that evaporates one cubic foot of water an hour; others a boiler that evaporates half a cubic foot; and there are many other significations of the term. A committee of the Franklin Institute, appointed to investigate the meaning of the "horse power of a boiler" failed to make any recommendation that was approved by the Institute, after deliberations extending over a period of more than a year and a half.

H. M. P. says: If I have a cylinder full of water with a flexible tube running lengthwise through it, also full of water, and I put 50 pounds pressure on the inch on cylinder with a force pump with a piston of the same diameter as the flexible tube one end of the tube being closed: What resistance would be required to prevent water escaping at the open end? A. As we understand the question, 50 lbs. per square inch.

E. C. asks: 1. Does the induction coil, if of sufficient size, produce an induced current more powerful than the inducing or battery current? If so, what lengths of wire must be employed to produce an induced current equal to the inducing one? 2. How is the bichromate battery constructed? A. 1. The induction coil produces a current of greater intensity than the battery current, that is, one capable of giving shocks, decomposing water, etc. 2. The carbon cell is filled with a mixture of a solution of bichromate of potash and dilute oil of vitriol, and the zinc cell with dilute sulphuric acid.

C. H. S. asks: How can a piece of iron, ¼ inch thick, be case [illegible]rdened on one side A. Probably it can be done with pru[illegible]te of potash.

M. R. B. asks: How can common cast iron be plated with tin? A. Clean the iron, cover it with muriate of zinc, and dip into melted tin.

T. S. says: My house burnt down, and some $20 gold pieces were tarnished by scooping them up-carrying them in an iron pot, and cooling by pouring cold water on them. Has the said gold been injured, and should the banks require a discount on such gold? How can I remove the brown color to give them the same appearance as before? A. Your gold has not been injured. You can remove the tarnished appearance by rubbing with jeweller's rouge, until there is a slight polish.

P. T. S. asks: The cast iron water back in my range, which has been in use about six months, continues to rust the water badly. The manufacturers of the range state that they never knew such a case. Can you suggest any remedy? The water used is soft water, rain water from a lead cistern. Would it be practicable to galvanize or nickel plate a new water back? Would not such treatment effectually prevent rust? A. If the water back is in constant use, it seems likely that the trouble arises from some outside connection. It would not cost much to galvanize the water back. Probably any good plumber could have it done for you.

C. F. M. asks: What is the best solvent for india rubber, and what (if any) for tanned leather? A. There are various solvents for rubber. One of the best and cheapest is bisulphide of carbon. We are not aware that tanned leather has ever been reduced to solution by any chemical solvent.

N. R. asks: How much water would a wooden pipe discharge per minute, under a head of 30 or 40 feet, the pipe being from 4 to 10 miles long? A. See our article on "Friction of Water in Pipes" on p. 48, vol. 29, for formula applicable to all cases.

A. H. asks: Where do fleas breed? A. Chiefly in dust, the fine of textile fabrics, old rags, etc. Cleanliness in the household and fresh air will hinder their multiplication. Oil of pennyroyal will drive them from any particular locality.

R. F. asks: What is infusorial earth? A. It is earth which contains the remains of minute animals.

J. W. asks: What power can I obtain by using an undershot water wheel, 10 feet wide, with 3½ inches fall? What are the most economical proportions for such a wheel, namely: diameter, number of buckets, and depth of shrouding? A. You should consult a water wheel manufacturer.

M. M. asks: Will the applying of brakes to driving wheels of engines have greater tendency to check the speed of a single engine than if applied to the trucks of the tender? If the power now applied to the trucks of the tender be applied to the driving wheels, will the speed of the engines be checked any quicker? A. We think it would be better to apply the brake to the trucks of the tender.

W. H. asks: 1. Of what is non-explosive gunpowder composed? 2. Can you tell me of a good renovating mixture for cloth clothing? 3. What is meant by a saturated tincture? 4. What does this mean: "Add water three ozs., and ammonia till slightly in excess?" A. 1. A process of rendering gunpowder temporarily inexplosive has been tried in England. It consisted in mixing fine glass dust with the powder. What you refer to may be something similar. 2. A little curd soap dissolved in water and mixed with a little clarified ox gall is a good cleaning mixture for clothes. 3. A tincture in which the alcohol will dissolve no more of the solid or liquid in solution. 4. In chemistry, generally, a body is said to be in excess when more has been added than is necessary for a given reaction, solution, or decomposition.

COMMUNICATIONS RECEIVED.

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

On Nail Biting and Finger Sucking. By C. M.

On Steam on the Canals By A., and by W. M.

On Creeping Rails. By H. H. P.

On Magic Squares. By E. W.

On Machinists in the Navy. By J. Q. A.

On Devil Fish. By J. T. N.

Also enquiries from the following:

J. C. V.—A. N. P.—C. L. Z.—W. T.—J. R. D. W.—T. J. McC.—G. G. P.—J. W.—W. S. S.—R. M. P.—R. U. S.—N. W. Y.—J. N. P.

Correspondents in different parts of the country ask: Who makes machines for molding candles? Who makes roadometers? Who makes machines for cutting tobacco? Whose is the best coal heating apparatus? Who makes billiard table cushions, that can be attached to a common table? Who makes shoe peg making machines? Who makes a wheel for grinding bayonet grooves? Who sells a family flour sifter? Makers of the above articles will probably promote their interests by advertising, in reply, in the SCIENTIFIC AMERICAN.

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal" which is specially devoted to such enquiries.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED IN THE WEEK ENDING

December 30, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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APPLICATIONS FOR EXTENSIONS.

Applications have been duly filed, and are now pending for the extension of the following Letters Patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

27,678.—FASTENING ARTIFICIAL TEETH.—A. M. & J. L. Asay. March 18.
27,736.—HAT VENTILATOR.—J. Pollock. March 18.
27,809.—WASHING MACHINE.—J. Johnson. March 25.
28,027.—CUTTING SHEET METAL.—J. Waugh. April 8.

EXTENSIONS GRANTED.

26,874.—CLOTHES DRYER.—P. B. Hawse.
25,679.—DOUBLE SEAMING MACHINE.—L. T. Hurbert.
26,689.—PIVOT BEARINGS.—F. C. Lowthorp.

TRADE MARKS REGISTERED.

1,588.—CIGARS.—Gilmor & Gibson, Baltimore, Md.
1,589.—SADDLE TREES.—S. E. Tompkins, Sing Sing, N. Y.
1,590.—COFFEE.—Hawley & Co., San Francisco, Cal.

DESIGNS PATENTED.

7,077.—RUFFLING.—S. E. Barney, New Haven, Conn.
7,078.—CUTLERY HANDLE.—J. D. Frary, New Britain, Ct.
7,079.—FIGURES.—J. D. Smith, Washington, D. C.
7,080.—PRINTING TYPES.—J. M. Conner, Greenville, N. Y.
7,081.—PINCUSHIONS.—A. Merriam *et al.*, West Meriden, Ct.
7,082.—LABEL.—A. M. Thomson *et al.*, Chicago, Ill.

SCHEDULE OF PATENT FEES.

On each Caveat	$10
On each Trade Mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On application for Extension of Patent	$50
On granting the Extension	$50
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On application for Design (7 years)	$15
On application for Design (14 years)	$30

[Specially reported for the Scientific American.]

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA JANUARY 5 TO JANUARY 9, 1873.

2,967.—F. H. Whitman, Harrison, Cumberland county, Me., U. S., assignee of E. H. Woodsum, South Boston, Mass., U. S. Improved gain cutting machine, called "Woodsum's Gain Cutting Machine." Jan. 5, 1874.

2,968.—J. McLarty, Strathroy, Middlesex, Ontario. Improvements in ladders, called "The Improved Flexible Ladder." Jan. 5, 1874.

2,969.—F. R. Butcher, St. John, New Brunswick. Improvement in spring bed bottoms, called "Butcher's Improved Hinged Slat Spiral Spring Bed Bottom." Jan. 5, 1874.

2,970.—W. T. Rand, Fitch Bay, Stanstead county, P. Q., and T. B. Rider, Magog, Stanstead county, P. Q. Improvements on saw arbors, called "Rand's Improved Saw Arbor." Jan. 5, 1874.

2,971.—J. T. Poole, J. S. Allen, C. M. N. Allen, J. Williamson, G. N. Clark, D. B. Jones and E. Moore, all of Canterbury, York county, New Brunswick. Improvements on life preserving dresses and air buoys combined, called "Poole's Life Dress and Buoys." Jan. 5, 1874.

2,972.—C. H. Billings, Cleveland, Cuyahoga county, O., U. S., and J. T. Raplee, Montreal, P. Q. Improvements on self-acting car couplers for railway cars, called "Billings' Automatic Car Coupler." Jan. 5, 1874.

2,973.—H. L. Lowman, Birmingham, New Haven county, Conn., U. S., and R. M. Bassett, of same place. Improvements on manufacture of shovels, spades, hoes, grocers' scoops and other like articles, called "Lowman's Swaged Shanks." Jan. 5 1874.

2,974.—W. O. Grover, Boston, Suffolk county, Mass., U. S. Improvement on bird cages, called "Grover's Improved Bird Cage." Jan. 5, 1874.

2,975.—G. Calcott, Thorold, Welland county, Ontario. Improvement on stoves for heating apartments, called "Calcott's Improved Base Burner Stove." Jan. 5, 1874.

2,976.—N. P. Slade, Rockford, Winnebago county, Ill., U. S. Improvement on anti-freezing writing fluid, called Slade's Non Corrosive Anti-Freezing Writing Fluid." Jan. 5, 1874.

2,977.—V. C. Meyerhoffer, Rutland, Rutland county, Vt., U. S. Improvements in mail bags, called "Meyerhoffer's Improved Mail Bag." Jan. 8, 1874.

2,978.—I. A. Welch, Hamilton, Ontario. Improvement on flat brushes, called "I. A. Welch's Improved Flat Brush." Jan. 8, 1874.

2,979.—W. H. Porter, Bradford, Simcoe county, Ontario. Improvements on dental plates, called "Porter's Dental Plate." Jan. 8, 1874.

2,980.—W. Ferris, Pleasant Plain, Warren county, O., U. S. Improvements on knife and pitman connection for reapers and mowers, called "Ferris' Improvement in Pitman Connection for Harvesters." Jan. 8, 1874.

2,981.—I. O. Jones, Boston, Mass., U. S. Improvements on rakes, called "Jones' Reversible Rake." Jan. 8, 1874.

2,982.—J. B. Gully, Montreal, P. Q. Art or method of preparing steel belts for alleviating and curing rheumatism, called "Gully's Anti-Rheumatism Belt." Jan. 8, 1874.

2,983.—W. Dunlop, Toronto, Ontario. Improvements on stench traps, for sewer and waste water drains, called "Dunlop's Improved Drain Trap." Jan. 8, 1874.

2,984.—J. Richards, G. W. Waitt, E. C. Shapley and C. F. Jones, all of Philadelphia, Pa., U. S. Improvements in locomotive chimneys, called "Richard's and Mechl's Locomotive Chimney." Jan. 8, 1874.

2,985.—A. S. McDonell, Osgoode, Carleton county, Ontario. Improvements in cultivators, called "McDonell's Cylinder Cultivator." Jan. 9, 1874.

2,986.—B. T. Nichols, Raselle, Union county, N. J., U. S. Improvements on nails and spikes, called "Nichols' Improved Nail and Spike." Jan. 9, 1874.

2,987.—R. S. Jarvis, Toronto, Ontario. Improvements on quilting frame, called "Jarvis' Adjustable Quilting Frame." Jan. 9, 1874.

2,988.—P. Cope, Perryopolis, Fayette county, Pa., U. S. Improvements on brackets for fence bars, called "Cope's Fence Bar Bracket." Jan. 9, 1874.

2,989.—W. T. Doremus, New York, U. S. Improvements on springs for furniture and other purposes, called "Doremus' Springs for Furniture and Other Purposes."

2,990.—F. E. Dixon, Toronto, Ontario. New window fastener and support, called "Dixon's Improved Sash Fastener." Jan. 9, 1874.

2,991.—I. I. Lahaye, Reading, Berks county, Pa., U. S. Improvements on car coupling, called "Lahaye's Improved Car Coupling." Jan. 9, 1874.

2,992.—E. F. Austin, Rochester, Munroe county, N. Y. U. S. Improvements on ottomans, called "Austin's Combined Ottoman and Ladies' Companion." Jan. 9, 1874.

2,993.—C. W. Saladee, Pittsburgh, Pa., U. S. Improvement in bolsters, springs and standards for wagons, called "Saladee's Bolster, Spring and Standard for Wagons." Jan. 9, 1874.

2,994.—E. Chanteloup, Montreal, P. Q. Improvements in self feeding hot water furnaces, called "Chanteloup's Improved Self Feeding Hot Water Furnace." Jan. 9, 1874.

2,995.—E. Mathieu, Montreal, P. Q. *Remede a guerir les hemorroides*, called "*Onguent pour Hemorroides, du Dr. Mathieu.*" Remedy for piles. Jan. 9, 1874.

2,996.—T. A. Lundy & E. Walker, Guelph, Wellington county, Ontario. Machine for suspending window blinds, called "Lundy & Walker's Independent Blind Roller." Jan. 9, 1874.

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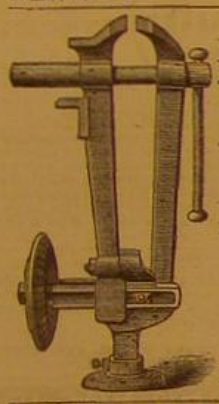

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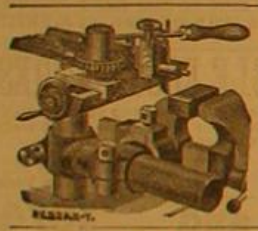

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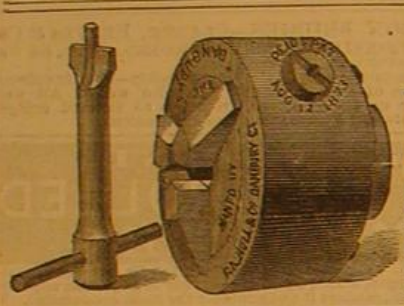

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