SCIENTIFIC AMERICAN

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AMERICAN INDUSTRIES.—No. 10.

SEWING MACHINES.

In pursuance of our purpose of illustrating and giving some account of important American industries, we have reached a department of the mechanic arts pre-eminently American in its origin and development.

Thirty years ago there was not a thoroughly practical sewing machine in existence; whether such a thing was possible was an unsettled question; how to sew successfully by machinery, if possible, was a problem for the solution of which American genius was projecting and experimenting in various directions. To-day all the markets of the civilized world are supplied, we might say glutted, with an almost endless variety of sewing machines, and almost every conceivable kind of stitching on every species of material that may be sewed is done by machinery. That family is poor indeed that cannot afford one of these most effective of labor-saving machines, and that family must be rich that can afford to do without one.

Let those who ascribe the privations and sufferings of the poor to the baneful effects of labor-saving machinery consider the tens or scores who now earn a comfortable livelihood with this admirable instrument, where formerly one with unremitting toil gained a scanty subsistence by plying the hand needle.

The approved form of machine stitch for general purposes is the so-called lock stitch, formed by the interlocking of two threads, which is accomplished by means either of a shuttle or of a rotary hook. Hence arise the two leading systems of sewing machines.

Happily it does not devolve upon us to decide the question of the relative merits of these systems, or of the particular forms of machines put forth by different manufacturers. We have the highest appreciation of the efforts of all who have effectively worked for the development of this useful art; whether of Elias Howe modifying old devices and applying them to the accomplishment of new purposes, or of A. B. Wilson discarding the shuttle and whittling the model of a thoroughly original, ingenious, and effective substitute therefor from the end of a broomstick. We have chosen to present our readers with some illustrations of the works of the Wheeler & Wilson Manufacturing Company.

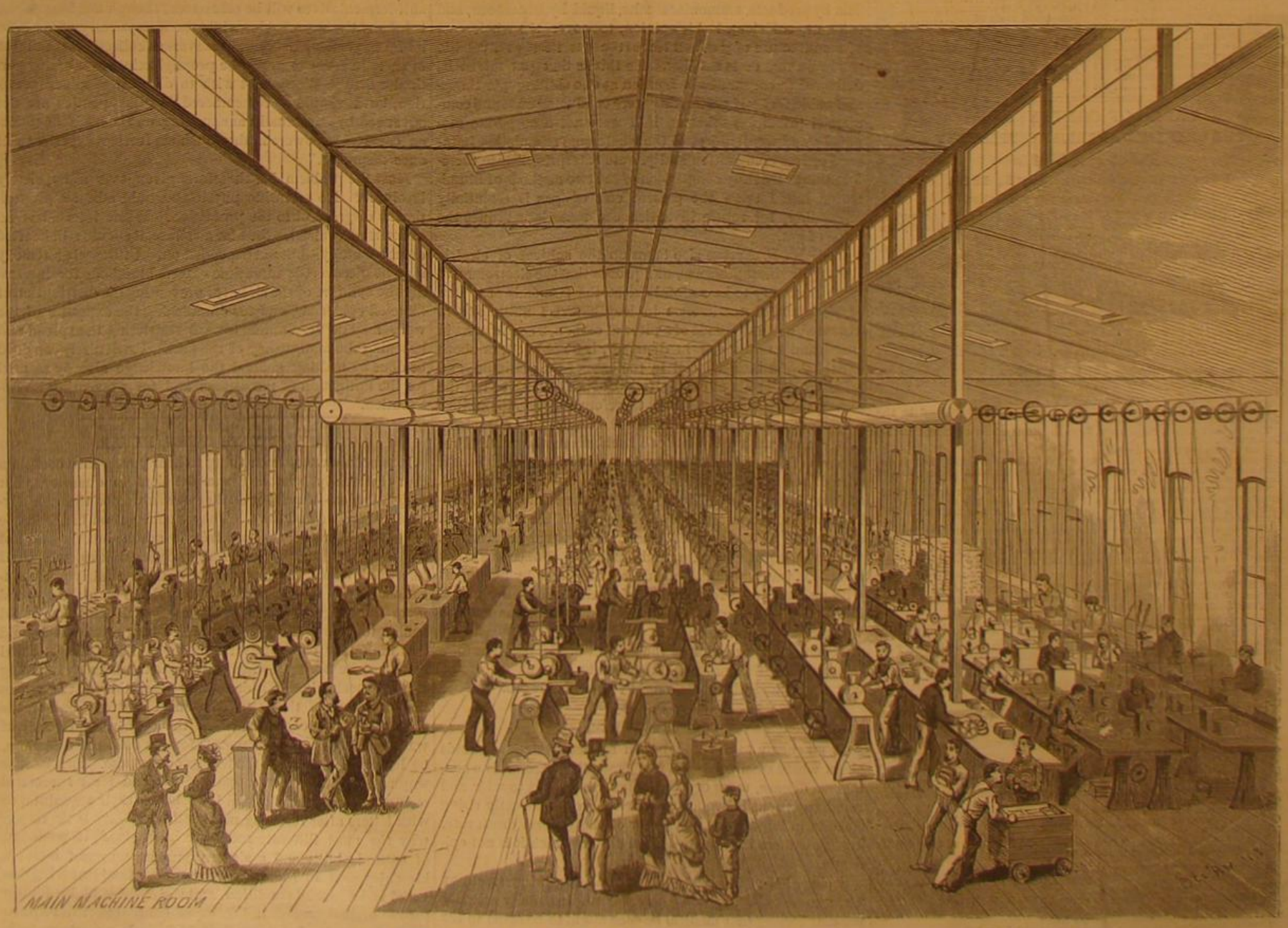
PUNCHING THE NEEDLE EYES

Without going into the history of this concern, we might say of those from whom it derives its name, that A. B. Wilson, by the original inventions of the rotary hook and four-motion feed (to say nothing of his admirable complete machines), placed himself in the foremost rank of inventors and achieved enduring fame; Nathaniel Wheeler, who for about twenty-five years has been the president of the company, by his sound practical sense and administrative ability, as well as by his knowledge of mechanics and practical skill in mechanical operations, has been the chief developer and organizer of an immense and successful industry.

The works of this company are situated in the thriving city of Bridgeport, in the State of Connecticut. The principal buildings consist of the main factory for metal working, assembling, testing, etc., occupying one complete square, 368x307 feet, under one roof; a woodworking factory, covering a second square, 526x219 feet; a foundry and needle [illegible] upon a third, 368x232 feet; the works altogether covering over seven acres of ground. To illustrate and describe the whole would require a large volume. Our artist has made sketches of a few rooms and interesting operations.

The main machinery room is that in which the principal mechanical operations are performed in the production of the metal parts of the sewing machines. This fireproof room is L-shaped, 300 feet in length, 210 feet in width in one part, and 100 feet in

[*Continued on page* 274.]



MAIN MACHINE ROOM

WHEELER & WILSON SEWING MACHINE MANUFACTORY.

Scientific American.

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VOL. XL., No. 18. [NEW SERIES.] *Thirty-fifth Year.*

NEW YORK, SATURDAY, MAY 3, 1879.

Contents.

(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT
No. 174,
For the Week ending May 3, 1879.

Price 10 cents. For sale by all newsdealers.

PROGRESS OF ELECTRIC LIGHTING.

While the sensational reports in regard to electric illumination have subsided, the electric light is making friends in various quarters. The Waltham Bleachery, Mass., have been using two generators of the Wallace-Farmer pattern. Ten lights supply 112 four foot gas burners. The generators require twelve horse power apiece, and the horse power is estimated at one cent per horse power per hour. It is stated that the quality of the light is good; no complaint is made of its flickering. Washburn & Moen, of Worcester, Mass., use the Brush electric light to a limited extent, lighting but a portion of one of their works. They state that they get much more light than from gas for an equal expenditure of money. No accurate experiments, however, have been made.

The Riverside Mills, of Providence, R. I., employ two Brush generators. One machine has been running about two months in a weaving room, and part of the rest of the mill has also been lighted by electricity. These mills run night and day, and use a large number of gas burners from 10 to 12 hours per day, and therefore are peculiarly well fitted for the employment of the new light. Twenty electric lamps have taken the place of 230 five foot burners ina weaving room, and give a better and more satisfactory light. The work requires an unusually strong illumination.

The lighting of the Boston Music Hall by electricity has been postponed until a larger machine of the Brush pattern can be completed. In the preliminary trials it was found that the light would be unpleasant to a general audience, and it is therefore proposed to modify its color and brightness by the employment of suitable glass or porcelain shades.

W. Mattieu Williams, F.R.A.S., in a recent paper gives an interesting resume of early English experiments on incandescence, particularly those by a Mr. Starr. The latter devised a peculiar method of winding the conductors of a dynamo-electric machine. Since the thick copper wire, usually made use of, necessarily is wound on the armatures in a spiral, there is a certain loss of compactness and an increase in resistance, which Mr. Starr proposed to obviate by using a core of square section, and winding around it broad ribbons of sheet copper, which were insulated by cementing on its surfaces a layer of silk ribbon. This ribbon is to be laid with one edge against one side of the core and carried on until the angle, then it is to be turned over so that its opposite edge may be laid along the next side of the core, and so on. It seems as if this method of winding dynamo-electric machines would have certain obvious advantages. The experiments of Starr, however, on lighting by incandescence did not result in much success, and they were unfortunately brought to an end by the untimely death of the inventor. Prof. Williams, who has devoted much attention to the manufacture of gas, believes that there is a greater field for invention in gas manufacture than in the field of electric illumination. The by products, ammoniacal salts, liquid hydrocarbons, and coke, are sufficient, in his opinion, to cover the whole cost of manufacture of gas, and leave the gas itself as a volatile residuum that costs nothing. He thinks that gas might be delivered to consumers in London at one shilling per thousand cubic feet "if gas making were conducted on sound commercial principles—that is, if it were not a corporate monopoly, and were subject to the wholesome stimulating influence of free competition and private enterprise." He therefore thinks that any comparison of the two methods of illumination based upon the present cost of gas is essentially misleading, for future invention can materially reduce the price of gas.

Prof. W. E. Ayrton also takes up the subject of electric lighting by incandescence, and proves that the electromotive force necessary to be maintained at the two ends of a wire of platinum, 5 centimeters in length and 1 millimeter in diameter, and at the ends of a piece of carbon, 2 centimeters in length and 1 millimeter in diameter, is 0·2848 volt, or about one-third of a Daniell's cell in the case of the platinum, and 0·46013 volt, or about one half that of a Daniell's cell in the case of the carbon wire. It is, therefore, possible to produce a light with an electromotive force less than that of a Daniell's cell, but not with a Daniell cell itself, since the internal resistance of the cell is far greater than that of the incandescent wire or rod of carbon. He was enabled to use the method of incandescence in 1873, when the government was employing divers to recover the property sunk in the French mail steamer Nil off the coast of Japan. An ordinary carbon rod was first scraped very thin, and then, with connecting wires affixed, it was placed in a vacuum globe; and by heating it with an electric current, and passing air through the globe, it was burnt to the required degree of thinness; the current was then stopped and the air pumped out and replaced by nitrogen. The agitation of the subject of electric illumination certainly will provoke inquiry into the subject of the cost of gas, and, therefore, ought to be encouraged.

SCARLET FEVER.

As an enemy to life and health scarlet fever now stands about where smallpox did a few generations ago. It is a contagious disease, more or less malignant, subject to wide and rapid variations in scope and severity, yet apparently rising steadily in importance as a factor of the general death rate. Just now there is scarcely a large city in which it is not epidemic.

Seeing that medical skill has been able to bring smallpox under practical subjection, there has very naturally arisen a popular feeling that medical science ought to be equal to the task of discovering a means for preventing scarlet fever, at least as efficient as vaccination has proved in the case of smallpox; and when this expectation has been unreasonably encouraged by the confident assertions of over-sanguine practitioners and theorists, that this, that, or the other drug may be counted on as a sure and trustworthy means for securing immunity from the scarlet fever, it is not surprising that people are disappointed by the failure of the medical profession to arrest the spread of the disease, now the most destructive of all the infectious diseases.

That the failure has not arisen from lack of effort on the part of the profession, medical literature abundantly testifies. That final success is not impossible no one would have the presumption to assert, though the prospects of immediate success are far from bright. The cause of the disease is as little understood as its cure. The microscope is as helpless as the telescope to detect the contagious principle, and no means for destroying it has been discovered, except a temperature higher than any patient can endure.

Inoculation seems to be almost universally attended with unfavorable results. Belladonna, so long insisted on as a prophylactic, fails to justify its reputation; and the long list of anti-fermentatives and similar remedies offers nothing that the experienced practitioner can resort to with any confidence in its efficacy.

"Indeed," says the editor of the *Medical Record*, "the logic which leads to the administration of any known anti-fermentative as a prophylactic has too unstable a ground to deserve much respect. In the first place, the question of what is the contagious principle of scarlatina has not yet got beyond the domain of probabilities. We can say, with much positiveness, to be sure, that it is no visible form of bacterium or micrococcus, and we can, perhaps, infer from analogy that it is a particulate something too small to be detected by the microscope, that it is albuminoid in composition, and multiplies at the expense of physiological processes. Whether it is living or dead, whether it is the degenerated protoplasm of man or the modified protoplasm of vegetable, whether it acts in conjunction with bacteria or feeds directly upon the tissues, all these questions are much beyond the pathologist as yet. But, in any case, it is very hard to see how anti-fermentatives can reach this virus. If it is dead, we certainly need not give such drugs to kill it; if it is living, there is no evidence or probability that the system can be so saturated as to destroy such infecting protoplasm and not the living matter of the tissues at the same time. In the blood of persons deafened with quinine or salicylic acid the bacterium disports himself with as much activity as elsewhere, and the amœboid movement of the white blood corpuscles can still be easily seen. It is a fact, to be sure, that there are drugs, like quinine, which affect the size and internal movements of the blood globules, but we cannot infer from this that there are prophylactic germicides, which will not prove to be homicides at the same time. The idea, then, we repeat, that anti-fermentatives will be efficacious, though not impossible, is inherently improbable, while the idiosyncrasy of the scarlet fever poison will oblige observers to collect a vast number of cases in order to prove the prophylactic power of any particular drug. We do not wish to discourage experimentation, but it should be remembered that therapeutics are not advanced by continually announcing on the basis of a dozen cases new powers in drugs which further experience at once disproves."

Must the problem be, therefore, given over as hopelessly insoluble? No scientific physician would admit a proposition so disgraceful to the profession. While internal medication is recognized as thus far a failure, it should still be tried experimentally—but not depended on. Ultimately a remedy may be discovered; meantime external methods for increasing the comfort of the sick, for preventing the distribution of infected epidermis, and for diminishing the exposure of the well, may do very much toward restricting the spread and lessening the malignancy of the pest. Particularly can good be done by making general the knowledge already assured for the mitigation of the disease and for preventing its distribution.

BETTER LATE THAN NEVER.

It is not an uncommon thing to hear young men complain that their early schooling was deficient in quantity, poor in quality, or—if neither of these—was wasted through boyish indifference and folly. They would get on better in life if they knew more, they are free to admit, but they do not see that they are daily wasting opportunities which, if improved, would in a few years give them a fairly good education. They think themselves too old to learn, and spend more time regretting their lack of knowledge than would suffice to give them the knowledge they need. It is said that the father of Professor Sumner, of Yale College, could neither write nor read when he came to this country, a young English mechanic. Within twenty years thereafter he was known as one of the best read men in Hartford, one of the most cultivated communities in the country. Instead of wasting his time in idle regrets for his deficient schooling, he learned to read, and read to good purpose. In a similar way many of the best, most honored, and most successful men our country has known have begun their acquaintance with letters after reaching manhood; and there is no reason why the most illiterate mechanic in our land, if possessed of natural ability and a sincere purpose, may not increase his enjoyment in life, his opportunities for improving his social and financial condition, and the chances of his family for the highest success in life, by an honest effort to retrieve by study the disadvantages by which early poverty or lack of educational opportunities has surrounded him.

MUSEUMS OF EUROPE.—METROPOLITAN MUSEUM OF ART.

As educators of the people the public museums of Europe perform no insignificant service. The artist and the artisan are not only allowed free access to such picture galleries and museums, but are encouraged to study and copy from the beautiful objects of art there exhibited.

Societies under various names, and patronized by the opulant and learned, and often supported in part by the government, award prizes for superior workmanship to those who copy or improve upon the original designs.

We read in a London contemporary that the new Sèvres Museum is doing its utmost to afford valuable instruction to those interested in studying the history and the progress of ceramic art. During the last few months a methodical classification of all the examples exhibited has been accomplished, and each one is classed according to its historical and geographical position as well as with regard to its technical worth. For this purpose labels are attached to all the pieces, giving the date and place of manufacture and the marks on various pieces, so that a wide knowledge can often be gained of a subject merely from studying these labels, 4,000 of which have lately been affixed. It is to be wished, says the same paper, that South Kensington could be made equally instructive in the way of ceramic labels.

Pity it is that our new Metropolitan Museum of Art is situated so far from the heart of this city as to render it almost unavailable to strangers, and to that class of residents who much appreciate its treasures, and who would derive the most benefit from frequently visiting it. But its inconvenient location in a hollow at the upper side of the Central Park is not the worst feature. The building itself is so lacking of architectural beauty—is such a monstrosity in design—that the visitor is almost repelled from entering after reaching it. Certainly but a fraction of the number who visited the Metropolitan Museum of Art when it was located in Fourteenth street will pay it a visit in its present out-of-the way position.

BARFF'S NEW PROCESS FOR PRESERVING IRON.

Professor Barff lately gave a lecture in London on the results obtained by his new process since its first announcement, about two years ago, an account of which was then published in the SCIENTIFIC AMERICAN.

The process consists, in brief, in subjecting the surface of the iron to the action of superheated steam at a high temperature. The result is the production upon the surface of the iron of a hard, smooth, and durable skin of black oxide of iron, which prevents rust far better than any paint, lacquer, rubber, or other compound or process heretofore known.

Iron articles to be treated by this new process are first cleaned with dilute sulphuric acid, and afterward with bran water. They are then placed within a muffle, the temperature of which is 500° or 600° Fah.; dry superheated steam at a temperature of 1,000° Fah. is admitted, atmospheric air being carefully excluded. The formation of the black oxide skin rapidly takes place.

This coating has peculiar properties. It is so hard that it resists emery powder and the file. Many substances which adhere to ordinary iron will not stick to this prepared iron. For cookery the new process is especially useful. Barff stew pans and other utensils are more cleanly, as arrowroot and other substances can be cooked in them and the vessel cleaned with great ease. Barff vessels can be heated red hot without injuring the skin. Barffed iron is proof against damp, water, hot or cold, and stands exposure to the weather far better than galvanized or painted iron. Barffed boiler and ship plates, whether of iron or steel, are superior to all others, as they do not corrode and sediment does not readily adhere. The process is applicable to almost every conceivable form of iron manufacture, and appears to be a scientific, important, and valuable contribution to the industrial wants of the world.

Professor Barff's interesting lecture is given in full in the current issue of our SUPPLEMENT, No. 174. See table of contents in another column.

VERMONT MARBLE.

Prof. J. P. Henderson, of Loyola College, Baltimore, Prof. J. E. Watson, of Oberlin College, Ohio, and some students of mineralogy, have been testing the capacity of Vermont and other marbles and other monumental stones to withstand the corroding influences of our climate. The results appear in a long letter from Prof. Henderson to the Nashua (N. H.) *Gazette*. Their first examination was of granite, of which 382 different specimens were tested. While the most of these were composed of such material as would wear tolerably well in the open air, nearly every piece showed a lack of ability to withstand long exposure to rough weather.

Marble was then tried, and as Vermont and Italian marbles are most used for out-door monuments, attention was given chiefly to these. The principal quarries of Vermont are the West Rutland, Sutherland Falls, East Dorset, Pittsford, and Columbian. In point of durability, the West Rutland marble was found to take the precedence, and the others followed in the order of their names. They found also that our native Vermont marbles are better adapted to stand our climate than the Italian, which is rapidly going out of use, and will most likely disappear entirely for outside work.

Prof. Henderson says: "The depth of most Vermont quarries now is such that better marble is obtainable than was produced by them three years ago. Hence our verdict, as rendered by the above course of research and reasoning, is, don't select as stock for cemetery work marble of a dark or bluish cast, but, rather, select the light color with greenish cloud."

The Gary Motor

To the Editor of the Scientific American:

In your issue of April 5, page 209, you publish a letter from me and make the following remarks: "None of the experiments here mentioned by Mr. Gary are new; there is no neutral line in any such sense as he asserts; what he above especially claims as his discovery is simply a very old, well known phenomenon imperfectly and erroneously alluded to in his italics. . . . All he appears to have done is to revive a few time-honored experiments, and trot out before the public an ancient perpetual motion delusion."

With all due regard for the opinions and assertions of the SCIENTIFIC AMERICAN, may I take the liberty to ask it to "trot out" before its many intelligent readers some of those "time-honored experiments," or tell them where they may be found; and will it also tell them where the "old and well known phenomenon" alluded to in my italics may be found, and in what manner I have imperfectly or erroneously alluded to it?

Surely the SCIENTIFIC AMERICAN must be in position to do this, as "time-honored experiments" must be on record. Can the SCIENTIFIC AMERICAN refuse to do this and maintain its well-earned reputation for fairness and ability?

W. W. GARY.

Huntingdon, Pa., March 31, 1879.

REMARKS.—In the letter of Mr. Gary's, published in our paper of April 5th, after describing his experiment of bringing a bar of magnetized iron into the vicinity of a magnet, he says: "What I claim as my discovery is that the iron, if of proper proportions, will change its polarity before it comes in contact with the magnet."

This alleged new discovery we specified as old and well known. Mr. Gary now desires us to state where this old and well known experiment may be found described. We will not now occupy space further than to give one reference, because the phenomenon is very familiar to experimenters. Mr. Gary will find it in "Rudimentary Magnetism," Snow Harris, 2d edition, revised by Noad (London: Lockwood & Co., 1872), page 31.

The author, in describing the influence of the pole of a magnet upon a bar of soft iron, says:

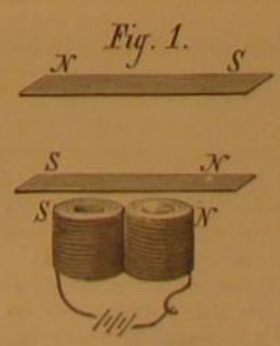
"It is, however, to be observed that the mean line will vary with the distance of the iron from the magnetic pole, and will approach the center of the iron as we increase its distance from the pole, and conversely, will approach the near extremity as we decrease its distance from the same pole; so that on making contact with the magnet the mean line vanishes, and the whole mass exhibits the same polarity as the pole of the magnet."

This may be readily demonstrated with an armature of considerable width, and the fact holds good in an armature of any kind. This affords the true explanation of Mr. Gary's sheet metal and tack experiment; shows the non-existence of any neutral line in the sense by him asserted; and proves that his alleged new discovery is simply a very old, well known phenomenon, imperfectly and erroneously set forth in his claim.

Mr. Gary claims from first to last that there exists in the magnetic field a neutral line, where the polarity of an induced magnetized iron bar ceases and beyond which it changes.

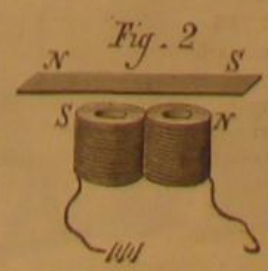
A method of proving that there is no reversal of polarity in the iron is illustrated by the accompanying engravings. Two helices without iron cores, having opposite poles pointing in the same direction, are connected with a battery, as in Fig. 1. When the armature is remote from the helices, polarity manifests itself in the bar in accordance with the established laws of magnetism, and a needle presented to the N end will have its S end attracted. On moving the armature quite near the helices the same end of the armature will repel the S end of the needle and attract the N end; but the polarity of the armature has not been reversed, anomalous as it may appear. This may be verified by disconnecting the battery, as shown in Fig. 2, when the magnetism remaining in the bar will be found the same as in its first position in Fig. 1.

Fig. 1.



As to the possibility of making the force of permanent magnets available as a source of power, Mr. Gary absurdly claims to cut off the attraction of the magnet by the use of a thin piece of sheet iron placed on his so-called neutral line; but this is no cut-off. The sheet iron acts simply as an induced magnet of very little power, sufficient, of course, to affect the delicately poised needle placed in its immediate vicinity; but when the needle is removed a short distance from the sheet iron armature, the superiority of the inducing magnet will assert itself, and the needle will obey it almost as if no armature were present.

Fig. 2



As there is no real basis for Gary's pretended claims to a new discovery concerning magnets, it follows that he is no better able to make a magnetic perpetual motion machine than his various predecessors. Some very curious frauds have been perpetrated in this line. Dircks, in his "Perpetuum Mobile," describes and engraves some alleged magnetic perpetual motors, one of which is stated to have been seen in the year 1821 in actual operation by crowds of people. Like Gary's, it was alleged to be run only by permanent magnets; but it was subsequently found out to be a deception.

We were called upon recently by a gentleman who stated that he was the friend and helper of Mr. Gary. He averred that he had himself seen Gary's magnetic motor in operation; that as many as three hundred people had also seen it. All we can say is that if the witnesses suppose that the machine was worked by permanent magnets, like many people before them, they were grossly deceived.

The Plague in Russia.

There is no doubt, says the London *Lancet*, that the medical profession in Russia are at the present moment in a state of profound unrest as to the near future of plague there. From the beginning of the outbreak in the province of Astrakhan, there has been a fear—determined perhaps by the course which the plague pursued during its recent prevalence in the province of Ghilan, Northwestern Persia—that this outbreak was probably but the forerunner of a wider and more serious manifestation in Russia which might be looked for in the course of spring. The cessation of the outbreak in the province of Astrakhan has not in any degree modified this view of the subject, and as the spring draws on expectation is on the alert to distinguish the first indications of that which is dreaded. The occurrence of another and happily not fatal case of plague within the infected area on the Volga, in the course of last week, gave rise to a momentary fear that the period of intermission between the forerunning outbreak and the greater invasion apprehended had come to an end. It is not, however, the indication in this direction which exercises at the present moment the minds of our professional brethren in Russia. Their attention is fixed upon seeming forerunners of the dreaded malady, which would appear to be scattered almost over the whole area of Russia in Europe. Our readers will remember the case of bubonic malady, unattended with much general disturbance of the system, which Professor Botkine observed a few weeks ago in St. Petersburg, and which he pronounced to be the slight form of plague which often precedes the deadlier manifestations of the disease. The weight of medical opinion in St. Petersburg declared itself against Professor Botkine's view of this case.

It is now known that the case in question is not the only one of the sort which has occurred in St. Petersburg, and that the later cases have been free from the complications which led to doubt in the earlier case. It is now known, too, that similar cases of this dubious bubonic affection have been observed also in Vitebsk, Tsaritsyn, Odessa, and in Warsaw; and it may be inferred that there is at present widely scattered in Russia a form of bubonic disease, of seemingly trivial character, unfamiliar to the medical profession there, and which it is feared may be of the sort which preceded the several recent appearances of plague in Mesopotamia, which occurred also prior to the late outbreak of plague in the province of Astrakhan, and which is, in fact, a form of plague.

Under these circumstances, it can be understood with what anxiety the near future as to plague is regarded in Russia by those who are most competent to judge of the possibilities of the case, and how anxiously obscure forms of disease are now being scanned over a large part of that empire. It is well that this state of things should be fully apprehended here. We shall not now have long to wait before the fate of Russia and our own prospect as to plague for the present year may be determined. But with the events of the Mesopotamian and Persian outbreaks before us, if Europe should be so fortunate as to escape from any further appearance of plague this year, it will be premature to think we have escaped with only the circumscribed explosion on the Volga until another winter and spring has passed.

Iron in New Zealand.

The Government of New Zealand has, within a few years, constructed over 1,000 miles of railroad, all the material for which, except the sleepers, have been carried out at a heavy charge in the way of freight, etc., from England. The present Minister of Public Works, the Hon. James MacAndrew, has determined to make the experiment of promoting the iron industry in the colony, and has, in the terms of the advertisement, which we published last week, calling for tenders for 100,000 tons of steel rails (or any portion thereof) to be manufactured in the colony from New Zealand ores.

A pamphlet containing full information on the subject, illustrated by maps and plans, has been published by order of the Government, and may be had from the Agent-General of the colony, Sir Julius Vogel, K.C.M.G., at 7 Westminster Chambers, London, by ironmasters and others desirous of obtaining further information on the subject.

[*Continued from first page.*]

the other. Power is distributed from four main lines of shafting, which have not perceptibly deviated from correct adjustment since they were first placed in position, thirteen years ago.

In this room there are no less than 1,003 separate machines for special mechanical operations, a large portion of which are automatic—that is to say, practically speaking, possessed of such intelligence and skill as to direct and control their own movements—only needing consciousness to rise to the plane of the skilled mechanic.

The number of driving belts which meet the view in this one room is, by actual count, 1,676, of the total length of 39,510 feet, or but 90 feet less than 7½ miles. This is exclusive of short feed belts, etc., of which there are probably as many more.

Here may be seen good examples of the economical results of the division of labor. Take, for example, the rotary hook. No man makes a hook. It is forged here, turned yonder, one machine makes this cut, another that, and so it is passed on from machine to machine, until after 128 distinct operations, that one part is completed, inspected, and ready to take its proper place. So the making of a glass presser involves, we are told, 32 different operations, and a hemmer 70.

In neighboring rooms are the plating, japanning, and ornamenting departments.

We were struck with the apparent excellence of the japanning, its smooth surface and brilliant luster, and were surprised to find, upon inquiry, that by peculiar processes and materials this extraordinary finish was produced more expeditiously, and at less cost, than ordinary and inferior work.

Here we may remark that, being given the liberty of the shop, we improved the opportunity to make inquiries, and in our probings for information one of the mechanics "let out" to us the following: Upon one occasion when Mr. Wheeler (the president) was deeply interested in improving the process of japanning, he stripped off his coat and put his hands to the work to demonstrate how it should be done—not a rare thing for him to do.

A Hibernian employe, happening to see him thus engaged, and not knowing or not recognizing the man, exclaimed to one of the workmen, "Be gorra, but it must be hard times outside!—to see a fine appearin' gintleman like that, rubbin' machines at a dollar and a quarther a day!" If we ought not to have repeated this anecdote, we beg pardon of whoever may be offended.

One of our sketches shows a portion of the assembling room. Here is illustrated the mechanical precision resulting from making all parts of the machines to exact gauge.

In assembling a machine each part is taken from an indefinite number of that kind, yet all come together with the most perfect fit. In other words, all parts of the same kind are perfectly interchangeable. The holes for the shaft bearings in the beds of the machines are reamed out with diamond reamers, producing a perfectly true and polished interior surface, the contact between which and the shaft, though air-tight, allows perfect freedom of motion.

For each part of the machine a standard model and a standard gauge are carefully kept, by which the working and inspection gauges are tested from time to time, and kept in the highest degree of exactness.

The organization and maintenance of the perfect system which prevails throughout these works reflect the highest credit upon the secretary, Mr. Wm. H. Perry, who has been connected with the company almost from the time of its foundation.

Passing through a tunnel under the street we reach the buildings in which are the foundry and the needle factory. Of the former we will only say that for convenience and perfection of all appointments it is not surpassed.

As the sewing machine proper is useless without the needle, the latter is, of course, an article of prime importance. No department of these works is more interesting than the mechanical processes of converting steel wire into perfectly finished needles, and in no department are more wonderful illustrations of the triumphs of inventive genius; but we cannot attempt a detailed description of the machinery and processes, some of which, in fact, we are not at liberty to describe. The distinct operations in the making of each needle—cutting, grinding, and tipping the blank, swaging, cutting to length, rough-pointing, tipping, grooving, eye punching, burring, hardening, tempering, polishing, brushing, scouring, buffing, etc., etc.—now number thirty-three, having been recently reduced from fifty-two by improved machinery.

In this department, as may be seen by our illustrations, useful employment is found for the gentler sex.

The buildings of the woodworking factory, or cabinet works, are two in number, each 526 feet in length. Here is made all the furniture for the machines, from a plain table top to the most elaborate and expensive full case or cabinet. The raw material is cut to dimension at the company's mill in Indianapolis, and transported here to be worked up into the desired forms.

The company's aim is to produce, for general purposes, substantial and well finished rather than simply showy work. In this department, as in all others, every piece of work is subjected to the most rigid inspection, and if any be faulty in any particular it is rejected.

A noticeable feature here is the perfect smoothness and luster produced in finishing the surface of the wood. For this purpose is used a "wood-filler," invented and patented by Mr. Wheeler, by means of which, we are told, the time, labor, and cost of wood finishing are materially reduced, with the production of better results as to the finish itself, the natural beauties of the colors and grain of the wood being fully developed and permanently fixed.

Some of the salient features of the processes of production having been thus briefly touched upon, the conclusion will have been anticipated that the complete products themselves are in all respects thoroughly substantial and as nearly perfect as can be made from the best materials by the most skilled labor with the most effective appliances. These products consist of sewing machines of various styles, suited as well to the heaviest manufacturing in cloth and leather as to the lightest domestic purposes.

In the heat of the lively competition which has existed for years among the rival manufacturers of sewing machines, it has been the custom for each company to claim that its particular machines were the best in the world.

There are few sewing machines that are not very much better than none. As we said at the outset, it is no part of our purpose to judge of their relative merits; but the fact that at the Paris Exhibition of 1878, the only grand prize for sewing machines from all the world was awarded to the Wheeler & Wilson Company, as is attested by the highest authorities, certainly indicates that the claims of superiority on the part of this company are far removed from idle boasting. At all events, it is gratifying to be able to state the

WHEELER & WILSON SEWING MACHINE MANUFACTORY.

fact that throughout the world American products in this branch of industry are more highly esteemed and fetch a materially higher price than those of any other country.

Enormous Public Works in France.

While England is groaning under the effects of a commercial depression which promises to be of long continuance, France, though it has its share in the general stagnation of trade, is occupied with gigantic projects for public improvements. The Republic, scarcely less than the Empire, adopts the paternal theory of government, and is setting itself to work to add incalculably to the means of internal intercourse and the facilities for commerce while providing employment for its laborers.

This theory of government is by some considered to be a false one, but it can be easily shown what can be done under it in the direction of public improvements. So the drainage of Haarlem Lake was done, and that of the Zuyder Zee in Holland is now being done by the Dutch government, which guaranteed the investments made by the capitalists. The only question to make such governmental management successful is whether honest men can be found to direct it. Unfortunately, as the majority of our government employes are politicians, and these, as a class, cannot be quoted as examples of honesty and disinterestedness, it is better for us to keep the government entirely out of all such enterprises, which experience has proved can be done quicker, cheaper, and better by private contract.

M. de Freycinet, the Minister of Public Works in France, has outlined a scheme of railway, canal, and harbor extension, for 1879, which will cost the enormous sum of $800,000,000, and will probably have legislative sanction for it in its entirety. The money for these unparalleled works he proposes to raise by an issue of three per cent bonds, redeemable in seventy-five years; and that he can get the whole amount without trouble the experience of all recent French loans affords abundant proof. The new chance for investment is eagerly awaited by capitalists, large and small; for enormous sums are now lying idle in bankers' hands.

One of the main features of the plan, and that which will consume the greater part of the vast appropriation, is the extension of the railroad system of France. The rest of the money will mainly go to the construction of new harbors and the improvement of the old ones. Another great public work which is urgently demanded by several of the departments is a canal from Creil-sur-Oise to Beauvais, Amiens, and Albert, with two important branches. It is averred that this extensive canal would be of the greatest value to the north of France; and it would certainly be the most considerable of all navigable French waterways, and would have the effect of reducing by one half the present freight charges from English ports to Amiens, Paris, and beyond.

A scheme for the construction of a network of metropolitan railways in Paris was hardly perfected before M. de Freycinet stepped in and claimed the perfected lines as belonging to the category of lines of general interest. Their concession has therefore been transferred from the Municipal Council to the general government. The cost of their construction is estimated at nearly a million dollars a mile. The Minister of Public Works has also obtained the appointment of a supreme commission on the treatment and utilization of French rivers, composed in equal thirds of legislators, officials, and manufacturers or agriculturists. It will consider irrigation, motive power, inundation, water supply, sewage, and similar questions. Add to all this his vast project of harbor improvement, and we see that M. de Freycinet has laid out a scheme of public works for France which will occupy the Republic for many years to come, constituting a system of internal improvements of extraordinary magnitude, which, if it is successfully completed, will itself make the new Republic memorable for generations.

One of the most interesting features of the plan is the construction of what are known as light or narrow gauge railways, largely as feeders to the main lines, on the most extensive scale. A commission was appointed last January to examine into this class of railways, both at home and abroad, and report on its value and feasibility; and the result of their inquiries has determined M. de Freycinet to build the narrow gauge railways throughout all France. The English engineering journals find fault with the conclusions of this commission, but they are very interesting.

They recommend a reduction of the gauge to 1 meter (3 feet 3⅜ inches), and in some instances even to 75 centimeters, ¾ of a meter (2 feet 6 inches), whereas in England a 3 foot gauge is preferred. They advise the dispensing with fences except at especially dangerous points and near dwellings; that the stations should consist merely of a waiting room, ticket office, and station master's lodgings; that the cars should be of two classes, with possibly an upper story; that they should be without useless ornamentation; and that the rolling stock should be at a minimum—in fact, that everything should be arranged with a view to strict economy. Under these conditions they estimate the cost of the roads, per mile, at an average of about $22,000. They put the average speed at from 9·3 to 12·4 miles an hour. The subject of narrow gauge railways is now one of the most interesting in the whole range of railway questions, and it is well worth careful thought and study. During the last few years they have been built more or less extensively here and abroad, and they are likely to come into still greater use, as being cheaper in construction and in working, especially in new countries.

SEWING MACHINE MANUFACTURE.

RECENT MECHANICAL INVENTIONS.

An improved tenoning machine has been patented by Mr. George H. Gregory, of Cannon's Station, Conn. It consists in a revolving cutter stock, which is recessed and provided with cutter heads, which are adjustable both laterally and longitudinally. The machine is designed for cutting tenons of round and oval shape.

An improvement in steam boilers, patented by Mr. Stephen J. Gold, of Cornwall, Conn., has a series of water receiving pipes that extend through a portion of the fire chamber and connect with the steam space. The object of the invention is to secure the maximum area of heating surface, together with the greatest compactness.

Messrs. B. J. Feldman and Theodore Schlag, of Franklin, Pa., have patented an improved fan for driving flies from the table. It consists of a novel arrangement of fans or feather holders, and mechanism for operating them.

An improved carriage step has recently been patented by Mr. Richard N. B. Kirkham, of Kansas, Ill. The step is arranged to fold up compactly, and is operated by a lever and a chain or cord.

Mr. William H. Stickle, of Terre Haute, Ind., has devised an improved vehicle spring which, it is said, overcomes the swaying side motion, the jostling, and bumping which are common to ordinary vehicles.

An improvement in pianoforte actions, recently patented by Mr. G. O. V. Roederer, of Indianola, Texas, is proof against atmospheric influences, all of the movable parts, as well as the supports, being made of sheet metal.

Mr. Theodore Bickerman, of Henry, Ill., has patented an improved windmill, in which the rim, spokes, and rods are made of gas pipe, securing both lightness and strength. The sails are made of sheet iron or wood.

An improved screw press, which may be operated by steam or horse power, has been patented by Mr. P. R. Campbell, of Hurricane, Miss. It consists of a combination of mechanism, by means of which a strong pressure is easily obtained.

Zenes McGinnis, of Petrolia, Pa., has devised an improved coupling for sucker rods of oil pumps, by means of which the rod may be coupled and uncoupled without ascending the walking beam.

An improved weighing scale, in which the weights are suspended so that when the material to be weighed is put into the scoop the weights are lifted one after the other until the desired weight is attained, has been patented by Mr. D. Hallock, of Coxsackie, N. Y.

An improved log roller for transferring logs from the log deck to the sawmill carriage has been patented by Mr. Esau Tarrant, of Muskegon, Mich. It consists of a bar having movable ratchet teeth for engaging the surface of the log and in novel mechanism for operating the toothed bar.

Mr. John R. Fish, of Grand Rapids, Mich., has patented an improved locomotive smokestack, which contains a novel arrangement of spark arresters, which offer little obstruction to the draught, but effectually prevent the escape of sparks.

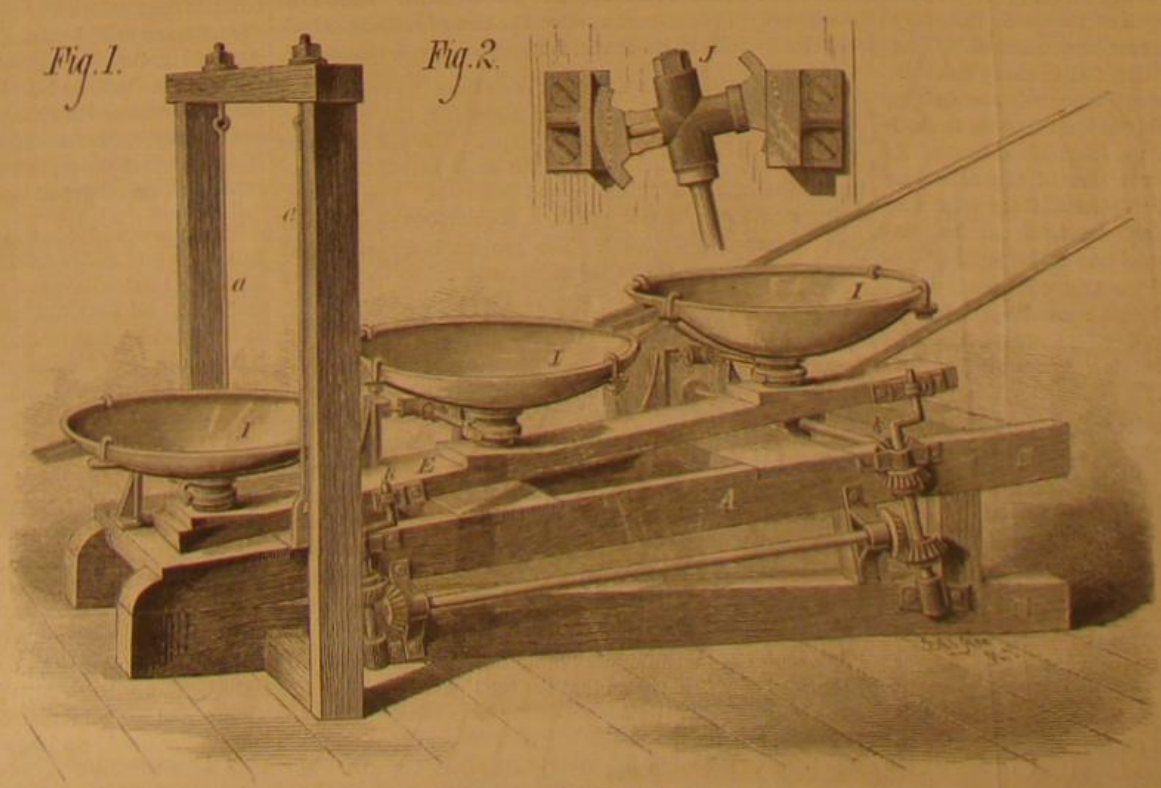
An improvement in rotary water meters, patented by Mr. Henry J. King, of Middletown, N. Y., is provided with a spiral screw for operating the registering mechanism. The screw is made in sections, and may be adjusted on its shaft, which is journaled in the water pipe.

AN IMPROVED AMALGAMATOR.

The accompanying engraving represents an amalgamator constructed on a novel principle, and having a peculiar arrangement of mechanism, by which an oscillating or vibratory motion is given to the amalgamated copper pans about their own axes while at the same time they are moved in a circular path and raised and lowered.

The pans, I, which are concave, are provided with internal rims or ledges, to prevent the swashing of the contents of the pan over its edges. Three or more pans are supported by short shafts journaled in the frame, E, which is suspended by the rods, *a*, from the standards of the frame, A, and oscillated by the cranks, *k*, whose shafts are connected by an inclined shaft and gear wheels so that they rotate together. The support of each pan is connected with the crosshead, J, by means of a short forked rod, which imparts to the pans an oscillating motion about their own axis as the supporting frame, E, is moved with a gyratory motion by the cranks, *k*, and is raised and lowered at its upper end by an eccentric on the upper horizontal shaft. Each pan is provided with a sheet iron spout, which discharges into the next below. The quicksilver readily unites with the copper to form an amalgam, which arrests the small particles of precious metal, and the escape of the quicksilver from the pans is prevented by the use of iron spouts, which do not become amalgamated.

This improvement was recently patented by Mr. Charles C. Peck, of Melrose, Mass.



PECK'S AMALGAMATOR.

RAILWAY NOTES.

AT a recent convention of railway men in Boston a prominent speaker expressed great satisfaction in view of the improvements adopted lately by railway managers to increase the comfort and safety of trainmen and passengers; yet much more, he said, remained to be done. Among the improvements and economies of the near future there were named: An improved freight car coupling; a suitable power brake for freight trains; the Miltimore safety axle, with independent wheels; the rail system of electric block signals; gas for lighting and heating passenger cars, without danger from fire in case of accident; shelter and protection for freight train men when on the road; and suitable resting and reading rooms for their comfort and improvement when waiting for delayed trains.

AT the late meeting of the Master Car Builders' Association in this city, the safety of trainmen—or rather the urgent need of devices for enhancing their safety—was discussed at considerable length. The President, Mr. Leander Garey, spoke of the effect of interchanging cars, whereby the cars of each road are scattered all over the country, and the resulting need of much more careful inspection of freight cars. Inspectors look to their running gear, draw attachments, and brakes, but seldom or never to dangerous ladders, loose brake wheels, broken running boards, or other things upon which merely the lives of brakemen depended.

Letters were read from a number of master car builders, yardmasters, and others, in which the deficiencies of the average freight car were severely criticised. Among the improvements needed to lessen the risks of trainmen, a master car builder mentioned better steps for climbing the cars. Such steps should be at the ends of freight cars, and the one at the sill should be stopped, so that a man's foot cannot slip off. There should be a strong step secured to the side of the sill, with a firm hand-hold at a proper height above it. Then the steps should be made reliable. Too often they are fastened on simply with screws that have been hammered in to their heads, and consequently give way when a strain is put on them precisely at the moment when a man's life depends upon their solidity.

A yardmaster mentioned as causes of accidents to train hands, first, the different heights of the draw bars; second, the insufficiency of follower heads and springs, which should be strong enough to stand a reasonable concussion without giving way; third, to the different kinds of draw bars employed. He strongly urged the adoption of a uniform style of draw bar, and recommended the Safford as best for saving fingers and hands, particularly when accompanied by the Griffiths attachment, he approved of it. Brake staffs, he thought, should be uniformly on one side, not, as now, sometimes on one and sometimes on the other, so that ofttimes brakemen are injured for life, or even killed, by being caught between them.

Another yardmaster expressed the opinion that the general adoption of the Safford bar and its use at a uniform height from the track would render mutilations and deaths in the work of coupling at least infrequent—would, in fact, do away with 90 per cent of the present proportion of injuries.

The need of wider running boards on the tops of cars was also insisted on; as also were guarded brake wheels, and frequent reliefs of trainmen in bad weather.

THE superior strength of American cars has been frequently shown in cases of derailment. Where foreign cars would have been knocked into kindling wood the American have withstood the shock wonderfully, to the relatively great protection of the passengers. An unusual and unusually severe test of their strength is reported in the *Journal of the Franklin Institute:*

When the Pennsylvania Railroad depot was demolished by a tornado last fall, a heavy car shed was blown over upon several trains of cars, which were under it, ready to be dispatched. So great was the strength of these cars that they held up the wreck. The 10 inch cast iron columns, 25 feet long, that supported the roof girders, fell in many cases directly against the cars with the force due to their own weight and that of the whole roof, probably at least six tons to each column, impelled by the force of the wind added to that of gravity. Notwithstanding this, not one of the cars was wrecked. In one instance a column struck a car near the middle and snapped off, but the framework of the car was not broken; the lower part of the column rested against the car, the upper part on its roof. A car that will stand, without injury, the impact of a 10 inch cast iron column, with six tons of extra weight, driven by a gale of 75 miles an hour, contains an excess of strength that is very assuring to the traveler.

IN Russia the machinery of factories and the engines of railroads and steamers are chiefly in charge of foreigners, on account of the lack of experienced native mechanics. It is now realized that this state of things is neither economical nor patriotic; and besides there have been accidents because the foreign mechanics and engineers did not understand the Russian language. In order to bring about a change the government, in 1871, ordered the railroad companies to pay 15 rubles per verst (two thirds of a mile) for the establishment and support of railroad schools. About 320,000 rubles a year are collected under this order, and now there are about twenty such schools. Twenty more are to be opened this year. These schools are situated on the railroad lines, and each of them is provided with a machine shop, where every pupil is obliged to work not less than three hours daily. The full course requires four years. Each student chooses his specialty as mechanic, engineer, or telegraphist. Besides these there are five conductors' schools. As the railroad schools have proved successful, other branches of industry are to follow the example. Many steamship companies and factories propose to establish schools to secure experienced hands for their service.

GREAT advantages are claimed for the Prosser "twin cylinder" cars for the transportation of grain. They are said to be cheaper, lighter, more durable, occupy less space, easier draught, will not laminate the track, may be run at a greater speed, lower the center of gravity, reduce the windage of train, remove the weight of load from axle, require less oil, less attention, less parts, can dry wet grain in the car, and prevent it from heating, souring, or moulding while in transportation.

More specifically the elements of superiority of the new car are shown by the following figures:

ORDINARY FREIGHT CAR.

Weight of car	10 tons.
Weight of load	10 tons.
Weight of car and load	20 tons.
Amount drawn by engine	600 tons.
Weight of cars	300 tons.
Weight of load	300 tons.
300 tons	600,000 lb.
600,000 lb	10,000 bu.
10,000 bu. at 15c	$1,500
Cost of transit	1,000
Profit	500

PROSSER CAR.

Weight of car	3 tons.
Weight of load	10 tons.
Weight of car and load	13 tons.
Amount drawn by engine	1,200 tons.
Weight of cars	280 tons.
Weight of load	920 tons.
920 tons	1,840,000 lb.
1,840,000 lb	30,666 bu.
30,666 bu. at 15c	$4,599.96
Cost of transit	1,000
Profit	3,599.96

THE unpleasant noise of escaping steam from safety valves, open steam pipes, vacuum brakes, and the like, is said to be entirely suppressed by discharging the steam through a small chamber filled with glass or metal beads. The beads—from one quarter to five sixteenths inch in diameter—are held in place by copper gratings, and the steam is entirely silenced by its passage through the tortuous interstices between them. At the same time it escapes freely, with little or no back pressure. The device has been patented.

A BERLIN paper says, in regard to one of the steps recently taken toward concentrating the railroads under the government, that it is to be feared that when the private roads have ceased to exist, the State, as the sole possessor of the whole railroad traffic, will dictate much higher rates than are now had; and the fact that this can be done only through the law, and with the consent of the representatives of the nation, will afford in appearance only a protection against such an excessive increase of charges. For the administration will need, to justify the increase, only to show that the lower rates do not cover the working expenses and the interest on the cost of the roads; and as it at present works at greater expense than private enterprise, it will probably be easy to show that justification.

THE Grand Duke Nicholas of Russia has issued a pamphlet urging the speedy construction of an Orenburg-Tashkend Railway. His argument for this route, based on that of De Lesseps and Cotard, is, in brief, as follows: If a grand circle be drawn of the globe between London and Calcutta, the segment of it intersected between the two cities goes through Amsterdam, then a little south of Berlin, then through Varsow, through Southern Russia to the Caspian Sea, which it cuts somewhat above 44° of latitude; then through the Sea of Aral, proceeds to the east of Samarkand, cuts the Indus about a hundred miles south of its great angle, and goes down the valley of the Ganges to Calcutta. Russia is in possession of the Asiatic part of that shortest route to India. She ought consequently to construct at once the line of railway which most closely follows it—to wit, from Orenburg to Tashkend.

THE construction of a line of railway from the port of San Jose de Guatemala to the town of Escuintla, the center of the chief coffee district, has been begun. The distance is 28 miles, and it is intended to build the road hereafter to the city of Guatemala, 32 miles beyond Escuintla. The government guarantees a certain profit on $1,000,0000 capital, and loans the company $210,000. The project includes a final extension from Guatemala 140 miles eastward to the port of San Tomaso on the Atlantic coast. Part of the material has been shipped from San Francisco, with a large number of Chinese laborers.

THE lowest cost of carrying freight yet reported is found in the report of the Northern Central Railway for 1878, which gives the cost per ton per mile on the Susquehanna Division (47 miles long) as 0·35 cent per ton per mile. On the whole road, however, the average cost is about twice as much, and on one of its branches, 9 miles long, the cost is nearly ten times as much—3·246 cents per ton per mile. It is not often the companies report separately the cost on different sections of the same road. If they did, perhaps some of them would show a lower cost than this.

THE report of the New York State Engineer and Surveyor of Railroads for 1878 shows that the total paid up capital invested in the steam railroads reporting in the State is $392,164,754.25, and the proportion for New York, pro-rating the roads lying in the State and in adjoining States, is $287,826,957.05. This is an increase in the total aggregate of $7,255,616.49. The paid up capital of the horse roads amounts to $23,167,130.36—a decrease of $73,357.63. This decrease was caused by roads reducing stock.

The total number of miles of road built (main line and branches), including leased lines out of the State, is 8,390·73, of which 5,752·24 are in this State. The double track, including sidings, amounts to 4,358·33 miles. There have been 107·79 miles of steam, and 8·24 miles of horse railroads built during the year. The total miles of road owned by horse railroad companies are 426·03, and the double track and sidings are 278·19 miles.

The steam railroads doing business in this State own 2,801 engines, 1,993 first-class passenger cars, 358 second-class passenger and emigrant cars, 741 mail, baggage and express cars, and 59,413 freight cars. Of the 278 steam roads now in existence in this State, 47 companies operate their own and other roads, 5 are operated by receivers, and 1 is leased and operated by a private person. There are also 7 corporations formed under the laws of other States leasing and operating roads in this State—a total of 60.

Sixty-one horse railroad companies operate their own and other roads. Two steam roads, the New York and Harlem, and the Utica, Clinton and Binghamton, operate part of their roads as horse roads, and 2 are leased and operated by private persons—a total of 65.

There are also 2 steam roads owned and operated by private parties.

There are 71 steam and 4 horse roads leased and operated by other roads, and 1 road owned by private persons is operated by a steam railroad company: 72 steam and 15 horse railroads are not in operation.

The number of passengers carried by the steam roads was 48,769,084, an increase of 8,756,863; classifying the roads last year to correspond with the present report, and an average of 20·84 miles was traveled by each passenger. The horse roads carried 244,290,364 passengers during the year, an increase of 5,748,628. The number of tons of freight carried by the steam roads was 38,320,573, an increase of 3,335,792.

THE one thing wanting to make a direct railroad communication between India and Europe is a railway from Alexandretta, the nearest point on the Persian Gulf, to Kurrachee. A committee has been formed in London, consisting of the Duke of Sutherland and several other noblemen and gentleman, to acquire certain routes through the valley of the Euphrates to complete the connection. This done, it will be possible to go from London to Kurrachee in about seven days—a distance which it now takes nineteen days to cover.

THE Belgian Government has decided on the abandonment of wooden railway sleepers. Its example will doubtless find imitators, if indeed the example be not improved upon, and steel be used eventually instead of iron. It should be noted that it is not the longrine, or longitudinal sleeper, that has been adopted, but a German system of cross sleepers.

THE greatest railroads in India are composed of the Punjab and Delhi system, some 1,200 miles in length, meeting at Delhi the East Indian Railway, which goes to Calcutta, and which is about 1,000 miles in length, with a branch at Allahabad to Jubbelpore, some 250 miles additional in length. More, it connects with the great Indian Peninsular system which is carried on to Bombay, some 550 miles. This system runs through a chain of mountains, called the Thull and Vhrne Ghatz, where the engineering difficulties have been immense, and 15 miles of tunnel made. The line then runs from Poonah to Magpore, where it is connected with the Madras Railway, some 850 miles in length. This line also serves Bangalore, the garden of the Madras Presidency, and the coolest spot in the plains of India. In the same direction is the Hyderabad State Line, belonging to the Nizam. The Bombay and Baroda Railway runs to Giucwarah, thence through Central India to Ahmedabad, where it is connected with the Rajpootan State Railway, running to Delhi. At Calcutta is the Eastern Bengal Railway, which goes to Barrachpore, thence to Kooshteah, from which a line of steamers connects with Assam, the great tea growing country of India. In Oude is the Oude and Rohlkund line, which runs 500 miles through some of the richest plains of that fertile region. The noble bridge, about 1¼ mile in length, which spans the Ganges at Cawnpore, belongs to this company. These comprise the general grand trunk system of railways in India.

THE *Railway Age* has given a list of forty-eight railroads that were sold under foreclosure during the year 1878, representing a total mileage of 3,902 miles, $160,014,500 of bonds and debt, and $151,616,700 capital stock—the entire amount of bonds, debt, and stock being $311,631,200.

A summary of foreclosure sales during the last three years stands as below; the moral is evident:

Year.	No. of Roads.	Mileage.	Capital Invested.
1876	30	3,846	$217,848,000
1877	54	3,875	198,984,000
1878	48	3,902	311,631,000
Three years	132	16,623	$728,463,000

A SINGLE locomotive on the Kansas Pacific recently hauled a train of 58 empty and 15 loaded cars, with caboose attached, from Ellis to Brookville, a distance of 102 miles, in 9 hours and 30 minutes. The monster locomotive "Uncle Dick," described in a late number of this paper, has already achieved distinction by climbing the steepest grade of the mountain division of the Atchison, Topeka, and Santa Fe Railroad, drawing 22 loaded cars.

HOUSEHOLD INVENTIONS.

An improvement in curtain fixtures has been patented by Mr J. S. Henry, of North Belle Vernon, Pa. It consists of a suspended ratchet hook pivoted in front of the roller, and extended below the ratchet, to form an eye or loop for the cord.

An improved child's chair, constructed so that it may be readily adjusted as a high chair or carriage chair, has been patented by Mr. C. H. Barnes, of Poughkeepsie, N. Y.

A flower stand, provided with one or more trays, supported by a single central standard, has been patented by Mr. Thomas Murgatroyd, of Clarinda, Iowa. By slightly modifying the construction the stand may be used as a workstand.

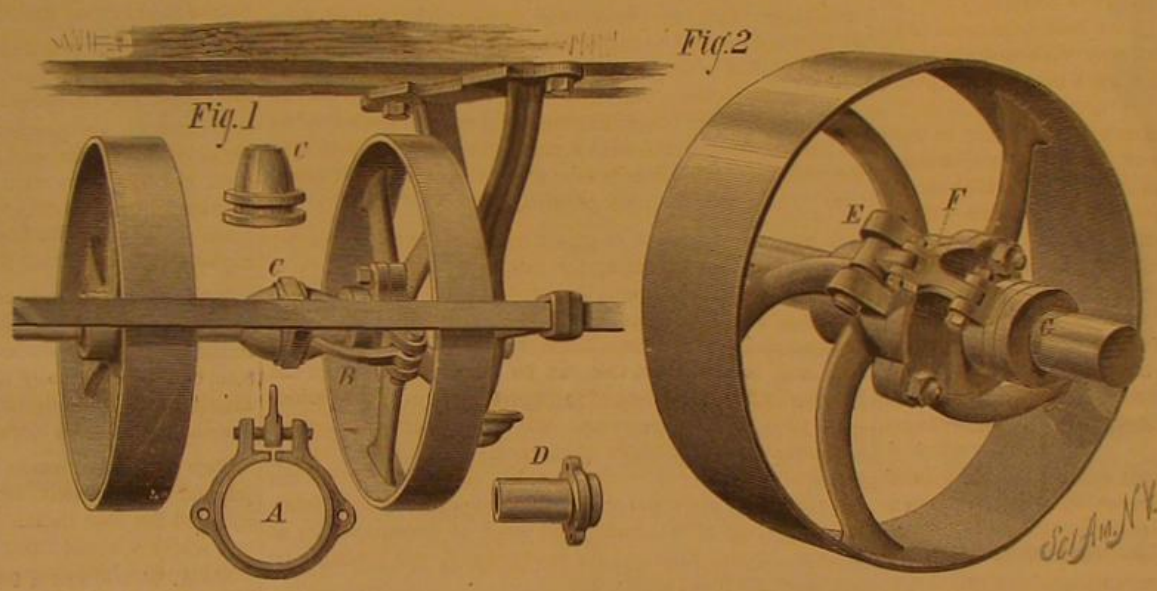
An improved candlestick, which will hold the candle firmly, and yet admit of burning the whole of it, has been patented by Mr. A. J. Smith, of Ukiah City, Cal. It consists of a standard fixed to the usual bottom, and having a thimble with fingers or prongs, which slides over it and holds the candle

A NEW CLUTCH PULLEY.

We present engravings of two forms of clutch pulley manufactured by Messrs. James Hunter & Son, of North Adams, Mass. In these pulleys a friction band is employed to clutch the boss of the wheel, and the means for operating the bands are both simple and efficient. In the form shown in Fig. 1, the pulley is placed on a sleeve, D, which is secured to the shaft, and is provided with a flange for receiving screws which enter the friction band, A. The latter surrounds an enlarged hub or boss of the wheel, and is split and provided with two ears, through which passes a bolt having a cam formed on its head that engages a similar cam formed on one of the ears. A lever, B, is secured to this bolt, and is curved so as to be engaged by a cone, C, on the shaft The cone is grooved circumferentially to receive the fork of the shifting lever. It requires very little effort and only a slight movement of the shifting lever to operate the clutch. This device is so simple that no special description of its operation will be required.

By moving the cone, C, toward the pulley the free end of the lever, B, is thrown outward, the ring, A, is contracted, and the boss of the pulley is clamped so that it is carried around with the shaft.

The clutch shown in Fig. 2 is similar to the one just described, the difference being that a right and left hand screw passes through the ears, E, and is turned so as to contract the split ring by the action of the toggle, F, when the sleeve, G, is moved toward the pulley. Of course it will be understood that moving either the cone, C, or the sleeve, G, away from the pulley releases it. The device is applicable to both driving and driven pulleys.



HUNTER'S CLUTCH PULLEY.

Pumping Money.

The above may appear to be a somewhat singular title for a paper, but, according to the *Foreman Engineer and Draughtsman*, it is literally true that a vast number of sovereigns, and, indeed, of other coins, are annually pumped into existence at the Royal Mint. Without entering into a detailed account of the numerous processes and manipulations by means of which ingots of gold are transformed into small circular disks of metal, of the exact size and standards of weight and of fineness for the reception of impressions, it may be said that those impressions are finally due to the action of the air pump. A very large proportion of the sovereigns, therefore, issued from the mint presses since the erection in 1810 of steam machinery for the purpose of coining, have undoubtedly been pumped, as it were, into the channels of circulation. Let us, then, proceed to explain the contrivances and means by which the operation of pumping sovereigns is performed at the Tower Hill money manufactory. We will commence with the prime mover. This is a steam engine of twenty horse power, on the combined high and low pressure principle, and which was erected in 1846 by the justly celebrated firm of George & Sir John Rennie. Originally this engine was intended only for pumping water from a deep artesian well on the premises for the supply of the coining department, but in 1851 Mr. J. Newton advised that the engine in question should be made to pump money as well as water, and showed how it could be done. The merit of entertaining the proposition and of ordering it to be carried into effect certainly belongs to Captain (now General) Harness, R.E., who was Deputy-Master of the Mint in the year named. This highly talented officer gave instructions to the Messrs. Rennie for the construction, under the eye of the inventor, of the necessary apparatus and appliances for the purpose.

An air pump of considerable dimensions constituted the main feature of the scheme, and this was formed on a perfectly novel plan. It consisted of a cast iron cylinder, closely resembling in exterior appearance that of an ordinary land steam engine, but very different in its internal arrangement. The piston of the pump was made up of a series of cast iron rings, and these were pressed out against the sides of the accurately bored cylinder by springs of steel. The effect was to make the piston perfectly air-tight, and yet capable of being easily moved upward and downward in the cylinder. There were no valves in the piston, as there are in those of almost all air pumps employed in manufacturing processes. The base of the cylinder was a hollow casting of iron, and so was its cover. In these hollow castings the inlet and outlet valves were placed. The upper casting contained sixty-four small apertures, which were covered by small pieces of steel saw-plate, each about two inches long by one inch wide, and fastened by a screw at one end. These delicate springs were, in fact, the valves. Thirty-two of them were made to open to the atmosphere, and thirty-two to the exhaust or vacuum pipe. The hollow base or bed plate of the cylinder was furnished in a precisely similar manner. The diameter of the cylinder was three feet six inches, and the length of stroke of the piston three feet. The pump was placed vertically, and immediately below the working beam of the engine to which the piston rod was attached.

By this method of construction the air pump became double-acting, and whether the piston was ascending or descending it constantly exhausted air from the vacuum tube through the inlet valves, and discharged it through the outlet series. Nothing in the shape of machinery could work more smoothly than did this pump, and this arose mainly from the peculiar character of the valves. The cost of the whole apparatus, with cast iron exhaust tube, two hundred feet in length, ten inches in diameter, and face-jointed, was about £400.

It has been said that the exhaust tube was two hundred feet in length. This arose from the fact that the engine house had been erected at that distance from the stamping presses. Instead of being carried underground, as in the pneumatic dispatch system, the tube was in this case carried over the roofs of the coining rooms, and, descending therefrom, was attached to the great vacuum chamber.

The vacuum chamber had existed from the period of the erection of the mint, and was originally devised by Messrs. Boulton & Watt, the well known engineers of Soho. They had supplied a steam engine of ten horse power, and two single-acting air pumps, each of which discharged air only in its downward stroke, for exhausting the chamber. This cumbrous and comparatively costly, though for its day very ingenious and valuable arrangement, was set aside when the new air-pump came into use. It had performed its mission, and was henceforth to be reserved as a duplicate in the event of the derangement, by accident or otherwise, of its modern supplanter. A regulating, or relief valve, and a barometer gauge fitted to the vacuum chamber, enabled the attendant to control and adjust the extent of rarefaction within the latter.

It will now be comprehended that at all times when the engine and pump are in action a vacuum of more or less extent must exist in the chamber. The chamber, it may be explained, moreover, is a horizontal tube of iron about fifty feet long, and two feet six inches in diameter. It runs along the floor of the mint pump room, in a line parallel to that in which the eight coining presses stand. Arranged along the top of the vacuum chamber, and supported by pipes opening into it, are a series of eight cylinders. These are vertical, and fitted with pistons, the rods from which are connected by levers and cranks with the presses. The cylinders are open-topped, and consequently their pistons are exposed to the pressure of the atmosphere once a vacuum exists below them. This is the case when the pneumatic valves within the cylinders are open to the vacuum chamber. The air within the cylinders then rushes down to the exhausted tube, the atmospheric column drives the pistons after it to the bottom of the cylinders, and the pistons drag with them the central screws of the coining presses. The instant that the beautifully engraved dies are thus made to come into contact with the disks of gold the latter receive by the force of impact their impressions. The presses then rebound, carrying with them their pistons. The pneumatic valves again open self-actingly, the dies descend upon new blanks supplied to them by mechanical fingers, another batch of sovereigns is pumped into bright and glorious being, and so long as the great air pump is exhausting the vacuum chamber and the presses are fed with blanks, so long the series of minor pumps will proceed with their work, and streams of gold, silver, or bronze coins will flow down from the presses into reservoirs placed below to catch them.

The Academy of Sciences.

The annual session of the National Academy of Sciences began in Washington, April 15. Vice-President Marsh presided, and delivered the opening address, in which he paid a feeling tribute to the late President of the Academy, Professor Joseph Henry, and gave a review of the work of the body during the past year. The members present were Professor Spencer F. Baird, Professor Charles F. Chandler, of New York; Mr. E. D. Cope, of New Jersey; Mr. Theodore Gill, Professor Julius Hilgard, Mr. George W. Hill, of New York; Professor O. C. Marsh, of Connecticut; Professor Alfred M. Mayer, of New Jersey; General M. C. Meigs, Dr. S. Weir Mitchell, of Philadelphia; Professor Simon Newcomb, Professor H. A. Newton, of Connecticut; Professor E. C. Pickering, of Boston; Mr. Raphael Pumpelly, of New York; Admiral John Rodgers, of San Francisco; Mr. Fairman Rodgers, of Philadelphia; Mr. Charles A. Schott, Professor W. P. Trowbridge, of Connecticut; Dr. J. H. Trumbull, of Connecticut; General G. R. Warren, United States Army; Dr. J. J. Woodward, United States Army; Professor Henry Draper, of New York; Mr. C. S. Pierce, Dr. S. H. Scudder, of Cambridge; Dr. Elliott Coues, Professor Francis S. Walker, and Professor G. F. Barker, of Philadelphia.

April 16, the venerable Professor William B. Rogers, "the Nestor of American Geology," was elected President of the Academy. The other officers were re-elected, as follows: Professor O.C. Marsh, vice-president; Professor J. H. C. Coffin, home secretary; Professor F. A. Barnard, foreign secretary; Mr. Fairman Rogers, treasurer; and Professors Baird, Agassiz, Gibbs, Newcomb, Hall, and General Meigs, the counsel.

The papers read the first day were as follows: "On Ghosts in Diffraction Spectra," and on "Comparisons of Wave Lengths with the Meter," by Professor C. S. Peirce, of Cambridge; on "The Relation of Neuralgic Pain to Storms and the Earth's Magnetism," by Professor S. Weir Mitchell, of Philadelphia; on "Continuation of Researches in Connection with the Discovery of Oxgen in the Sun," by Professor Henry Draper, of New York; on "Vowel Theories Based on Experiments with the Phonograph and Phonautograph," by Professor R. Graham Bell; and on "The Palæozoic Cockroaches," by Dr. S. H. Scudder, of Cambridge.

The programme for the second day's session included papers by Mr. E. C. Pickering, on the "Eclipses of Jupiter's Satellites;" by Mr. C. S. Peirce, on "Errors of Pendulum Experiments," and on "A Method of Swinging Pendulums," proposed by Mr. Faye; by Mr. E. W. Hilgard (read by Mr. Pumpelly), on "The Loess of the Mississippi and the Aoelian Hypothesis;" by Professor J. Le Conte (read by Mr. S. K. Gilbert), on the "Extinct Volcanoes about Lake Mono and their Relation to Our Glacial Drift;" by Professor J. E. Hilgard, "Report of Progress of the International Bureau of Weights and Measures;" by Mr. G. K. Gilbert, on "Stability and Instability of Drainage Lines;" and by Professor C. F. Chandler, on "Polariscope Methods."

Among other papers announced were "Critical Remarks on Observations Alleged to be of Intramercurial Planets," by C. H. Peters; and on "The Extinct Species of Rhinoceros and Allied Forms of North America," by E. D. Cope.

The New York World's Fair.

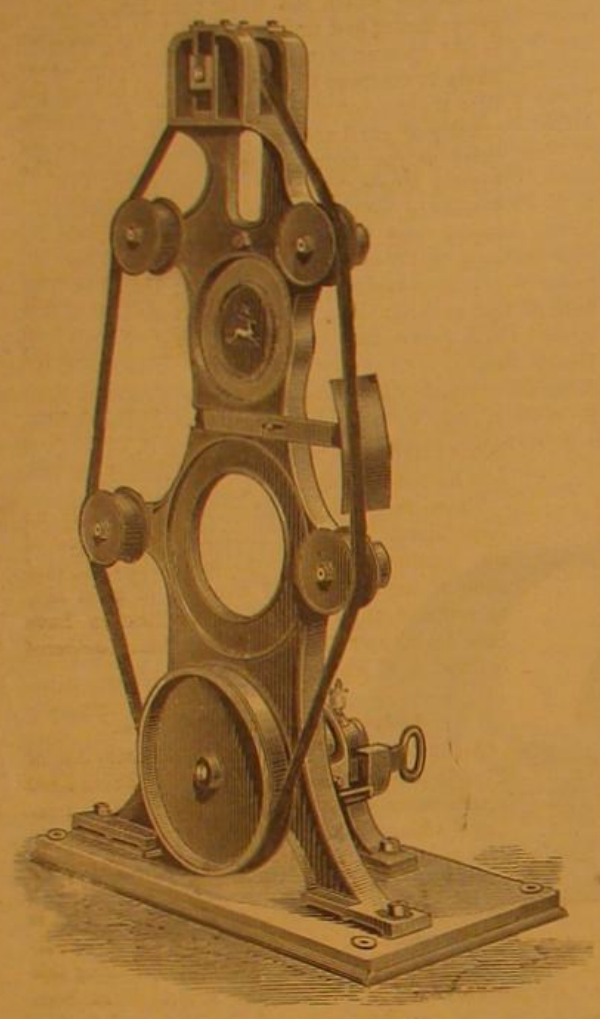
At a recent meeting of the Executive Committee of the United States Board of Trade, and the members residing in New York, the decision of the Committee in favor of 1883 was approved. The Board has invited the governors and mayors throughout the country to send delegates or commissioners to a great national convention, with reference to the fair, to be held June 18 next.

Dew.

Mr. George Dines, who has made extensive experiments and observations on the formation of dew, finds that the depth of deposit in England in an evening rarely exceeds a hundredth part of an inch; and that the average annual depth of the dew deposited upon the surface of the earth does not exceed an inch and a half.

EMERY BAND POLISHING MACHINE.

There are many things which cannot be very well polished by means of grindstones, emery wheels, or any rigid tools in common use. Polishing by hand must be resorted to in the finish of many articles, in which that part of manufacture is the more costly. We need not mention any of the many purely ornamental articles to find illustrations of this. Most of the brass fittings for boilers have corners and compound curves, difficult to polish and sometimes impossible to get at with any ordinary wheel, or even an annular emery or polishing wheel. For work of this kind, the machine we illustrate herewith seems to recommend itself. It will be seen to consist chiefly of a standard provided with bearings, carrying a driven pulley, over which runs an emery band, which is also carried by five loose rollers, the upper one of which is supported in a movable bearing acted upon by spiral springs to keep the belt tight.



EMERY BAND POLISHING MACHINE.

The bands used are endless, and usually of leather covered with emery of a number suitable to the work to be done. Some bands are of tape specially prepared for the purpose. The emery coating is easily renewed by the user. The machine is made by Slack's Emery Wheel and Machine Company, Manchester, and seems to be generally applicable for polishing irregular and curved forms.—*Engineer.*

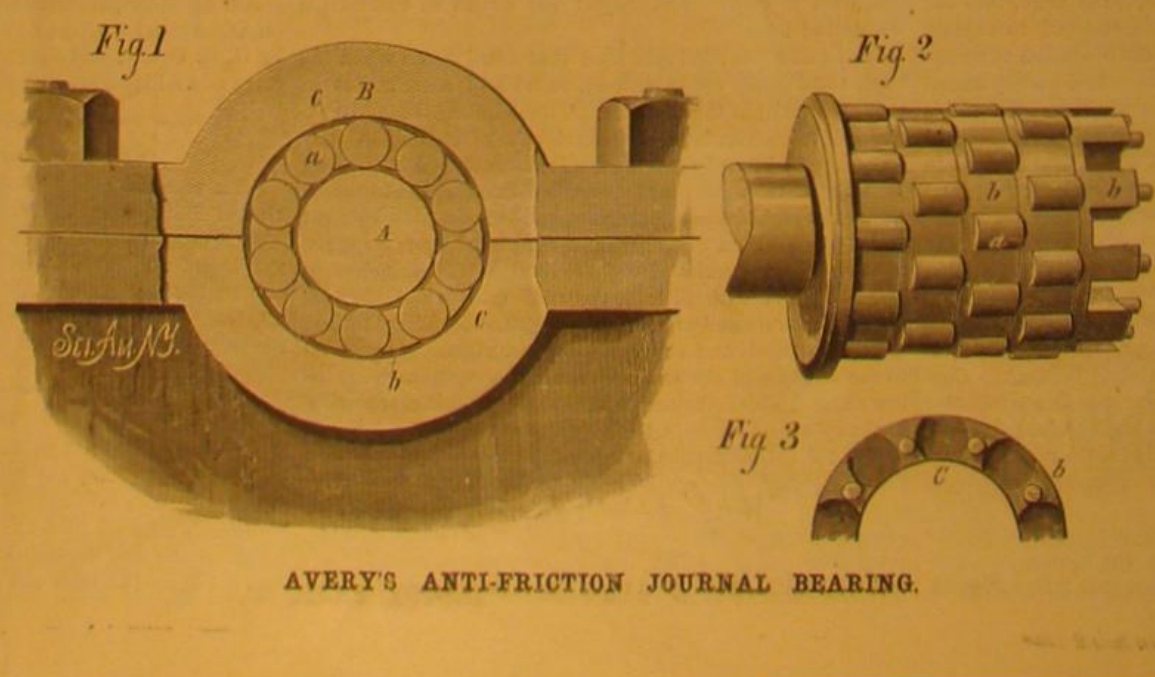
A NEW ANTI-FRICTION JOURNAL BEARING.

The accompanying engraving shows a novel anti-friction journal bearing which was first publicly introduced at the American Institute Fair, in this city, last fall, where a balance wheel, six feet in diameter, weighing 1,755 lbs., and provided with this ingenious mechanism, was run by a single thread of No. 40 spool cotton, instead of a leather belt. Since then the patentees have exhibited their invention upon railroad cars, wagons, machinery of various kinds, and, in fact, wherever there is circular motion. Upon railroad cars the decrease of friction is said to be so great that a single locomotive can draw a train of loaded cars, equipped with these bearings, as easily as it could draw the same number of empty cars provided with the ordinary journal bearings.

The device also effects a great saving of expense from the fact that it is operated entirely without lubricants, in fact they would only be a hindrance to it; and it is said that "hot boxes" are impossible where the device is employed. The officers of a single line of railroad recently stated that they had to deal with the annoyance of three thousand hot boxes in a single month.

The same difficulty is experienced more or less on ocean steamships and yachts, in mills and factories, and in fact, everywhere where there is rotary motion. This device was invented by Mr. William Tucker, patented by Messrs. Tucker & Avery, and is manufactured by Mr. John G. Avery, of East Brookfield, Mass. We are told that the invention proceeded from a suggestion made by the SCIENTIFIC AMERICAN, some months since, in which we set forth the desirability of a device of this kind. The invention, which is shown in Figs. 1, 2, and 3, comprises a shell, *b*, containing hardened steel rolls, *a*, a journal, A, of hardened steel, revolving upon these rolls, and the whole working in a box, B, lined with hardened steel. The shell contains sixty rolls, no two of which are in line with each other, and as the journal revolves entirely upon these rolls, friction is decreased to the minimum, and no lubricants are required. The box and journal, also being of hardened steel, are very durable, and will far outlast those equipped in any other way. Rolls are also set in the end of the journal, thus decreasing the friction at that point.

We are informed that this bearing has been in constant use on a road wagon without lubricants, without showing any wear; also that a hand car on one of the principal railroads has been used eight months with the same result, and one of the Boston street railways has a car fitted with the journal that has run over 5,000 miles without appreciable wear. Mr. Avery has successfully applied the principle to engine slides and other sliding surfaces.



AVERY'S ANTI-FRICTION JOURNAL BEARING.

MISCELLANEOUS INVENTIONS.

An improved process of inlaying metallic ornaments in wood or stone has been patented by Mr. L. A. Amouroux, of West Mount Vernon, N. Y. In consists in working the alloy in a hot or melted state into engraved or indented portions of the surface to be ornamented, and afterward polishing all together.

Mr. Lyman R. Dexter, of Lancaster, N. H., has patented an improvement in sleds, which consists in a novel clamp for securing the runner to the upright. This device is an improvement on a clamp for which the same inventor received a patent in 1869.

An improved safe or vault, provided with air and water tight chambers entirely surrounding it, has been patented by Mr. Samuel A. Wilkins, of Victoria, Texas. The chambers are arranged so that they may be filled with water from the exterior of a building. The inventor also provides an ingenious burglar alarm.

Mr. John B. Belcher, of Charlotte, Mich., has patented an improved strap for rubber boots, which consists of a rigid ring connected with the boot leg by a strap. The inventor claims that the strap is stronger and more convenient than the ordinary ones.

Mr. G. G. Wright, of Winchester, Conn., has devised an improved rotary engine, having several novel features, which cannot be clearly described without an engraving. The object of the invention is to render the parts simple and accessible.

An evaporating pan having a corrugated bottom stamped from a single piece of sheet metal, the corrugations of which extend alternately from opposite sides, so as to form a tortuous passage for the liquid, has been patented by Mr. John L. Bleeker, of Cincinnati, O.

An improvement in riding saddles has been patented by Mr. William M. Herring, of Spring Hill, Texas. The pommel has a hollow neck, and is formed in one piece with the fork and web, and wooden filling pieces are provided, which complete the tree.

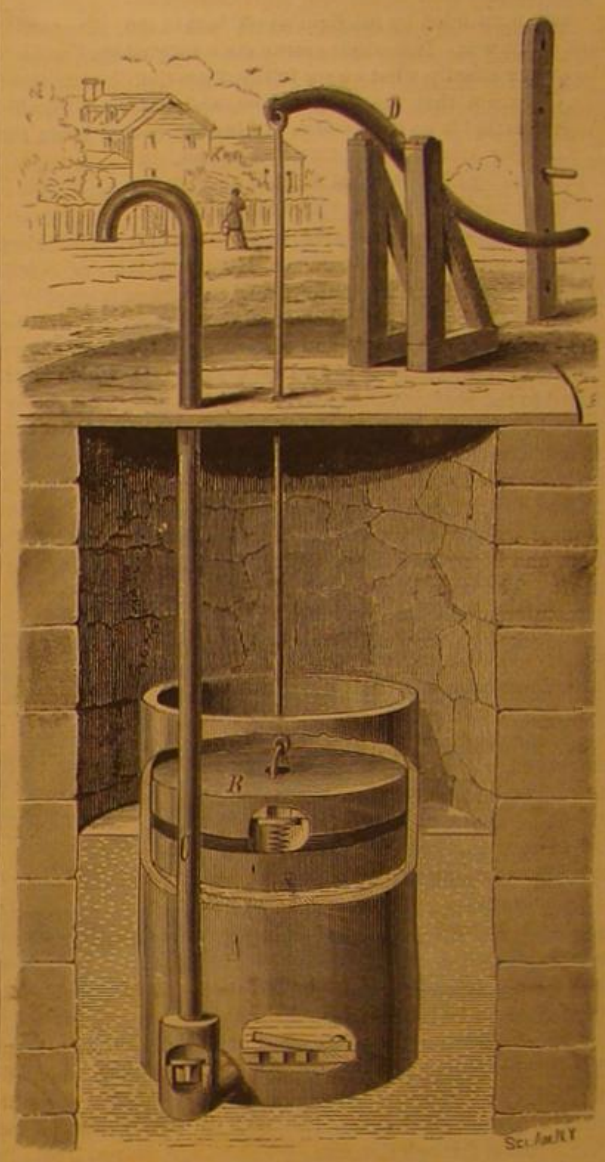
Mr. William H. Fix, of Moffatt's Creek, Va., has patented an improvement in axes, the object of which is to adapt the broad ax or hand ax for use by either a right or left handed person. The ax head is pivoted to the handle, so as to rotate in the plane of the axis of the handle.

An improved cover for the steps of wagons, carriages, and other vehicles for preventing the slipping of the feet in wet, muddy, and snowy weather, has been patented by Mr. William Mellon, of Philadelphia, Pa.

A runner stone—provided with a ventilating channel cut diametrically across the face, and having its bottom beveled upon opposite sides of the eye, away from the direction of the rotation of the stone—has been patented by Mr. George Helfert, of New York city.

AN IMPROVED WATER ELEVATOR.

The water elevator shown in the accompanying engraving is the invention of Mr. A. W. Coates, of Alliance, Ohio. It consists, as will be seen from the engraving, of a cylinder, A, which is wholly or partly submerged in the water of the well. A weighted piston, B, is fitted to the cylinder, and connected with a lever or handle, D, fulcrumed in a standard on the well platform. The cylinder is provided with valve covered apertures in the bottom, and also with a delivery pipe, C, having a check valve at its lower end. The piston is provided with a downwardly opening valve held up by a spring. This valve allows any water that may escape



A. W. COATES & CO.'S WATER ELEVATOR.

through the packing of the piston to return to the interior of the cylinder.

The pump is operated by depressing the handle so as to raise the weighted piston; the handle is then released, when the descent of the piston by its own gravity forces the water up the delivery pipe. The quantity of water raised may be measured by restricting the movement of the handle by means of the pins in the standard near the end of the handle. These pins also serve to hold the piston in an elevated position, so that all that need be done to raise a quantity of water is to release the handle from the pin which retains it.

Further information in regard to this invention may be obtained from Messrs. A. W. Coates & Co., of Alliance, O.

The South African Cable.

The telegraphic cable to connect the European and Asiatic telegraphic systems with Cape of Good Hope will be 4,000 miles long, extending from the Red Sea cable, at Aden, around Cape Guardafui and along the east coast of Africa to Port Natal, where it will make a junction with the present land line to Cape Town. The cable will be laid along the coast, the depth being moderate along that side of the continent, and the facility for repairing possible breakages has been carefully ascertained. The cable will touch at Zanzibar, Mozambique, Sofala, Delagoa Bay, and thence to Durban as the submarine terminus, from which point the land telegraph becomes available to complete the circuit to Cape Town. The cost of constructing and laying the cable is estimated at $7,500,000. The line from Durban to Zanzibar is to be finished in July, and the whole cable by the middle of November.

REMARKABLE ACCIDENT TO A RED DEER.

The accompanying engravings represent a curious mishap to one of the red deer in Windsor Park, the following account of which is given by Mr. Frank Buckland, in *Land and Water*:

On the 16th of January last, one of the keepers who has charge of the deer in the royal domains was going his rounds, when he suddenly came upon the scene as represented in Fig. 1. A magnificent red deer was lying on his back, with his leg tightly fixed in the forked branch of a white-thorn tree. This unfortunate animal was lying on his near or left side, with the tip of his right shoulder resting against the trunk of the tree. The chest and fore part of his body were clear of the ground, suspended by his right or off foot in the fork of the tree. Immediate examination showed the keeper exactly what we see in the engraving, Fig. 2, except that the body of the animal (in the engraving) is no longer attached to the foot. The keeper attempted to remove the foot, but found it so tightly fixed that with all his force he was quite unable to do so. The shank bone of the stag's f.. t was fractured and splintered diagonally. The fractured bones had made their exit by a cut through the skin, thus causing a compound comminuted fracture. The portion of the bone below this fracture—tough and strong as the red deer's shanks are—was shattered into minute fragments the size of dice. The bone was again fractured at its lower part, and the thick skin entirely lacerated through. The large sinews at the back of the bone, as well as the wire-like sinews that work the toes of the foot, were elongated and pulled out, and in fact everything was broken right off except two very slender sinews and a small portion of the skin. The total length of the portion of the deer's leg caught in the tree is seventeen inches; from the fracture to where it was torn off, eight inches. The leg was caught by the branches of the tree about four feet from the ground, and the lowest boughs carrying leaves were about nine feet from the ground. The deer was dead, and it is not known how long he had been held a prisoner by his foot.

As there were no eye witnesses as to how this occurred to the stag, it becomes somewhat difficult to account for this extraordinary event. It is probable, however, that in consequence of the weather the animal was short of food, and that in his wanderings he had observed above his head something edible on the lower branches of the thorn tree, possibly leaves, moss, or lichens, on which deer feed in snowy weather. These he could not reach when standing on all fours. He, therefore, probably raised himself upon his hind legs, and when stretching himself upward and forward, the hoofs of his hind legs slipped from under him, or else, when letting himself down again, his right leg slipped suddenly between the forked branches of the tree, and was instantly held there tight. The animal then probably began immediately to struggle, but the more he kicked and fought the tighter the wrist of his foot got wedged in; in fact, when the preparation was brought to me the foot was so tightly fixed into the notch of the tree that it could not have been more jammed if it had been hammered down, and then a long screw passed through it. In his struggles to get loose the first thing that happened was the fracture of the leg bone. This allowed the animal to fall on his back, from which position, of course, he could not rise. Terribly alarmed at what had happened to him, the poor stag then began to pull and tug at his captive leg, assisting himself so to do by means of his horns. In his frantic exertions to get free, the stag a second time broke his leg, then the skin gave way, and lastly, the large tendons. If his strength had lasted long enough to have ruptured the two small tendons it is possible that he might have escaped, leaving his leg in the fork of the tree. Prince Christian, having been informed of the accident, judiciously ordered the portion of the tree which held the foot to be sawn off bodily. He then kindly sent the whole thing to me, with a request that the foot should be preserved for him without being removed from the fork in which it had been so tightly jammed by the animal itself.

The preparation will be the most unique specimen of an accident that ever occurred in the royal forest in the annals of English history.

Fig. 2.—FORE LEG OF THE STAG CAUGHT BY FORKED BRANCHES.

Fig. 1.—ACCIDENT TO A STAG IN WINDSOR PARK.

Coral.

The popular idea that coral is formed by an insect busily working to build up reefs in the ocean, is erroneous. A piece of coral is composed of the skeletons of tiny animals that in life are covered with a gelatinous substance. More than a thousand species of the coral animal have been described by Dana in his work entitled "Corals and the Coral Islands."

Of the sub-kingdoms into which the animal kingdom is divided, namely, vertebrates, articulates, mollusks, radiates, and protozoans, coral animals belong to the radiate division. These creatures have no sense except a low degree of sensitiveness, and live in salt, clear water, having a temperature of from 68° to 85° Fah. They do not live singly, but grow together in clusters, which start from a single, little animal, that is soft, oval, white, and jelly-like, and has the power of rapid motion. It attaches itself either to a rock or the sea bottom by one end, while the other spreads. Then a mouth, stomach, tentacles, and corporeal partitions are soon formed, and the last become quite hard from accumulations of particles of lime.

Coral animals belong to the class familiarly called polyps, and they multiply themselves by eggs and also by budding, until there are countless numbers living together in one community. Different kinds of coral bud in different ways; as some grow in bunches, others in round masses, and so forth. A piece of dead coral shows the spot were every animal has lived. As a mass of coral grows, the lower creatures gradually die, but their hard skeletons, consisting mainly of carbonate of lime, remain and furnish a firm foundation for those that work above them. By the striking of the waves against this foundation, its interstices gradually become filled with mud, bits of shells, and other substances which sea water contains, so that it grows firmer and firmer. If such a foundation is laid upon an elevation of the ocean floor, it is likely to continue to increase in size; but by the time it has reached the sea-level, the whole community of coral animals has become lifeless, for these polyps cannot live out of water. The beating billows break off portions of the skeleton formation, which are soon worn into sand by the water, and afterwards, perhaps, thrown with other *dēbris* upon the surface of the mass, which is thus supplied with soil. Then perhaps seeds are scattered upon this soil, which give rise to vegetation, and so a pleasant home is prepared for man.

These coral structures, called reefs, are often circular in form, and many of them inclose a lake or lagoon, whose waters furnish an excellent harbor for ships.

These reef-builders have not only built up large islands, but also considerable portions of the continents of Europe and America; and some of their structures must be of great age, as remains of a prehistoric civilization have been found upon them.—*From a lecture delivered by Prof. B. F. Mudge in Science Observer.*

Industrial Uses of Bamboo.

A late report of Dr. Schlich, Conservator of Forests in Bengal, says that there are about 1,800 square miles of pure bamboo forests in the Arrakan division of British Burmah, within a moderate distance of the coast, and all accessible by navigable streams. All these bamboos have flowered several years ago, and the ground is now covered with seedlings, which make the forest impassable. The question as to the practicability of using this plant for purposes of paper-making has several times been raised by Mr. Thomas Routledge, of England, and he has very recently returned to the charge again in a pamphlet entitled "Bamboo and its Treatment," wherein he has brought together information from botanists and cultivators well worthy of serious attention. From the *Lumberman's Gazette* we learn that a company has been formed in England, with a large capital, for the extensive and various utilization of this plant in the arts of industry, the enterprise having its origin in the multitude of uses for which the material is and for so long a time past has been employed in India. Besides being used in the latter country in the construction of the implements of weaving, Bamboo is there utilized for almost every conceivable purpose for which wood is resorted to in other countries. It forms the posts and the frames of the roofs of huts; scaffolding for building houses; raised floors for storing produce, in order to preserve it from damp; platforms for merchandise in warehouses and shops; stakes for nets in rivers; bars, over which nets are spread to dry; the masts, yards, oars, spars, and decks of boats. It is used in the construction of bridges across creeks; for fences; as a levee for raising water for irrigation. It is the material of which several agricultural implements are made, as the harrow, the handles of hoes, clod breakers, etc.; hackeries or carts, doodles or litters, and biers are all made of it; and a common mode of

carrying light goods is to suspend them from the end of a piece of split bamboo laid across the shoulder. Further, a joint of this material serves as a holder of many articles, as pens, small instruments, and tools, and as a case in which little articles are sent to a distance: a joint of it also answers for the purpose of a bottle, and is used for holding milk, oil, and various fluids, a section of it constituting the measure for liquids, in bazaars. A piece of it, of small diameter, is used for a blowpipe to kindle the fire, and by gold and silver smiths in melting metals. It also supplies the place of a tube in distilling apparatus. These, of course, comprise but a portion of the uses to which this valuable material is applicable, and it opens up a wide field for manufacturing industries.

NEW AGRICULTURAL INVENTIONS.

A gang plow in which the tongue and axle frame are combined with a pair of plow beams, connected adjustably at the rear end and pivoted to the tongue in front, so that it may be readily operated, has been patented by Mr. L. M. Kelly, of Litchfield, Ky.

An improved cultivator fender, which may be used with either a one horse or two horse cultivator, has been patented by Mr. Andrew Simmons, of Green Vale, and Michael Simmons, of Lena, Ill. It is designed to prevent the earth from being thrown upon the plants by the cultivator plows.

Mr. R. D. Norton, of New Sharon, N. J., has patented an improved pulverizing disk harrow, in which some of the details of the machine are perfected so that it is rendered more durable and effective.

An improved machine for the distribution of liquid or powdered poison upon cotton or other plants has been patented by Mr. Thomas B. Taylor, of Mount Meigs, Ala. It consists mainly in a perforated cylinder mounted on bearings supported by a plow beam, and capable of turning so as to sift or sprinkle the poison on the plants.

Ozone in Relation to Health and Disease.

Henry Day, M.D., in an address delivered before the Congress of the Sanitary Institute of Great Britain, gives the history of the discovery of ozone, and notices the successive theories of Schöenbein, Williamsom, and Odling concerning its nature. He then describes the pathological action of this form of oxygen, and reveals facts which will probably startle those who believe ozone and "ozonized" articles of food or of medicine to be universally beneficial. He describes the death of animals after exposure to ozonized air under symptoms closely resembling those of acute bronchitis. He considers that if present in excess in the atmosphere, catarrh, bronchitis, and even pneumonia would be its natural results. Whether there is ever such an excess as would involve these consequences is an open question. He feels also bound to admit, according to the researches of Dr. Moffat, that during "ozone periods," apoplexy, epilepsy, vertigo, neuralgia, and diarrhea are more frequent. Further investigations in this direction are imperatively needed, but what has been said may serve as a caution to dabblers in science who keep an ozone apparatus in action in their sitting-rooms as a prophylactic against diseases in general.

The absence or the deficiency of ozone has been, perhaps, too hastily placed in connection with zymotic disease. But that such a connection exists in case of cholera can scarcely be doubted. The author shows that in 1864, in the Bombay Presidency, cholera was in its greatest ascendency when ozone was either wanting or at its minimum; that the disease showed a most marked decrease when ozone was registered as increasing, and when at its maximum the epidemic ceased altogether if the maximum continued for any time. Similar results were obtained at Strassburg in 1854 and 1855, and the experiments of Mr. Glaisher and of Dr. Moffat give confirmatory testimony. Whether there may be other causes in operation in addition to deficiency of oxygen is still doubtful. As a disinfectant the author pronounces it the best, safest, and least objectionable known. That it may kill disease germs—whatever they may be—is no doubt highly probable from its action on the superior animals; but the question arises, pertinently says the *Chemical News*, Which will be killed first? and adds, We are somewhat surprised at finding in this address no reference to the well known and justly admired work of Dr. C. B. Fox.

Varying Velocity of Sound.

Some interesting experiments have been made at the U. S. Arsenal at Watertown, Mass., to determine whether the velocity of sonorous waves is or is not affected by variations in intensity and pitch. A 6 lb. brass field piece was placed in the midst of a large level field, and behind it, at distances ranging from 10 feet up to 110 feet, were placed a series of membranes electrically connected with a chronograph, which would thus give the instant at which the sound wave from the gun met each membrane in succession. The experiment was repeated many times and always with the same result. It was found that immediately in the rear of the cannon the velocity of sound was less than at a distance, but that going further and further from the cannon the velocity rose to a maximum considerably above the ordinary velocity, and then fell gradually to about the ordinary. When the gun, however, was pointed at right angles to its first position it was found that the position of maximum velocity was brought nearer to the cannon, and if the gun had been turned in the direction of the line of membranes, which was impracticable, it is thought the retardation which produced the first low velocities would probably have become an acceleration. The heaviest charges of powder caused the greatest deviations from the ordinary velocity. The experiments, accordingly, prove that the velocity of sound depends to some extent on its intensity, and that experiments on the velocity of sound in which a cannon is used contain an error, probably due to the bodily motion of the air near the cannon. Evidently a musical sound of low intensity must be used for a correct determination of the velocity of sound.

JAPANESE MIRRORS.

Mr. R. W. Atkinson, of the University of Tokio, Japan, communicates to *Nature* the following interesting account of these curious mirrors:

A short time ago a friend showed me a curious effect, which I had previously heard of, but had never seen. The ladies of Japan use, in making their toilet, a small round mirror about 1-12 to 1/6 inch in thickness, made of a kind of speculum metal, brightly polished and coated with mercury. At the back there are usually various devices, Japanese or Chinese written characters, badges, etc., standing out in strong relief, and brightly polished like the front surface. Now, if the direct rays of the sun are allowed to fall upon the front of the mirror, and are then reflected on to a screen, in a great many cases, though not in all, the figures at the back will appear to shine through the substance of the mirror as bright lines upon a moderately bright ground.

I have since tried several mirrors as sold in the shops, and in most cases the appearance described has been observed with more less distinctness.

I have been unable to find a satisfactory explanation of this fact, but on considering the mode of manufacture I was led to suppose that the pressure to which the mirror was subjected during polishing, and which is greatest on the parts in relief, was concerned in the production of the figures. On putting this to the test by rubbing the back of the

JAPANESE MAGIC MIRROR.

mirror with a blunt pointed instrument, and permitting the rays of the sun to be reflected from the front surface, a bright line appeared in the image corresponding to the position of the part rubbed. This experiment is quite easy to repeat; a scratch with a knife or with any other hard body is sufficient. It would seem as if the pressure upon the back during polishing caused some change in the reflecting surface corresponding to the raised parts whereby the amount of light reflected was greater; or supposing that, of the light which falls upon the surface, a part is absorbed and the rest reflected, those parts corresponding to the raised portions on the back are altered by the pressure in such a way that less is absorbed, and therefore a bright image appears. This, of course, is not an explanation of the phenomenon, but I put it forward as perhaps indicating the direction in which a true explanation may be looked for.

The following account of the manufacture of the Japanese mirrors is taken from a paper by Dr. Geerts, read before the Asiatic Society of Japan, and appearing in their *Transactions* for 1875–76, p. 39:

"For preparing the mould, which consists of two halves, put together with their concave surfaces, the workman first powders a kind of rough plastic clay, and mixes this with levigated powder of a blackish 'tuff-stone' and a little charcoal powder and water, till the paste is plastic and suitable for being moulded. It is then roughly formed by the aid of a wooden frame into square or round cakes; the surface of the latter is covered with a levigated half-liquid mixture of powdered '*chamotte*' (old crucibles which have served for melting bronze or copper) and water. Thus well prepared, the blackish paste in the frame receives the concave designs by the aid of woodcuts, cut in relief. The two halves of the mould are put together in the frame and dried. Several of these flat moulds are then placed in a melting box made of clay and 'chamotte.' This box has on the top an opening into which the liquid bronze is poured, after it has been melted in small fireproof clay crucibles. The liquid metal naturally fills all openings inside the box, and consequently also the cavities of the moulds. For mirrors of first quality the following metal mixture is used in one of the largest mirror foundries in Kiôto:

Lead	5 parts.
Tin	15 "
Copper	80 "
	100

For mirrors of inferior quality are taken:

Lead	10 parts.
Natural sulphide of lead and antimony	10 "
Copper	80 "
	100

"After being cooled the melting box and moulds are crushed and the mirrors taken away. These are then cut, scoured, and filed until the mirror is roughly finished. They are then first polished with a polishing powder called *to-no-ki*, which consists of the levigated powder of a soft kind of whetstone (*to-ishi*) found in Yamato and many other places. Secondly, the mirrors are polished with a piece of charcoal and water, the charcoal of the wood, *ho-no-ki* (*Magnolia hypoleuca*) being preferred as the best for the purpose. When the surface of the mirror is well polished it is covered with a layer of mercury amalgam, consisting of quicksilver, tin, and a little lead. The amalgam is rubbed vigorously with a piece of soft leather, which manipulation must be continued for a long time until the excess of mercury is expelled and the mirror has got a fine, bright, reflecting surface."

Professors Ayrton and Perry give the following explanation of the phenomena of the Japanese mirror:

"The magic of this Eastern mirror arises not, as has been supposed, from a subtle trick on the part of the maker, nor from inlaying of other metals, nor from hardening of portions by stamping, but from the natural property possessed by certain thin bronze of buckling under a bending stress so as to remain strained in the opposite direction after the stress is removed. And this stress is applied partly by the *megebo*, or 'distorting rod,' and partly by the subsequent polishing, which in an exactly similar way tends to make the thinner parts more convex than the thicker."

Lifting a Railway Bridge without Stopping Traffic.

A dispatch from Easton, Pa., dated April 10, states that the cleverest feat of engineering ever attempted in that region has just been successfully carried out. It seems that, owing to their immense weight, the iron shoes, in which rest two of the spans of the long bridge of the Lehigh Valley Railroad, had sunk about an inch, throwing the bridge out of grade. The inside masonry of the pier being less solid than the outer casing, it was evident that the depression would continue; accordingly an iron casting, 12 feet long, 3 feet 3 inches wide, and 3 inches thick, and weighing 7,000 pounds, was placed under the spans to elevate them, the spans being raised for that purpose by hydraulic jacks. The spans weigh 180 tons each. The spans were raised, the masonry redressed, the castings placed in position, and the spans lowered, without the stoppage of a single train.

A Large Steel Bridge.

The five span steel railway bridge over the Missouri River at Glasgow, Mo., is the first large bridge in this country built entirely of steel—from nuts to girders. The American Bridge Company built it of steel manufactured by the Edgar Thompson Bessemer Steel Works, but the steel was made by the A. T. Hay process. This consists of a decarbonizing followed by a recarbonizing of the iron, by which much greater tensile strength and elasticity are secured. This kind of steel allows of the construction of a much lighter bridge than if made of wrought iron, and is not affected by frost or cold weather.

Erratum.

In the description of Messrs. Pew & Wearts' carbureter, in our last issue, there is an obvious error in the statement of the economy of the apparatus. It should read: The gas meter registers one foot per hour for each burner, instead of the usual six feet, or only one hundred and twenty-five feet during five tests of five hours each, as compared with seven hundred and fifty feet, the amount usually consumed.

Importance of Patents Abroad.

The American Consul at Verviers, Belgium, in a dispatch to the Department of State, recommends American inventors to procure patents for their inventions in Europe as well as in the United States; that the drawings in the SCIENTIFIC AMERICAN are extensively copied in Europe, and American inventions are thus reproduced with no profit to the inventors.

THE MEXICAN EXHIBITION.—At the end of March 600 mechanics and laborers were engaged on the Exhibition Building, which was making rapid progress. Señors Riva Palacio and Sebastin Camacho are reported to have offered to advance the Government a loan of $200,000 toward completing the Exhibition Building at an early day.

IT is said that the oil that exudes from orange peel when bent between the fingers, will check the progress of carbuncles in their incipient stage. Perhaps the oil may also be useful for other cutaneous eruptions.

CALCAREOUS SPONGES.

This group of sponges received its name from the crystalline calcareous deposits scattered throughout the entire body of the sponge, and forming a skeleton similar to those formed by the silica composing the greater portion of silicious sponges. These calcareous deposits are formed by slender needles arranged in groups of from four to six each around a common center. The sponge possesses a small quantity only of organic tissue, and therefore on drying the sponges retain their original shape and size, and present, whether alive or dead, a chalky appearance.

The most elaborate monograph of calcareous sponges is that of Haeckel, the naturalist, in which he proves beyond doubt that the so-called one hundred and eleven species of calcareous sponges sent to him from all parts of the globe cannot be considered distinct species, but that they possess the capability of adapting themselves in form and structure to the variable conditions presented by different localities. Haeckel has, however, for the sake of convenience, divided these species into several families, the structural differences of which evince a progressive tendency from the simple to the complex. We are acquainted with the successive stages of development of a few species only, and of these the most important one is that of the larvæ.

If a calcareous sponge arrived at maturity, which is generally the case in May, is cut in slices or torn apart in small species, the larvæ are liberated and may be observed by means of a good microscope. They consist of two portions, differing greatly in appearance. One of them is composed of long conical cells carrying a long thread each (Figs. 1 and 2). The other consists of a number of round cells, rendered opaque by granular deposits.

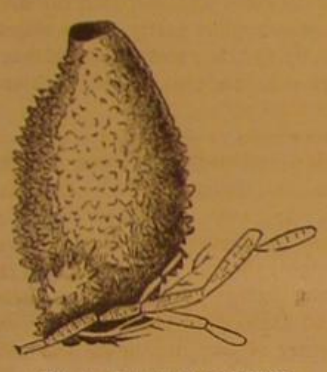


Fig. 3.—*Leucandra penicillata.*

Shortly after separating from the mother sponge the larva attaches itself to a rock. The threads attached to the cells of the upper half disappear, and the interior of the conical cells rapidly fills with calcareous crystals penetrating soon to the surface. An aperture is formed, lined by masses of crystals; the sponge grows and hardens gradually. The following spring it sends forth swarms of larvæ, which are carried to great distances by the sea currents.

The larger quantity of the water necessary for the maintenance of sponge life is alternately drawn in and ejected through pores scattered throughout the superficial crust of the sponge. Of these sponges there are three groups—bag sponges or ascones, bulb sponges or leucones, and honeycomb sponges or sycones. Bag sponges form closed or open cylinders, the walls of which are very thin. They are frequently so small and tender that they are hardly noticeable. Often a number of cylinders are united together, forming agglomerations of the size of the fist. To this family belong the beautiful *Ascetta clathrus* found plentifully in the Gulf of Naples and the *Ascaltis botryoides*, met with in the Northern seas.

The second family is characterized by an excessive development of the calcareous deposits. Among the most common representives of this family is *Leucandra penicillata*, illustrated in natural size by Fig. 3.

The highest degree of development is attained by the third family. Numerous individuals are united so as to form round disks resembling a honeycomb. The individuals have the shape of an elongated cup, Fig. 4, or a cylinder resting on a short stem. The edge of the cup is lined with a row of long slender needles.

Haeckel speaks as follows of the conditions under which the calcareous sponges pass their semi-animal life:

Calcareous sponges are found only in the sea. Not a single species has so far been found in fresh water or even in the mouths of rivers. Not a single species has been met with in the Baltic, the waters of which are very poor in salt, and this is also the case in the fjords of Norway. Placed in fresh water they die in a short time. Water containing a large percentage of mineral substances in solution seems, therefore, to be indispensable for maintaining the life of calcareous sponges.

Most of the species so far examined have been obtained from considerable depths. To all appearances light is injurious to their development, as the larvæ invariably select dark, shady spots for permanent attachment.

The Fruit of the Rose Bush as a Preserve.

Brillat-Savarin, in his "Physiologie du Gout," says that "the discovery of a new dish does more for the human race than the discovery of a star." If this be true, a writer in one of our French exchanges (*La Maison de Campagne*) has elevated himself above the average astronomer in announcing the discovery that the scarlet fruits of the rose bush, or "rose hips," as they are called, are capable of being made into most delicious preserves. Considering the fact that nearly every genus of the order *Rosaceæ* already furnishes man with delicious fruits, as strawberries, peaches, apples, pears, plums, etc., there is certainly no reason why the rose genus should not do so likewise. The fruit of every rose bush, says this writer, no matter what the species, provided it has single flowers (in other words, provided it is a wild species, for the flowers of the cultivated kinds are usually double), is good for preserving as soon as it has become ripe and tender. The essential point is to gather the fruit at the right moment, which, in the case of the sweetbrier (*Rosa rubiginosa*), would be in September. Gather the fruits, then, as soon as they have become soft, take out their seeds, put them in an earthen or porcelain-lined saucepan, and place them over a slow fire, having added just enough good wine vinegar to make them pass readily through a colander, after five minutes' cooking. Place them over the fire again, and add enough sugar to overcome the acidity of the vinegar, and let them boil again very gently, stirring all the while, until they become of a homogeneous and pasty consistency.

Put this in jars or wide-mouthed bottles, and it will keep indefinitely.

The author adds that preserved rose hips, properly prepared, give an exquisite flavor to sauces, go well with beef, veal, and chicken, and combine well with truffles and mushrooms; and that a dash of Madeira wine in no wise injures the preserve. Wild rose bushes exist everywhere, by the roadside and in fields, all over the country, and their fruit can be had for the gathering. It only remains for the American housekeeper to take the hint and try the experiment.

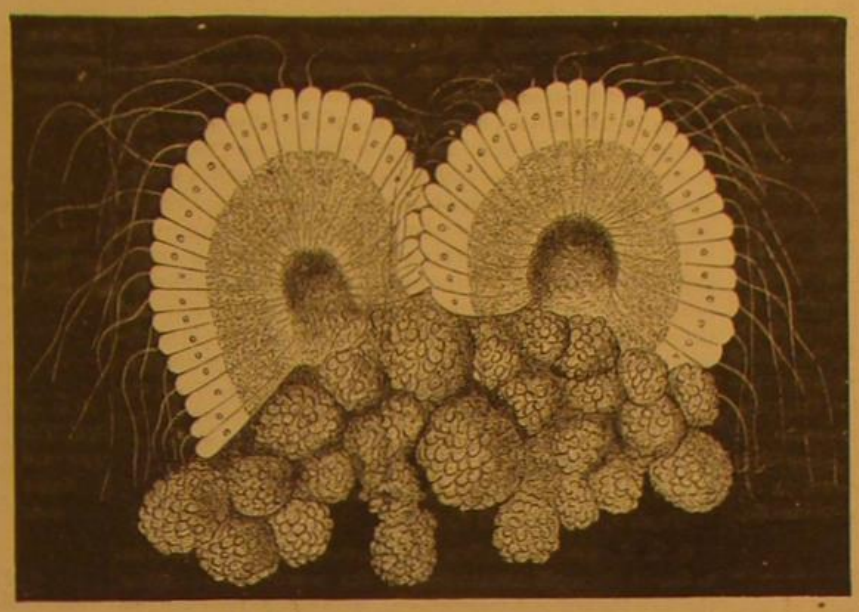


Fig. 2.—Transverse section of a twin individual of larva of *Sycandra raphanus*, 1:600.

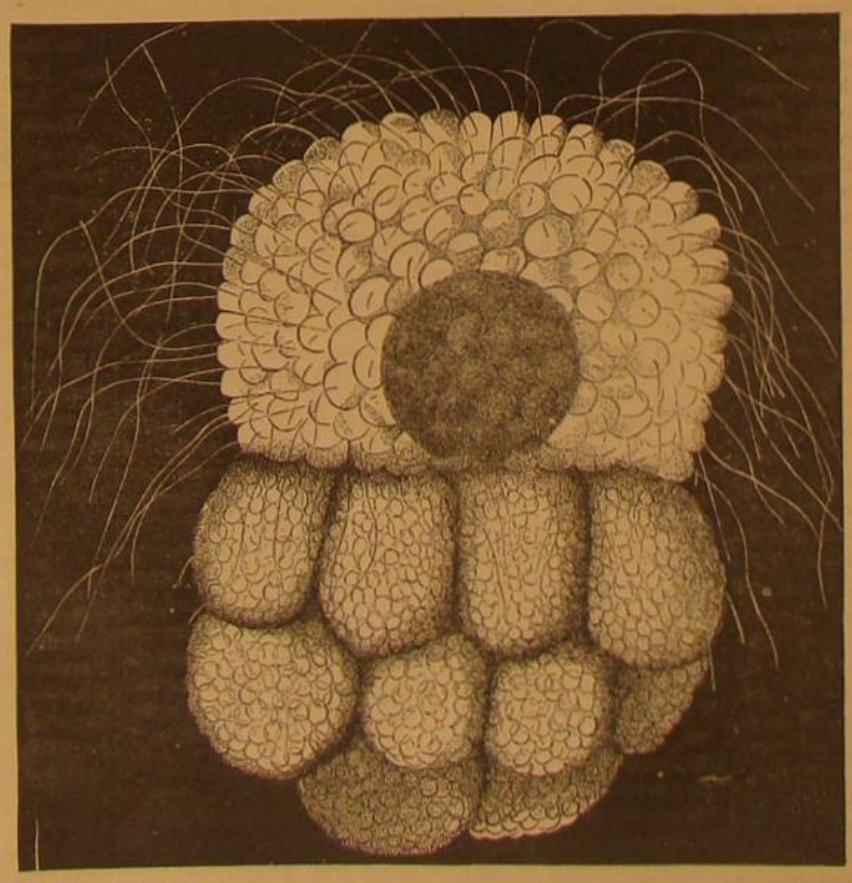


Fig. 1.—*Sycandra glabra*, 1:600.

The Grape Phylloxera.

[Latest Facts about the Phylloxera: read by C. V. Riley at the recent annual meeting of the Missouri State Horticultural Society.]

The fact that about 280 tons of California grapes were received weekly and sold in the markets of Philadelphia during the past season, is sufficient to show that the grape interest in this country is increasing in importance, and to lead to the hope that the discouragement which the Missouri grape grower naturally feels, after four consecutive unfavorable seasons, must needs soon give way before brighter prospects that, it seems to me, are necessarily in store for him. One thing is sure, namely, that the interest manifested abroad in our American grape vines does not flag. These vines are constantly discussed in the foreign horticultural journals, while one periodical, entitled *La Vigne Americaine* (The American Vine), is entirely devoted to them. It is a source of no little satisfaction to me that the varieties which I first recommended, seven years ago, are in the main those still sought for and used by the French sufferers from phylloxera, as stock on which to graft their *viniferas*. It is further interesting to observe that the grounds which I took in regard to grafting above ground, in my 7th Report, pp. 108–116, are justified by the experience had during the last few years in France. Such grafting is found to be quite practical, notwithstanding the want of faith shown in it by our earlier ampelographers.

I sincerely hope that this question of grafting the vine above ground as a means of evading the injuries of phylloxera, or of improving such varieties as do not succeed upon their own roots, will be discussed by your society, so as to bring out whatever experience on the subject the Missouri grape growers have had of late. The fears which I expressed in my 7th Report, as to the danger of the introduction and spread of the phylloxera in California, have also been more than justified, since many vineyards have already been seriously injured or totally destroyed by the insect. I am glad to be able to confirm, in this connection, the truth of the statement of Mr. P. J. Birckmans, of Augusta, Ga., namely, that this insect does not occur in that locality. While spending a few days with him last September, I was able to verify its non-occurrence there; and here let me remark that, however much contempt a Missourian may have for the Scuppernong, no one can witness the prolificacy or experience the delicacy and sweetness of such varieties as Tenderpulp and Thomas, as they grow in that region, without having a due appreciation of their value for the Southern States.

Fig. 4.—*Sycandra ciliata.*

Regarding the range of phylloxera, it had often been asserted that around Washington the root insect was not to be found. Yet I have found it extremely abundant, both in the vineyards of the district, and of those just across the line in Virginia, some of the latter suffering to such an extent that the crop was a failure, though the owners were unsuspicious of the cause.

After reviewing, in my 8th Report, all that was then known of the habits and natural history of the grape phylloxera, I drew certain practical conclusions, to the effect that complete knowledge of its habits, instead of simplifying its destruction, showed that it was almost if not quite hopeless to expect its destruction by any possible or practical means, and rendered preventive measures all the more urgent. I expressed my doubt as to the value of decortication of the vines, and the burning of the bark in winter, or by any means which aimed at the killing of the winter egg upon the branches and canes of the vine. Diligent search has failed to reveal these winter eggs in anything like the quantity one might expect, and the fact remained that the insect could go on propagating under ground for at least four years without the necessary intervention of the impregnated egg. Further researches, made since, confirm me in the belief that the normal mode of hibernation of the species is as a young larva upon the roots. From the results of the deliberations of the International Phylloxera Congress, held last summer at Lausanne, and that held at Montpellier, in France, it was conclusively proved that decortication, as I had anticipated, was of little or no avail.

Before leaving the question of phylloxera, let me briefly refer to certain theories first propounded by Prof. A. C. Cook, and that have been extensively promulgated during the past two years, as to the relation of phylloxera and grape-rot. I took occasion, last spring, to protest, in the New York *Tribune*, against the supposed connection between the two, and it will not be out of place to repeat the reasons:

"Already, in 1871, when I first announced the presence of phylloxera on the roots of American vines, and explained

the injury which it caused, there were writers who, not content with the simple facts, went much further and asserted that this little insect must also be the cause of mildew, rot, etc Professor Cook has jumped to similar false conclusions, and has, during the present winter, promulgated before various societies his belief that the phylloxera is the cause of black rot in grapes. This is sensation, not science, and it is to be deplored, coming from the source it does. The phylloxera occurs in most grape-growing sections of the country east of the Rocky Mountains, and will quite naturally be found on vines on which the fruit has rotted.

"But an experience covering several years, and the examination of hundreds of vines, with rot of fruit and without it, enables me to deny the assertion that the insect is more numerous on the former than the latter. The phylloxera disease has its own peculiar characteristics, which are at once distinguished from other vine diseases by those understanding it. There are also very conclusive reasons for discarding the views of Prof. Cook. 1. In France, where the phylloxera has been so very destructive, the black rot has not accompanied or followed it. 2. The rot, so far as I have observed it, is no worse on the susceptible than on the more resistant varieties; while many cases might be adduced of healthy vines, and those least affected with the insect suffering most from rot. 3. On account of three successive wet summers of 1875, 1876, and 1877, in this part of the country (Missouri), the phylloxera has been less numerous and less injurious than at any time since 1871, and many vines that were suffering near to death have recuperated, yet no year since the time mentioned has black rot been worse than it was last summer."

Correspondence.

The Genesis of the Mosquito.

To the Editor of the Scientific American:

For several years past I have noticed in warm weather, that my wooden cistern, which is above ground, has been infested with peculiar looking little red worms. I have heard many others like myself complain of these worms, and I had taken it for granted that they were a species of earth worm. However, last summer I procured a glass jar and sprinkled the bottom of it with a very small quantity of sand and clay. I then half filled the jar with clear fresh water, and, after putting a dozen of these worms in the jar, I tied a piece of cloth over the mouth, and placed it in a light, airy place.

The worms were from half to three fourths of an inch in length, of a bright red color, and had rather a jointed appearance about the body. They would crawl on the bottom of the jar, swim through the water by a rapid bending of the body backward and forward, and occasionally come up to the surface of the water and float.

Within twenty-four hours after placing them in the jar, I noticed that they had all gone down to the bottom of the vessel, and had enveloped themselves separately in a kind of temporary shell made of earth and sand.

In a few days after this I saw one of these worms crawl out of his temporary house at the bottom of the jar, and swim to the surface of the water. Here, after twisting about for a few seconds, he ruptured a thin membrane that enveloped his body, and came out a full fledged mosquito ready for business. I noticed many of the other worms going through the same performance within a short while afterward. Some of the mosquitoes were much larger than others, but, as I have already stated, some of the worms were also larger than others.

F. W. COLEMAN, M.D.

Rodney, Miss., April, 1879.

Remedies for Carpet Beetles, Moths, etc.

To the Editor of the Scientific American:

At this season we are frequently besieged by inquiries in relation to the "carpet beetle," moth, etc. Many of your readers may be glad to know of the following simple remedies:

First.—Steep one quarter of a pound of Cayenne pepper in a gallon of water; add two drachms of strychnia powder. Strain and pour this tea into a shallow vessel, such as a large tinned iron milk pan. Before unrolling a new carpet, set the roll on each end alternately in this poisoned tea for ten minutes, or long enough to insure the saturation of its edges for at least an inch. After beating an old carpet, roll and treat all its seams and edges to the same bath. Let the carpet dry thoroughly before tacking it to the floor, in order to avoid the accidental poisoning of the tacker's fingers by the liquid. It is perhaps unnecessary to state that the residue of the liquid should be thrown out where it will not be drunk by any domestic animal, or if preserved for future use, carefully labeled "poison."

This preparation will not stain or disfigure carpets nor corrode metals in contact with the carpet, as will most preparations of corrosive sublimate.

Second.—One pound of quassia chips, one quarter of a pound of Cayenne pepper steeped in two gallons of water. Strain and use as above. This preparation, although irritating to the human skin, especially on cut surfaces, has the advantage of not being poisonous.

To either of these teas from one quarter to one half more boiling water may be added at the time of first using, if greater depth of the liquid in the vessel be required. When it is desirable to treat carpets that are not to be taken up, either of the above preparations may be applied by means of any of the common atomizers to every seam and margin with good results, although a second, and even third, application may be needed.

FRANCIS GREGORY SANBORN.
Consulting Naturalist.

Andover, Mass., April 10, 1879.

The Ice Cave of Decorah, Iowa.

To the Editor of the Scientific American:

"H. M. W." is mistaken about the formation of the Upper Iowa Valley, Winneshiek county, Iowa, where the Decorah Ice Cave is situated. It is in the Trenton limestone, which is highly fossiliferous, and manufactured into monuments, table tops, paper weights, etc., presenting, when polished, a very beautiful appearance.

The Ice Cave is a fissure in the Trenton limestone cliff facing to the south, and runs nearly parallel with its face, is about 100 feet long, and varies from 2 to 6 or 8 feet in width. Height irregular, in places compelling progression on hands and knees. Says White's "Geology of Iowa," vol. 1, p. 80: "The formation of the ice is probably due to the rapid evaporation of the moisture of the earth and rocks, caused by the heat of the summer sun upon the outer wall of the fissure and the valley side. This outer wall is from 10 to 20 feet in thickness where the ice is most abundant. The water for its production seems to be supplied by slow exudation from the inner wall of the cave." It forms the most rapidly during the extreme heat of summer, and disappears in winter entirely. From several years' acquaintance with the cave, I believe the above explanation correct.

A. M. M.

Waukon, Iowa, April 2, 1879.

C. B. A. submits another explanation, namely, that the ice is due to the rapid evaporation of the moisture percolating through the soil and rocks above. To produce the ice "two conditions are necessary: first, that the supply of moisture in the cave must not be (as it was when I visited it, a hot day in June, after much rain) great enough to warm the cave and thus overcome the cooling tendency of the evaporation to form ice or to melt the ice that may have been previously formed.

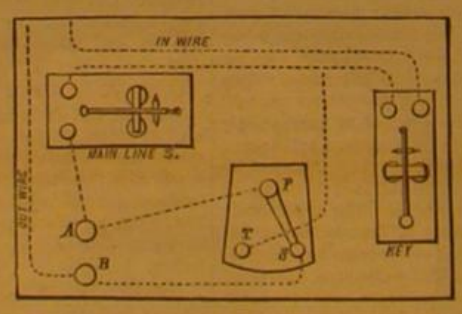
"Second, the supply of water must be sufficient to carry on the evaporation and leave a surplus for conversion into ice. This condition is met only during the summer months, when the temperature is high enough to create a current of air upward through the cave, and when supply of water is not so great as at other seasons. In the winter the ground is frozen and water prevented from soaking through, and so the ice formed in the summer evaporates. Also, the temperature outside and inside being so nearly the same, very little air passes through."

C. G. C. writes that a counterpart of the Decorah Ice Cave occurs on the south side of Black River, at Watertown, N. Y., the rock being the well known Black River limestone.

Telephones and Sounders.

To the Editor of the Scientific American:

As some of your readers appear to find difficulty in using telephones and sounders in the same circuit, I would recommend the following plan, which has been found to work well in practice upon a line where there are twenty offices, and nearly as many telephones in use:



The diagram shows the arrangement. The in wire, which comes from the zinc pole of the battery, is carried to the key and from the key to the relay or main line sounder, and thence to a binding post marked A. B is another binding post, from which the out wire goes to the line. P T S is a two point switch, one point of which, T, is joined to the wire between the key and sounder. P, the point on which the switch tongue turns, is joined by a wire to the post, A, and the point, S, to the post, B. All these connections are beneath the table, the posts, A and B, rising above, and in them the conducting cords of the telephone are inserted. When the switch tongue rests on S the sounder only is in circuit, and can be used to call. When the tongue rests on T the telephone is in circuit, and the sounder is cut out. When the telephone is not in use the switch should be kept on S, closing the circuit through the sounder and preventing waste of battery. Care should be taken that the Z pole of the telephone is attached to the post which receives the zinc wire from the battery, the post, A, in the arrangement as described. If desired, bells may be substituted for sounders.

JOHN E. NORCROSS.

Tracing the Hudson under the Sea.

The *Atlantic Coast Pilot*, published by the United States Coast Survey, explains the origin of the curious deep holes met with along the New Jersey coast, some distance out at sea. Of these "mudholes," as they are termed, nine are known to navigators, the deepest and the furthest out being the hundred and forty-five fathom hole, 83 miles southeast of Sandy Hook light vessel. These remarkable depressions, as the *Pilot* points out, bear the appearance of having been originally a continuation seaward of the Hudson River Valley. They were in all probability scooped out by the river being forced to run through narrow gorges. Several of these gorges can still be traced running almost parallel with the New Jersey shore line. In fact, the soundings along the coast would seem to indicate that the whole coast line, ages ago, was many miles seaward of its position to-day; that then the Hudson River entered the ocean at least a hundred miles southeast of its present mouth, and that the whole continent has since subsided, the sea encroaching further and further inland, as the country gradually sank.

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

The computations in the following notes are by students of Vassar College. Although only approximate, they will enable the ordinary observer to find the planets.

M. M.

POSITION OF PLANETS FOR MAY, 1879.

Mercury.

On May 1 Mercury rises at 4h. 20m. A.M., and sets at 5h. 6m. P.M. On May 31 Mercury rises at 3h. 40m. A.M., and sets at 5h. 38m. P.M.

Mercury will be best seen near the middle of the month, in the morning, as it is then at its greatest elongation.

Venus.

On May 1 Venus rises at 6h. 45m. A.M., and sets at 9h. 54m. P.M. On May 31 Venus rises at 7h. 21m. A.M., and sets at 10h. 29m. P.M.

The motion of Venus among the stars from night to night is very perceptible. On May 21 it will be 4° south of Pollux in declination, and will precede that star by about 2° in right ascension. Venus and the crescent moon will be nearly in conjunction May 24.

Mars.

On May 1 Mars rises at 2h. 27m. A.M., and sets at 0h. 58m. P.M. On May 31 Mars rises at 1h. 22m. A.M., and sets at 0h. 51m. P.M.

Mars is very distant, but its ruddy color and its nearness to Jupiter on the morning of the 9th will cause it to be easily found.

Jupiter.

Jupiter is coming into a better position. It rises on May 1 at 2h. 35m. A.M., nearly with Mars; and sets at 1h. 25m. P.M. On May 31 Jupiter rises at 48m. after midnight, and sets at 11h. 47m. A.M.

Although Jupiter is in south declination, it is so large a planet that it will be very conspicuous in the early morning. Jupiter will be near the waning moon on the morning of the 14th.

Saturn.

Saturn rises on May 1 at 3h. 57m. A.M., and sets at 4h. 11m. P.M. On May 31 Saturn rises at 2h. 6m. A.M., and sets at 2h. 28m. P. M.

Uranus.

On May 1 Uranus rises at 0h. 47m. P.M., and sets at 2h. 16m. A.M. of the next day. On May 31 Uranus rises at 10h. 51m. A.M., and sets at 18m. after midnight.

Uranus follows the bright star Regulus on May 1 by 2° in right ascension, and is one third of a degree below it in declination. The position changes very little during the month.

Brorsen's Comet.

This small periodical comet has passed its perihelion and is approaching the earth. It resembles a nebulous star, and moves so rapidly by one and another star that with little optical aid the observer can see the change in an hour's watch.

Its motion is from the constellation Camelopardalus to that of Ursa Major. After April 21 the comet is circumpolar and does not set in this latitude. Following the ephemeris of Schulse, the comet will be nearest the earth on May 10. Its place at that time will be among the small stars in the head of the Great Bear.

How to Prevent Diseases among Children.

A correspondent of the New York *Times* says that he has followed a recommendation from a lady to evaporize a little carbolic acid daily in the heaters as a disinfectant and a preventive against contagious diseases, and the results have been most satisfactory. "I have a large school, and out of the whole number only two pupils have been sick with scarlet fever, and even these cases were indirect ones. In my own family, which consists of fourteen children—fortunately not all my own—and five adults, not one has been afflicted with any malady, not even with a sore throat, for longer than a day or two. We certainly keep the house minutely clean, ventilate it thoroughly every day, and never heat the rooms above 66° Fah. During my thirty years' experience I have never seen the like."

We think it probable that the use of a small quantity of carbolic acid in the manner above mentioned may in some cases be beneficial. But if it were the golden rule in every family to keep the house minutely clean, ventilate it thoroughly every day, and never heat above 66° Fah., there would probably be little need of carbolic acid or any other drug.

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NEW BOOKS AND PUBLICATIONS.

TABELLEN ZUR BESTIMMUNG DER MINERALIEN NACH AUSSEREN KENNZEICHEN. Herausgegeben von Dr. Albin Weisbach. Leipzig: Arthur Felix.

Contains in clear, concise terms the chemical composition, outward appearance, and other properties necessary for the recognition of about 1,000 minerals, together with such remarks as may be of special interest. Only one feature diminishes the value of the book for practical purposes—the minerals are arranged in groups solely according to the similarity of their outward appearance. To determine a specimen the student must, therefore, select one of the numerous tables and hunt up among its members one the properties and behavior of which will exactly correspond with those of the specimen, at the cost of much time. Had the reverse order been chosen, as by Fresenius in his "Qualitative Chemical Analysis," the practical value of the book would have been much greater. Nevertheless the completeness and conciseness of the work render it valuable as a book of reference to the chemist, miner, and mineralogist.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) H. C. R. asks: What kind of varnish is used to obtain the fine finish on fish rods, and how is it applied? A. Try a mixture of alcoholic shellac varnish 2 parts, boiled linseed oil 1 part, shake thoroughly before using, and apply with a cloth pad, rubbing the article to which the polish is applied, until the varnish is dry and hard.

(2) H. A. M. asks: Will you inform me if there is any difference between a foot square and a square foot. A. As surfaces, no. In terms, yes. A "foot square" is a square 12 inches on a side (=144 sq. in.) A "square foot" is 144 sq. in. in any shape.

(3) B. asks: What is the lifting power of street gas per cubic foot? A. The average when petroleum is not employed for "enriching," is about 35 lbs. per 1,000 cubic feet.

(4) "Science" writes. My intention is to learn the engineering profession, but I have a liking to either steamship, locomotive, or steamboat engineering. 1. Which, in your opinion, is the best and most skilled position of the three, and receives the best salary? A. Locomotive engineering offers the best field. 2. What is the salary of locomotive engineers on our Western roads? A. We do not think there is any standard; they differ on different roads and with the kind of train.

(5) A. T. T. asks: Will a crank give the same motion as an eccentric to work the valve on an engine? A. Yes.

(6) R. C. L. asks: How can I obtain a high polish on cattle horns? A. *a*, scrape the horn carefully; *b*, smooth with powdered pumice stone and oil; *c*, polish with rotten stone and oil.

(7) H. S. C. writes: A portable 2 horse power steam engine can be purchased for two hundred dollars or less; in view of this why are not our machinists and steam men awake to the fact that there are hundreds of men waiting for a steam road wagon which we know can be got up for less money than to purchase a horse wagon and appliances? A. Your two horse engine would cost nearer $400 than $200. Have you considered the expense of a skilled engineer, the current repairs, the chances and costs of accidents, etc.?

(8) J. D. H. writes: If J. A. F. (43) "Notes and Queries," SCIENTIFIC AMERICAN, March 8, will reduce the blast nozzle to seven eighths inch, he will have all the power he wants.

(9) G. M. D. asks: 1. What is waterglass? A. A variety of glass (silicate of soda or potash) containing excess of the alkaline base, soluble in water. 2. How are agates polished? A. Usually horizontal disks of iron, pewter (or copper), wood, and leather covered with moistened emery of different grades of fineness, sand, rotten stone, or tripoli, and putty powder, respectively.

(10) J. F. & J. H. W. write: We saw in SCIENTIFIC, February 22, an alloy of tin and phosphorus. Is phosphorus a metal, and how is it mixed with tin or copper? A. Phosphorus is non-metallic; it may be forced beneath melted metal by means of a rod of baked clay having a small bell-shaped cavity at the lower end.

(11) J. M. asks if hair can be produced on the face by artificial means, and if so, how. A. See answer No. 40, p. 252, current volume, SCIENTIFIC AMERICAN.

(12) W. C. writes: 1. A train is traveling at a speed of 50 miles an hour. A cannon placed on one of the cars is fired off at a given point in the same direction as the train; the projectile from cannon has same velocity as train. How far will projectile be carried in an hour? A. Add the uniform speed of the train to the range of the projectile. 2. Reverse the cannon and shoot in opposite direction. How far will it carry? A. If the ball leaves the gun at same velocity as train is running it will fall nearly vertically to the ground.

(13) H. C. R. asks: How long has the engine in the United States Mint at Philadelphia been in use? A. The horizontal engine, built under the direction of Franklin Peale, Esq., was erected in 1837, and removed in the end of 1877, after 40 years' service. The "Steeple" engine was erected in 1850, and is still in use.

(14) S. M. D. asks: Is there any process by which iron can be prevented from rusting, when not painted; if so what is it? A. See articles on Professor Barff's process, No. 126, SCIENTIFIC AMERICAN SUPPLEMENT, and pp. 327 and 367, vol. 39, SCIENTIFIC AMERICAN.

(15) V. writes: I propose to lay an inch or one and a half inch iron pipe from this office to another office, 260 feet distant, and the pipe is to lie mostly underground and to be used for a speaking tube. It will have three turns or elbows in it. Could conversation at one end be heard distinctly at the other? A. Yes, if the corners turned are not too sharp. Make the curves of your elbows of large radius, say 12 or 18 inches.

(16) T. D. H. asks: What will set the colors in new calico or gingham that are likely to fade, without injury to the goods? A. The mordant will depend altogether upon the character of the dye or color used on the goods. Many dyes (such as the coal tar or aniline series) become bleached by prolonged exposure to sunlight; as a rule this cannot be remedied.

(17) O. S. W. asks: Is ozone produced during the process of ironing cotton clothing? I have frequently noticed the odor of ozone on going into the kitchen where the girl was ironing. A. Probably not; the odor of hypochlorous acid and of nitrous vapors is often mistaken for ozone.

(18) L. L. W. asks: 1. Why is the present apparatus of log chip and line preferred by navigators to any other mode of ascertaining the speed of a vessel? A. Because of cheapness and simplicity; further, "old salts" understand it. 2. Is there any reason why the telephone should not in time carry the voice across the ocean through the cable? A. The electrical current works so slowly through a long submerged cable as to render the use of a telephone in connection with it impossible.

(19) A. P. S. asks how to polish pearl shell (mother of pearl for umbrella handles). A. *a*. Smooth it on a common grindstone wet with soap and water. *b*. Apply powdered pumice stone and water with a buff wheel. *c*. Finish with rotten stone moistened with sulphuric acid a little diluted with water.

(20) O. W. F. writes: If three men have a shaft to carry which is 12 feet long, and two men was to carry with a lever (and the other man at one end) where will they place the lever so as to carry two third of the shaft? A. Three feet from end of shaft.

(21) E. S. C. writes: My engine is horizontal, 6 inches stroke, 3 inches diameter; what size boat of side wheel pattern will it run with ease; what size of paddle wheels and how many strokes to the minute, when the engine runs at 300 strokes? A. Your engine would probably drive a light skiff about 5 to 6 miles per hour in still water; it would, however, depend much on your boat, and whether the engine is geared or works direct on paddle wheel shaft. Paddle wheels about 4½ feet diameter by 15 inches face would suit.

(22) J. R. F. writes: We have a 75 horse high pressure engine which exhausts by way of a Berryman heater up through pipe 30 feet high. We have a hole at the bottom, and the steam condensed is now running to waste. Can I utilize this water by pumping it back into the boilers, or would the grease from the cylinder prevent my using it? A. As the Berryman heater heats all the feed water you require, the gain by returning the condensed water will not be worth the cost.

(23) H. L. V. asks: 1. What is "manifold" paper? A. The white paper is only very fine thin writing paper. The black is soft paper, prepared by being smeared with a composition of grease and plumbago or lampblack; this mixture is allowed to remain on for 12 hours, and the paper then wiped with a piece of wool or cotton waste. Place white paper over black, and write with a blunt point. 2. What was the size and capacity of the Mary Bell, said to have been the largest steamboat on the Mississippi? A. We do not know; will some correspondent at the West inform us? 3. Our canary chews the quill end of such of his feathers as fall out. What does it need? A. Cuttle fish. 4. What are some good works on spectrum analysis? A. Spectrum Analysis, by H. E. Roscoe; Spectrum Analysis, by H. Schellen, and Spectrum Analysis, by Professor Redwood, No. 79 SCIENTIFIC AMERICAN SUPPLEMENT.

(24) F. G. writes: In reply to B. S. S., April 12, you say it is known in practice that higher results are obtained by throttling. Do you mean by that that it is advisable in an automatic cut-off engine following far enough to show a terminal pressure of say 17 lbs. absolute, to throttle the steam and allow it to follow enough further to make the average pressure the same in both cases? A. The gain by throttling is greatest when working without expansion or with a fixed expansion. We think there is gain in all cases in carrying a greater pressure in the boiler than is required for the engine.

(25) J. S. P. asks how a soft solder for tin vessels can be made, which is used by heating from the flame of a candle. There is such a solder sold on our streets, which so far has given satisfaction. A. Melt together 2 parts of block tin and 1 part of lead. Take a ladle having a small hole in the bottom, and hold it over a barrel of water, and pour the melted solder into it. As the stream of melted solder is cooled by the water it forms a sort of wire.

(26) C. L. asks: If in a room 50 feet long there is a mirror at one end, will the reflection of an object at the other end of the room appear in size the same as one 50 feet from the observer standing at the mirror, or will it appear the same as one 100 feet from the person? A. To a person standing at the mirror it appears 50 feet away. To a person standing 50 feet from the mirror it would appear to be 100 feet distant.

(27) W. G. H. asks: 1. Can an ice boat run dead ahead of the wind at a speed greater than the velocity of the wind? A. No. 2. Do the Gatling guns when fired at an object send the successive shots to the same point if the aim of the gun is not altered, or do the shots spread or scatter? A. We think they do not scatter.

(28) C. P. T. asks: 1. Is there any back movement in the current of a stream of water in a hose pipe when the stream from any cause is suddenly checked, so as to occasion bursting of the hose? A. Yes. 2. If so, does it extend back to the engine or hydrant throwing the stream? A. Yes. 3. Would the pressure or strain on the hose be less after the stream was closed, or greater than while the stream was in motion? A. Greater.

(29) J. H. asks what kind of oil is the best to use in boilers to keep them free from scales; also the best oil for cylinders; also what effect has tallow and lard oil on piston valve, rods, etc.? What effect has petroleum? A. Mineral oil can be used in boilers. Special cylinder oils are prepared for cylinders, though good mineral oil answers very well when properly applied. Pure tallow and lard oil can be used without injurious effects.

(30) J. B. M. writes: I have a vertical boiler (30 H. P.) without flues or tubes; it is 10 feet high; the firebox is a shell within a shell, 4 inches between the walls, with 4 apertures equidistant for the escape of smoke and flame some 6 inches below the crown sheet; the firebox is 5 feet high; from the crown sheet upward is the steam chamber or dome; the boiler stands on a cast ring, some 6 inches larger than the boiler; and around the boiler there is a sheet iron jacket, the size of the ring, the entire length of the boiler, fitted close by a cap of same at the top. Now, the questions I wish you to answer are these: 1. I want to put a brick wall in place of the iron jacket. Is it essential that I should run the wall the entire length of boiler, or would it do as well if I were to draw in the wall (say 12 inches above the usual water line in boiler) until the brick touched the boiler, and continue to the top; or had I better keep the wall the same distance from boiler all the way up? A. The latter way would be the best. 2. Could I put in a heater made of ordinary wrought iron piping (say 1 inch diameter), placing it between the wall and boiler, where it would be acted on by the heat of the fire so as to save fuel by it, having the same connected directly to feed pump? A. It would be better to use cast iron pipes. 3. I use strong lime water, and it forms scale. Would not an inch pipe soon choke up by formation of lime cake? A. You should arrange the pipes so that they could readily be cleaned.

(31) J. B. asks: Is there any rule for finding the diameters, focal lengths, and distances apart of the field and eye lens of a Huygheus or negative eyepiece of any power; also the diaphragm aperture and distance of same from either lens? A. The focal lengths

of the lenses are as 1 to 3, and their distance apart is equal to half the sum of their focal distances. The lens of greatest focal length is the field glass. The diaphragm should be placed about midway between the lenses, and its aperture should be as small as possible without cutting down the field. Eye-pieces of different focal lengths may be used with the same objective.

(32) L. O. asks what to apply to old plaster Paris busts, that have become dirty, that will make them look like new. Dust has settled in the pores and I can not remove it. A. Give them a dead coat of china white, or you may varnish them and apply a coating of silver, gold, or bronze colored bronze powder.

(33) W. D. S. writes: 1. I have a vertical boiler, 4 feet high, 27 inches diameter (including furnace, which is internal and 18 inches high); boiler has nineteen 2 inch flues; is made of five sixteenth iron; engine, 3 inch bore, 7 inch stroke, running 350. We have not enough power to run a small planer; we use from 60 to 80 lb. steam pressure. Could we with safety increase this pressure; the boiler has been in use only 2 years; or could we run a larger engine with the same boiler, say 4½x4½? A. If your boiler is five sixteenths inch thick, of good iron, and well made, you may carry 120 lb. without hesitation. 2. I noticed in a recent number of the SCIENTIFIC AMERICAN a correspondent wants to know if oil will stop priming. I frequently use the common black lubricating oil, feeding it with feed water with good effect. Will it injure the boiler? A. No.

(34) G. H. P. asks: 1. What is the expansion of glass between 32° and 212° Fah? A. Glass which at 32° F. is 1,000,000, at 212° becomes 1,000,861. 2. How to solder brass on to a valve seat of a steam cylinder. A. Clean the valve seat, coat it with solder by means of a heavy soldering iron. Tin the brass plate, heat it quite hot, and put its tinned side downward on the valve seat. If the brass plate has not sufficient thickness to admit of this treatment you may "sweat" it on.

(35) S. A. B. asks: 1. How can I put a very high polish on steel? A. The steps in the process are as follows: 1st, Coarse wet stone; 2d, fine wet stone; 3d, buff wheel having fine emery applied; 4th, crocus, different degrees of fineness. 2. On brass? A. Finish as finely as possible with files, then with Scotch gray stone, and finally, with the powder of Scotch gray stone and oil, or with rotten stone and oil. 3. How is the so-called "Florida sea bean" polished? A. After smoothing, use powdered pumice stone and water. Finish with rotten stone and water or oil.

(36) S. F. writes: I have an induction coil, of Ladd's make (London), of the following dimensions: Length of coil proper, 11¼ inches; diameter of coil proper, 5 inches; diameter of core, 1½ inch; base board containing condenser, 19¾ by 9 inches; condenser plates, 19 by 8½; number of condenser sheets, unknown; length of primary wire, estimated, 75 feet; number of secondary wire, 3 miles (16,000 feet). This coil was sold promising to give a spark in air of 4 inches, but I never realized more than 3 inches, and then a feeble spark. The battery which I employed with this coil consists of four 1 gallon jars, in each of which there are immersed a zinc plate 6 by 8 inches between two carbon plates of the same size. The construction of the battery is that of Grenet; the solution in which the plates are immersed is saturated solution of bichromate of potash and sulphuric acid. Is the battery not strong enough to give the desired result, or can you suggest any other reason? A. Your battery seems to be ample. The coil may have been injured by an internal discharge, or it may be that the interrupter is not properly adjusted. If the spark from the primary coil is large it would be well to increase the surface of the condenser.

(37) C. H. M. asks: 1. For a method of producing brilliants resembling diamonds. A. Pure caustic potash, 16¼ parts; white lead, 85; boracic acid, 4½; arsenious acid, 1·6; pure quartz sand, 50. These materials, carefully selected, are ground together, placed in small glass pots (the French clay pots will answer if the first charge is discarded after several hours firing) and heated to quiet fusion in a suitable furnace for about 24 hours; then cooled very gradually and cut. The art of imitating the diamond and other precious stones has attained to great perfection in Egypt and Greece, as well as in France. The following analysis by Sonault gives the composition of the colorless French *Pierres de Strass:* Silica, 38·1; alumina, 1·0; oxide of lead, 53·0; potash, 7·9; borax and arsenious acid, traces—100. 2. Give a simple method of qualitative test for the presence of silver in ores. A. Reduce the ore to an impalpable powder by grinding, gradually heat it to redness for half an hour or more, with constant stirring; boil with pure nitric acid; filter; evaporate the filtrate to small volume, and add a few drops of hydrochloric acid—a white precipitate which does not dissolve in boiling water, and blackens on exposure to sunlight indicates silver. Gold, if any, remains in the powdered ore. If the ore contains chlorides the silver may escape detection by this test. It is safer to proceed as follows: Mix the ore with 10 or 15 times its weight of finely granulated test lead—free from silver—and 2 or 3 pieces of borax glass the size of peas, in a small scorifier, and expose in a nearly white hot open muffle until the ore is fluxed and the fused metal disappears beneath the liquid slag of litharge. Then remove, cool, break, hammer, and clean the lead button; place it in a dry bone ash cupel of equal weight, and expose in the muffle until all the lead is slagged and absorbed by the porous bone ash, leaving the silver, together with the gold, if any, as a bright, clear molten button in the bottom of the cupel. Very small quantities of silver and gold in an ore may be thus detected.

(38) J. A. writes: In my last SCIENTIFIC AMERICAN, April 5, No. 14, I notice in answer to L. B., you say that 8 inch cylinder, 12 inch stroke, 150 revolutions per minute, 60 lbs. steam, 20 horse power; by my rule I only make 13·7 horse power. My figures are:

Piston 50·2656 square inch
60 lbs. steam.
3015·9360
150 rev. per m.
h. p. 33,000)452390·4000
13·7 h. p.

If I am wrong, please tell me where I make my mistake. I am only an novice any way. A. 150 revolutions per minute is 300 feet; double your result and you will be then right, except that you have made no allowance for friction.

(39) W. A. J. asks: What chemical action takes place when sulphuric acid is applied to common salt? A.

$$\underset{\text{Salt}}{2NaCl} + \underset{\text{acid}}{\underset{H_2SO_4}{\text{Sulphuric}}} = \left(\underset{NaHSO_4}{\text{Sodium bisulphate}} + \underset{NaCl}{\text{Salt}}\right) + \underset{HCl}{\text{Hydrochloric acid}}$$

When strongly heated on the hearth of a reverberatory furnace the reaction is completed, resulting in the formation of neutral sulphate of soda (Glauber salt, $NaSO_4$) and hydrochloric (muriatic) acid.

(40) H. S. asks how to arrange an earth battery for nickel plating. A. We could not advise the use of an earth battery for this purpose. You should use a Smee or a Daniell battery, or one of the forms of the gravity battery.

(41) A. E. asks how to make a drill point that will enable him to drill through glass, porcelain, or transparent china pictures. A. Make the drill of the finest quality of steel, heat it to a cherry red, plunge it in mercury, hold the extreme end in a pair of cold pliers, and draw down the temper except at the end protected by the pliers. Wet the glass or porcelain with turpentine to which a little gum camphor has been added.

(42) H. L. asks what size of engine and boiler to run a velocipede capable of carrying one person, at the rate of about 6 or 8 miles an hour. A. Perhaps some of our readers will furnish this information.

(43) S. R. E. asks whether or not honey will keep in glass cans. A. Yes, if the jars are well filled and sealed air tight. 2. What is the best noted cure for bee stings? A. Dissolve 3 parts of pure carbolic acid in 5 parts of good glycerine.

(44) J. M. asks: 1. How long will the carbon remain good in a Fuller bichromate battery? A. It will last for a number of years. 2. I am running a burglar alarm in my house, with a Fuller bichromate battery, 4 one gallon cells, and No. 32 wire. Please tell me how to make an electric light in my house with these 4 cells. 2. You cannot make an electric light with four Fuller cells.

(45) A. B. P. asks: Would it not be much better in making a Siemens hand power electric machine, illustrated in SUPPLEMENT No. 161, to make the electro-magnets of malleable iron, and have them permanent magnets, or can common cast iron be permanently magnetized as well? A. Neither cast nor malleable iron retains the magnetic charge to any very great extent. You will get the best results by using the electro-magnet.

(46) J. P. B. asks: If a telegraph line of No. 14 galvanized wire be used, how small a piece of boiler iron could be used in damp earth as a ground plate, to give the electricity as free a pass to the ground as over the line? A. Use a plate having a surface of 10 or 12 square feet. A thin copper plate would answer better than the boiler iron.

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

A.—It is a variety or syenite or hornblende schist—it has little commercial value.—G. S. A.—The ore contains traces of silver.—J. H. G.—It is mica schist—of no value.

COMMUNICATIONS RECEIVED.

On Binding. By E. C. M.
On Squaring the Circle. By C. P. K.
On a New Form of Telephone and Battery. By H. W. F.
Horse Shoeing. By C. S.
On Cleaning Lamp Chimneys. By S. B.
On a Rare Geological Specimen. By H. M.
On Animal Intelligence. By H. D. O.
Artificial Stone Foundations. By W. M.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending March 25, 1879,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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

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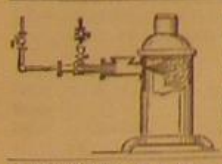

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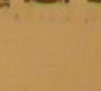

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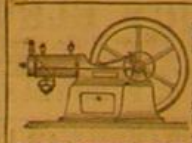

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