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INDICATING FIRE DAMP IN COAL MINES.

The apparatus invented by Henry Guy Carleton, of New York, for indicating fire damp, is herewith shown. It consists, essentially, of one or more indicating balances to be permanently placed in a goaf or drift of the mine, as shown, and a registering balance to be used by the observer in the testing room, connected by well-insulated wires as shown. Each balance holds in equilibrium a thin glass bulb of about 300 cubic inches, capacity hermetically sealed. They are counterbalanced at the same moment by the weights, W and W′, respectively, and hence will be equally affected by future variations in the atmospheric pressure. Attached to the vertical arm or pointer, H, of each balance is a soft iron needle, *d*, gilded to prevent rusting. Its ends plunge freely into helices of insulated wire, *a* and *b*.

The helices on both instruments are exactly of the same size and electrical resistance, and of sufficient internal diameter to exert but feeble influence on the needles with an ordinary current. The right-hand helix of balance No. 1 is connected with the right-hand helix of balance No. 2, and is supplied at will from battery II. with a current whose strength can be lessened gradually and delicately by resistances thrown into the circuit by the rheostat, as shown, enabling the magnetic force of the helices to be regulated to a nicety. The left-hand helices are similarly connected, through battery I. and rheostat (Diagram, page 52).

The vertical arm, H, of balance No. 2 has a platinum tip capable of electrical contact with insulated screw, *c*. Connection from binding post 4 to the vertical arm is made by means of the mercury cup, *m* (see engraving), into which a wire from the beam is dipped. By contact between H and *c*, the relay in the observing room is kept closed. Breaking contact opens the relay, whose back stroke shunts the local circuit on the bell, ringing it continuously. The resistance coil, *g*, connected to binding posts 3 and 4, prevents a spark passing when H and *c* break. The case surrounding balance No. 2 is of marble or unglazed tiling, excluding air currents and dust, yet admitting gases by diffusion. Chloride of calcium, in the holder, D′, keeps the interior free from moisture. The whole is protected from injury by a perforated iron case, as shown. Once placed in its position in the mine, its temperature will be constant.

Balance No. 1, in the observing room, is provided with two riders, moved along the graduated beam as shown. If more delicate readings are desired, additional riders of less weight may be also employed, a separate way being provided on the beam. Balance No. 1 is incased, dried by chloride of calcium, and placed in a room artificially maintained at constant temperature by means well known.

By this arrangement it will be seen:

1st. That as the two bulbs, S and S′, are equal in bulk, and balanced at the same moment, they will be affected equally in weight by an increase or decrease in atmospheric pressure.

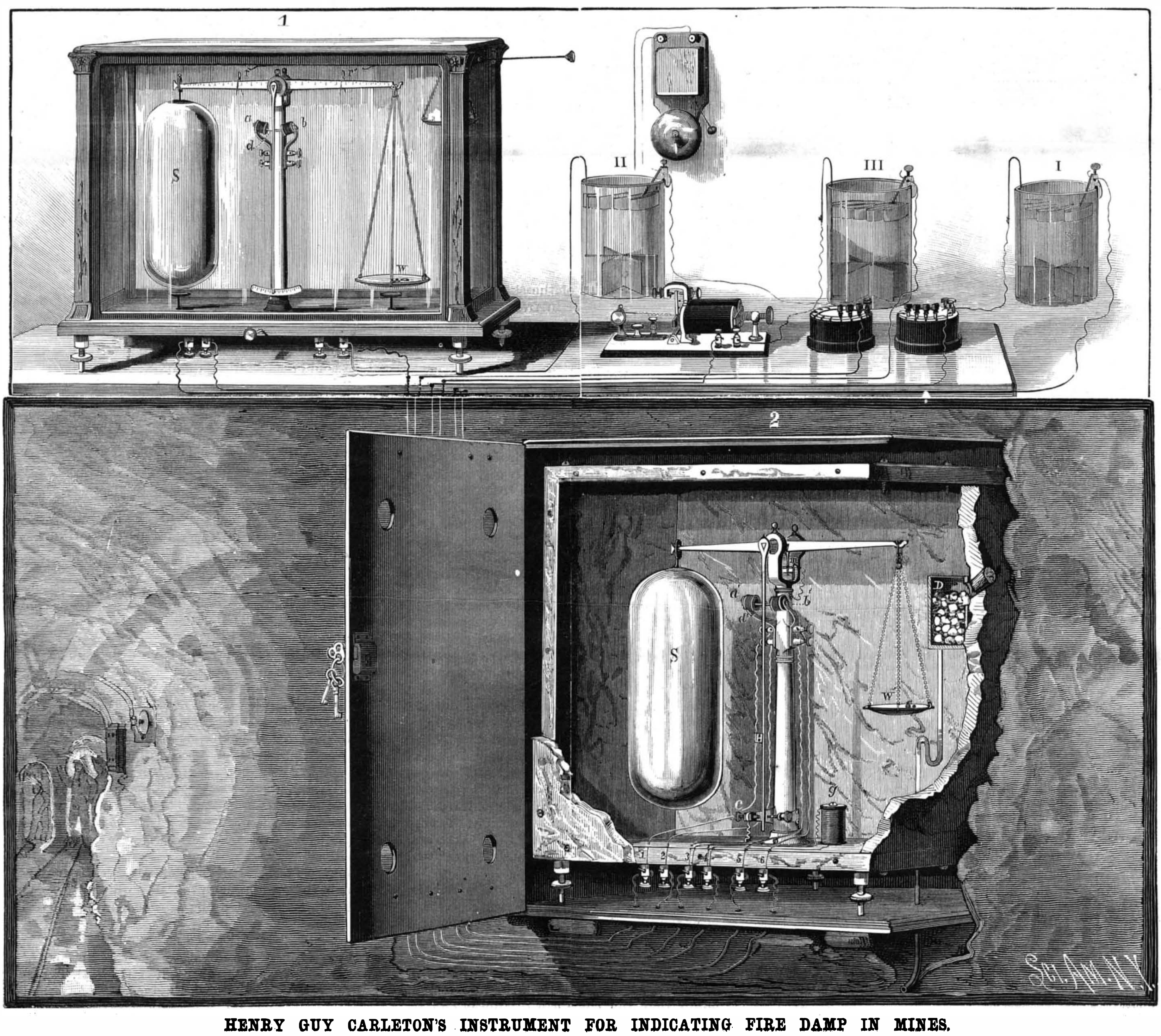
2d. That the right-hand helix of each instrument will exert the same amount of force on its responsive needle, both being supplied with current from the same battery, and that the same rule will apply to the left-hand helices.

3d. That as each instrument is kept in an atmosphere of constant temperature and equal hygrometric condition, it will only be sensitive to a change in the pressure of said atmosphere or a change in its atomic weight.

GRADUATION AND ADJUSTMENT.

Both instruments are balanced at the same moment by their weights, W and W′, respectively. The case of balance No. 2 is then filled with pure fire damp at normal pressure, obtained from a "blower" in the mine. (This will obviate the necessity of correcting for that percentage of carbonic acid always associated with

(*Continued on page* 52.)



HENRY GUY CARLETON'S INSTRUMENT FOR INDICATING FIRE DAMP IN MINES.

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NEW YORK, SATURDAY, JANUARY 23, 1886.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 525

For the Week Ending January 23, 1886.

Price 10 cents. For sale by all newsdealers.

A NEW INVENTION TO SECURE SAFETY IN COAL MINES.

We illustrate this week a very interesting and remarkable invention by Mr. Henry Guy Carleton, of this city, designed for the humane purpose of indicating the presence or approach of fire damp or other dangerous gases in coal mines. It consists of a pair of balances, each having at the beam a receptacle containing a given quantity of hydrogen gas; the receptacles are duly counterbalanced. The moving parts of the two instruments are electrically connected; and when properly adjusted, any motion of one balance will instantly affect the balance of the other instrument, no matter how far apart the instruments may be located. Thus, one instrument may be placed within a coal mine and the other in the superintendent's office. Should an inflow of fire damp occur in the mine, the beam of the balance will instantly turn, carrying warning signals and alarms wherever wanted, together with information to the office showing the degree of change in the atmosphere of the mine. Ample time thus will be afforded, whether in night or day, to secure the safety of the miners; and the condition of the mine, whether safe or dangerous, will at all times be indicated by the instrument. The general adoption of this admirable invention will put an end to those appalling horrors of the coal mine, by which so many lives are now annually sacrificed, and so many families reduced to misery.

The author, influenced by the noblest of motives, gives the free use of his invention to the world, and will take no patents on any of the novel parts or devices which enter into its construction. In view of these considerations, and also because the invention may be put in at trifling expense, we presume it will be gladly adopted, without delay, by mine owners in this country and in all parts of the world. Mr. Carleton will cheerfully aid this good work by further explanations or advice in respect to any features not made plain in the description as presented on our first page. Copies of the plans and description have been sent to the Royal Commission on Accidents in Mines, England, of which Sir Frederick A. Abel is president, and to other persons of prominence likely to be interested in the subject.

IS NERVE FORCE AN AGENT IN COLORATION?

We are compelled to admit that the tints of the skin of the human countenance depend to a certain extent on the mental condition. A deep blush and a deadly pallor may succeed each other with great rapidity over the same face, because, perhaps, an emotion of modesty or shame is followed by some fearful fright. But in this case we say that the color of the skin is dependent on the relative amount of blood in the superficial capillaries, and that no real change of color has been produced. The perturbation of nerve force concerned in the mental condition which has made the temporary change has neither produced color nor removed it. The true color of the skin, as in a person of swarthy complexion, or in freckles or blotches, we say is produced by pigmentary material deposited in certain cells, which we call pigment cells. Has nerve force any control over this?

The answer to this would seem to be necessarily in the negative, for we know that they remain year after year without change; but perhaps we may learn from observations on the lower animals some facts which can give us a better understanding. We are well aware that their colors vary according to circumstances. Many of them are habitually of the color of the substance on which they rest, so that the species cannot be said to have any color which is its own. Others change their colors rapidly, the chameleon being a notable instance. We need not, however, seek so far as to a foreign lizard for an example. Our common flatfish may often be seen to undergo such extreme changes as this. Lying on the light sandy bottom of a shallow pool, his entire aspect is of a dark brown with numerous much darker spots. If you approach the pool, the dark fish disappears almost instantly, and yet he has not moved away. He lies where he was before, but has discharged his color so completely that he matches the sand, and all that can be detected is his *two black eyes*. If left undisturbed for a few minutes, he regains his dark hue and the darker spots.

Once more, our common squid, or cuttlefish, *Loligo pealii*, is ornamented with great numbers of round spots of an exceedingly rich, dark, mahogany brown, making it a most conspicuous object; but, if alarmed, these spots disappear almost like magic, and the entire animal becomes colorless and nearly invisible. And so quickly and freely can this be done that bands and waves of dark and light can be seen running back and forth over its surface.

Here are true pigment cells as can be found anywhere, of very striking richness and strength, whose color is discharged at the owner's will, that is, they are subject to the control of nerve force. If we ask in what manner it is possible this can be done, there may perhaps be diversity of opinion. If the color of the pigmentary material is dependent on its structure, we can scarcely admit that the color can disappear and return; its disappearance would imply destruction. But we are by no means sure that the color is associated entirely with structure; it may very possibly have its relation to position as well.

The iridescent inner surface of so many shells gives us a perfect illustration of this. And the suggestion may fairly be made that the nerve force of the cuttlefish has such relations to the pigment of its rich mahogany spots that it can change their cell relations, and thus render invisible that which was strongly marked a moment earlier. This is given only as a possible solution, and it is given only in relation to these lower forms of life.

It is certain, however, that we can argue from these to the higher and more differentiated types, in which all changes are effected more slowly and with much greater difficulty; and it is, therefore, with some degree of confidence that we may advance the idea that though no direct agency of our will or nerve force can produce pigmentary changes, yet it is quite possible that long continuance of environments which control and modify nerve force may develop results of change which have not hitherto been taken into account.

The peculiar tints characteristic of various types of the human race are certainly not dependent on heat or cold, burning sun, or any other meteoric conditions. It is fair to raise the question whether nerve force may not have some agency in the matter, or we will modify it—may not *have had* for ages past.

REMOVAL OF SNOW FROM STREETS BY STEAM.

Some years ago, the project was discussed of removing snow from streets by melting it, the plan having then been proposed to melt the snow by steam blown directly into it or upon it from a steam pipe or hose. It was satisfactorily shown that such a use of steam would be attended with great waste of fuel. Not only the heat required for melting the snow would, by this method, be required, but large quantities would be expended in useless heating of pavements and vast volumes of cold air, which must unavoidably be drawn into and mingled with the steam escaping from the hose.

Notwithstanding this, the use of steam for removing snow is feasible, both in a practical and economical point of view.

To melt a ton of snow when the latter is at a temperature of 20° F. will require an expenditure of 147·4 heat units $\times 2{,}000 = 294{,}800$ heat units. Each pound of steam used will deliver 966·5 heat units while becoming condensed to water at 212° F.; therefore, $\frac{294{,}800}{966 \cdot 5} = 305$ would be the number of pounds of steam required to reduce a ton of snow to water at 32° F., exclusive of all waste.

Any method of applying the steam would be attended with some waste, but it is probable that the method of confining the steam in pipes inclosed in a box with insulated sides, the snow to be shoveled or by some other means put into the box as fast as the melting would make room for more, would reduce the waste as nearly as possible to a minimum. In this way no heat could escape from the pipes without at once passing into the snow, where it would be almost totally absorbed in producing the required effect. The losses would mostly arise from defective combustion and exposure of boilers; but it would seem that the latter source of loss might meet with effective resistance from some of the many excellent boiler coverings now obtainable.

If an effective evaporation of 6 lb. of water per pound of coal could be secured, which is only about half what is now obtainable from well constructed and housed boilers, we should have $\frac{305}{6} = 50\frac{5}{6}$ pounds, say 51 lb., of coal required to do the work.

The water from the melted snow could easily be conducted by hose into the sewer openings at the street corners.

Now, as to the economy, we have for a ton of snow removed the cost of 51 pounds of coal or about $\frac{1}{40}$ of a ton, which, at five dollars per ton, would be 12½ cents. To this must be added the interest on the cost of plant, cost of labor for attendance, and deterioration, all reduced to the basis of one ton of snow removed. These items are, of course, not susceptible of estimate without data of cost of machine, etc., but we think their total could not reach, or at least exceed, 37½ cents, making the cost of removal not to exceed 50 cents per ton, which is, we believe, not more than half what it now costs to shovel snow into carts and convey it to the rivers which receive it.

It would seem that there is a field for inventive enterprise here that might be profitably worked by some engineer skilled in designing portable heating apparatus.

AT the meeting of the Royal Academy of Sciences of Stockholm, Sweden, December 9, 1885, Dr. R. H. Thurston, Professor of Mechanical Engineering of Cornell University and Director of Sibley College, was elected one of its "Membres Etrangers."

PHOTOGRAPHIC NOTES.

Copying Oil Paintings.—The photographing of an oil painting is perhaps one of the most difficult and unsatisfactory things a photographer, be he amateur or professional, has to contend with, particularly if the painting be old and varnished. We find some practical suggestions on this subject in the *British Journal of Photography*, wherein it is advised to have the canvas removed from the frame, and the surface of the painting well cleaned by taking a sponge dipped in clean rain water, and rubbing it over gently, then to quickly dry the surface by wiping with a soft linen cloth.

If the picture is varnished, a very small quantity of pure soap should be put on the sponge, but this should not be done if there are any cracks visible in the surface. Every particle of soap must then be wiped off and the surface dried. It is then a good plan to gently rub the surface with a soft rag smeared with nut oil, and then to remove all that possibly can be, with a clean dry cloth.

An oil painting is usually painted in such a scale of colors that, even in a good light, it is slow to act upon the film; and in an ordinary studio, unprovided with special dark screens to place before the painting, it would be found that much of the light would have to be shut off to prevent the studio itself becoming so bright as to be inevitably reflected by the surface of the picture, and, in consequence, repeated in the negative. This may happen to such an extent that the reflection overpowers the picture itself, and as a matter of fact it is generally the case with the unpracticed that in their copies there is more reflection than picture. It is only through the uneven surface of the varnish distorting and breaking up the reflection that the latter is not seen in its entirety, showing at a glance what it is, instead of the photographer believing it to be an inevitable fogginess attendant upon such work.

A little consideration will show the reasonableness of our remarks. Let a mirror be placed over the surface of the painting, and in the same plane; then all objects seen in the mirror will also be reflected by the painting, though less brightly, and without definition. A photographer standing by the side of his camera during exposure, lens cap in hand, would inevitably cause a foggy mark where his face and hands were reflected. A white pocket handkerchief exhibited would be fatal.

The best plan is to place the painting so that the light strikes it rather obliquely; this reduces the accidental reflections to a minimum. Be it remembered that cleaning a picture, as we recommend, though conducing to excellence of results, adds to difficulties in other directions, and leads to very trying experiences with reflections. The haze-producing scum is gone, but reflection haze may take its place. Oblique lighting, as we recommend, will be obtained by placing the picture well in advance of a good portion of the skylight, when the remainder may be screened, which will considerably reduce the amount of light entering the room, and lessen the intensity of any possible reflections in consequence. But these must be reduced to a minimum. The dark cloth should be thrown over the front of camera and stand; dark screens, curtains, or other movable "properties," must be made to close round a part of the camera in front of the picture, so as to give dark and, consequently, non-injurious reflections only, and shut off all others. All light-colored objects must be removed out of the sphere of the reflecting power of the canvas, and any window or light that may possibly lurk unscreened in front of it must be covered over, and, indeed, no light, skylight or otherwise, side or top light, allowed to be uncovered when it is more than a few feet in advance of the picture placed for copying.

If all these precautions are well taken, a negative that will have a satisfactory appearance all the while during development will be secured; but if too much reflection prevail from the surface of the painting, the negative will have an eminently unsatisfactory and foggy aspect as soon as the details begin to appear. Should such a contingency occur, fresh exertions must be made to remove bright reflections, and, if necessary, the painting brought forward so as to receive still less light and enable still more of the skylight to be covered over.

The only other difficulty of importance will be the obtaining equality of illumination. A small studio will never permit of a large painting being equally illuminated, so that it will be useless to attempt it Otherwise, if our hints be well attended to, the copying of an oil painting will be robbed of any real difficulty; though we may say he will be an expeditious worker who obtains a satisfactory negative, and is free of the presence of the painting within an hour or an hour and a half of the time it first enters his premises.

THE factory of Messrs. C. E. Jones & Bro., electricians and manufacturers of electrical supplies, at Cincinnati, Ohio, was burned on December 13, but the firm have lost no time since then in their efforts to put things again in working shape, in which they have been materially aided by the fact that they were carrying stock outside their factory, which was not injured.

The Sibley College Lectures at Cornell University.

In our this week's SUPPLEMENT we present the first of a series of reports of lectures delivered during the current year, at Cornell University, by the "Sibley College Non-resident Lecturers." These lectures are delivered at intervals of two or three weeks, before the assembled associations of civil and mechanical (including electrical) engineers and architects studying in the various professional courses given in the several departments. The lecturers are gentlemen who have attained a distinguished position in the profession, and who have consented to give to the students who are so fortunate as to be able to study at Cornell the fruits of their professional experience. These lecturers, selected by the Director, Professor Thurston, include the most successful and noted men among the civil, mechanical, and electrical engineers of the country. The lectures will be carefully reported and will be published in our columns, from time to time, as received. They may not always appear in their order of delivery or with regularity; but, as each is independent of every other, and as all are given at dates selected simply with reference to the business engagements of the lecturers, and are without any relation of sequence, the order of publication is a matter of no importance.

The first of these lectures appearing in our pages is by Dr. R. W. Raymond, the distinguished founder and past president of the Institute of Mining Engineers, and formerly Commissioner of Mining Statistics of the United States. Its subject is novel and attractive, and it fittingly leads the series. The lecture is one of the most interesting of the orator's always interesting productions, and although, in part, previously given to an audience, has never before appeared in the public prints. The succeeding lectures are usually more purely technical and practical, and include the discussion of important problems in engineering, the treatment of great subjects now demanding the attention of the practitioner, and the consideration of the vitally important matter connected with the relations of the engineer to his men, of the profession to the working classes, and of capital to labor. As may be believed, when the character of the lecturers is considered, they will, in all cases, be likely to prove as important as interesting. The subjects are such as most interest the profession, and they are treated by the men from whom the profession most desire to hear, by the leading authorities upon the matters presented.

Proposed National Laboratory for Inventors.

The injustice that has been done the inventors of the country, from providing an insufficient Patent Office force, while the revenues of this department have been so great that there is now a large accumulated surplus, has been frequently referred to in these columns. In commenting upon this subject, the *National Republican*, of Washington, proposes, as some compensation to that general class of citizens who have contributed to swell this surplus, that Congress shall establish, at the national capital, what would be an extensive laboratory and museum, in which motive power, shafting, and all appliances necessary for the running of machinery shall be furnished free of cost, and inventors or owners of patents invited to set up and exhibit working models therein, making thereof what it conceives would be the greatest mechanical school on the globe. Our contemporary states that it intends to keep this subject before Congress and the people, and argues as follows:

"Instead of expending the gross amount of receipts in the maintenance of the Patent Office, increasing its facilities and advantages, and making it a better guide and more potential stimulant to invention, a large balance of receipts, in excess of expenditures, has been annually deposited in the Treasury. Thus, the Government has assumed the right to put a tax or penalty on invention, and make this branch of the public service tributary to the support of departments which yield no income. Departments which bring in no returns at all are supported with a degree of liberality entirely unknown in the management of the Patent Office. Because this office was intended to be self-supporting—an agency managed by the Government in the interest of inventors and the general public—Congress has acted on the theory that it ought to be made a source of profit, and has, therefore, failed to expend the money taken from inventors in promoting the great interest for which the office was established. This is as unjust as it would be to impose excessive postage, and get a surplus from the Post Office Department to support the army. Nor is its injustice its worst characteristic. It is a fatal policy to tax the inventive genius of the country, to make it pay penalties, and this is precisely what Congress has been doing for a good many years.

"Invention is not a misdemeanor, inventors are not criminals, and it is high time to reverse this policy—to expend the money that has accrued and that may hereafter accrue on a grand and comprehensive enterprise for the encouragement of invention and for the education of the people in the scientific and mechanical progress already achieved. Let the fees of the Patent Office remain as now fixed by law, and let all the constantly increasing income be utilized for the stimulation of thought, the suggestion of new paths of progress, the possibilities that one man's triumph suggests to the mind of another, so that our great temple of invention may enter upon a broader field of usefulness, and become what it ought to be—the great mechanical educator, not only of the United States, but of all the nations of the world."

There has hardly been sufficient opportunity, thus far, to judge of the disposition of the present Congress toward the patentees and inventors of the country, but it is to be hoped that this, its first session, will not close without such additional appropriations being made for carrying on the Patent Office business as the experience of the past year has shown to be urgently demanded, in order to enable careful attention to be given to all applications, and at the same time to closely keep up the current work, which has for so long a period been in such backward state.

The Exploration of Thibet.

Col. Prejevalsky, the well-known Russian traveler, has just completed his fourth expedition into the almost unknown region lying between Siberia and China. After two years' exploration, he has returned to Europe, bringing a large accession to our meager knowledge of Mongolia, Thibet, and Chinese Turkestan. The most important result of his journey has been the discovery of the upper waters of the two great rivers of China, the Hoang-ho and the Yang-tsze-Kiang. The Chinese made an attempt before the Christian era, and again in the last century, to explore the sources of these rivers, but in both cases they were unsuccessful, owing to the fierce mountain tribes which defend the interior of Thibet from the intrusion of strangers. Prejevalsky and his party of fourteen gained their knowledge at the cost of two severe battles; but, while forced to inflict injury on the savages, escaped serious harm themselves.

At an elevation of nearly 14,000 feet above the sea, the explorer found several modest streams whose union forms the Hoang-ho or Yellow River. To the southward of this spot, about 67 miles, he found the Yang-tsze-Kiang, a muddy, rapid stream, which at this point has a width of 300 feet and a considerable depth. The party spent several weeks in this region, which is supposed never to have been seen by white men before. His journey carried him across the great Gobi desert. Although noted for its terrible cold in winter, its almost tropical heat in summer, a scarcity of water, and a general barrenness, the Mongols occupy all portions of it, raising their flocks on the poorest possible provender, and themselves subsisting with great difficulty. The elevated plateau of Northern Thibet, its lakes and mountain passes, were explored with care.

The party were again defeated by the Chinese in their attempt to reach Lhassa, the Rome of Buddhism, and were forced to complete their journey by way of Eastern Thibet and Turkestan to the Russian territories in Central Asia. The explorers state that gold is plentiful in Northern Thibet. Near the sources of the Hoang-ho, natives were found washing gold sands; and though they dug only one or two feet below the surface, they possessed whole handfuls of gold in lumps as big as a pea. With more careful working, the region is probably capable of producing a yield as large, if not greater, than the California placers in the early days of the gold fever.

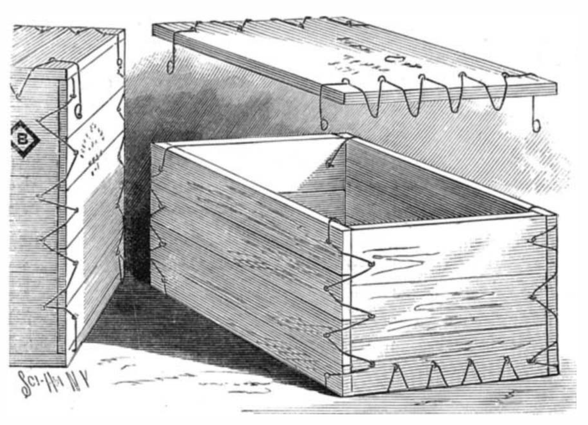
The Asiatics are reported to be heartily discontented with the oppressive rule of China, and to long for the milder despotism of the Tzars. They are represented by the explorers as inviting the intervention of Russia, and agreeing that, if a leader be furnished them, they will revolt, and place themselves under the imperial domination. The rest of Europe has no means of judging how strong this invitation was made, but the impression prevails that the Russian thirst for Asiatic conquest has more to do with these various expeditions than the disinterested love of science.

Do Amateur Mechanics Make Skillful Workmen?

A machinist in the *Mechanical Engineer* thinks they do not. He says a failing common to all amateurs or non-professional workers is too great haste. It matters not whether they are amateur machinists, or carvers, or painters, or amateurs in any handicraft, the same weakness affects them all. The amateur wishes to see how his work will look when it is done, and he slights the preliminary process and hastens toward the final one, with the result of making a botch of the business in hand. The work shows to the practical eye that it has been done hastily (carelessly is a better word), and it is inferior for that reason. The amateur himself sees it, and after a time, after the first joy of completion is over, he hates the sight of his hurried job, and very often destroys it out of hand. The better way would have been to stifle all impulses to get the work finished before it was fairly entered upon, and go through the processes which all work must go through before it can be properly completed. If I were asked what were the most necessary qualifications for a successful amateur, I would say patience and perseverance. Rarely do amateurs make good workmen, and it is most frequently for want of these virtues.

IMPROVED PACKING BOX.

Dry goods and packing boxes are weak at the corners, where the sides are nailed to the end boards, and to overcome this defect it is common to bind them with wood or sheet metal hoops. The invention herewith illustrated consists principally in substituting for these hoops a lacing of wire passed back and forth across the corners of the box, and having its bends secured to the outside of the box, and its ends passed over the edge of the box and secured to the inside, thereby rendering the box much stronger than the use of hoops would, and without adding much to the cost. The ends of the wire and the angles at each bend are held by staples. The cover has a wire at each end secured by staples, and bent to form loops that reach over the ends of the cover and fall below its lower surface; the ends of the wire are turned to form eyes. In applying the cover to the box, it is only necessary to



BEACH'S IMPROVED PACKING BOX.

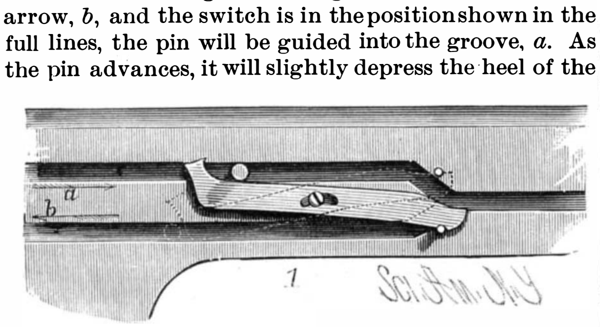
place it thereon and secure the ends and loops to the sides and ends of the box by staples. The box is thus stayed all about its corners in a very secure manner. The wires may be so bent as to bind each board, so that all the boards will be equally well adapted to sustain the contents of the box.

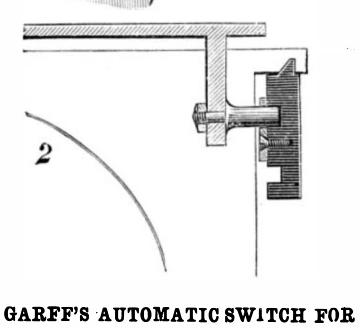
This invention has been patented by Mr. Wm. H. Beach, whose address for the Eastern and Middle States is 333 West 43d St., New York city, and for the Western States, 422 Wabash Ave., Chicago, Ill.

AUTOMATIC SWITCH FOR DOVETAILING MACHINES.

The device illustrated herewith is for automatically tilting the table on the reciprocating carriage of a dovetailing machine. Fig. 1 is a view of the grooved side rail of a dovetailing machine with the automatic switch applied, and Fig. 2 is a sectional view, representing portions of the reciprocating carriage and tilting table. The grooves, *a b*, branch off from the other to form the upper and lower tracks for the pin of the tilting table of the carriage. The switch consists of a flat bar formed with a central longitudinal slot, through which passes a set screw, which serves as the pivotal connection with the side rail, the switch being so placed that its right-hand point projects slightly beyond the end of the single groove. The shape of the bar is plainly shown in the cut.

When the carriage is moving in the direction of the arrow, *b*, and the switch is in the position shown in the full lines, the pin will be guided into the groove, *a*. As the pin advances, it will slightly depress the heel of the





GARFF'S AUTOMATIC SWITCH FOR DOVETAILING MACHINES.

switch to break the connection between the notch in the switch and the lower limit pin; as it further advances, it will strike the curved projection and carry the switch with it until the set screw strikes the opposite end of the slot. This movement overbalances the switch and causes it to drop to the position shown by the dotted lines, where it is held by the upper limit pin. Upon the return of the carriage, its pin depresses the point of the switch, which returns to the dotted position after the pin has entered the central groove.

When the carriage again moves forward, the pin will be guided into the groove, *b*, simply lifting the heel of the switch in its passage. When the carriage returns in the direction of the arrow, *a*, it will move the switch until the other end of the slot strikes the screw, when the switch will assume the position shown by the full lines. At the next movement the pin enters the groove, *a*. The pin thus moves alternately in the grooves, *a b*. The use of this device gives the operator the free use of both hands, thereby enabling him to do more work, and saves time and material, as he cannot possibly make mistakes by forgetting which way he has switched.

This invention has been patented by Mr. Christian Garff, of Logan, Utah Territory.

Blasting without Powder.—The Lime Cartridge.

Sir Frederick Abel, in his recent address before the Society of Arts, London, gave the following information:

The considerable and very rapid increase in volume which freshly burned quick lime sustains when slaked led, many years ago, to attempts to apply it to the bringing down of coal; but the idea did not assume a really practical form until Messrs. Sebastian Smith and Moore worked out a simple method of applying the lime so as to insure the effective operation of the disruptive force which it is capable of exerting, and to utilize the considerable heat developed by the energetic chemical union of the lime with water in the rapid generation and superheating of steam in somewhat considerable quantity, thus supplementing, in an important manner, the force exerted by the expansion of the lime. The public has been made familiar, in last year's and this year's exhibitions, with the general nature of Messrs. Smith and Moore's lime cartridges, and of the system of using them; briefly, the freshly burned and finely ground lime is compressed into the form of very compact cylinders, and the introduction into a bore hole of a simple appliance, together with these lime cartridges (the hole being charged with them, and tamped in the ordinary manner), enables the operator to accomplish expeditiously the simultaneous application of water throughout the entire length of the charge.

Several holes, at suitable distances from each other in the face of the coal, are charged before the watering is taken in hand; they are then set into operation in rapid succession, and after the lapse of several minutes their combined action brings down the coal in large masses. The Commissioners witnessed the performances of these lime cartridges at Shipley Collieries, in Derbyshire, soon after their successful elaboration; and the results of subsequent inquiries and experiments connected with this subject have convinced them that, for coal getting, the lime process can be, to a large extent, substituted for powder, and that its employment secures comparative immunity from danger, and is unattended by any important practical difficulties.

In spite of the obstacles which have always to be surmounted by any complete departure from old practices and traditions, the lime system has gradually received more or less extensive trial in many of our mining districts, and also on the Continent, and has already taken firm root in some parts of Staffordshire, Yorkshire, and Derbyshire, having proved itself capable of competing, and even advantageously in point of economy, with powder in many descriptions of coal, which are so worked as to allow of several charges being applied at one time.

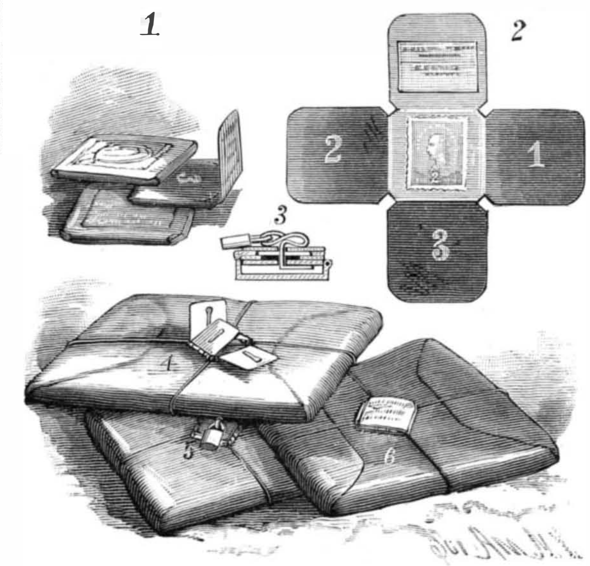
It is not contended by the elaborators of the lime-cartridge system that it affords the means of dispensing with the use of explosives or of specially powerful mechanical appliances in the removal of stone, or even in some hard coal or in connection with certain methods of working undergound; but it is now beyond doubt that in many of the collieries where the prevalence of fire damp renders the use of the safety lamp imperative, the replacement of shot firing by the use of lime cartridges, while unattended by any increase in the cost of getting the coal, would reduce the risk of explosions to those arising from carelessness on the part of the men, or from what should now become the very remote contingency of the use of unsafe or defective lamps.

Spirits of Turpentine.

This is one of the most valuable articles in a family, and when it has once obtained a foothold in a house, it is really a necessity, and could ill be dispensed with. Its medicinal qualities are very numerous; for burns it is a quick application and gives immediate relief; for blisters on the hands it is of priceless value, searing down the skin and preventing soreness; for corns on the toes it is useful, and good for rheumatism and sore throats, and it is the quickest remedy for convulsions or fits. Then it is a sure preventive against moths; by just dropping a trifle in the bottom of drawers, chests, and cupboards, it will render the garments secure from injury during the summer. It will keep ants and bugs from closets and storerooms, by putting a few drops in the corners and upon the shelves; it is sure destruction to bedbugs, and will effectually drive them away from their haunts, if thoroughly applied to the joints of the bedstead in the spring cleaning time, and injures neither furniture nor clothing. Its pungent odor is retained for a long time, and no family ought to be entirely out of a supply at any time of the year.

FASTENING FOR TIED PACKAGES.

This fastening, made of paper or any other suitable material, is shaped as shown in Fig. 2; it is shown folded in Fig. 1, and attached to the cords of the package in Fig. 6. The fastening incloses and secures the tied ends of the strings, so that the package cannot be untied or opened and tied up again without destroying the seal thus formed. The several flaps are so shaped as to admit of the crossing of the cord between them without interfering with the edges of the flaps when folded or turned over one upon the other, as shown in Fig. 1. The flaps are provided with mucilage,



McCARTY'S FASTENING FOR TIED PACKAGES.

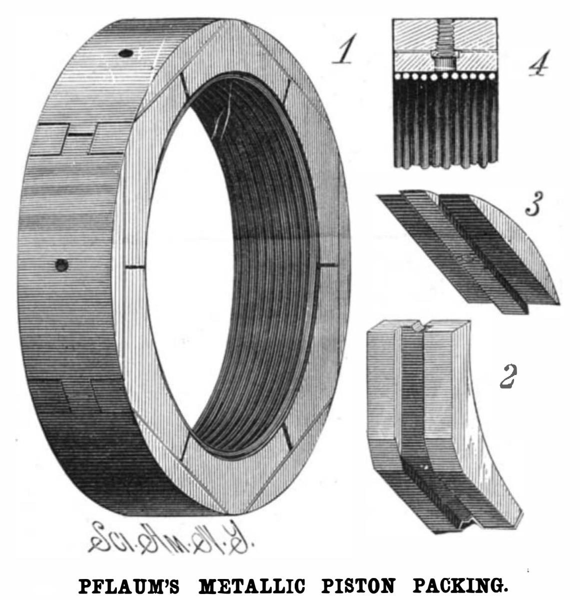
so that when turned down upon each other they inclose and securely hold the knotted ends of the string.

The fastening shown in Figs. 3, 4, and 5 is made of paper, metal, or other suitable material. Instead of being made of flexible material to permit the folding of the flaps, the latter may be hinged to the body part, which would then be made dish-shaped to receive the knot of the binder. On one flap is a turning staple, which passes through slots in the other flaps and receives a lock. The package so secured can only be opened by destroying the fastening, cutting the binder, or bursting the package itself, or picking the lock. The wide applications of these devices and the security they afford are apparent.

These inventions have been patented by Mr. Michael McCarty, of Newport, R. I.

METALLIC PISTON PACKING.

The exterior faces of the inner blocks, Fig. 2, are angular, and have their apices rounded off upon the arc of the circle of the inside of the cylinder in which the packing is to be placed, as shown in Fig. 1. Grooves are formed in the central parts of the outer faces of the blocks, whose interior faces are concaved on the arc of a circle. Plane convex segments, Fig. 3, are formed with tongues to fit the grooves of the blocks, and are curved to fit the cylinder. The packing is held against the cylinder by open-ring springs, shown in Figs. 1 and 4. The packing is secured between the piston head



PFLAUM'S METALLIC PISTON PACKING.

and follower in the usual way, and which close up the opposite sides of the packing and form a chamber. The interior of the packing is designed to be filled with tallow, which gradually escapes through perforations in the centers of the segments and ends of the blocks, so that the inner surface of the cylinder will be kept lubricated. With this construction the outer surface of the packing, as it wears, will always retain its circular form, and will thus always remain in close contact with the cylinder.

This invention has been patented by Mr. N. Pflaum, 27 Front Street, Port Jervis, N. Y.

Lantern Condensers.

For many years a plano-convex lens, flat side next to the light, and a double convex of crown glass have been employed, but this is now being gradually supplanted by the two plano-convex lenses described. The most perfect system of this class is when the face of the lens nearest to the transparency is not quite flat, but slightly convex.

A great increase of illumination is often to be obtained by the interposition of a third lens between the light and the condenser. The form of this lens should be plano-convex, or, by preference, of a slightly meniscus shape, although, from such trials as we have made, we do not find any very marked degree of advantage in the latter. The gain in illumination arising from the employment of a supplementary lens, such as that described, was proved in one instance to exceed 30 per cent. But as this third lens will necessarily be close to the light, it must not only be placed somewhat loosely in its setting—to allow of expansion of the glass by the heat—but it must be warmed up slowly and thoroughly before being introduced into the lantern, otherwise the heat may cause it to crack.

The great object in a condenser is to collect the largest possible amount of light emitted from a burner, and cause it to be projected forward to the object glass in a manner as free from observation as possible. When the condenser consists of two lenses, the first one collects the rays of light which diverge from the flame, and transmits them in a nearly parallel manner to the second, its function being to converge them to a point at a distance equaling the position of the front lens of the object glass, or nearly so. If the eye were situated at the apex of this cone, it would perceive the whole of the condenser to be one mass of intense illumination, no one part being brighter than another.

It may be asked why one lens would not answer the purpose of a condenser instead of two. We reply that it is not possible to effect the transmission of a large angle of light by one lens alone. While some of the cheap toy lanterns have a single condenser of the "bull's eye" or hemispherical form, yet is the angle of light transmitted but small, owing to the spherical aberration of single lenses having short radii of curvature. Hence must a good condenser consist of at least two elementary lenses.

We may here observe that if the purpose of the lantern be the production of enlargements from negatives of cabinet or greater size, then must the diameters of the condensers be increased in a corresponding ratio. For purposes of this nature, the condensers may with advantage be eight inches in diameter.—*Photo. Times.*

Locomotive Cars for the Transcaspian Railway.

The Russian government is having built, at the engineering works of M. Struve, at Kolomna, some locomotive cars of a special type for the Transcaspian Railway, designed to meet two difficulties—the waterless character of a large section of the line and the insignificant ordinary traffic. To meet the former, the locomotive car is equipped with tanks containing sufficient water to last seventy miles. As the waterless stretch from Michaelovsk to Kazantchik is about fifty miles in length, this supply is expected to be amply sufficient under any contingencies that may occur. With regard to the second difficulty, the locomotive has been constructed with a car connected to it, and capable of conveying eighty passengers. The locomotive car will be warmed by the exhaust steam from the engine, and there will thus be an economy in the consumption of fuel—an important consideration in a country where no timber or coal exists, and where the winters are extremely severe.

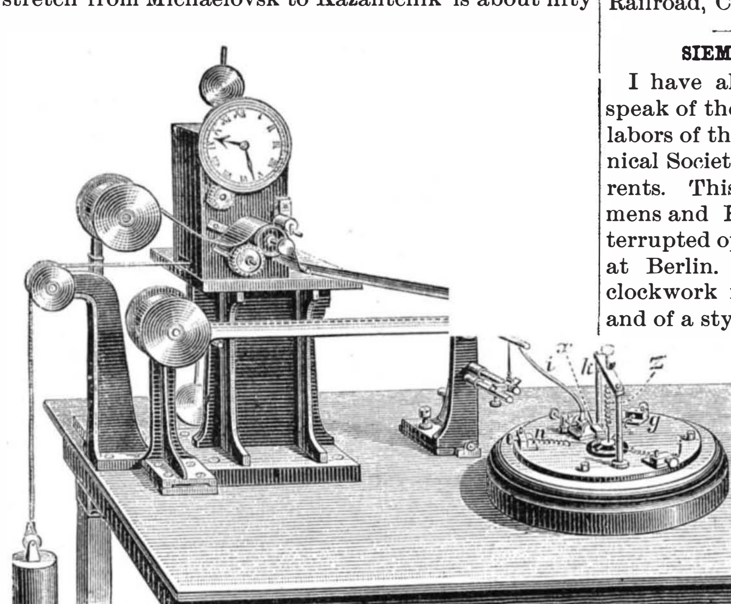
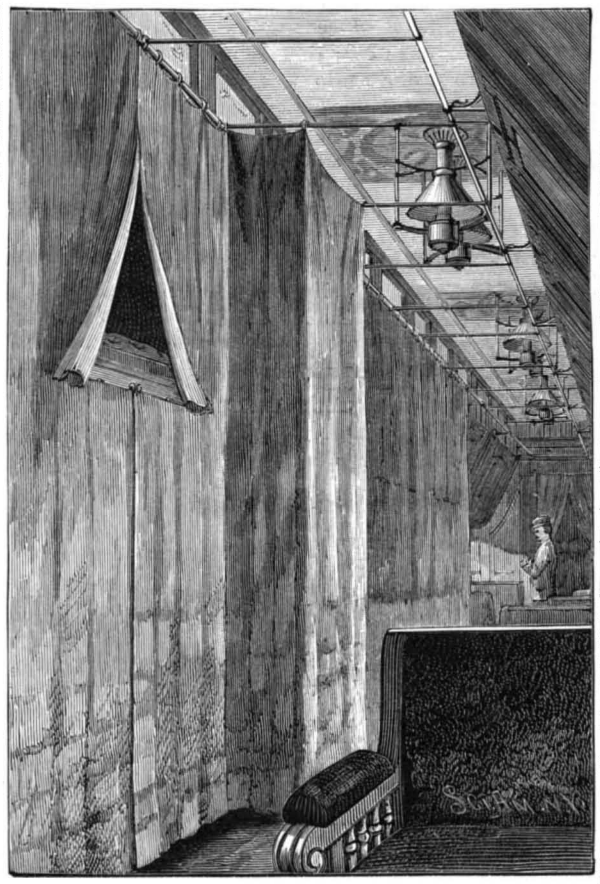


Fig. 1.—SIEMENS & HALSKE'S SOOT INDICATOR.

MOVABLE DRESSING CLOSET FOR SLEEPING CARS.

The object of the invention herewith illustrated is to provide a shelter or screen for use upon sleeping cars of the Pullman model, whereby the occupants may stand upright in the aisle and dress without being within sight of other passengers. The closet is made by a curtain suspended from four hooks on stationary cross rods, and extends about one-third across the aisle, leaving ample space for people to pass. The cross rods are about 30 inches apart, making the width of the closet, up and down the aisle, about the same. To close the closet, the hooks carrying the outer corners are moved up against the curtain rods of the car, thereby drawing the closet curtain up against the berth. The arrangement of the main curtains is clearly shown in the left of the engraving. Each curtain is cut back on the line of the upper berth about one foot; a hook on each corner is placed over the edge of the upper berth, so as to hold up the lower part of each curtain. It will be seen that the occupant of the upper berth can get in or out of the same without opening the lower curtains, while the movements of the occupant of the lower berth do not in any way interfere with his neighbor. The advantages possessed by this closet over the old style of curtains are apparent.



MOVABLE DRESSING CLOSET FOR SLEEPING CARS.

This invention has been patented by Mr. A. J. Chandler, whose address is care of C., I., St. L. & C. Railroad, Cincinnati, O.

SIEMENS AND HALSKE'S SOOT INDICATOR.*

I have already more than once taken occasion to speak of the soot indicator, especially apropos of the labors of the committee appointed by the Electrotechnical Society of Berlin for the study of telluric currents. This indicator was constructed by Messrs. Siemens and Halske, and has now been in almost uninterrupted operation for three years in the central office at Berlin. The apparatus consists essentially of a clockwork mechanism, which actuates a paper band, and of a style that marks the deflections (Fig. 1). This paper band is blackened every twenty-four hours. The tracings made by the style are fixed by means of a solution of colophony in benzine applied with a pencil.

Beneath the platform of the apparatus there is arranged an electro magnet, which is excited by 26 elements. This electro is shown in diagram in Fig. 2, where N is a solid piece of iron around which is wound an insulated conductor, whose extremities communicate with the poles of the battery, and which forms one of the poles of the magnet. The other pole of the magnet is concentric at N. Between S and N is placed a bobbin, whose winding is connected with the ground conductor. This bobbin is suspended from a spiral spring, *z*, and attached by wires to the points, *j*, *g*, and *n* (Fig. 1). The bobbin is so wound that the deflections of the needle, *i*, shall be proportional to the intensity of the current that is traversing it. The entrance and exit wires of the bobbin are attached to the terminals, *j* and *g*, respectively.

* Dr. Michaelis, in *La Lumiere Electrique.*

The apparatus is interposed in terrestrial lines as follows:

The ordinary cable that connects Berlin with Dresden is used. This consists of 7 insulated wires that are surrounded in a body by an insulating envelope. This latter is surrounded by non-insulated wire that serves to collect the telluric currents along its entire length. At Dresden, one of these copper conductors is connected with the winding wire, and at Berlin the apparatus is interposed in the metallic circuit thus formed.

When telegraphing is being done, the wires exert an induction upon each other, so that the curves traced by the apparatus consist of a succession of slight oscillations (especially during the day). The curves are extremely well defined.

Absorption of Nitrogen by Soils.

The remarkable statements of M. Berthelot respecting the fixation of atmospheric nitrogen by certain descriptions of soil have attracted considerable notice. M. Joulie has contributed to the *Comptes Rendus* an account of some carefully conducted experiments of his own which corroborate M. Berthelot's results. In these experiments, M. Joulie placed equal weights of soil in glass pots, watering the samples automatically with distilled water, and protecting the surface from any possible contact of ammonia-bearing substances, while leaving it freely exposed to the air. Different species of plants were raised from the soil under observation; the crops being at the end of every season dried, weighed, and analyzed. The soil also was similarly treated, in order to ascertain whether this and vegetation together had gained or lost nitrogen.

By operating in this way upon many samples of soil, tested during a series of years, M. Joulie has satisfied himself that nitrogen has been gained (often in considerable quantity) in two descriptions of soil—the one being a loam and the other a sand devoid of clay. The results have been very fairly uniform in quality, but differ in quantity. The bed of soil in these experiments was about one decimeter thick; and if it may be admitted that the same amount of fixation might take place over the area of a hectare of meadow and throughout a layer of the same thickness, the weight of which would be about 2,000 tonnes, the weight of nitrogen thus fixed would not be less than 1,144 kilogrammes. If the area of surface only, and not depth, is to be taken into consideration, the result would be to diminish the approximate fixation of nitrogen to 432 kilogrammes per hectare. In M. Joulie's opinion, this action is not to be attributed to any other cause than the direct absorption of atmospheric nitrogen; but he admits that a further series of experiments upon samples of soil without vegetation is necessary to clear up the only doubt existing on the point.

Cholera.

Henry Downes, M.D., Deputy Inspector-General of Hospitals, Springfield, Tiverton, England, says his experience of the disease enables him to deduce the following conclusions:

1st. That cholera is the result of atmospheric influences generated in localities in which numbers of men are assembled without due regard to sanitary precautions.

2d. That cholera is only an aggravated form of diarrhœa, and that its later symptoms are the result of the long continuance of this disorder and of a sudden loss of a large portion of the watery constituents of the blood, these symptoms being a shrinking of the whole body, blueness of the surface, cramp of the lower extremities, obstinate vomiting, diminution of the pulse, and gradual cessation of the heart's action.

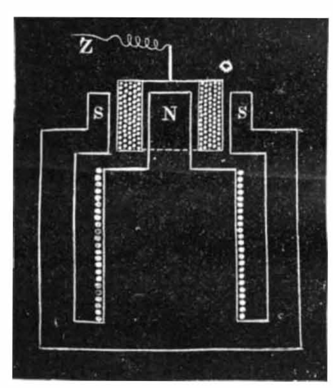


Fig. 2.—DIAGRAM OF ELECTRO MAGNET.

The nature of the contagion, or in what manner it is received into the system so as to produce these results, has not been ascertained; but in my opinion it is most probably gaseous, existing in the atmosphere, and is received into the human body by respiration through the medium of the lungs. As long, therefore, as large numbers of men are assembled within a confined space, without due regard to sanitation, will cholera be produced, and prove fatal to many thus situated; and although up to the present day we are in possession of no antidote, there is one remedy which is often available, and that is immediate removal from the locality in which the disease is prevalent.

INDICATING FIRE DAMP IN COAL MINES.

(Continued from first page.)

marsh gas in fire damp, as would be necessary if pure marsh gas were used.)

Care, of course, is taken to keep a stream of the gas flowing in, to counteract the diffusion of air through the case. Bulb, S', will now sink, its increase in weight being about 39 grains, H will break contact with *c*, and the bell rings. The observer now switches on battery I., which applies a force of say 45 grains through helix, *a'*, to the needle attached to the vertical arm of balance No. 2. This more than compensates for the increase in weight, H is brought back to *c*, and the bell ceases to ring. The observer now throws in small resistances until H breaks again, and thus finally satisfies himself that the amount of force applied through helix, *a'*, of the distant instrument is just enough to balance it and no more. Now, as this amount of force is also exerted by helix, *a*, upon the needle of Balance No. 1, its equilibrium is disturbed. Rider, *r*, is therefore shifted until equilibrium is restored. The position of this rider equals the force applied through helix, *a*; equals the force applied through the helix of the distant instrument, No. 2; and necessarily equals the increased weight of the bulb, S', in pure fire damp. From this point, therefore, to zero, the observer graduates his beam into hundredths and minor subdivisions. The graduation is then made in similar manner for carbonic acid, employing rider, *r'*, and battery II. In practice, these graduations would be made before the instruments were placed in position, allowances being made for the depth and increased temperature to which each balance is to go.

Thus adjusted, the instrument will act under the conditions named as follows:

1. *Rising Barometer and no "Fire Damp."*—The pointer of the observer's instrument will be deflected to the left. On applying battery II., both balances will come to equilibrium with the same amount of electrical force —the distant instrument indicating by the bell, as described.

2. *Falling Barometer and no "Fire Damp."*—The bulbs in both instruments will sink when the atmospheric pressure is below the point at which they were adjusted. Equilibrium will be restored to both by force applied from battery I., as described.

3. *Rising Barometer and "Fire Damp."*—The observer will find, on applying current from battery II., that the distant instrument comes to equilibrium with a weaker current than his own. Keeping that in equilibrium by the current, he moves the rider, *r*, until his own balance is in poise. The position of this rider necessarily gives him the percentage of fire damp in the case of the distant instrument.

4. *Falling Barometer and "Fire Damp."*—Both balances are disturbed, but balance No. 1 is only affected by the change in barometric pressure, while balance No. 2 is affected both by that and by the fire damp. Hence, the power now applied by battery I., sufficient to balance the distant instrument, will overweight the observer's. The amount of this overweight is determined, as before, by rider, *r*, and the percentage of fire damp is given.

The tests for carbonic acid are similar, rider, *r'*, being found necessary to restore equilibrium to the observer's instrument.

GENERAL SYSTEM.

Applied to a general system, a number of balances like No. 2 would be placed in various portions of the mine, the left-hand helices all being on one circuit, and the right-hand helices on another, connected with the one balance to be used in the observing room. Separate wires would be run for the bells serving to indicate the movements of each instrument. The tests would then be simultaneous, full battery power being thrown on, and then gradually weakened by the rheostat; measurements being taken on the observer's balance as each bell gave warning that one or more of the distant balances were in equilbrium. These tests could be frequently made, and notification promptly signaled to the miners in any drift in which a dangerous percentage was observed, or to the fire boss and his assistants.

NOTES.

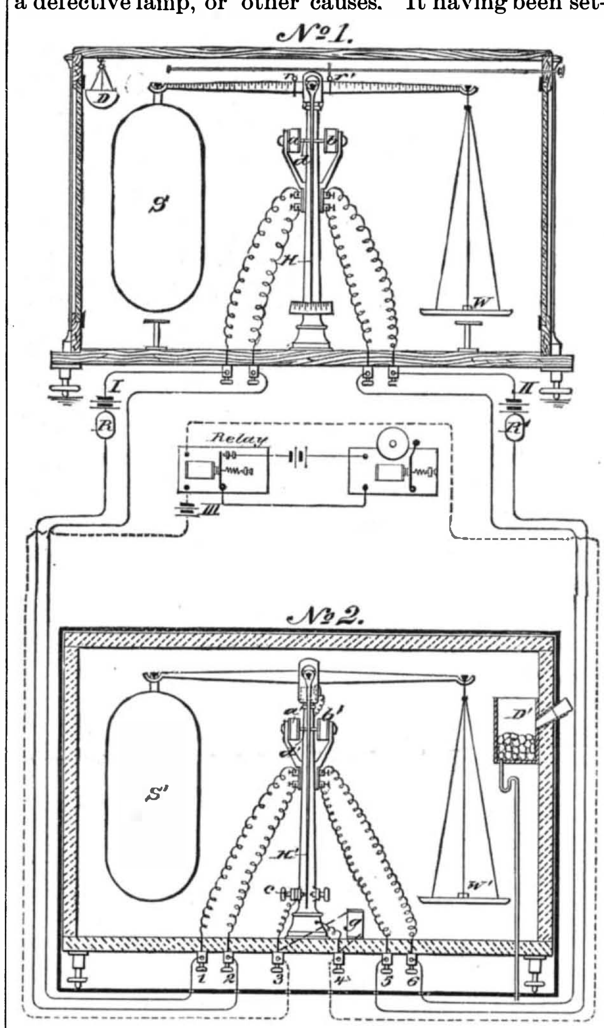
1. The percentage of carbonic acid exhaled from coal usually runs from 0·30 to 2·1 per cent. in fire damp, varying in different mines, but practically constant in any one. There may be a sudden increase by an explosion, but ventilation would soon restore the normal condition. The quantity produced by the lamps and men is insignificant, since the ventilation necessary to keep the mine free from fire damp sweeps away the carbonic acid from this source as fast as formed.

2. Should it be desirable to test for marsh gas only, balance 2 may be surrounded by an air tight case, provided with a tube opened or shut at will by a mercury valve operated by an electro magnet controlled from the observing station. This tube would be opened for, say, five minutes. During that time the external gases would diffuse perfectly through the tube into the case, but both moisture and carbonic acid would be immediately absorbed by caustic potassa placed in D'. The tube would then be closed, and measurements taken, pure marsh gas being the standard. These tests would be made as often as desired, the observer having full control of the valves on all the instruments and operating all on one circuit.

3. While a separate circuit is shown for the right-hand or left-hand helices, it is practicable, by a simple device arranged by the inventor, to operate either helix at will from the observing station, and yet use but a single circuit.

4. With bulbs of 300 cubic inches capacity, a balance weighing to $\frac{1}{10}$ of a grain will give the percentage of marsh gas to $\frac{1}{8}$ of one per cent. The bulbs weigh 6 ounces. This weight may be lessened 86 grains by filling them with pure hydrogen. A reading to $\frac{1}{8}$ of one per cent is close enough in practice.

5. The instrument is especially designed for use in goaves, where large accumulations of the gas are more liable to form. A decrease in atmospheric pressure forces it out in the workings, where it may be fired by a shot, a defective lamp, or other causes. It having been settled that the explosions supposed to be wholly due to coal dust depend on marsh gas in conjunction with the dust, the necessity for close watch upon even small percentages is obvious.



INSTRUMENT FOR INDICATING FIRE DAMP IN MINES.

6. As marsh gas spreads with tolerable rapidity, one instrument will guard a considerable area, especially in a goaf where ventilation is neglected.

A Torpedo Catcher.

The construction of torpedo catchers was as much a necessity in naval warfare, after the development of the torpedo system of small, quick steaming torpedo craft, as armored protection for battle ships became in consequence of the growth of the gun. The catchers, or police of the sea, do not differ, except in bulk and speed, from the active and dangerous little enemies which they are intended to capture or destroy; and in this respect the Admiralty would appear to have applied the old detective principle of setting a thief to catch a thief. The first of the new craft yet afloat was tried in Stokes Bay, near Portsmouth, lately, with remarkable results, not only as regards speed, but also as regards maneuvering power. This latter quality of the torpedo catcher was even more noteworthy than the former, and has been secured by the application of a principle which, though successfully tried in steam pinnaces and launches and in various submarine miners, built for the royal engineers, had not previously been adapted to first-class torpedo vessels.

During the past four years we have on various occasions noticed the gradual development of the invention of Mr. John Samuel White, of East Cowes, which is now popularly known in the service as his "turn-about" system. Boats built according to this plan have their deadwood removed in order to obtain facility in turning, and are fitted with an inner and an outer rudder, simultaneously actuated, either of which would suffice to steer the vessel in the event of the other being lost or disabled. The present experimental torpedo boat was undertaken by Mr. White for the purpose of demonstrating the applicability of his invention to larger vessels, and with a view to her acceptance by the Admiralty on her fulfilling all the conditions guaranteed. She is considerably larger than any of the existing torpedo craft in Her Majesty's navy, being 150 feet long, 17 feet 6 inches broad, and 9 feet 6 inches deep. Her displacement is about 125 tons. Her lines resemble those of similar vessels now in use but she is fitted with a turtle deck and a spur ram. Like the others, she is built of thin steel, and has a conning tower amidships, from whence she will be steered in action. Messrs. G. E. Belliss, of Birmingham, the makers of all the machinery of Mr. White's boats, joined with him in the undertaking, supplying compound engines of the three-cylinder type, the high pressure cylinder being 20 inches, and the two low pressure cylinders 24 inches in diameter, the whole being supported on light steel columns. The stroke is 18 inches. Great care has been taken in the design to keep the weights as low as possible, having due regard to efficiency. There are two air pumps driven off the low pressure crossheads, while the feed pumps are driven direct from the crank shaft. Steam is supplied by two locomotive boilers, with the feeds so arranged as to insure an equal supply of water to each boiler; and, as the result of the trial, the possibility of successfully employing two boilers with forced draught without difficulty, either as regards the feed or priming, was clearly demonstrated.

A great feature in the design is the division of the boiler room by a longitudinal water tight bulkhead, the connections being arranged so that either boiler can be worked independently in case of accident. The vessel is also steered by steam. The trial, which was conducted by Mr. White and Mr. Morcom, on the part of the builder and engineers, was witnessed by Commander the Hon. F. R. Sandilands, of the steam reserve; Mr. T. Soper, R. N., and Mr. Smale, of the Controller's Department of the Admiralty; Chief Inspector of Machinery Alton, and Messrs. Mayston and Gowing, of the dockyard. Admiral Herbert and a number of naval officers also watched the running from the deck of the Camel. The weather was somewhat boisterous, but, notwithstanding the state of the sea, the vessel was remarkably steady, and also free from vibration, when going at her maximum speed. The total weight on board was 25 tons, 15 tons representing coal and 10 tons (furnished by iron ballast) her armament of Whiteheads and rapid firing guns. Provision, however, has been made for carrying 35 tons of coal in the bunkers, while the space forward and aft for the accommodation of officers and crew and stores is unusually large. Six runs on the measured mile were first made for the purpose of ascertaining the speed under the special conditions of load, which resulted in the realization of a mean speed of 20·79 knots, the mean boiler pressure being 126 pounds, the revolutions 319 per minute, and the indicated horse power 1,387. The highest speed in the direction of the wind was 22·43 knots, and the following times which it took to complete the miles will show the regularity with which the speed was maintained: With the wind, 2 minutes, 43 seconds, 2 minutes 40½ seconds, and 2 minutes 40½ seconds (repeated). Against the wind, 3 minutes 9 seconds, 3 minutes 7 seconds, and 3 minutes 5 seconds. The average indicated horse power per square foot of grate was 23, which was maintained with a mean air pressure in the stokeholes of 2½ inches, which was considered a very high result. The vessel was afterward tested in the usual manner for maneuvering power. At full speed, with the helm hard over 30 degrees, the starboard circle was completed in 1 minute 17 seconds (238 revolutions of the engines), and the port circle in 1 minute 12 seconds (270 revolutions). At half speed the starboard circle was completed in 1 minute 14 seconds (237 revolutions), and the port circle in 1 minute 15 seconds (246 revolutions). The diameter of the circles was about a length and a half of the boat, or 225 feet. The craft was finally run for three hours' continuous full power steaming, to test the endurance of the mechanism. No mishaps occurred, and the speed and revolutions were maintained throughout. The absence of vibration during the trial, as well as the very slight inclination on the helm being put hard down by the steam steering engine, was the subject of general remark, and Mr. White and Messrs. Belliss were congratulated at their joint success in the building and engining of what is regarded as the best type of torpedo catcher.—*London Times.*

Improvement of Hearing.

A prize is offered, of 3,000 francs, by Baron Leon de Lenval, of Nice, France, for the best readily portable instrument constructed according to the principle of the microphone, for improvement of hearing in cases of partial deafness. The Award Committee will receive instruments intended for competition up to Dec. 31, 1887. The awarding of the prize will take place at the Fourth International Congress for Otology, to be held at Brussels, in September, 1888.

Correspondence.

High Science Gunnery.

To the Editor of the Scientific American:

Long range guns are so rapidly being developed that the rotundity of the earth is offering a serious impediment to correct artillery practice, as a target placed at the extreme limit of the range is necessarily below the horizon. A gun, therefore, whose range is fifteen miles is supposed to be the most perfect instrument of war that can be devised. This is an error. Let us continue in enlargement until we obtain a gun whose range is 12,000 miles. It could be mounted like the Lick telescope, with equatorial mountings, and be loaded and aimed by a corps of competent astronomers. Suppose we were involved in a controversy with Germany over the libels which that nation has published on the American hog. Our ultimatum having been sent and war declared, the astronomers, knowing the longitude and latitude of Berlin, could accurately train the gun; the mathematical corps compute the number of grains of powder necessary to impel the projectile; the engineer corps time the fuse with accuracy, and work out the trajectory; and the electrical corps fire the several cubic miles of powder at the precise moment appointed by the Secretary of War for hostilities to begin. The missile would clear all friendly and neutral nations, land immediately in the center of the doomed city, and insure peace by leaving no German alive. There are some few mechanical difficulties yet to be overcome before this gun can be properly constructed, but I believe it will yet prove to be the gun of our national armament. H. G. C.

Treatment of Stammering.

To the Editor of the Scientific American:

The treatment of stammering given by your North Carolina correspondent, in your issue of Jan. 9, needs modification, inasmuch as it will not have the same effect in the majority of cases as in his own. A person may stammer with a full lung as well as with an empty one, and for the former to increase the quantity of air already inhaled would augment his difficulty. After many years of personal experience and the observation of scores of stammerers, I confidently assert that the quantity of air; be it large or small, in the lungs has little or nothing to do primarily with this affection. Using familiar terms, my theory is that stammering is an abnormal action of the laryngeal valves. The latest physiological authority shows that the larynx—the voice box—has two valves, namely, the one formed by the true vocal chords and the one formed by the false vocal chords, the closure of the former preventing the ingress of air, and the closure of the latter preventing the egress of air. Now, stammering is a conflict between or an antagonism of these two valves—all of the contortions, shortness of breath, and various other manifestations resulting therefrom. The only rational and effectual treatment of this speech defect, therefore, is to establish a harmonious action between these two valvular processes, together with correct diaphragmatic activity, whereby the proper tension of air takes place in the lungs, and the column of air reaching to and playing upon the vocal chords is rightly supported, and the super-laryngeal parts left free to mould, modulate, and articulate the voice which has been produced at the vocal chords.

EDGAR S. WERNER, *Editor of The Voice.*
48 University Place, New York.

Zinc Chloride.—A Useful Suggestion.

To the Editor of the Scientific American:

I have read with considerable interest the report of the committee of the American Society of Civil Engineers on the preservation of timber, as printed in your SUPPLEMENT.

The conclusions arrived at have led me to write you in relation to the source of a cheap supply of zinc chloride, which I think is worth the attention of railroad men.

In Colorado, and other parts of the mining regions of the Rocky Mountains, many of the silver mines carry so high a percentage of zinc blende as to impair the value of the ores for silver. Such ores are discounted by the ore buyer or smelter according to the amount of zinc they contain, as its presence renders the ore difficult of fusion, and causes also a loss of silver by volatilization.

The whole of this zinc could be saved as chloride, with great advantage to the smelter, by calcining it with common salt.

Many of these ores carry from 30 to 50 per cent of zinc blende, and by treating them with salt for the formation of chloride, and then leaching it out, the bulk to be smelted would be proportionately reduced, and a saving of labor or fuel greater than the cost of the operation would result.

The chloride of zinc would have a market value, if burnettizing the ties becomes general, and the miner of such ores would not be at a disadvantage from the presence of zinc in the ore.

But a small addition to the smelter's plant would be necessary, and such works as the Argo and Grants, at Denver, and the works at Pueblo, could furnish enough chloride to treat the ties of many thousands of miles of road.

It is true that some silver would be leached out with the zinc, but that can easily be recovered by the addition of metallic zinc, in proportion to the silver in the vat. The addition of vats and pans for concentrating the zinc chloride would not be a great cost, and all the smelters have the necessary calcining furnaces. Give a market for the chloride, and the thing is done.

Another point deserves consideration; that is, after impregnating the timber with the solution, I would suggest the dipping in a solution of silicate of soda, which would form a silicate of zinc in the outer pores of the wood, and preserve them from the action of rain and moisture.

The regions of the mines supply a large portion of the ties, and from careful calculations I am led to believe that the ties could be prepared in Colorado and delivered to the railroads at a cost much less than in any other part of the country.

If this short notice attracts the attention of railroad men, the purpose is answered.

WM. WEST,
Sup't of Western Chemical Works, Denver, Col.

Waste in the Larder.

There is a useful article on this subject in the *Exchange and Mart*, from the pen of Miss J. Ascham.

A housewife's duty is to prevent waste. She must therefore know what is likely to go to waste and why, or perhaps she will do just what is wanted to spoil things which would have kept a little longer if they had been left alone. Most things in the larder are perishable, but not all alike.

Meat will keep three weeks in dry, frosty weather, and more than a week in cold dry weather, but not one week in damp, and hardly a day in very hot weather. If it has been frozen, it must lie in a rather warm place three or four hours before it is cooked. Meat should be taken down from the hooks every day, well looked over and wiped dry, and the hooks scalded and dried before the meat is put up again. Do not flour it. In very hot weather it is sometimes necessary to rub salt over the outside of a joint which is not to be cooked that day; but putting into a pan of treacle is much better, only it requires care, so as not to leave bits of fat, etc., in the pan when you take out the meat, and plenty of cold water to wash off what sticks to the joint when it comes out. It must, however, be carefully looked over when it comes from the butcher, and any doubtful bits pared off and burnt. If meat shows signs of "turning," it must at once be put into a very hot oven for half an hour, so as to be partly cooked. If it has really spoilt, nothing will save it, because the inside of the joint is then bad; but if it is browned, not just scorched, in time, the inside will be found perfectly nice. Of course, in a doubtful case, it may all be sliced up and fried; but then, as a joint, it is spoilt.

The dripping from a half spoilt joint is useless for food, and the bone will certainly spoil soup. Some cooks will plunge the meat into boiling water to save it, but this additional wetting is much more likely to hasten the catastrophe. In hot weather every bone must be baked, whether it is to make stock that day or not. Soup is just as good from baked bones as from raw ones. Every bone that has been boiled must be placed in a sharp heat and quite dried, and "scraps" which would help to make stock must be burnt if the cook has no time or room to make it. For one little bone is enough to spoil all the milk and cream, and will cause all perishable things in the larder to be just ready to decay.

The microscope helps us to understand the amazing rapidity with which germs multiply and diffuse themselves, but no one is yet able to say where their venom stops; probably they do harm to the entire house at the least. If bones are thoroughly dried, they will do no harm. All fat and suet should be cooked as soon as possible after it comes into the house; it should be wiped, sliced thin, and boiled for two or three hours, then strained, and the skin, which seems like leather, burnt in the middle of a hot fire. As soon as the fat is hard, it should be removed from the gravy, soup, or stock, wiped dry, and folded in thin paper. In very hot weather, sometimes it will not cake. Then a plate must be spared for it. The superfluous fat from a joint reduced to mince should be treated in the same way.

Fish must be cooked as soon as possible after it is caught. If, however, there is more than can be eaten in one day, the superfluous part should be boiled for five minutes, even if it is to be fried afterward—it can be dried; but nearly all fish is very nice stewed like eels, with the same sauce, and par-boiled fish is as good this way as if it were quite fresh.

It is said that Condy's fluid will perfectly cleanse meat or fish just beginning to taint on the outside. I think this is true; but prevention is much better than cure. Never allow any meat or fish to lie if you can hang it up.

Game and poultry should be drawn, but not plucked or skinned, dried inside, and hung head upward.

Milk is the most troublesome article in the larder, and really wants a little safe to itself. It "takes up" the slightest suspicion of taint, and becomes most objectionable without turning sour. City people, at any rate, should boil the milk as soon as it comes in, from April to December. Then it should be strained into a clean flat pan, which must be scalded and rinsed with, first, a little soda, and then clean water, every time it is used. It is a help to mistress and maid to have two pans—one brown, one white—to use on alternate days, so as to insure time for purification. Country milk a little sour may be used for a pudding, or to make scones (one-half pint to one pound of oatmeal or brown meal, into which you have mixed one-fourth ounce carbonate of soda); but the milk which has been rattled about from 2 A. M. to 8 or 9 generally seems good for nothing when stale. In case of serious illness in hot weather, or whether a young child's nourishment is in question, ice is necessary. In default of "professional" apparatus, tie up as much ice as half a yard of flannel will hold, pass a stout lath through the string, and lay it across a metal tub; oval is more convenient than round. The ice will hang down and drip in the middle of the tub, and jugs of milk, bottles of soda water, or anything else will stand at the ends. Cover the tub, stick and all, with a thick board, and that with a damp, almost wet cloth. The milk may be boiled first, but must, of course, be cold before it is put with the ice. A damp cloth, without ice, keeps things much cooler than they are when uncovered.

Cheese, uncut, only needs to be kept dry. After it is cut, it should be wrapped in a buttered paper scraped almost dry. Butter may be rendered less troublesome in summer by being covered with a huge flower pot large enough to inclose the plate and rest in a tray in which there is some cold water. Leaving butter in water spoils it. Bread should be covered closely from the air. The pans want wiping once or twice a week, and then heating very hot; the bread must not be put in again until the pan is cold, nor warm bread ever covered up. Baker's bread often acquires a most disagreeable smell and taste if these precautions are neglected.

All vegetables, when cut, may be kept fresh by putting the stalks into water. Servants generally insist on immersing them, which favors decomposition. Parsley in particular can seldom be guarded from a watery grave. Carrots, turnips, and the like, if placed in layers in a box of sand, will keep for many weeks, I believe months. Clean new laid eggs will keep quite fresh for months if buried in dried salt well closed. Boiled potatoes ought to be laid out on a plate, and are then as good for frying or mashing as if they were freshly cooked. Servants have an unaccountable fancy for throwing them away, or, if desired to fry them, chopping and mashing them first, which entirely spoils them. If left heaped up, they will often spoil in one night, and must be burnt. No vegetables should be put into soup until the day that it is to be used. If any soup, complete, is left, it must be sharply boiled the next morning, and put into a fresh, clean pan. The gray earthenware jars made for salt are most valuable for such purposes and for keeping viands hot or stewing things. Chopped spinach can be warmed in one of them, and, as it takes time to prepare, may be boiled, etc., the day before, and thus served in perfection at the early dinner or luncheon. Cabbage, French beans, and vegetable marrows are better dressed as salad if they have cooled, and in hot weather are almost as treacherous for keeping as shellfish.

Fruits, like vegetables, will keep very fresh if you can manage to put the stalk into water, only it must not be in a close or dark place. When apples, oranges, pears, lemons, etc., are to be stored, they must not touch each other, and must be protected from heat, cold, and damp as much as possible; sunshine is not desirable. It would be easy, if an amateur carpenter was at hand, to make a frame of laths, like a Venetian blind, which would contain a very large quantity of such fruit, and take up hardly any room. Flour and meal, sago, macaroni, semolina, and all like substances, are sometimes attacked by mites. They are so small as to be invisible singly, but a peculiar fine powder is be seen at the top of the farina, and is not motionless. There is also a smell something like honey or fermentation. I think they never appear in a dry storeroom, though they are sometimes brought from the grocer's. The only thing to be done is to burn the infected store, and heat the jar almost red hot before using it again.

THE electric tramway on the promenade at Blackpool, Eng., is now in full working order, and cars driven by electricity run daily. A statement of the cost of laying the line by the Corporation has been issued. The line is 2 miles 1,000 yards in length, and the actual sum expended was $55,000. The cost of laying the central channel for the electrical apparatus was borne by the company which works the line.

Keep the Boiler Clean.

The cleaning out of kitchen boilers is too often neglected. All sediment cocks should be left open at least once a week for the space of fifteen minutes, so as to clean and wash out all foul sediment. Oftentimes, when complaint is made that the water smells, or that it don't heat properly, the real cause will be found to arise from this neglect alone. In fact, people seem to go on the plan that once in order, always in order. All plumbing fixtures, says an old plumber, require cleaning and looking after, just as the plate we eat off of.

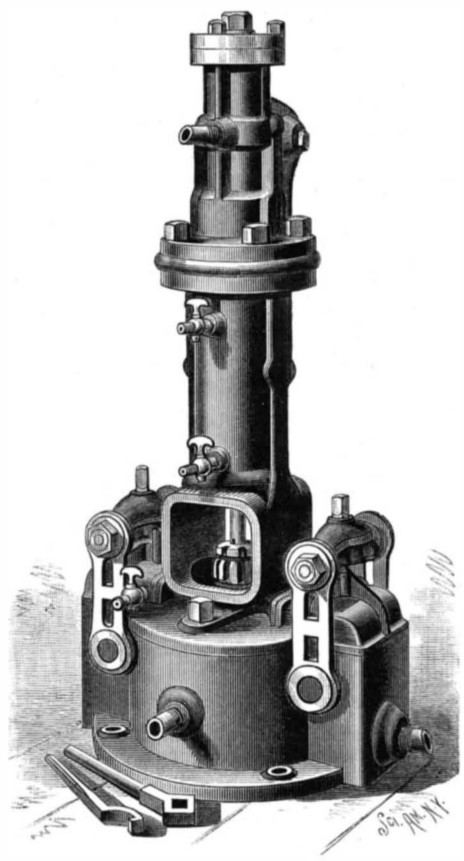


Fig. 1.—THE EMPIRE STEAM PUMP.

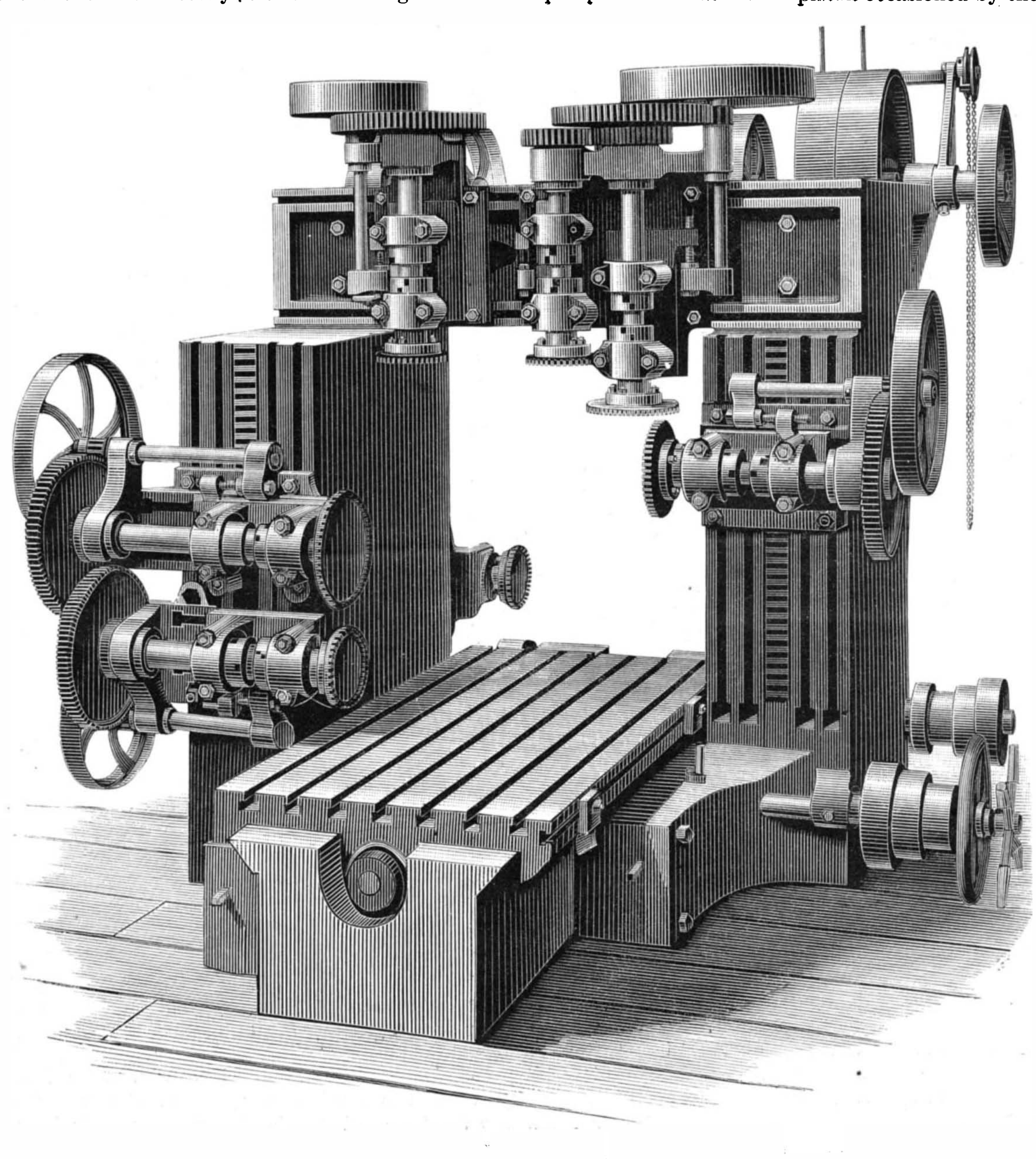
IMPROVED MILLING MACHINE.

The machine here illustrated has been specially designed by Hetherington & Co., of Manchester, for facing the various bosses and seatings on mule headstocks at one operation and at one setting, and is intended, says the *Engineer*, to supersede the old and costly method of planing. On the table of the machine is a strong chuck bracket—which is not shown in our illustration—so arranged that the mule headstock can be readily chucked into position, and supported while being operated upon. The machine itself, as will be seen from our engraving, consists of a strong bed, with table sliding upon it; attached to the bed on either side are massive double-faced uprights, carrying on the top a strong cross beam.

Mounted on the face of the uprights and cross beam are powerfully geared cutter heads, each having an independent compound movement for the adjustment of the cutters, provision having been made that when the cutters have been finally adjusted the heads can be firmly bolted to uprights, thus insuring the utmost rigidity. The machine will admit 3 feet 6 inches between the uprights, and the table is 6 feet long, with a traverse of 4 feet 6 inches. There are in all seven cutters, six on the front side of the machine and one at the back, and these seven cutters operate upon the different facings of the mule headstock, finishing them all to standard sizes with once traveling through the machine.

The table is arranged with a variable feed and quick-return motion, controlled by a hand wheel at the side of the front upright. This wheel being turned in one direction engages the slow cutting feed, and turned in the opposite direction causes the table to run back quickly on the return, while the middle position disengages both motions, and thus brings the table to a standstill. On the front edge of the table are two stops, which act upon the end of a lever coupled with a clutch on the feed cone pulley, and so arranged that when the stops come in contact with the lever, the feed motion or quick return is at once disengaged. A cross handle is also provided, for moving the table by hand if necessary. All the motions are driven separately from a countershaft carried by two brackets bolted to the back of the uprights and provided with an adjustable strap-shifting apparatus. The headstocks on the uprights are driven by open belts, and those on the cross beam by half cross belts. This arrangement allows the headstocks to be moved in position, when necessary, by altering the length of belt.

As already stated, the special feature of this machine is the great saving of labor effected over the old system of planing; and as an illustration of this we may mention that whereas formerly three days were occupied in the planing of a mule headstock, the same result is, with the special milling machine we have described, obtained in two hours; in addition, the further advantage is secured that all the headstocks are in exact duplicate, while the machine requires no attention after it has been started, the stopping motion coming automatically into action when the table has made the required traverse.



SPECIAL MILLING MACHINE.

THE EMPIRE STEAM PUMP.

The accompanying engravings represent a vertical steam pump, the most prominent peculiarities of which are its automatic valve gear and quick return plunger, which moves down at a given speed, but returns much more quickly. Its steam valve is operated without the aid of tappets, compound levers, or metallic connections of any kind.

It neither strikes a blow nor operates suddenly upon the plunger. The piston cushions noiselessly upon steam at the end of each stroke, recedes gradually for an instant until the water valves close, and then completes its stroke; this cushioning upon the steam allows of the pump being driven at great speed without danger of hammering. There is no outside moving gear or delicate adjustment, the only visible moving part being a portion of the piston rod, and even this when necessary can be inclosed.

In the steam chest there are but two pieces—shown in Nos. 2, 3, and 4, of Fig. 2. No. 1 being a sectional elevation through the entire pump—a slide valve and a differential piston to move the valve, these constituting the whole valve gear. The steam piston and water plunger are cast in one piece of steel or composition, as shown in No. 2. The stuffing boxes and water valve seats are made of composition. The links and bolts holding the valve caps are steel, and all other bolts are casehardened. These caps can be easily and quickly removed, thus permitting access to the valves whenever necessary. Although having but two water valves, the pump possesses the same advantages, as respects a steady flow, as the ordinary double-acting pump, by reason of the quick return of the plunger and the creating of a partial vacuum on both the up and down stroke. The quick return movement of the piston prevents any vibration or quake, such as usually accompanies quick reciprocating motion. The pump being vertical, there is no wear to the cylinder or piston occasioned by the weight of the piston, and all foreign substances pass under or over the plunger, thereby preventing all abrasions or cutting, so destructive in many other styles of pumps. The arrangement of the parts is such that there can be no such thing as dead centers, and hence it can be run at one stroke per minute if desired. The pump is so made that the water cylinder may be changed, at a trifling cost, in accordance with the work to be done.

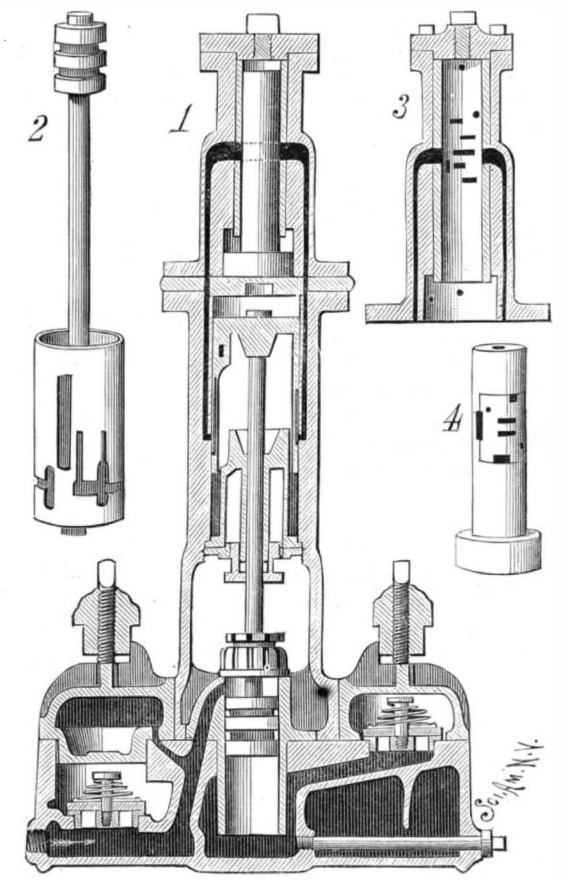


Fig. 2.—DETAILS OF THE EMPIRE STEAM PUMP.

Any further particulars regarding these patents can be had by addressing the inventor, Mr. E. G. Shortt, of Carthage, N. Y. The pump is manufactured by the Empire Steam Pump Co., at whose office, 12 Cortlandt Street, this city, one may be seen in operation.

PASTEUR'S discoveries, according to the German press, were anticipated. It is pointed out that, on pages 213 and 467 of G. H. Jahr's "Clinical Directions," published in 1849 by H. Bethmann, Leipsic, under the headings of "Hydrophobia" and "Cases of Poisoning" mention is made of "inoculations with the virus of rabies" as a remedy against the bite of rabid dogs. "The physician who advocated and practically employed this remedy was a German, Constantin Hering by name, and resided in Philadelphia."

Push or Being Pushed.

As we have said repeatedly, there is nothing in the world like energy. In order to succeed, it is required that the aim in view be pursued with unwavering determination. It is the persistent effort to advance which we commonly designate by the term *push*. A business man without push might as well shut up shop and save his money, for sooner or later he will be swamped by the irresistible onward rush of progress.

Quite different, however, from this faculty of push, exerted in a particular direction for individual advancement, is the being pushed by others. He who is awake to his own interests, who is possessed of push, needs no pushing from others, and, on the other hand, no amount of pushing will benefit the weak and the laggard. Constant spurring will only induce stubbornness and sulkiness, and we all know how the mule will act if urged against his will.

We believe that he who does not feel that diligence and earnestness and a constant striving for improvement (be it in his own business or in that of another, if he is not his own master) will pay best in the end, cannot be brought to it by compulsion.

Compulsion, force, driving, moreover, is unworthy of the spirit of our age. Let him who will not move his arms and legs to keep himself afloat go to the bottom, the sooner the better. It is a deed of charity to such a being and in the best interests of others.

We have no patience with men who are like *dumb, driven* cattle, and who work solely because they must have their earnings in order to fill the stomach, whose chief prayer is

" *Come day, go day,*
God send pay day."

They are not *men*, but *machines*, and in the case of machines we expect a certain amount of work from the expenditure of a certain amount of fuel, and we take steps to get it. But a *man*, be he employer or employe, will do his best; what he may lack to-day, he will make up to-morrow. He will have *push*, but will object to being *pushed*.

Push is absolutely a requisite in this world; *pushing* is unnecessary, and may result in the very opposite of that which it was intended to accomplish.—*Lithographer and Printer*.

Petrifaction of Organic Bodies.

At a recent meeting of the Italian Medical Society at Perouse, Prof. Angelo Corni, of Rome, made known the processes of preserving anatomical specimens and of petrifying corpses, the secret of which he has kept to himself for more than fifty years. These processes are two in number, and are as follows:

1. *Process of Making Organic Bodies as Hard as Stone.*—The substances employed are boiled linseed oil and dentochloride of mercury, which are to be stirred up in a mortar until a soft paste is formed. In this oily paste is immersed the corpse or any anatomical specimen that it is desired to render unalterable by giving it the consistency of stone. The immersion is prolonged for several months, according to the bulk of the body which is to absorb the above-named substances.

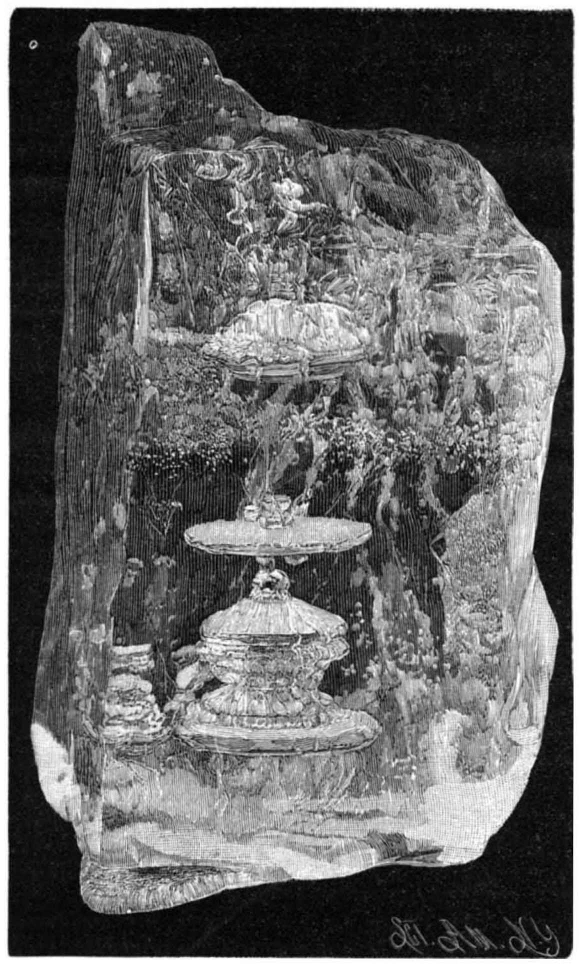
When the induration seems sufficient, the objects are washed with turpentine, and exposed to the air until they become thoroughly dry. Then they are polished with an agate, and burnished as is done in the silvering and gilding of wood, but without the use of water or soap. These operations necessarily require considerable practice combined with a certain dexterity.

If the objects to be preserved contain cavities, the latter must be previously filled with a mixture of equal parts of finely powdered cement and dentochloride of mercury. Finally, if it be desired to preserve the body with its eyes open, artificial eyes must be substituted for the natural ones before immersion in the paste.

2. *Process of Preserving Bodies in a Soft and Flexible State.*—For preserving organic bodies in a soft and flexible state for several months, and permitting them to be dissected without any danger to the preparator or the anatomist, they are placed in some sort of a receptacle or other and covered with a layer of the thickest and purest honey that can be found in the market. If it be desired to preserve an entire cadaver by this simple and cheap process, we begin by carefully filling the encephalic, thoracic, and abdominal cavities with a sufficient quantity of tannin. This process, when applied with care, gives remarkable results, and a corpse thus prepared appears for several months to be asleep. One might say that the alcoholic fermentation that occurs under these circumstances serves it as food while preserving its softness and flexibility. When the fermentation ceases, a hardening of the parts occurs and renders the artistic forms of the body still more marked. —*Revue Scientifique*.

A CURIOUS ICE FORMATION.

The accompanying illustration represents a photograph of an air bubble found near the center of a cake of ice by one of our correspondents at Eau Claire, Wis. The beautiful shapes which ice often assumes in such formations are sometimes quite notable, but it is very rare, we think, to find a specimen of nature's work in this direction where the idea of some design seems to be so well suggested as here. The whole may indeed



CURIOUS FORMATION IN ICE CAUSED BY AN AIR BUBBLE.

be taken as a shadowy representation of a beautiful flower stand, most delicately carved in crystal, suspended above which, and partly seeming to spring from it, are formations which give no bad suggestion of flowers and vines, while tapestry and bric-a-brac of rare excellence can be evoked, with but little effort of the imagination, from various other details of the representation.

EXTENSIVE soda works have been begun at Owens Lake, in California. A portable engine is employed, and as soon as a vat is filled the engine is moved to another, and the water is left to evaporate from the one that had been filled. This process will be repeated at all the vats until the soda sediment in the water accumulates in the pit until it reaches the surface. It will take about a year to get a crop of soda by this method, which will bring $35 per ton. They expect to gather fifty tons of soda to the acre annually. The number of vats will be increased till they hold an area of 50,000 acres of soda, the income from which is expected to be nearly $2,000,000 a year.

THE CALIFORNIA ROADRUNNER (*Geococcyx Californianus*).

JOHN R. CORYELL.

A very singular and yet a very little known bird is the roadrunner chaparral cock, or, as it is known in Mexico and the Spanish sections of the United States, the paisano.

It belongs to the cuckoo family, but has none of the bad habits by which the European cuckoo is best known. It is a shy bird, but is not by any means an unfamiliar object in the southwestern portions of the United States and in Mexico. Sometimes it wanders up into middle California, but not often, seeming to prefer the more deserted, hotter, and sandier parts of southern California, and from there stretching its habitat as far east as middle Texas.

It is not by any means a brilliantly colored bird, although some of its hues are very beautiful. The prevailing color of the roadrunner is olive green, which is marked with brown and white. The top of the head is black blue, and is furnished with an erectile crest. The eyes are surrounded by a line of bare skin.

It is not a large bird, being seldom twenty-four inches long, with a tail taking more than half of that length. The tail, indeed, is the most striking feature of the bird, being not only so very long, but seemingly endowed with the gift of perpetual motion, since it is never still, but bobs up and down, and sidewise, too, into every possible angle, and almost incessantly.

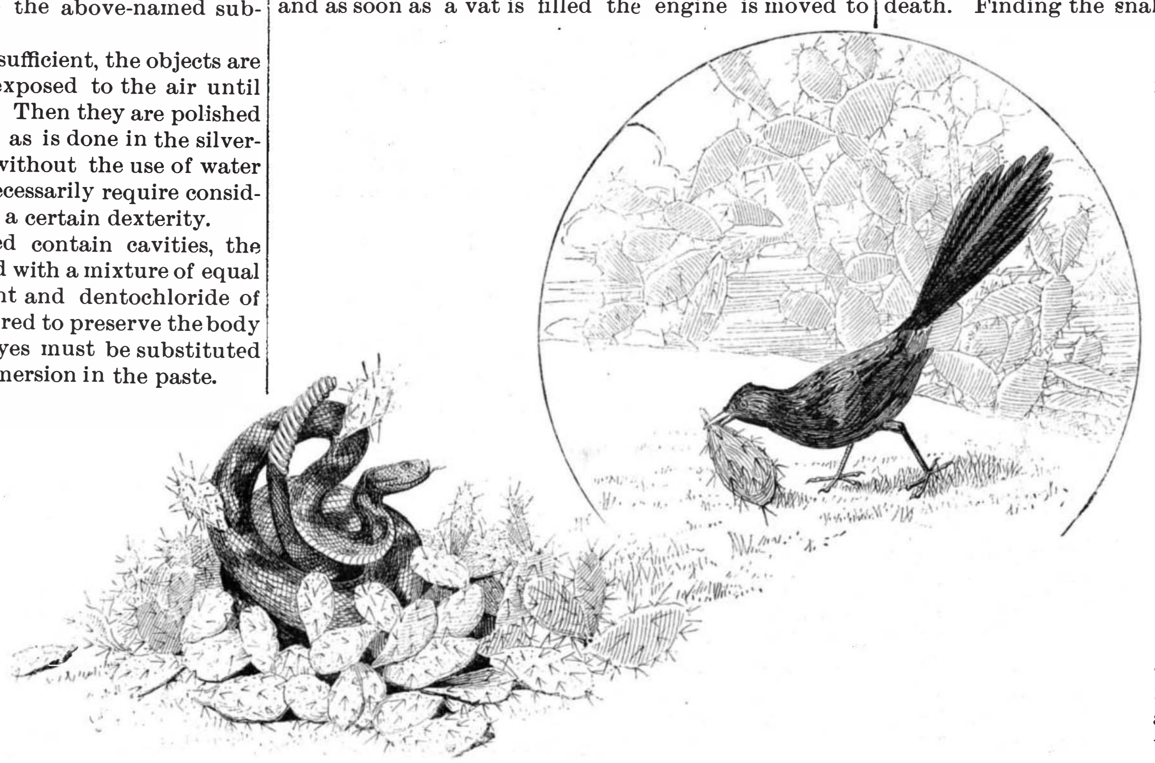
But while its tail is most striking, its legs are most remarkable, being not only long and stout, but wonderfully muscular. How muscular nobody would be able to imagine who had not put them to the test.

A traveler in Mexico tells of going out with his ranchero host to hunt hares with a brace of very fine hounds. Going over a long stretch of sandy plain, relieved only by pillars and clusters of cactus, the Mexican called the attention of his guest to an alert, comical-looking bird, some distance from them.

With the remark that the gentleman should see some rare coursing, the Mexican slipped the leashes of the straining hounds, which sprang off as if used to the sport, and darted after the bird. For a moment it seemed to the stranger a very poor use to put the dogs to, but he was not long in changing his mind.

Instead of taking wing, the bird tilted its long tail straight up into the air in a saucily defiant way, and started off on a run in a direct line ahead. It seemed an incredible thing that the slender dogs, with their space devouring bounds, should not at once overtake the little bird; but so it was. The legs of the paisano moved with marvelous rapidity, and enabled it to keep the hounds at their distance for a very long time, being finally overtaken only after one of the gamest races ever witnessed by the visiting sportsman.

The roadrunner, however, serves a better purpose in life than being run down by hounds. Cassin mentions a most singular circumstance among the peculiarities of the bird. It seems to have a mortal hatred of rattlesnakes, and no sooner sees one of those reptiles than it sets about in what, to the snake, might well seem a most diabolical way of compassing its death. Finding the snake asleep, it at once seeks out the spiniest of the small cacti, the prickly pear, and, with infinite pains and quietness, carries the leaves, which it breaks off, and puts them in a circle around the slumbering snake. When it has made a sufficient wall about the object of all this care, it rouses its victim with a sudden peck of its sharp beak, and then quickly retires to let the snake work out its own destruction, a thing it eventually does in a way that ought to gratify the roadrunner if it have any sense of humor. Any one watching it would say it was expressing the liveliest emotion with its constantly and grotesquely moving tail.



THE CALIFORNIA ROADRUNNER (GEOCOCCYX CALIFORNIANUS).

The first impulse and act of the assaulted snake is to coil for a dart; its next to move away. It quickly realizes that it is hemmed in, in a circle, and finally makes a rash attempt to glide over the obstruction. The myriad of tiny needles prick it and drive it back. The angry snake, with small wisdom, attempts to retaliate by fastening its fangs into the offending cactus. The spines fill its mouth.

Angrier still, it again and again assaults the prickly wall, until, quite beside itself with rage, it seems to lose its wits completely, and, writhing and twisting horribly, buries its envenomed fangs into its own body, dying finally from its self-inflicted wounds. After the catastrophe, the roadrunner indulges in a few gratified flirts of its long tail and goes off, perchance to find its reward in being run down by hounds set on by men.

Steam Engineering.

In the September number of *Wood and Iron* were propounded to the engineers of the Northwest fifty questions on steam engineering. Replies were received from a large number of correspondents. The winner of the prize gave the following replies to the queries propounded, which, whether beyond criticism or not, contain many points of interest and instruction:

1. Steam is an elastic fluid, generated by the action of heat upon water.

2. Steam, when separated from the water from which it is generated, follows the law of all other gases, expanding 1·459 of its volume for each additional degree of heat while the pressure remains the same; and while the temperature remains the same, the pressure is in inverse proportion to the volume.

3. The temperature of steam is equal to that of the water from which it is formed, and its elastic force is equal to the pressure under which it is formed.

4. Total heat of steam at 212° is 1,178°.

5. Latent heat of steam is found by subtracting its sensible heat from 1,202°.

6. Heat in steam becomes latent heat whenever there is a change in the temperature; then the heat produces the change, but does not raise the temperature.

7. To find the amount of water to condense a given quantity of steam: Subtract temperature of hot well from total heat of steam. Divide difference by difference between temperature of injection water and that of hot well. Divide first by second. Result is the number of times the injection water must exceed its weight in steam.

8. Low pressure is pressure not exceeding one atmosphere.

9. To find average pressure in a cylinder, divide length of stroke in feet by distance that steam follows before being cut off, which gives the ratio of expansion. Multiply pressure by corresponding number in some reliable expansion table. Result is average. This is the most expeditious method, provided the table is reliable.

10. Superheated steam is steam which has a greater temperature than that due to its pressure.

11. Formulæ for estimating power of engines: Non-condensing engine—Power (average pressure — counter pressure) × area of piston in inches × piston speed in feet per minute. Condensing—Power = (average pressure × vacuum) × piston area in square inches × piston speed.

12. The "dead center" is the point in the stroke where the crank and piston rod are in the same right line. To find dead center, turn engine in the direction it runs until crosshead is within a short distance of its limit of motion. Mark guide at end of cross head shoe. Mark some revolving circular part of engine, as disk crank or flywheel, and place one point of a fixed tram in this mark and the other on some fixed object in line. Now turn engine past the center in the direction she runs until end of crosshead shoe passes mark on guide. Turn back till shoe reaches mark. Holding tram still on the fixed object, place other point on selected revolving part and mark as before. Bisect distance between marks on revolving part, and turn engine till point of tram rests on central mark, and the engine is on "dead center."

13. To find diameter of cylinder for a given power: Multiply horse power of engine by 33,000. Divide product by the product of cylinder area × steam pressure × piston speed in feet per minute.

14. Rule for finding contents in cubic feet of a cylinder of any given diameter: Multiply the square of diameter in inches by 0·7854, and this product by length of stroke in inches. Divide last product by 1,728, and result is contents of cylinder in cubic feet.

15. The diameter of the valve rod should be from 1-10 to 1-12 of the cylinder diameter, or from 1-350 to 1-300 of unbalanced area of slide valve. This last is considering the valve as a piston. Steel rods, of course, will bear being made smaller.

16. The function of the steam engine crank is to change reciprocating rectilinear motion of the piston rod to the constant rotary motion of the crank shaft.

17. The steam engine governor controls the speed of the engine within certain limits, by regulating the supply of steam to the cylinder, either by means of a throttle valve in the steam pipe, as in the case of all throttling engines, delivering a uniform supply of steam at the pressure necessary for the speed, or as all automatic cut-off governors, delivering steam at boiler pressure at the beginning of a stroke for a sufficient distance to maintain the speed, then cutting it entirely off.

18. The most common causes of heating in the journals of steam engines are: Insufficient lubrication, tightness of journals, faults in the alignment, and the action of foreign substances, such as dust.

19. To ascertain lap and lead of a slide valve without opening chest, we should disconnect drip pipes, so that steam would appear at them as soon as it entered the cylinder; then opening the throttle a very little, watch drip pipes while the engine is being slowly turned by hand in the direction it runs. When steam appears in front of the piston near the end of the stroke, mark valve rod at edge of stuffing box or some other convenient point. Then turn engine on center, mark rod again and measure distance again, which is the lead. The lap is found by marking rod when steam ceases flowing from one end, and again when it commences flowing from the other, measuring between marks, as for lead. Proceed the same for other end of valve.

20. The amount of lubrication required for any engine is influenced by the quality of lubricant, speed of engine, amount of work in proportion to size of engine, tightness of journals, correctness of alignments, finish of journals, truth of valve face, perfection of cylinder bore, and fit of piston.

21. The functions of the steam engine indicator are to show by its diagrams the pressure of steam at every part of the stroke, the amount of lap and lead of the valve, point of cut-off, average pressure, counter pressure, point of exhaust opening, point of exhaust closure, and amount of cushion, enabling the happy possessor to calculate the power of his engine, amount of work it is doing at the time diagrams are taken, frictional load, and theoretical rate of water consumption.

22. A close approximation to the theoretical diagram, high initial pressure, early cut-off, and low terminal pressure indicate good construction and performance.

23. Indicator diagrams show the pressure in the cylinder by the relation of their lines to the atmospheric line, which is a line drawn when the indicator piston is in equilibrium, having the pressure of the atmosphere on both of its sides.

24. The diagram shows by the changes of direction of its lines the exact time, in relation to the stroke of the piston, that each event of the valve stroke, admission, cut-off, etc., occurs.

25. "Compression" is confinement of steam by closing the exhaust opening before the return stroke is ended, thus causing a rise in pressure and assisting to stop the motion of the reciprocating parts. "Cushion" is steam used to stop the motion of reciprocating parts, and may be steam entrapped by exhaust closure or admitted from boiler. "Clearance" is the name given to space between piston follower and face of valve.

26. The term "energy" originally meant capability to produce motion, but has become nearly obsolete in a mechanical sense, being used chiefly in connection with men and animals.

27. A pound of pure carbon is capable of liberating, if perfectly burned, about 14,500 heat units, which if used in one hour = 5·65 × horse power.

28. The usual friction of a large engine is about five per cent of its power.

29. Part of the wasted heat might be saved by placing a heater in the chimney, and feeding injection water, having a good condenser, as a matter of course.

30. The value of any kind of fuel is determined by the number of heat units produced by its combustion.

31. A horse power is a power sufficient to raise 33,000 pounds one foot in one minute.

32. To determine the power of an engine, multiply the area of the piston in square inches by the average pressure of steam in cylinder, and this product by piston's speed in feet per minute.

33. Law of movable pulleys: The power is doubled by each movable pulley.

34. A 3 inch pipe is nine times the area of a 1 inch pipe. For $3^2 = 9$, $1^2 = 1$, $1 \times 0·7854 = 0·7854$, $9 \times 0·7854 \div 0·7854 = 9$; 3 inch pipe has nine times area of 1 inch pipe.

35. If a non-condensing engine, having an initial pressure of fifty pounds above atmosphere, cuts off at half stroke, the mean pressure in the cylinder will be 42·35 pounds per square inch.

36. Automatic engines use twenty-eight to thirty pounds of water per horse power per hour, and throttling engines from forty to sixty pounds per horse power per hour.

37. Consider one inch below water level the best place to introduce feed pipe to boiler.

38. Steam gauge pipe should be taken from the highest part of boiler.

39. About 156 cubic feet of air must pass through the grate to burn one pound of coal.

40. A ready method of testing a steam gauge is to raise the pressure until the gauge indicates point at which safety valve should commence blowing. If it commences blowing at the proper pressure as indicated by gauge, it is fair to conclude that both are right. If they do not show the same pressure, one is wrong; most probably the gauge.

41. Good anthracite coal makes 3·89 per cent of ashes. Hence, 2,000 pounds would produce about 80 pounds of ashes.

42. It is a disputed point whether coal is improved by wetting or not; but as most furnaces supply from 1¼ to 1⅜ as much air as is necessary for the perfect combustion of coal, it is safer to conclude that oxygen resulting from the separation of water (if possible) would be of no benefit.

43. The best time to remove clinkers from furnace walls is while they are hot, as the clinkers are then soft and will come off without injuring the walls.

44. If two pulleys on opposite shafts are twenty feet from center to center, the length of a belt to fit around them is 46¼ feet. Rule: Add to twice the distance between centers of shafts the product of half the sum of the diameters of the pulleys and 3⅛.

45. A unit of heat is the amount of heat required to raise a pound of water 1° Fah., from 39° to 40°.

46. The principle involved in the working of the injector is that steam occupies more space than its weight of water, so that there is less volume returned to the boiler than is taken from it, as the steam used in working the injector is condensed and enters in the form of water, occupying at sixty pounds above atmosphere but 1-353 of former volume.

47. I consider its latent heat, and the manner in which it varies, the most remarkable property of steam.

48. A cubic foot of fresh water weighs 62½ pounds at 60° Fah., and contains 7½ gallons nearly.

49. A perfectly aligned and firmly built engine, set on a solid foundation, having perfectly fitted yet easy moving piston, tight shutting, balanced, light running valves, high and dry steam, reliable automatic cut-off, cutting off early, good condenser, and run at moderately high speed, will effect the economical use of steam.

50. I would suggest the universal adoption of a key on each side of crank pin box to equalize clearance and lessen it.

The Atlantic and Pacific Ship Railway Company.

A bill for the incorporation of the Atlantic and Pacific Ship Railway Company was introduced by Mr. Vest in the Senate on December 15, 1885, and after being read twice has been referred to the Committee on Commerce. In addition to the act of incorporation, by which Captain Eads and his associates are empowered to build a ship railway across the Isthmus of Tehuantepec, the bill outlines the position of the United States in connection with the enterprise. The Government of Mexico having, in addition to land grants amounting to 2,700,000 acres, guaranteed that one-third of the annual net revenues of the company shall, for the period of fifteen years after the completion of the railway, amount to $1,250,000, the United States shall, it is proposed, guarantee that the remaining two-thirds of the annual net revenues shall amount to $2,500,000. Fifty per cent of the gross earnings are assumed to represent the net revenue. The guarantee is only to go into effect when a loaded vessel, weighing not less than 3,000 tons, has been safely transported from one ocean to another at an average speed of at least six miles an hour. The speed requirement does not apply to such distance as may be made by canal. Whenever moneys are advanced by the Government, in fulfilling this guarantee, it is to receive corresponding bonds, payable in fifteen years from the date of issue. In default of such payment, the company is to receive these bonds at ten per cent premium in payment of tolls on American vessels.

In consideration of the accommodation, the company binds itself to transport all Government vessels, property, mails, and officials, and to transmit all messages, for the annual sum of $500; to accept from American coasting vessels, for a period of thirty years, seventy-five per cent of the regular tolls charged other nations, except Mexico; and to transport no war vessels, troops, or supplies of any nation at war with the United States or Mexico. The Government is to be represented by two-ninths of the total directorship, and when the revenue of the company amounts to over ten per cent on its total indebtedness, may, in connection with the directors appointed by Mexico, establish a reduced tariff.

Such are the main provisions of the bill, and in expressing our own favorable attitude toward it we are inclined to believe that we are but voicing the sentiment of a very large majority. While the Government would make itself liable for a considerable sum of money, it is not probable that it would ever be called upon for more than an unimportant fraction of that amount. The benefits to be derived from the enterprise seem to us more than a compensation for any possible losses.

Heat and Pressure of Explosives.

If a charge of gunpowder be placed in the chamber of a gun, the gravimetric density of the charge being unity, and if it be completely exploded before the shot be allowed to move, the state of things immediately prior to the shot being permitted to move in the powder chamber, roughly speaking, is as follows: The products of explosion are divided into two classes of substances, about two-fifths, by weight, of the powder being in the form of permanent gases and three-fifths solid matter, the solid matter being perfectly liquid at the moment of explosion and in an extremely fine state of division. By the combustion is generated some 730 units of heat. The temperature of the explosion is about 2,200 deg. C., or about 4,000 deg. F., and the exploded powder exercises a pressure of about 6,500 atmospheres, or about 43 tons per square inch, or about 90,000 pounds per square inch, against the walls of the chamber and against the projectile.

The Barometer as a Guide to Health.

Dr. M. A. Veeder, of Lyons, N. Y., has been led by his observations to believe that the barometer may become an instrument of as great value in saving life as it is now in saving crops or ships. It is a familiar fact, he says, that many persons who are afflicted with rheumatism are able to foretell changes of the weather by means of the aches and pains that they experience. Persons who are subject to headache, also, are apt to suffer most when the mercury in the barometer is changing its level rapidly, as, for instance, before a thunder storm. The cause of these symptoms appears to be a difficulty in the adjustment of the volume and rate of the circulation of the blood to the varying atmospheric pressure upon the surface of the body. Ordinarily, the results are not serious, and but little attention is given to the subject. The question arises, however, as to whether there may not be a class of cases in which the movements of the mercury in the tube may become of great prognostic import. Dr. Veeder says that he has noted the occurrence of several deaths from apoplexy at times when rapid fluctuations of atmospheric pressure were indicated by the barometer; and he believes that at such times over-excitement, over-eating, improper clothing, and the like may induce consequences most disastrous to those who are predisposed to apoplexy, the weakened blood vessels being already subjected to unusual strain by reason of the unfavorable atmospheric conditions. Although the cases observed by the writer thus far are not numerous, yet he maintains that the probabilities with regard to the matter are such that it is the part of wisdom that those who are advanced in years, or subject to symptoms that indicate an apoplectic tendency, should be warned to exercise great moderation in all things, whenever the mercury is seen to be unusually active in its movements.—*Medical Record.*

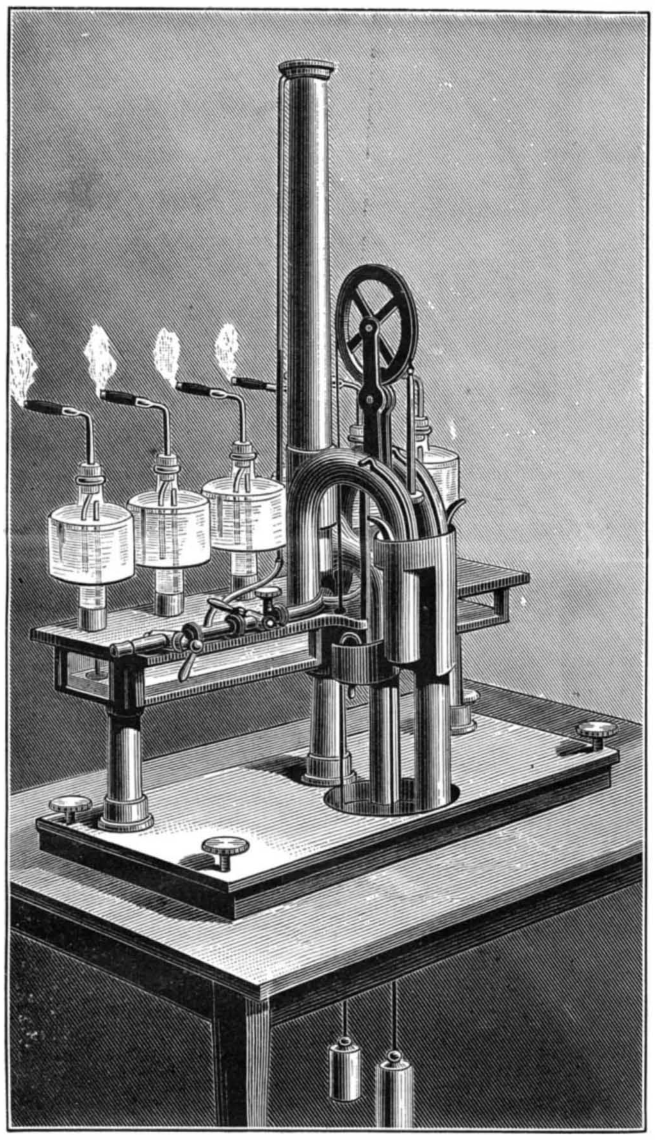


Fig. 1—PARENTY'S SMOKING MACHINE.

Treatment of Diabetes.

Contrary to the general practice followed, Dr. Boucheron, in a note to the Academy of Sciences, advises diabetics to abstain from albuminoid food and alcohol, as well as from hydrocarbonized food. By this means, according to him, the sugar will disappear in three or four months. The boulimia and polydipsia are the first symptoms to give way, and strength will return with the general improvement.

SQUEAKY boots having proved a source of annoyance at pharmaceutical meetings, the *Chemist and Druggist* suggests their cure by the injection of powdered French chalk through a perforation in the inner sole, and adds that the free use of the same substance between the soles when boots are being made will effectually prevent any trouble of this nature.

PARENTY'S SMOKING MACHINE.

We reproduce herewith, from *La Nature*, an illustration of a novel apparatus, called by its inventor, Mr. Parenty, a "smoking machine." Tobacco manufacturers make their cigars out of quite a large number of different leaves, whose physical and chemical qualities have to be so combined as to yield an article that gives out an agreeable odor and burns well. Combustibility, then, is a physical quality that must be estimated for each variety of leaf. Such estimate is made by measuring the time during which a certain style of cigar, made solely from the tobacco to be tested, holds its fire without drawing on it a second time. In this comparative determination the intensity of the lighting is the element that has to be determined and regulated. To accomplish this is the object of the machine under consideration, which is so constructed as to imitate all the motions of a smoker, who, at regular intervals, would inhale a definite volume of air with a definite and constant force of suction.

The apparatus (Fig. 1) is fed by a constant level reservoir. The liquid enters continuously through an orifice whose narrow section, ω (Fig. 2), may be modified by means of a small regulating cone, V. The feed-pipe is provided with two cocks, R and R', with gauges, one of them graduated from one to three minutes and the other from three to ten, to show the interval between the beginning of two successive suctions. From the orifice, ω, the water enters the aspirator, *a*, which rests upon a reservoir, *b*, fed by the same orifice. When the water lowers in this system of communicating vessels, the smoke is sucked through the cigar holder tube, A; and, when it rises, the smoke is expelled through the tubes, B, which are alternately opened and closed by the water contained in the collector, C. This latter collects the smoke that comes from the aspirators, and holds the water designed for closing the bottom of the tubes, B. It is closed above by the aspirator box, and this latter is provided with a hydraulic joint that arrests the smoke and allows it to make its exit through the chimney, *g*, only. The variations in level that produce the successive inspirations and expirations are effected by means of two movable reservoirs, D and E, which are connected with the preceding parts by siphons, S_1 and S_2. These reservoirs are balanced by counterpoises, whose cords pass over pulleys, and they rise or fall according to the weight of water that they contain. One them, D, is divided into two compartments by a vertical partition, the first of which, D_1, communicates with the aspirator box through a siphon, S_1, while the second, D_2, connects the collector and the reservior, E, through a siphon, S_2.

The complete operation comprises four periods:

1. The aspirator, A, and the compartment, D_1, are full of water, as is also the connecting siphon, S_1. The water flows over the partition into compartment, D_1, and then runs through the siphon, S_2, into the collector, C, where the liquid reaches the extremity of the tube, B. At this moment the reservoir, D, contains a sufficient weight of water to make it descend and cause a suction. At the same time, the collector stops filling, and expels through the chimney the smoke that has been previously sucked in.

2. The reservoir, E, has likewise filled with water, and descends through its own weight and empties the collector and compartment, D_1.

3. The reservoir, D_1, being relieved, rises. The aspirator begins to fill with water, and the smoke expelled therefrom through the tube, B, enters the collector.

4. The reservoir, E, resumes its initial position under the action of a small siphon, S, at its upper part, which primes itself and frees it from the excess of liquid.

The apparatus operates, then, through the establishing by the siphons, S_1 and S_2, of two levels, n, n', and n_2 n_2', whose variations produce the above described effects.

For experimentation, we begin by making an approximate classification of cigars, each representing some variety of tobacco; this being done by lighting them at intervals of from 1½ to 2 minutes. As the resistance of the cigars to the passage of the air is unequal, the suction is made uniform before each lighting by means of a small cock, *v*, on the aspirator tube; and, in order to utilize the graduation of the gauges, the cock, R, is fixed in such a position that it shall be possible, though the cock, R', to bring about a coincidence between the two liquid levels at a common point of the graduations, this being three minutes.

After two successive suctions the cigar is fully lighted, and we then note by a chronometer the length of time that it burns. In a subsequent experiment, on grouping cigars of analogous combustibility, we endeavor to find out whether, after a determinate lighting, they are capable of holding their fire during an operation in which the suctions are regularly spaced at intervals fixed by the first classification. An identical motion may be communicated to any number of aspirators by the same motor. The apparatus shown in Fig. 1 is arranged for testing six cigars at once.

This ingenious apparatus, which does its inventor great credit, was presented to the Administration of Tobaccos in 1884, and excited great interest at the Anvers Exhibition.

Navigable Balloons.

The French Academy of Sciences received, at its sitting of the 23d of November, an interesting communication from Captain Renard on the subject of some experiments recently made by him with his navigable balloon. The memoir was received with great favor by the Academy, which decided that it should be inserted verbatim in the Transactions, although this is contrary to the general practice. The experiments described took place on the 22d of August and the 22d and 23d of September. The motor employed was a Gramme dynamo-electric machine making 3,000 revolutions a minute, and developing 9 horse power. The current actuating the machine was furnished by a battery, which constitutes the most interesting feature in the installation, but the arrangement of which is kept secret. To measure the velocities, Captain Renard employed a sort of aerial log formed of a small balloon of gold-beater's skin, and filled with 120 liters of common gas. This was held in equilibrium in the air, attached to the end of a silk thread 100 meters in length, and wound on a reel. To measure the speed, one end of the thread is wound round the finger, the time is noted when the balloon log is liberated, and the relative movement is recorded by the unwinding

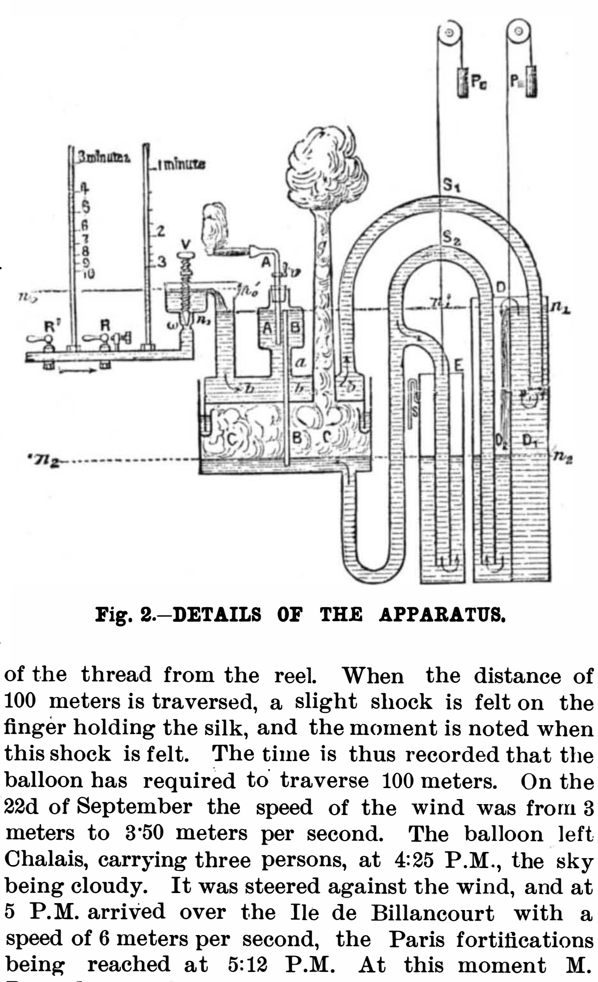


Fig. 2.—DETAILS OF THE APPARATUS.

of the thread from the reel. When the distance of 100 meters is traversed, a slight shock is felt on the finger holding the silk, and the moment is noted when this shock is felt. The time is thus recorded that the balloon has required to traverse 100 meters. On the 22d of September the speed of the wind was from 3 meters to 3·50 meters per second. The balloon left Chalais, carrying three persons, at 4:25 P.M., the sky being cloudy. It was steered against the wind, and at 5 P.M. arrived over the Ile de Billancourt with a speed of 6 meters per second, the Paris fortifications being reached at 5:12 P.M. At this moment M. Renard gave the order to return, which was done, and the balloon reached its point of departure in 11 minutes, while the outward journey had occupied 47 min. The maximum height attained was 400 meters. The day following, the same voyage was repeated in the presence of the Minister of War and the President of the Committee of Fortifications. There appears little doubt that M. Renard's experiments, so far as they went, were a complete success. The Minister of War has ordered the construction of a much larger balloon, for conducting experiments on a more extensive scale; these will take place next year.

Glass Flooring.

The substitution of glass flooring for boards continues to increase in Paris, this being especially the case in those business structures in which the cellars are used as offices. At the bank of the Credit Lyonnais, the whole of the ground in front is paved with large squares of roughened glass embedded in a strong iron frame, and in the cellars beneath there is sufficient light, even on dull days, to enable clerks to work without gas. The large central hall at the offices of the Comptoir d'Escompte has also been provided with this kind of flooring; and, although its prime cost is considerably greater than that of boards, glass is in the long run far cheaper, owing to its almost unlimited durability.

ENGINEERING INVENTIONS.

A steam engine has been patented by Mr. Martin Burkley, of Moline, Ill. The cylinder has two diametrically opposite inlet and outlet openings at each end, with rocking valves on the ends of the cylinder fitted in pairs upon a common axis, which are operated from the working parts of the engine to alternately close the outlet and inlet openings, and make a simplified form of construction.

A fanning device for railway cars has been patented by Mr. Robert W. Macgowan, of New York city. It has an outside current or driving wheel and an inside fanning wheel on opposite ends of a shaft uniting the two, to be held in position by the closing of the window sash, and driven by the resistance encountered by the moving train, and thus introduce fresh and cool currents through the particular window to which it is applied.

A winch engine has been patented by Mr. Earle C. Bacon, of New York city. It is so constructed that any desired number of windlasses, each carrying a hoisting rope, can be set in motion by a train of gear wheels which derive their motion from a steam engine by suitable connections, and the windlasses can each be thrown separately in and out of gear, and held at any point with a suspended load without interfering with the movements of the other windlasses.

AGRICULTURAL INVENTIONS.

A hay rack has been patented by Mr. Joseph Grimes, of Perry, Ill. On the outer surfaces of the side pieces of the wagon box are pockets or loops for receiving the lower tapered ends of stakes on the ordinary extension boards, with other novel features, whereby the rack can easily be converted into a stock rack or box for vehicles.

MISCELLANEOUS INVENTIONS.

A hat stand has been patented by Mr. Joseph Mersman, of Delphos, Ohio. It is made of wires twisted to form a standard, having an arm and a ring at its upper end and legs with spring loops at the lower end, being simple in construction, but intended to be strong and durable.

A stencil holder has been patented by Mr. Augustus D. Klaber, of New York city. A frame is hinged on a board, and a clamping frame on the hinged frame to make a convenient device for holding a sheet of paper while stenciling and while impressions are being made.

A farm gate has been patented by Mr. William W. Sweetland, of Edwardsburg, Mich. This invention covers a novel construction and combination of parts, designed to afford a gate which can easily be opened from either side, and is automatically locked in position either when open or closed.

A rice huller and cuticle remover has been patented by Mr. John S. Moore, of New Orleans, La. It consists of a case with discharge doors and hopper, two parallel shafts with a right and left spiral flange each, and means for operating them, whereby the hulls will be removed from the rice kernels by friction.

A medical compound for the treatment of consumption and like diseases has been patented by Mr. Rufus G. Gish, of Redfield, Kan. It is made of bloodroot, dandelion, black cohosh, burdock root, spikenard, bittersweet, water, sweet yeast, and other ingredients, in certain proportions, prepared in a specified way.

An explosive compound has been patented by Mr. Milton F. Lindsley, of West Hoboken, N. J. It consists of nitro-cellulose, saltpeter, charcoal, chlorate of potash, starch, and carbonate of potash in certain specified proportions, mechanically mixed and prepared, to make a powder suitable for use in firearms of all descriptions.

A wire stretcher has been patented by Mr. George H. Brackman, of Lake Run, Pa. It consists of a clamping device with hinged arms carrying plates between which the wire to be stretched is placed and clamped, with other novel features, to facilitate stretching plain, barbed, or insulated wires, and holding them taut while splicing.

A draught equalizer has been patented by Mr. Albion Wheeler, of Ridgeway, Iowa. The evener is arranged to draw against a rocking yoke or clevis placed in its front, producing a shifting fulcrum that automatically equalizes the draught, the device being such that it may be used for equalizing the draught for any number of horses.

A flaxseed separator has been patented by Mr. George Adams, of Sherburne, Minn. It has an inclined frame and a vibrating frame with overlapping plates and guard plates, in connection with a hopper, and means of operating, whereby round seeds will be separated from the flaxseed and discharged beneath the machine.

A combined cooking stove and baking and warming oven has been patented by Mr. Fredrick Artmann, of Lexington, Miss. It has a baking and a warming oven, with flues above and between them, a flue below the warming oven, and three horizontal flues below the baking oven, with other novel features for economizing fuel and promoting efficiency.

A tapping machine has been patented by Mr. Victor H. Ernst, of Jersey City, N. J. Its construction is such that the pressure of the taps on the foot stock, when the machine is in operation, is received by the follower, which yields sufficiently to prevent the breaking of the taps, which is likely to occur when the action of the taps is met with a rigid resistance.

A gate has been patented by Mr. Thos. H. O'Reilly, of Canandaigua, N. Y. Its construction is such that by pulling a rope on either side an angle lever is made to raise the bolt, and release the gates, a further pulling swinging the gates in the direction from the person, the gates being closed by pulling a rope on the opposite side after the person has passed through.

A fastener for barrel heads has been patented by Mr. James W. Weston, of New York city. It consists of croze-shaped double legged permanent fastenings and removable brace head nails, made to act in conjunction with the permanent fastenings, to secure and support and brace the head or end of the barrel, its chine, and the outer end hoop.

A horse boot has been patented by Mr. Allen H. Tyson, of Lansdale, Pa. Between the outer leather facing and the inner fabric lining is a stiffening plate, preferably of metal, and of the desired form to correspond with the size and shape of the boot, to keep the latter in its original shape, so that the boot will keep its proper place when strapped to the animal.

A neck yoke coupling has been patented by Mr. Samuel Maneer, of Craigville, Ont., Canada. A collar or sleeve is fitted adjustably on the tongue, so that it may be moved along the tongue to suit the size of the draught animals, and this collar has an eye through which the bight of a chain held at one end to the neck yoke is passed, making a reliable and easily adjustable attachment.

A roller skate has been patented by Mr. James B. Harris, Jr., of Geneseo, N. Y. On the rear axle is carried a small additional roller suspended behind, which, by raising the toe of the skate, is brought into contact with the floor, either to guide the movement or apply the brakes, but this roller may be adjusted to bear on the floor for aiding beginners, and the brake may be applied to either the toe or heel of the skate.

A device for moulding brick has been patented by Mr. Silas Wright, of Washington, Middlesex Co., N. J. The base frame has a frame hinged at one end to and movable toward and from the base frame, with cutters on the lower side of the hinged frame, and a moulding box fitted therein, the device being also susceptible of adjustment to make keystone and beveled brick, etc.

A lifting jack has been patented by Mr. Emanuel Nordyke, of Heppner, Oregon. Its construction is such that the center piston of the jack is raised during one stroke of the hand lever, and is automatically held from falling back during the reverse movement of the lever, and the self-sustaining clutch is thrown out of action and the center piston allowed to slide back when required.

A hose coupling has been patented by Messrs. Frank Atherton and Manton T. Bentley, of Paterson, N. J. It is so made that when the ends of two tubes are brought together only two movements are necessary in fastening the coupling, an outward movement of a sleeve to bring it over the joint between the tubes, and a rotary movement of the sleeve to bring the lugs of the two tubes into slots of the sleeve.

A breast strap hook has been patented by Mr. Walter D. Drake, of Santa Fe, Mo. It is pivoted to the breast strap slide or guard, and has a retaining ring for locking the ring of the neck yoke in the hook, the retaining ring having a loop to receive the holdback strap of the harness, the device being calculated to facilitate the work of attaching the neck yoke to and detaching it from the breast strap.

An excavator has been patented by Mr. Cyrus Howard, of Pittsburg, Pa. This invention covers an improvement on a former patented invention of the same inventor, its object being to shear off slices of earth as a plowshare does, to move the earth from the path of the machine to one side, and to throw it to a distance therefrom.

A snow plow has also been patented by the above inventor. It is designed to clear snow from railways, throwing it to one side on levels and in cuts, first removing it from the road bed and then compacting it at the sides, to form inclines down which the snow may slide, in order more conveniently to receive the snow into open cars, and removing it by withdrawing the cars from the cut and dumping at any convenient point.

NEW BOOKS AND PUBLICATIONS.

A TREATISE ON THE MANUFACTURE OF SOAP AND CANDLES, LUBRICANTS, AND GLYCERIN. By William Lant Carpenter. London: E. & F. N. Spon, 1885.

Much of the material comprised in this treatise has appeared before in others of the Messrs. Spons' publications, but in its present form all of the subject matter has been carefully revised and brought down to date. Mr. Carpenter was for several years practically engaged in the industries of which he treats, and has therefore the advantage of both theoretical and experimental knowledge. The manufacture of these commodities is essentially a chemical operation, and the successful manufacturer must needs be something of a chemist. In describing the underlying principles, the sources of the raw materials and the subsequent processes by which they are utilized in these different products, the author assumes that his readers have such a chemical foundation. Treated in this spirit, these processes of manufacture are at once removed from the blind following of cook book recipes to the higher level of an applied science. With the *rationale* of the matter in mind, the manufacturer can select better materials, prepare them more effectively, and consequently turn out more valuable products. He will find the study of this volume much to his advantage, even if he must prepare himself for it by a preliminary course in chemistry. Sketches of apparatus illustrate the text where necessary.

AN IRON CROWN. A novel tale of the Great Republic. Chicago: T. S. Denison.

In this anonymous novel, an attempt is made to picture in alarming colors the dangers which menace a free government from the amassing of immense wealth in the hands of a single individual or in the still less governable hands of a powerful corporation.

The *Technique* is the title of the first annual issued by the students of the Massachusetts Institute of Technology. It is an exquisitely printed book of 150 pages, containing useful and interesting information for students and their friends, and shows very creditable work on the part of the class of '87.

Among the many calendars which business houses exercise their taste and energy in getting out the first of the year, we notice one of Messrs. Styles & Cash, New York stationers, as showing beautiful work in a clock face form, a removable dial for each month, the twelve tablets mounted on a brilliantly colored card. Another one, by the American Bank Note Company, gives the twelve months in exquisitely colored and shaded divisions, each month being different from every other, and the whole work printed in the most perfect manner. Of statistical calendars, perhaps one issued by Messrs. Palen, Nelson & Co., New York leather brokers, is the most complete. Accompanying each month's calendar are the prices of leather and hides for the corresponding month of four preceding years, and there are tables showing our exports of sole leather and receipts of foreign hides for many years.

Received.

A LUCKY WAIF. Novel. By Ellen E. Kenyon. New York: Fowler & Wells Co., 1885.

Business and Personal.

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

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest, cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Minerals sent for examination should be distinctly marked or labeled.

(1) J. M. K. asks what kind of cement to use in fastening together the ends of leather belting. A. Use the best and toughest white glue.

(2) E. A. A. asks: Is there such a thing as an iron railroad tie? If there is, why is it not in general use? A. Various forms of iron ties have been invented, and they are extensively used in countries like India, where wood is very dear. In this country wood is cheaper; hence iron ties are little used.

(3) C. H. asks how to make an electric coil used in electrical medical apparatus. A. Make a thin wooden spool 3½ inches long, and ½ in. diameter; wind the spool with 4 layers of No. 24 wire; surround these layers of wire with two thicknesses of writing paper covered with shellac varnish, and upon this wind 8 to 12 layers of No. 36 silk covered copper wire. This will form your coil. Connect the ends of your coarse wire with your interrupter and battery; connect the ends of your fine wire with handles. Make a bundle of annealed wire to fit loosely in the hole of the spool, so that you can withdraw it and insert it to vary the strength of the shock.

(4) M. R. A. asks: How can I put a high polish on a piece of walnut and preserve the natural color? A. If the piece of walnut is small, you can put a high polish on it by rubbing with a mixture of equal parts of shellac varnish and boiled linseed oil. If the piece is large, this would be a laborious process of securing a polish. It would be better to give the article several coats of varnish, rubbing each coat down by means of pumice stone and water; and finally applying a flowing coat of fine, hard drying varnish. If this does not produce the finish required, you can rub the last coat down with fine pumice stone and finish it with rotten stone.

(5) B. F. B. asks what printers' ink is made of. A. A varnish composed of linseed oil, resin, and soap, and the pigment; in the case of black ink, lampblack and indigo with Prussian blue.

(6) W. B. R. asks if there is anything that can be used to refinish japanned iron and marble, which has got dull and faded by standing in the sunlight. A. By rubbing down with French polish you may improve the appearance of japanned work that has become dull. Polishing with a paste of oxide of tin and water on a buff or rubber of cloth or soft leather will bring out the gloss, if there is no oil on the japan.

(7) T. B. W. asks how phenol sodique is made. A. It is made of carbolic acid 1·177 per cent, soda salts, water, and impurities 98·823 per cent.

(8) C. M. W. asks (1) the difference between a yard square, a square yard, and a cubic yard. A. The first two are the same, and are measures of surface; the second is a measure of volume. 2. Will common black powder, if placed in a vacuum or in something where air is excluded, explode when a spark is applied? A. It will not.

(9) E. C. T. asks a practical method by which a right lined quadrilateral figure or square may be reduced to one-half its area, preserving its relative proportions. A. The areas of similar rectangles are to each other as the squares of the sides.

(10) J. A. G. asks how to make orange water. A. Orange flower water is the product obtained by distilling 10 pounds of orange flowers with 7 fluid ounces of proof spirit. You will find directions for the preparation of similar compounds in the U. S. Dispensatory.

(11) J. R. T. asks: How can I mix a body of plaster of Paris, say 24 inches square, for the life size bust of a man, so that there will be no air holes in it when it is cut? I had one cast, but when cut, it was full of small pin holes. I would like to get one perfectly smooth and hard, so that when it is carved the tools will leave it clear of these holes. A. The process for taking a plaster cast is as follows, some of the details of which you have probably ignored: The person must lie on his back, and his hair be tied behind; into each nostril put a conical piece of paper, open at each end to allow of breathing. The face is to be lightly oiled over, and the plaster, being properly prepared, is to be poured over the face, taking particular care that the eyes are shut, till it is a quarter of an inch thick. In a few minutes, the plaster can be removed. In this mould, coated with paraffine, a second cast is to be taken, that will furnish casts exactly like the original. To avoid pin holes, pour the plaster very thin and agitate till it forms.

(12) P. B. asks: How is pool and billiard chalk made, and of what is it composed? A. The chalk referred to is dug from the ground, carefully selected, and cut in the shape generally used. It is imported almost entirely from France.

(13) E. B. R. and H. S. (1) a recipe for ebonizing wood. A. See answer to query 11, SCIENTIFIC AMERICAN of July 11. 2. One for destroying smell from a goat skin rug, cured with hair on. A. Hold the skin over a fire of red cedar boughs and sprinkle with chloride of lime; or wrap them in green hemlock boughs, when they are to be had, and in 24 hours they will be deodorized.

(14) F. S. asks the ingredients, proportion, and process of making liquid stove polish. A. Black lead pulverized 1 pound, turpentine 1 gill, water 1 gill, sugar 1 ounce, grind together.

(15) G. M. asks: What mineral would be nearest in color and appearance to potato starch? A. Ground limestone or barytes would resemble starch as closely as any mineral will. The greater specific gravity of the mineral makes the difference plain in every case.

(16) J. M. asks: What will remove varnish from furniture without removing the stain, or color it? A. Turpentine, benzine, alcohol, ether, etc., will remove varnish, but attack the stain also, if it be soluble in these liquids. The only way, always practicable, is to carefully scrape off the varnish.

(17) F. W. S. asks how to make a glue for gluing a musical instrument. A. The great point in this operation is, first, to remove all of the old glue from the parts to be joined, then warm the part to be attached very thoroughly, and a good carpenters' glue can readily be used.

(18) C. A. B. asks: What is put into water to assist in producing a tone, when tumblers are filled and the fingers moistened and drawn across the edge, ~~produce such lovely strains~~? A. Nothing but pure water is used. The different notes are produced by filling different tumblers with varying amounts of liquid.

(19) W. M. R. asks (1) how to set a common slide valve in stationary, locomotive, and marine engines. A. For an excellent practical treatise on the setting of slide valves, see SCIENTIFIC AMERICAN SUPPLEMENT, No. 13. 2. A rule for calculating the safe working pressure of steam boilers, when you have the dimensions given? A. Divide the minimum tensile strength of boiler plate (40,000 pounds) by 4 for safe load, and again by 2 for single riveted seams or 1·66 for double riveted seams. Multiply this product by the thickness of the plate in decimals of an inch—0·25 for ¼ in. iron or 0·31 for five-sixteenths inch iron. Divide this sum by half the diameter of the boiler in inches for the safe working pressure. If the boiler shell is all steel, use 60,000 pounds for tensile strength.

(20) J. M. writes: Would like to know how to make a spoiled home-made blackberry brandy good. Two buckets of blackberries were boiled slowly for one hour, then squeezed through a rag, the juice put into a jar with ¼ gallon of brandy and allowed to stand about two months, after which time another ½ gallon of brandy and 4 pounds of dissolved sugar were added, and now it tastes sour. A. Your process of preparation was not correct. The fermentation has yielded an excess of acid, which can be remedied by the addition of some potassium bicarbonate, a substance in itself perfectly harmless.

(21) L. A. O. asks: 1. What will prevent the hair from falling out? What will strengthen the hair so it won't snap and break, when it is combed at all briskly? A. See "Loss of Hair," etc., contained in SCIENTIFIC AMERICAN SUPPLEMENT, No. 173. 2. What will stimulate the growth of the eyelashes? A. Cologne 2 ounces, liquid hartshorn 1 drachm, tincture cantharides 2 drachms, oil rosemary 12 drops, lavender 12 drops. 3. What will effectually and easily remove an objectionable crop of hair from a lady's arms, so that it won't grow in again? A. Use some depilatory; as, for instance, a strong solution of barium sulphide, made into a paste with powdered starch. It should be applied immediately after it is mixed, and allowed to remain there for 5 or 10 minutes.

(22) A. F. O. writes: I have a complete human skeleton, just from the caldron of the medical college, which I desire to bleach. To 4 gallons of water I added ½ pound of chloride of lime and ½ pound of washing soda—the latter to cut the grease and give the chlorine a chance. I kept the bones in this solution for four days, but the results are not satisfactory. What can I do without resorting to the slow process of rain and sunlight? A. Your error is in thinking that the work can be done speedily. It is impossible to extract the oily material from the bones except by a very slow process. Boiling in any amount of alkali, say your washing soda, will not accomplish it, and all the oil must be absolutely removed before you can do anything toward the bleaching. Very long maceration in water alone or in soda and water will eventually effect it, but a much better material is benzine. Make a tin box into which you can pack your skeleton, solder on the cover, leaving only a round hole for filling. Pour in benzine till the box is filled, stop the hole closely, and leave it undisturbed for three months. Your skeleton will come out clean, and can be bleached perfectly by sunlight. Chlorine will do the bleaching quicker, but it injures the bones; never use it. Any shorter process will give you a skeleton which will be always nasty.

(23) F. C. asks: 1. What is the difference or distinction, if any, between cotton wool, absorptive cotton, cotton batting, etc.? A. The absorptive cotton is a specially prepared compound, which, in consequence of its treatment with different chemicals, has its oily constituents entirely removed, and hence is more absorbent than the common cotton batting. 2. Is there any real value in the widely advertised electric bands, belts, pads, brushes, etc.? A. Those who employ them claim to be benefited by their use. 3. Could not a person construct one for himself that would be nearly as serviceable? And if so, how should it be constructed to give the best results? A. It will be found in nearly every instance much more economical to purchase out and out an article of this description than to attempt to make one. Moreover, they are patented.

(24) A. J. G. writes: I have a quantity of red wine vinegar which I am anxious to settle; it is rather muddy. A. Take 2 quarts of ground horse radish and 1 pound of thick gray filtering paper to the barrel, and either shake or stir until the paper has separated into small shreds and let it stand for 24 hours, when the cider may be drawn off by means of a siphon or a stop cock. Instead of paper, a preparation of wool may be taken, and is preferable to paper, as it has simply to be washed with water, when it may be used again.

(25) F. B. S.—The exact period of the building of Jerusalem is not definitely proved. The hill of Zion was a mountain fortress there about 400 years before it was captured by King David, about 1046 B.C., and made the seat of his government.– Fence posts are raised by the frost in the ground, but less in sandy loose soils than in hard pan or clay soils. Have known posts to be raised enough to allow the fence to overturn, on the prairies.

(26) J. H. A. asks: What is the cause of putty losing its color and turning white in the joints of bricks? A. Venetian red contains but a slight amount of oxide of iron, so that the putty made from such a pigment is not likely to contain over 5 per cent of the coloring matter. Good putty made with chemically pure oxide of iron will not lose its color. There is no destruction of coloring matter, simply the putty, unless properly made, does not contain sufficient pigment.

(27) J. J. R. writes: I have a large tank (circular) which I wish to coat with something before I let in the water. Material, white pine. What can I use to keep the water from penetrating the wood and that will not injure the water for family use? A. We know of nothing better for painting wooden tanks than Prince's metallic paint (red oxide of iron) and boiled linseed oil, 2 good coats, first well dried before the second is put on. The best coating for a wooden tank for drinking water is paraffine, which can be put on the wood with a warm iron, such as a sad iron or tailor's goose, heated about 250°.

(28) F. J. W.—Arsenic is put in lead shot to facilitate the process of finishing. It makes the shot slightly poisonous. Game that has been kept for a time with much shot in it might be poisonous from both lead and arsenic. You will find excellent articles on the various kinds of explosives in SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 406, 407, 342, 127.

(29) J. T. B.—There will be very little difference in your house with a 4 inch air space and a 1 inch air space, as to warmth or dryness. A 2 inch space is preferable. Your 4 inch outside wall is very objectionable; it has no stability of itself, and the means of tying it to the terra cotta lining is limited and not reliable. A cheaper and better way is to build your house with substantial walls, 8 inches or 12 inches thick, according to size and height, and fur off the outer walls and lath and plaster.

(30) A. R. writes: 1. We have a theater, field, and marine glass, combined. The marine eye pieces do not register, that is, we see two images, yet each eye piece, when used alone, gives clear and sharp views; how should this be rectified? A. The axes of the glasses are not parallel. Try twisting the glasses one way or the other. Any good instrument maker will tell you what to do, or will correct it at trifling cost. 2. The best means of bleaching a sail, which is good, but dirty. A. Use a solution of chloride of lime in water, in which the sail may be immersed for a short time and then thoroughly washed and dried in the sun. This will whiten it. 3. We have labels printed in blue that we want to reproduce by photo lithography; can it be done successfully? A. Not in any satisfactory way; you can reproduce a blue label by the wax process, but for any other reproduction it must be redrawn.

(31) C. B. B. asks: 1. What diameter shafting should be used to transmit eight horse power from a high speed steam engine, shafting to be in one line thirty feet long, and to carry about twelve pulleys, engine connected near one end? A. With 100 to 125 revolutions, 2¼ inches diameter; 150 to 200 revolutions, 2 inches diameter; 200 to 300 revolutions, 1¾ inches diameter. 2. How many hangers should be used? A. Four hangers. 3. Which works and wears the best for the above description of engine—the vertical or horizontal type of engine and boiler? A. The horizontal engine of moderate speed gives the most satisfactory result in wear. As well also the horizontal tubular boiler, set in brickwork. 4. Mention a good work on the steam engine, treating more particularly on the management and care of the steam engine, and taking of indicator cards, etc., also rules for calculating sizes of belts and shafting, to transmit different horse powers. A. "Steam for the Student or Cadet Engineer," by Long & Buel, $2.25; "Engineer's Guide," by Edwards, $2.50; Le Van, "The Steam Engine Indicator," 50 cents; Cooper, on Belting, $3.50; which we can send on receipt of price.

(32) W. R. B.—You cannot obtain a general license in New York city. Only a license to run the boiler of parties that you are engaged with. You have to go before the sanitary police boiler inspector. We recommend to you for study, Roper's "Questions and Answers for Engineers," $3.00.

(33) B. A. W.—For falling bodies: The velocity in feet per second$=\sqrt{S \times 2g}$. S=space fallen through; $2g$=twice gravity, or 64·33. Velocity in feet per second × weight= force in foot pounds. The dynamical effect of impact on solid heavy bodies is found to be over four times the above by experiment. The air slightly retards bodies falling by gravity, in inverse ratio to their density. See Haswell's "Engineer's Pocket Book"—gravitation, impact, and pile driving.

(34) W. R.—It has been found that the oil from the cod's liver contains iodine, bromine, chlorine, acetic acid, phosphoric acid, and other constituents which make it a valuable remedy for those who need a fattening and nourishing compound. Its constituents are determined by various chemical tests.

(35) R. W. S. asks the simplest way of making lard oil. A. The process is simple, yet requires expensive machinery for any considerable product: Steam for clarifying in kettles with coils of iron pipe; wood or iron vats, with stirring machinery, for bleaching the lard product; and screw or hydraulic presses in a cold room for separating the oil from the stearine. The cold lard is placed in sacks, which are laid between iron plates under a press, when by gentle and increasing pressure the oil separates from the stearine and oozes through the bags. The room is cooled by ice or any other available means.

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

R. H. L.—The specimen is a variety of slate. It has no value in New York, but, ground to a fine powder and mixed with oil, you could manufacture an excellent paint, which could be sold in your vicinity.

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January 5, 1886,

AND EACH BEARING THAT DATE.

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