SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES.

Vol. XLIII.—No. 9. [NEW SERIES.] NEW YORK, AUGUST 28, 1880. [$3.20 per Annum. [POSTAGE PREPAID.]

A Peruvian Infernal Machine.

On the 3d of July the Chilian transport steamer Loa was destroyed in Callao Bay by an ingenious and effective torpedo boat. A Peruvian officer took an ordinary fruit boat, put a torpedo in the bottom, and over this he placed a false bottom, resting on springs kept down by the weight of the cargo. He then loaded it with a very choice assortment of camotes, yucas, chirimoyos, grandillas, fowls, turkeys, green vegetables, etc., and, towing it toward the blockading squadron before daylight, set it adrift.

After floating about for some hours the torpedo boat was seized by the Chilians and brought alongside the Loa. As the weight on the false bottom was diminished by the transference of the cargo, the machinery in connection with the torpedo was set free, and in a moment 300 pounds of dynamite were exploded and the Loa was almost lifted out of the water. The effect, as described by those who were watching the operation from the shore, was awful in the extreme. Every house in Callao was shaken to its foundations, and every ship in the bay shivered as though a fearful earthquake had spent its fury beneath them. The fated ship appeared as enveloped in one mass of flame, which resolved itself into dense clouds of black smoke. When this cleared away she seemed not to have suffered, but suddenly she was seen to sink at the stern, while her bows went high in the air, and the Loa disappeared forever.

Boats from neutral vessels picked up about 40 of the Loa's crew; the rest, to the number of 150 or more, perished.

The Loa was an English built iron steamer. She was armed with one long range seventy-pounder and four smaller pieces, and at the time of foundering had on board two long range seventies, which were to have been mounted on the iron clad Blanco Encalada, 140 tons of shot and shell, and a miscellaneous cargo for the fleet.

ELECTRIC LIGHT FOR MARINE USE.

The unprecedented number of disastrous and terrible accidents that have occurred from collisions of steam vessels in fogs, during the last six months, have created a great deal of speculation and provoked much discussion in mechanical and scientific circles as to the best means of averting such disasters. It is generally conceded that among all the devices and appliances proposed for this purpose there is nothing that promises so well as the electric light. It is not only the strongest artificial light, but the smallness of the point from which the light emanates renders it singularly well calculated for projecting a concentrated or parallel beam, and makes it possible to get one hundred times more light exactly in the focus of a reflector than by any other means.

Fog is simply a supersaturated atmosphere, an atmosphere whose transparency is affected by a surcharge of vapor. A slight rise in the temperature dissipates it. The sun raises the temperature of the air, and the air absorbs the water and becomes transparent. The quantity of solid or liquid matter required to give a foggy appearance to the air is surprisingly small, and the heat required to dissipate it is not very great. The electric beam, owing to its great heat, warms up all opaque bodies in its path, and, as it might be said, cuts out a way for itself through the fog; thus giving it an unobstructed path for a considerable distance. To produce this result, however, the beam of light

[*Continued on page* 130.]

Fig. 2.

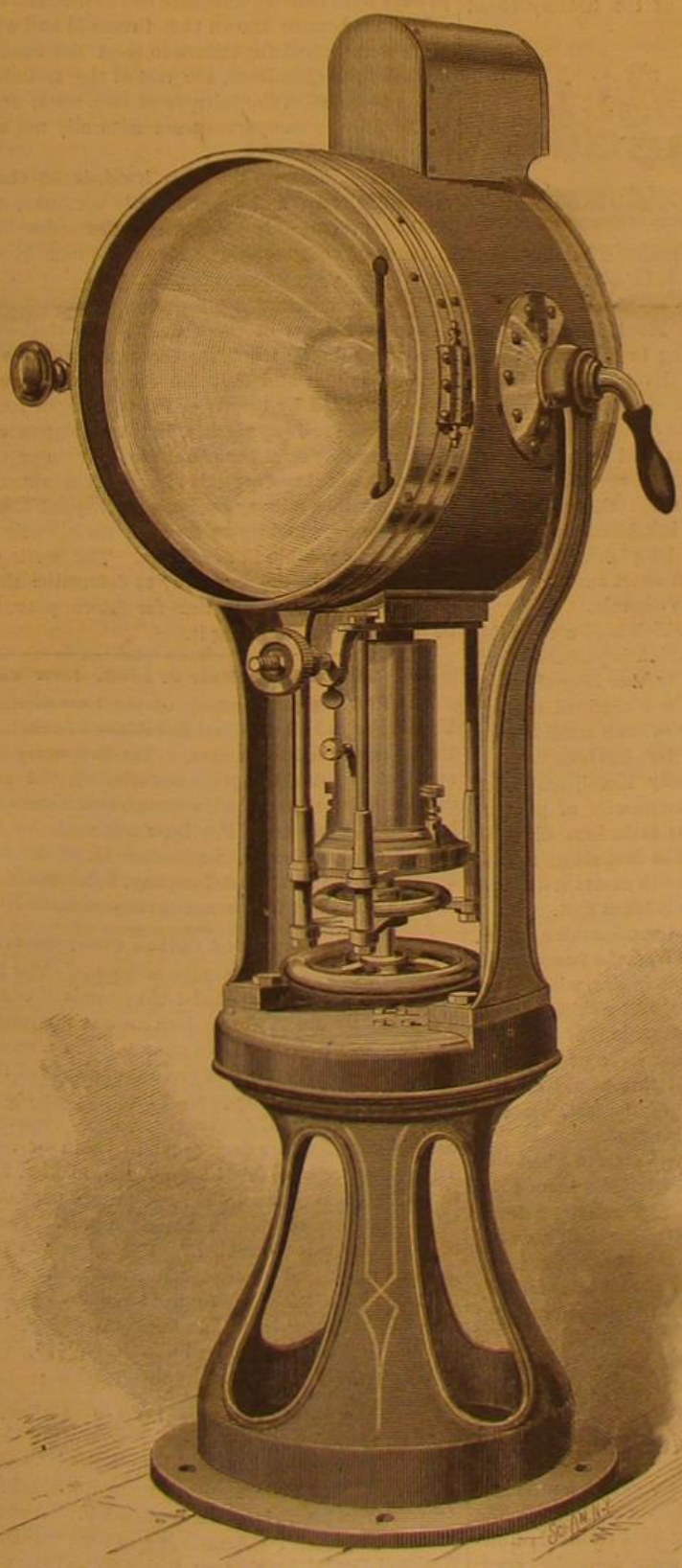
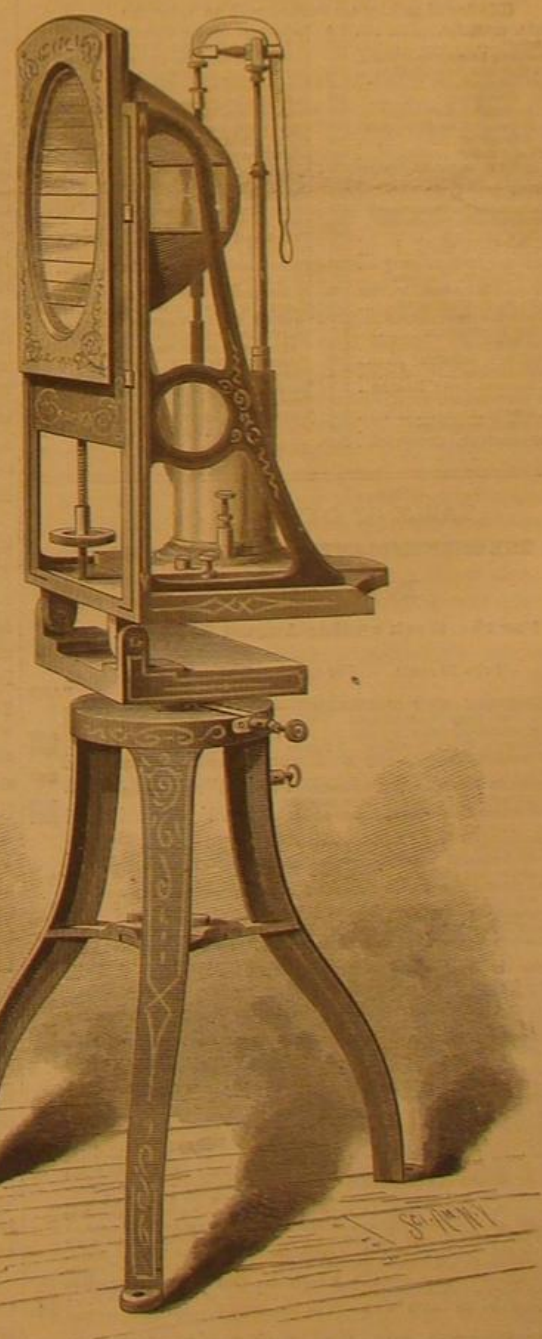


Fig. 3.



MAXIM'S ELECTRIC LIGHT PROJECTORS FOR LAND AND MARINE PURPOSES.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS FOR THE SCIENTIFIC AMERICAN.

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One copy, six months, postage included 1 60

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NEW YORK, SATURDAY, AUGUST 28, 1880.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 248,

For the Week ending August 28, 1880.

Price 10 cents. For sale by all newsdealers.

EFFECT OF STARVATION ON THE BLOOD.

During the last hour of Dr. Tanner's forty days' fast, some of his blood was withdrawn from the hand and subjected to a careful microscopic examination by Dr. P. H. Vander Weyde. It was found to be entirely different from healthy blood. The corpuscles, which are otherwise smooth and round flat disks, with a depression in the center, and of an average diameter of 1-3600th part of an inch, were found to be ragged, irregular, and shrunk to the average of about 1-5000th part of an inch in diameter.

When blood is given time to dry on the microscope slide, the corpuscles may lose their smooth appearance and become smaller by shrinkage, but in this case there was no chance to be misled into error by such a cause, as the blood was examined while perfectly fresh and the corpuscles still moving freely in the plasma.

This ragged appearance was so common in all of them that there was scarcely a smooth corpuscle among them, except the white ones, which had very nearly the normal size and were smooth. Their number, which ordinarily bears to the red corpuscles the proportion of 1 in 400, was apparently increased, as in a field covering a diameter of 8000th of an inch, and containing 40 corpuscles in its diameter, nearly touching one another, a dozen white corpuscles were seen. As this field contained 20 x 20 x 3·14 or 1,256 corpuscles, it gives an average of nearly 1 white corpuscle in 100. Occasionally the white corpuscles were seen clotted together in a way never observed in normal blood.

A further study of these abnormal red corpuscles showed that their rough appearance was generally caused by points projecting from their surface, and looking like a fungoid growth which covered them, while in many this growth appeared to be taking place at the expense of the corpuscle itself and living on its substance, as the corpuscles most densely covered were the smallest and the most irregular in shape; in fact some of them appeared disintegrating and breaking up.

We represent here some of the corpuscles as they appeared in the blood of Dr. Tanner, as seen and drawn by Dr. Vander Weyde, and at the side of the healthy blood the contrast is striking.

Appearance of the Corpuscles of Normal Human Blood.

Appearance of the Corpuscles of Dr. Tanner's Blood after Forty Days of Starvation.

It is a common law observed in organic substances that when a breaking up of the structure is impending, foreign living organisms spring up, and are sustained at the expense of the decaying organic body. Mould, and all kinds of fungoid growth, originate according to this law, while in infusorial life it reaches its highest development. In the latter case it appears intended to economize the organic materials of the structure, and in place of allowing them to decompose into their primary elements, and to be built up again by the slow and laborious process of vegetation under the influence of light, these organic materials are directly transformed into food for the larger inhabitants of water, and finally for fishes. In this way a long laborious course of natural successive operations is cut short and the decaying organic material made useful more directly.

If the formation of fungoid spores, which is of a vegetable nature, also serves a useful purpose (which is probable), is as yet a question to be determined by further investigation; but certain it is that such a growth is not confined to large masses, but even found on the surface of such small objects as the corpuscles of the blood; this in fact has been recently investigated by microscopists, especially Korel, and such growth was found upon the blood corpuscles of patients when seriously suffering from various malarious diseases, such as typhus fever, etc., also in the last stages of consumption; and they agree that this growth exerts a destructive influence upon the body in which it takes root.

The appearance of Dr. Tanner's blood verifies this opinion. Very few, if any, corpuscles were free from the fungus, and all appeared to have suffered and shrunk in size, while many of them had become irregular in shape, and evidently were breaking up. As it appears to be the function of the liver to secrete the effete blood corpuscles, the liver of Dr. Tanner must have been taxed greatly, and this would explain his biliousness during the latter stages of the fast, when he often vomited bile with the mucus of his stomach.

In regard to the latter its digestive powers are phenomenal. Immediately after breaking the fast at the exact hour that the forty days were ended, by eating a peach, he drank successively two large glasses of milk, ate half a watermelon, two beafsteaks, five apples, drank Hungarian wine, and had a good time generally, and was the next day already in good condition, gaining at the rate of five pounds weight every twenty-four hours.

The effect on the blood was already very perceptible twenty-four hours after breaking the fast. The fungoid spores had disappeared from a great many of the blood corpuscles, or, rather, perhaps, fresh ones had been evolved in the system, which is the most probable, as they looked as smooth and fresh as if they were entirely new. At the second day about half of the blood had become normal, while on the third day most all the corpuscles were restored; however, there were here and there still some imperfect ones, irregular in shape, as if they were remnants, and even some of these were not yet entirely free from the fungoid growth.

Powers of endurance have been exhibited by various individuals, but we believe that none have ever gone through such severe and well authenticated test of physical endurance as Dr. Tanner, to whom at least the credit should be given to have practically demonstrated what man can endure when he, to use Dr. Tanner's own words, "once understands his own machinery and knows how to run it."

COLOR BLINDNESS IN CONNECTICUT.

A recent act of the Connecticut legislature provides that on or before October 1 next, the railway companies of the State shall cause every person in their employ, as locomotive engineers, firemen, conductors, brakemen, station agents, switchmen, flagmen, gate tenders, or signalmen, to be examined at the expense of the railroad company in regard to color blindness and visual power, and under such rules as the Board of Health shall prescribe; and any corporation employing a person not possessing a certificate showing that he has passed a successful examination shall be liable to a fine of from $200 to $1,000.

Two grades of certificates have been adopted by the Board of Health, the first grade being issued to engineers, firemen, and brakemen, the second grade to all other railway employes. The tests adopted are very severe, and the results have led to the circulation of a petition, signed by most of the railway officers in the State, asking the Board of Health to change the methods of examination. On the first day of the examinations first-class certificates were refused to engineer Charles Bullard, of the Shore Line Road, and engineer William Fisher, of the New York and New Haven Road, both of whom had been many years in the service. Mr. Bullard had run an engine for twenty-eight years, giving daily proof in all sorts of weather that his eyes were equal to the requirements of his calling; and when subjected to practical tests on the road by the president of the company Mr. Bullard gave ample evidence of strong and clear vision. In the same way Mr. Fisher satisfied the officers of his road that his visual powers were entirely adequate to the needs of the service.

When it became known that these old and well tried engineers were barred for failure to meet the exacting requirements of the examiners, the rest of the trainmen naturally began to question the fairness of such tests; and the officers of the railway companies were naturally not without sympathy with their men.

The examiners, on the other hand, insist that their tests are simple, fair, and unmistakably accurate; and that any method of correctly testing eyes for color blindness and strength of vision would condemn the men to whom certificates had been refused.

From an impartial point of view it really looks as though the over-niceness of theoretical hobby-riders might bring into disrepute the whole matter of visual tests for railway men and pilots; and that the evidence of practical visual power afforded by twenty or thirty years of recognition and obedience to railway signals, in the management of locomotives, certainly ought to count for as much as that obtained with a lot of colored crewels in as many minutes. The question is whether railway men can distinguish the red, green, and white flags and lights used on their roads under such conditions as obtain in actual life. The sorting of colored worsteds may be the best way to determine this question; but, in view of the results thus far shown, practical men may be pardoned for doubting it.

The World's Fair of 1883.—New York.

The first regular meeting of the Commissioners of the United States International Exhibition of 1883 began August 10 and continued three days. The temporary organization required by act of Congress was effected, and an executive committee was appointed, with sub-committees on finance, legislation, and sites. Provision was made for the opening of subscription books, September 15, at the office of the Farmers' Loan and Trust Company, fiscal agents. The commission will meet for permanent organization November 14.

An Improved Cotton Compressor.

Three years ago the average cargoes of ships sailing from New Orleans did not exceed 1,425 pounds of cotton per ton register. By use of the modern cotton compressors the average has been raised to 1,725 pounds. In a recent issue the New Orleans *Price Current* gives as evidence of the efficiency of the Morse cotton compressor the fact that the British ship Ben Lomond, of 887 tons register, lately cleared with 4,363 bales of cotton under deck (none in cabin or crew spaces). The cotton weighed 2,054,848 pounds, making 2,316 pounds to the ton measurement, the largest cargo per ton ever taken by a sailing vessel from an American port. The larger part of this cargo was "doubled." The cargo was tied by hand (colored men), and consequently without the 20 per cent advantage claimed for steam "band pullers." The cargo was thus 35 per cent greater than the average obtained with average compression, and the gain in freightage at the current rate was nearly $4,000 for the single voyage.

The National Dental Association.

A mass meeting of dentists, representing the American Dental Convention, the American Dental Association, and two Southern societies similarly named, was held in this city, August 11, with a view to consolidation. About 150 delegates were present. The result was the organization of the National Dental Association, which hopes to absorb the other organizations.

INFLUX THE SOURCE OF INVENTION.

Your correspondent, G. G., in a very learned and able article on "The Evolution of Ideas," on page 97, has, I think, laid himself open to attack in some of the views advanced. He says, "Science declares that ideas are the results of the same natural forces which act in organic nature; and mental phenomena are not different from other natural phenomena in kind, but only in greater complexity," and upon this unsubstantial foundation builds up the theory that "evolution in nature on our globe has reached its highest stage in man, and with him terrestrial development has arrived at a remarkable turning point." "Instead of producing higher organisms, nature has given to the human species the faculty of invention." In other words, having created a being in all respects equal to itself, it has transferred to him all its powers, and has retired from the scene of action for ever, leaving to him and his mysterious mistress Evolution the government of the world on which he dwells.

G. G. quotes Herbert Spencer to prove "that no idea or feeling arises save as a result of some physical force expended in producing it;" but a greater than Spencer has said: "Man's mind is his spirit, and the spirit is a man, because the mind means the whole will and understanding, which exist in first principles in the brain, and in derivatives in the body, and they therefore include in their forms the whole man. Therefore the mind rules the body in all its particulars at will. Does not the body execute whatever the mind determines? It directs the ear to hear, the eye to see, the tongue and lips to speak; it impels the hands and fingers to do what it pleases, and the feet to go where it wills. Is not the body, therefore, mere obedience to the mind, and could it be such unless the mind were in its derivatives in the body? Is it conformable to reason that the body should obediently act because the mind so wills? They would thus be two, one above, the other beneath—one commanding, the other obeying. This no reason will admit; therefore it follows that man's life is in first principles in the brain, and in derivatives in the body. All the constituents of the mind relate to the will and understanding, and the will and the understanding are receptacles of love and wisdom from the Lord and constitute man's life."

"That the first principles or primary forms of life are in the brain is obvious: First, from sense itself; for when man exerts his mind and thinks he feels that he thinks in the brain; he introverts his sight, contracts his brow, and feels a speculative process going on within, especially in the upper part of the forehead. Secondly, from man's formation in the womb; for the brain or head is first formed, and for some time continues larger than the body. All the external senses, sight, hearing, taste, feeling, and language, are located in the fore part of the head, and by means of fibers communicate immediately with the brain and draw from it their sensitive and active life. The affections, which are derivatives of love, portray themselves in the face; and the thoughts, which are derivatives of wisdom, portray themselves in the light of the eyes. Anatomy teaches that all the fibers descend from the brain through the neck into the body, and that none ascend from the body through the neck into the brain.

"Where the fibers are in their first principles and primary forms, there life is in its first principles and primary forms."

Will Herbert Spencer or G. G. maintain that the origin of life is not at the origin of the fibers? What, then, becomes of the proposition that "all ideas are the result of some physical force expended in producing them"?

If I interpret correctly the teachings of the great Swedish philosopher, we must look higher for the source of life and inspiration than to the wonderful organization of flesh and blood known as the natural man, which the scientists say is "the highest stage yet reached by evolution."

Within the smallest particulars, as well as in the larger members, organs, and viscera of the human body—the grand microcosm of the universe—there is a conscious, breathing, pulsative soul in constant communication with the author of life. So in and above the world of matter there is a world of spirit, through which life from the Divine is constantly flowing into all forms and organizations of matter fitted for its reception. If this was for a moment suspended, all animal and vegetable life would immediately end, the revolving earths and the mighty suns be consumed like meteors, and chaos would come again.

But as the heavens are eternal, and material worlds and systems of worlds are but representatives of the grander glories of the spiritual and celestial degrees of life, so will the physical universe endure for ever. Here, then, is the source of all inspiration. The poet, the artist, the inventor, or the divine may drink from this inexhaustible fountain.

As the blazing center of our solar system is daily seeking in the crevices of the rocks for seed to germinate, or in the fathomless oceans for leviathans to bring forth; so the great Sun of the spiritual universe is sending forth his light and heat to bless with new inventions for the comfort, new delights for the eye, new harmonies for the ear, and new joys for the hearts of his children. Not a step do we take but by his permission, not a mouthful of food that he does not provide, not an hour of sleep that he does not send.

Man, the crowning glory of the universe, comes into the world more helpless than the vilest worm. Without assistance he would soon die for lack of nourishment, whereas all other forms of animal life are born into full knowledge and ability where to seek their food, to know their companions, which are friends and which are enemies; construct houses, form marriages, bring forth young, love them tenderly, provide for them until able to care for themselves, and to perform the same offices, and by procreation perpetuate their kind.

Man is born without any knowledge whatever, and yet he has the capacity to attain the wisdom of the highest angels, and light is given in proportion to his power to receive and appropriate. All inventions are given by influx from the world of spirits. When the printing press, the steam engine, the sewing machine, and the telephone were needed suitable mediums were found for transmitting the knowledge of them to mankind. No amount of "physical force" could have produced one of them.

Within the past one hundred years a greater flood of light has been poured upon the earth than has fallen during any ten centuries since its creation. What tongue can tell the progress of the next golden cycle? When higher altitudes are attained by the spiritual man on the earth and in the heavens, the natural will rise to higher stages of development than have yet been reached. When the new schools of philosophy, instead of attributing all things to *nature*, and *evolution*, and *force*, will "render unto Cæsar the things that are Cæsar's, and unto God the things that are God's," when science and religion, hand in hand, drink together from the fountain of divine revelation, and reason and rationality prevail over skepticism and pride of opinion, then will come the golden age of the world.

CHARLES REESE.

Baltimore, August 9, 1880.

ARTIFICIAL CITRIC ACID.

Among the latest triumphs of the synthetical chemist we have to record the preparation of citric acid by Messrs. Grimaux and Adam, of France. All the principal acids found in the vegetable kingdom had already been prepared, and for several years citric acid, the acid of the lemon, the currant, and gooseberry, has been the only one of which it could be said, "this acid has not yet been made artificially." Tartaric acid had been made several years ago from dibromsuccinic acid, and malic acid, the acid of unripe apples, from monobromsuccinic acid, an acid obtained from amber; but succinic acid itself was made from ethylene cyanide.

It would be hard to tell why the synthesis of citric acid had never before been attempted, since the process involves no unusual operations or unexpected reactions. As early as 1872, C. Bischoff, in Berlin, began the study of the dichloracetone, from which citric acid has recently been made, in the hope, as he said, of making artificial citric acid. Having learned that Glutz and Fischer were also studying the compounds of this dichloracetone, he withdrew from that field. As these gentlemen had not published anything further on that subject for several years, one of our own chemists in this city again began the synthesis of citric acid, but stopped on learning that Grimaux and Adam had preceded him, and secured the field by a communication made to the Paris Chemical Society in May last.

The details of the preparation of citric acid, as published in *Comptes Rendus* (xc., 1,052), are nearly as follows: Glycerine is subjected to the action of hydrochloric acid gas, whereby two atoms of hydrogen are replaced by chlorine, forming a liquid called dichlorhydrine, $CH_2Cl,CHOH,CH_2Cl$. This substance when oxidized by a mixture of potassic chromate and sulphuric acid yields dichloracetone, CH_2Cl,CO,CH_2Cl. This product was next treated with concentrated prussic acid, which formed with it a cyanide readily convertible by hydrochloric acid into dichloracetonic acid. This acid had not previously been prepared, although Bischoff long since made an acid isomeric with this one from another form of dichloracetone. The graphic formula of Grimaux's acid is:

$$\begin{array}{l} CH_2Cl \\ | \\ C(OH)COOH \\ | \\ CH_2Cl. \end{array}$$

This acid was distilled in vacuo and then extracted with ether, which left on evaporation a sirup that gradually became solid, forming transparent tabular crystals, soluble in water, alcohol, and ether, and fusing at 90° to 92°, and sublimable at a gentle heat, but cannot be distilled.

The concentrated solution of the soda salt of this acid was heated with two molecules of potassic cyanide, when the chlorine exchanged places with the cyanogen, producing potassic chloride and dicyanacetonic acid:

$$\begin{array}{l} CH_2CN \\ | \\ C(OH)COOH \\ | \\ CH_2CN. \end{array}$$

This substance, as expected, proved to be a *nitrile, i. e.*, a substance which by saponification with potash yields an acid, or rather its potash salt. The acid thus obtained is identical in every respect with that obtained from lemons; in fact, is really citric acid, thus establishing the formula of this acid as:

$$\begin{array}{l} CH_2COOH \\ | \\ C(OH)COOH \\ | \\ CH_2COOH. \end{array}$$

The synthesis of citric acid is looked upon at present as a triumph of more theoretical than practical interest, because citric acid can be made more cheaply from natural sources than by this new process. Since citric acid, too, is much employed in flavoring and in medicine, the use of cyanides in its manufacture is highly objectionable, lest in its manufacture a trace of this deadly poison remain in the finished product.

Now that the constitutional formula has been fully established by this synthesis, there is more probability of citric being made by other methods, and although the preparation of an acid from a cyanide is the easiest and best known, other processes may yet be devised which shall remove this objectionable feature. For use in dyeing citric acid made from cyanhydrine would be as good as any other, if the process can be improved so as to render it profitable on a large scale.

Some encouragement can be derived from this synthesis as showing that in some departments, at least, chemistry has reached the point where it is possible to predict what will be the result in certain cases. Like an engineer planning a series of works, these chemists started out with a definite object in view, planned each step, and followed the plans which lead to the expected point. In this sense, at least, it is a victory.

E. J. H.

A GOOD YEAR FOR STATISTICS.

Besides being a "census year," 1880 has the distinction of showing the largest foreign commerce, both in exports and imports, ever known in the history of the country. The grand total for the fiscal year ended June 30 amounts to $1,503,679,489, an increase of 30 per cent on the foreign trade of 1879, and about 81 per cent on that of ten years ago. The "balance of trade" in our favor, or the excess of exports over imports, amounts to $167,908,359, although we have imported, as partial payment of this balance, $75,891,391 in gold and silver coin and bullion, more than our coin and bullion exports; it is probable, however, that no inconsiderable proportion of the remainder has been taken up as the profits of carriers, a service in which American ships find comparatively little employment.

There is hardly an intelligent American but would feel greater pride than is now possible were the large exports we are making to a more considerable extent of manufactured articles. The enormous increase in shipments has been made up almost exclusively of breadstuffs, cotton, and provisions, while in manufactured articles our foreign trade for the past year has been almost at a standstill. The principal explanation of this is probably to be found in the great and sudden advance in prices which took place last fall, with the general revival of trade here, but values have again dropped, in most articles, nearly to where they were a year ago, and those who are endeavoring to enlarge the foreign market for American manufactured goods are now working under more favorable conditions than they have been at any previous time within the past twelvemonth. It may be interesting, however, to note that in some important specialties of American manufacture the exports show an increase. The complete figures have not yet been collected from all the custom houses for the year, but, taking the last statement of the Treasury Department, which brings down the returns to May 31, we find that there has been a small increase in our shipments of all the following articles: Plows and cultivators; railroad, passenger, and freight cars; car wheels; stationary steam engines; firearms, cannon, and gunpowder; clocks and parts of; mathematical, philosophical, and optical instruments; organs and melodeons; paper and stationery; printing presses and type; scales and balances; wines; tin and manufactures of; and watches and parts of. That we have been able not only to hold our own, but actually to increase our exports in all these specialties during a year when the home market has been so disturbed, presents an outlook for the future which contains much of promise.

When, however, we turn to our imports, and find that they exceed those of 1879 by 50 per cent, and that many of the articles which help to make up the increase are such as we excel in the manufacture of, and on which have to pay a high duty, we then are presented with a practical demonstration of the cheapness of labor and capital in Europe and the far more favorable situation of all classes here. These increased imports are of every description of staple and fancy articles, but the larger trade is principally conspicuous in manufactures of cotton, flax, iron and steel, silk, and wool. Our own manufacturers in all these lines have had a full business, but, besides what they have produced, we have been taking liberal supplies from abroad in exchange for our bountiful agricultural products. The circumstances under which this trade has been done, showing no accumulation of foreign indebtedness, and a liberal balance to our credit abroad, to be covered by gold shipments to this country, are more favorable to our continued prosperity than they have ever been in any former period of excessive imports.

The St. Lawrence River Tunnel.

Surveys were begun August 9 for the long-talked of tunnel under the St. Lawrence River at Montreal. The line contemplated is from the Liverpool wharf, Montreal, to the Hudson Cotton Factory, at Hochelaga. The river has a depth of 42 feet, and the tunnel will be 40 feet below the bottom. The work has been undertaken by the South Shore Railway and Tunnel Company. Mr. Walter Shanly, well known through his connection with the Hoosac Tunnel, is chief engineer.

FIRE IN A PENNSYLVANIA COAL MINE.

A fire which threatens to be one of the most disastrous in the history of American coal mining, broke out August 9, in the Keely Run Colliery, at Shenandoah, Pa. No lives were lost, and all the mules and portable machinery had been safely brought to the surface before the fire became fully developed. Mine Inspector Parton and Ex-Mine Inspector Edmunds attribute the fire to spontaneous combustion in a quantity of coal waste which had been dumped into a break leading into the mine. A breast had been worked up to the surface not far from the breaker, and the opening had been used as an economical receptacle for dirt, slate, and other mining refuse. The natural oxidation of this stuff caused an outflow of "white damp" into the mine, and the efforts made to ventilate the mine only served to force more air through the heated and inflammable matter, resulting in its general combustion and the threatened destruction of the entire mine.

The Keely Colliery is in the mammoth vein, and its workings connect with those of the Kohinoor Colliery and with those of Colliery No. 8. The situation is a critical one, as the Keely Run Colliery cannot be flooded without drowning others; while if it is not flooded the fire must spread to and ruin a number of very valuable properties.

ELECTRIC LIGHT FOR MARINE USE.

[*Continued from first page.*]

must be a very strong one, and concentrated to its smallest possible dimensions, in order that the volume of air operated upon may be very small.

We give herewith engravings of electric light apparatus designed by Hiram S. Maxim, M.E., the electrician of the United States Electric Lighting Company, for projecting a strong parallel beam for marine and other uses.

Fig. 1 (on this page) represents the dynamo-electric machine for producing the electric current This machine has an armature of soft iron rings, with the wire wound parallel to the axis, both plates and wires being so arranged that a free circulation of air through the armature prevents any dangerous heating, even if the machine is run on a short closed circuit—a test that would soon destroy many of the best foreign machines. The armature is so built up in sections that no current is induced in anything except the wires which generate the current for use. The magnets are of soft iron bars with spaces between.

The commutator is large and heavy, with the sections curved in a right and left hand spiral, so that no break in the current is possible.

The whole forms a neat and compact piece of machinery, admirably built and well calculated for the purpose intended. It may be driven with a belt from any source of power, or a small high speed engine which has been especially designed by the same inventor may be applied directly to the spindle, thus completely obviating the annoyance and vexations accompanying the use of belts in a damp atmosphere.

Fig. 2 represents the projector for throwing the light. It consists of a strong brass cylindrical case mounted on trunnions, so that it moves freely in any direction. The lamp used in this projector is the same as described in these columns some months ago (Maxim's patent). It is a focusing lamp, that is, one that feeds both carbons in proportion to their consumption, thus keeping the luminous points always in the same place. To enable the operator to bring the carbon points exactly in the focus of the reflector, regulating screws are provided. The lamp may be raised or lowered at will, or moved forward or backward with equal facility. A small lens placed in the side of the reflector throws an inverted image of the carbon points on a ground glass screen, so that their action and position may be observed without any danger or inconvenience to the eyes of the operator. The silvered reflector is eighteen inches in diameter, and in form is a perfect parabola. The apparatus is highly finished and presents a fine appearance on the deck of a ship. It is inclosed so that a heavy sea cannot interfere with its perfect working. When it is desired to cut off all light in the foreground, and illuminate only distant objects, a long funnel-shaped bonnet is fastened to the front, thus removing all except the small central beam.

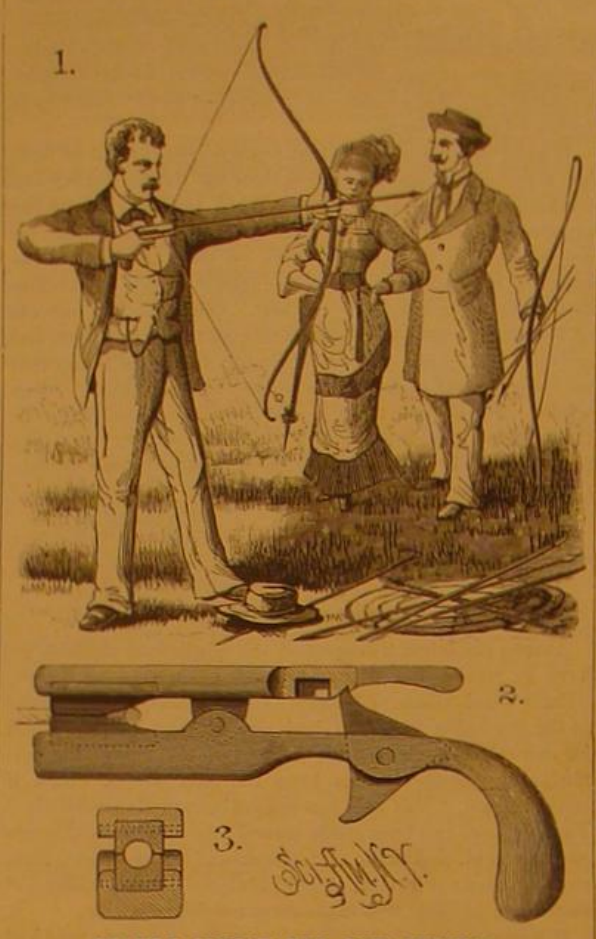
Fig. 3 represents a cheaper form of projector, which may be used on land or on river steamers. It has all the movements and will produce the same results as the more expensive type, shown in Fig. 2. The front glass is in strips to prevent breakage, due to the intense heat evolved. Either of these projectors will throw a beam of light strong enough to read by, at a distance of five miles on a clear night and many hundred feet in a dense fog.

Further information may be obtained by addressing the United States Electric Lighting Company, 120 Broadway, New York.

THE great Corliss engine of the Centennial Exhibition now drives the machinery of the San Francisco Mint.

CLUTCH FOR BOW STRINGS.

A novel arrow holder, which holds the arrow and the string while the bow is being drawn, is shown in the annexed engraving. It is designed to be held in the hand like a pistol, and it clamps the arrow as well as the bow string, and when the string is strained to the required tension, it may be instantaneously released by simply pulling the trigger, and without the relaxation of the muscles of the archer's arm. The manner of using the device is shown in Fig. 1, while the clutch is shown on a larger scale in Fig. 2. Fig. 3 is a cross section near the end.



BEARD'S CLUTCH FOR BOW STRINGS.

This invention was recently patented by Mr. C. M. Beard, of Elroy, Wis.

A Plucky and Intelligent Dog.

Recently a number of soldiers went from Fort Craig to the Rio Grande for a bath. Among them was Captain Jack Crawford. After being in the water about three quarters of an hour Captain Jack started to cross toward the other side of a sand bar, on which the water was only from six inches to a foot deep. Several of the others followed Jack, and they had considerable fun tripping each other and rolling over in the water, while two of the boys got Jack down in the shallow water and tickled him in the ribs until he was nearly exhausted with laughter, being very ticklish. In order to get away from his tormentors Jack rolled over toward the deep water on the lower edge of the bar, and when he got up on his feet he kept backing down stream, and although there was not more than two feet of water where he stood, yet the current was so strong that it would carry him down should he lose his footing. He kept splashing water on those who had been tickling him, and bantering them to come on after him, when suddenly he made two or three desperate efforts to get back, but failed. Yet he said not a word, or the others might have joined hands and reached for him. No one dreamed for a moment that he was trying to extricate himself from the quicksand. All at once he went down like a piece of lead.

The next instant Jack's dog Hero, a beautiful St. Bernard, was seen swimming toward his master, while he set up a howl that seemed to say "I'm coming." Jack came up about twenty-five yards below where he went down, and right in the center of a terribly swift current, near where the river made a quick, sharp turn. He was almost exhausted when the sand broke from under him, and, striking a whirlpool, he could make little or no headway, and had to use all his strength to keep from being caught in the suction. Hill, a soldier, as soon as he saw the dog go for Jack, also sprang in the current, but Hero got to Jack first, just as he was going down the second time, and, taking him by the hair of the head, brought him above water. Jack, who never lost his presence of mind, caught the dog by the back just above the hip, and the faithful Hero brought him safe to shore, almost a mile below where he first went down. This was a narrow escape, as an officer and five soldiers went down nearly in the same place a few years ago and were never seen. A wagon and team of mules disappeared in the river two years ago and have not turned up yet.

An old Mexican brought Jack over from the opposite shore in a boat, while Hero never ceased licking his hands and face until he came out of the boat.—*Denver (Col.) Tribune*

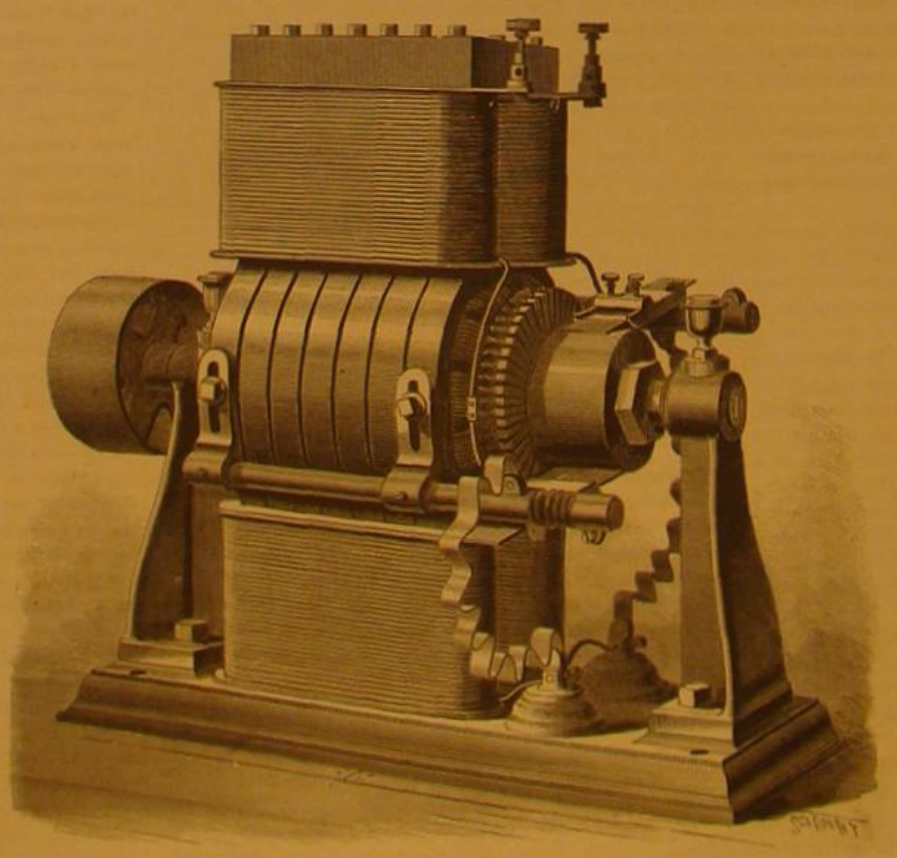


Fig. 1.—MAXIM'S DYNAMO-ELECTRIC MACHINE.

MECHANICAL INVENTIONS.

Mr. Herbert Symonds, of Detroit, Mich., has patented an improved hooded coal hod, which is so constructed that the coal cannot fall off at the sides and back while being emptied, and so that they cannot have their discharge aperture clogged while being filled.

An improved folding attachment for sewing machines has been patented by Messrs. James S. Foley and George W. Comee, of Waseca, Minn. The object of the invention is to fold the cloth once before it is hemmed, and it consists in a combination which cannot be clearly described without engravings.

Mr. Joseph Langlois, of St. Johns, Quebec, Canada, has patented an improvement in heel trimming machines, which consists of novel devices for holding, tightening, raising, lowering, centering, and otherwise adjusting the trimming knife, and for holding and releasing the boot or shoe operated upon, and of other novel auxiliary parts.

An improved attachment for sewing machines which will fold down the seam immediately in front of the needle, so that the basting and ironing will not be required, has been patented by Mr. Johann F. Schroeder, of Brooklyn, E. D., N. Y.

An improved portable elevator which is to take the place of ladders has been patented by Mr. Horace H. Barnes, of Dryden, Mich. It is simple and convenient, and it consists of a central post provided with a number of pivoted braces, and surrounded by a sliding box platform provided with a windlass, the rope of which passes over suitable pulleys and is fastened to the central post, so that by winding the rope on to the drum of the windlass the platform and the person on it are raised to any desired height, and may be held there by a pivoted brake pawl.

A simple and effective double action lifting jack has been patented by Mr. James F. McCormick, of Louisville, Ky. The invention consists of a hollow rack toothed column, in which moves a vertical working bar that carries pivoted on its head a bifurcated lever, within each end of which lever are pivoted curved swinging pawls that engage alternately with the rack teeth of the column as the lever is operated, and thereby elevate the working bar.

Mr. Charles H. Shippee, of Wickford, R. I., has patented an improvement in car couplings, the object of which is to permit of coupling the cars automatically and avoid danger to life and limb; also to construct couplings so that they will couple with the Miller coupling and with a common link to any usual form of drawhead.

Mr. Charles Seymour, of Defiance, O., has patented an improved hub turning lathe, the object of which is to obtain a more rapid reduction of the hub block than can be obtained by the ordinary means; also to dispense with complicated and rapidly wearing parts, and simplify the mechanism for shifting the cutters.

Mr. Albert F. Pflughaupt, Jr., of Brooklyn, N. Y., has patented an improved device for preventing the entrance of sewer gas into buildings. This device is so constructed as to operate automatically to discharge the sewage into the sewer.

A LENS WITH VARIABLE FOCUS.

The human eye has frequently been compared with the camera obscura, and in many respects this comparison serves to illustrate the formation and action of the eye; but one of its most sensitive members, the crystalline lens, is so far superior to all instruments that can be produced, that all attempts to illustrate its nature and functions by means of instruments have so far been in vain. The camera is only adapted to clearly produce the images of objects when they are within certain limited distances governed by the nature of the lens, whereas images are produced in the human eye with the greatest clearness, independently of distances. This property is due to the crystalline lens, which, under certain influences which we cannot examine here, changes its form and produces greater or less deviations in the directions of the pencils of luminous rays that enter the eye.

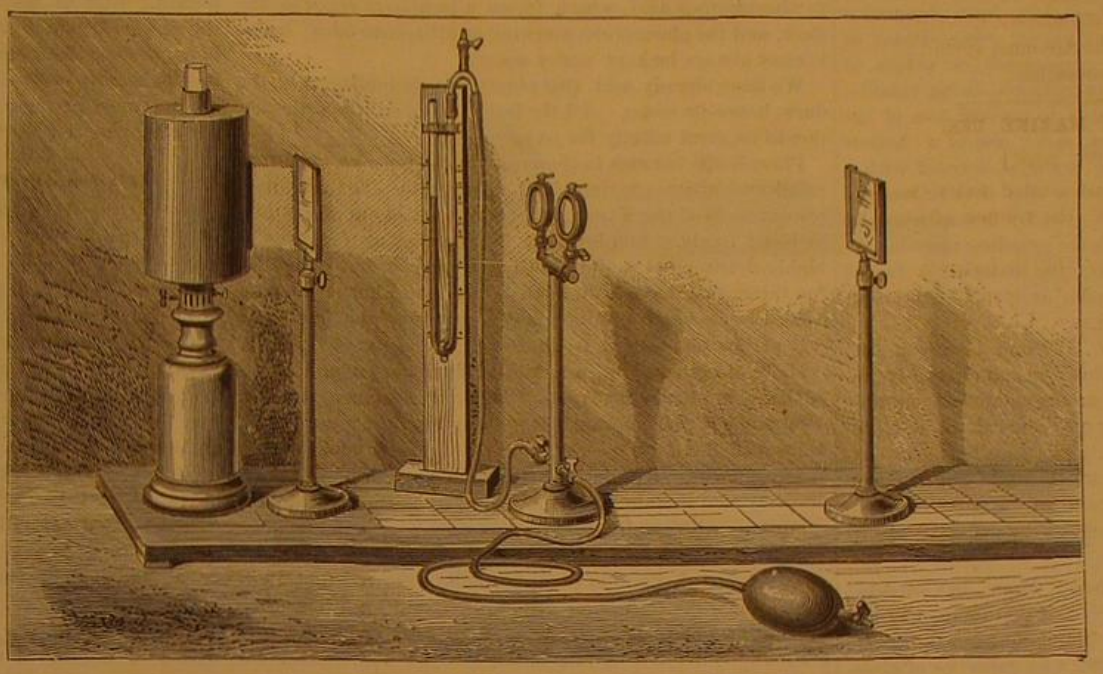
Dr. Cusco, who has occupied himself very extensively with ophthalmology, has invented a lens with variable focus which beautifully shows the action of crystalline lens. A metal ring of a suitable thickness is mounted on the top of a hollow standard, and two disks of glass are secured in the ring, one at each edge, with tight joints. The hollow disk thus formed is filled with water or some other transparent liquid, and the hollow standard is connected with a small reservoir that can be conveniently raised or lowered, as may be desired, or with a rubber syringe bulb connected by means of flexible tubing.

The reservoir must be adapted to be raised or lowered so as to permit of varying the pressure of the liquid in the apparatus. In this case two rings, or double disks, are shown, but they are provided with cocks so that either can be shut off from communication with the rest of the apparatus. The apparatus is connected with a siphon pressure gauge, filled with water or mercury. If the pressure gauge indicates zero the pressure in the apparatus and between the glass disks will be equal to the pressure of the exterior air, and the glass disks will remain plane, simply forming a refractive disk with two surfaces, which cannot produce any variation in the divergence and convergence of the pencil of light that traverses it; so that if a real image of a luminous object is produced on a screen by means of another lens, and the above described disk or water lens is interposed so as to cause the rays of light to traverse it, the clearness of the image will not be impaired; but if the pressure of the water in the apparatus is increased, the disk of glass will swell outward under this pressure, and the two disks will form a double-convex lens, which produces an augmentation of the convergence of the rays of light, and thereby destroys the clearness of the image on the screen. The changes of the pressure may be very minute, for the instrument is so very sensitive that the least compression of the rubber bulb, which corresponds to the most feeble variation of the pressure, will produce a change of the focal distance. But the experiments with this interesting instrument do not end here, for a concave lens can be produced in a similar manner. If the pressure gauge indicates zero, the rubber bulb or the reservoir is lowered and consequently produces a vacuum between the two disks, so that the pressure of the outer air presses them inwardly, forming a double-concave lens. This lens will diverge the rays of light and cause the images obtained by another lens to appear more distant.

This apparatus is very well adapted for obtaining and making lenses of a certain power. Each model is specially graduated according to the thickness of the glass used, its nature, the manner in which it is secured in the ring, etc., as all this influences the action of the pressure of the water.

It is necessary to determine directly the focal distance that corresponds to a certain given pressure. The method of doing this is represented in the engraving, which we take from *La Nature*.

In a dark chamber an opaque cylindrical hood, provided with a longitudinal slot, is placed over a lamp in such a manner that the rays of light can only pass through the slot, and are thrown upon a screen of ground glass, upon which graduated lines are drawn. Another similar screen is placed upon a standard provided with a scale, and the variable lens is placed in the middle between the two screens. The pressure in the variable lens is equal to the ordinary air pressure. A lens of known strength which produces a real image on the second screen is added to the combination. Then the lens and the second screen are gradually moved from the lamp, but always in such a manner that the lens is midway between the screens, until an image of the figures on the first screen is seen clearly on the second. The pressure of the water in the variable lens is then gradually increased until this lens produces a clear and exact image on the second screen. The subdivisions on the lines of the screens permit of comparing the sizes of the images very accurately.

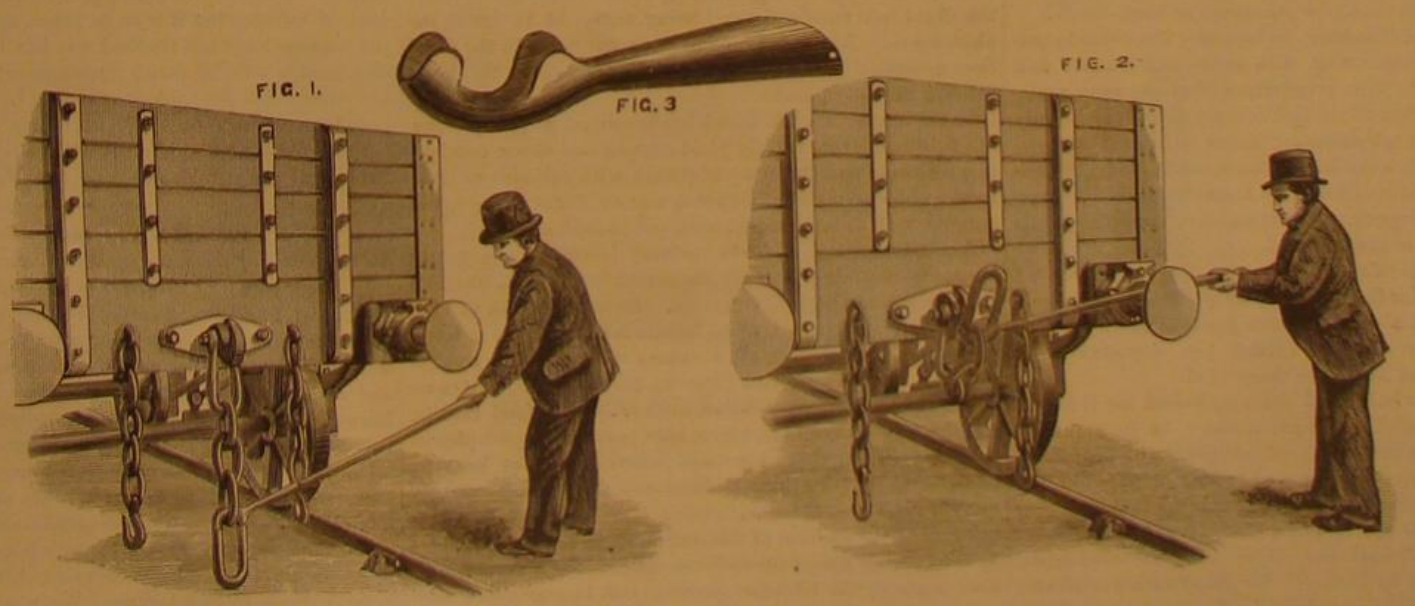


DR. CUSCO'S LENS WITH VARIABLE FOCUS.

NEW COUPLER.

During the past few years attention has been prominently directed to the dangers attending the coupling and uncoupling of railway trucks in shunting operations, and a good deal of ingenuity has been expended in devising means of diminishing this risk. The inventions which have been produced for this purpose may be broadly divided into two classes; namely, first, those in which the ordinary couplings are replaced by automatic appliances, which couple the trucks on the latter coming together; and, second, those which consist of appliances by means of which the ordinary couplings can be connected or disconnected without the necessity of a man going between the wagons for the purpose. As regards inventions of the first class, they are open to the objection that, however efficient they may be, they involve extensive alterations of rolling stock, and a large expenditure, which railway companies are little disposed to undertake, while, moreover, they also involve for their efficient introduction something like a concerted action between different railway companies and wagon owners—a most difficult thing to secure. Even for this latter reason alone appliances of the second class are far more likely to find favor.

These appliances of the second class above mentioned, may, in their turn, be divided into two sub-classes, the first comprising appliances fixed to the wagons (and some efficient arrangements of this kind have been devised), and the second comprising portable appliances to be carried by the men engaged in shunting operations. Mawlam's railway truck coupler, the illustration of which we take from *Engineering*, belongs to this last-named class. It consists simply of a light wooden handle, having mounted on it an instrument of the form shown in Fig. 3 of the annexed engravings, this instrument enabling an ordinary coupling link to be effectively grasped. The mode of using the instrument will be at once understood from an inspection of Figs. 1 and 2, but we may remark that many shunters prefer keeping the handle wholly below the buffers during the coupling operation instead of resting it upon the buffers, as shown in the last mentioned figure. Mawlam's coupler has now been in use about two years at the Northeastern yard at Stockton-on-Tees, England, and a shorter time at some other yards, and the testimony of the shunters using it is very strongly in its favor, both as to the rapidity and safety with which it enables the work to be done.



MAWLAM'S RAILWAY TRUCK COUPLER.

NEW INVENTIONS.

Mr. William R. Phillips, of Milford, Del., has patented an improvement in fruit driers, which consists in combining with slotted walls slides, cleats, and movable cross bars.

Mr. Gerhart Rauman, of Middletown, Conn., has patented a spring closer for doors, gates, and blinds, so constructed that it will close a door, gate, or blind however much or little may be opened.

An improved toy pistol has been patented by Mr. Henry S. Lockwood, of South Norwalk, Conn. The improvement relates to pistols having their barrels pivoted so that the breech may be swung upward to permit insertion of a cap or cartridge. The object of the invention is to dispense with the use of springs or catches for holding the barrel in place, and thereby simplify and cheapen the construction of the pistols.

Mr. Edward P. Haff, of New York city, has patented a double crochet needle formed of a tube, into each end of which a crochet needle is inserted. These needles may be fine or coarse, and may be replaced by others when desired and are inverted in the tube when not in use.

Mr. John McAnespey, of Philadelphia, Pa., has patented an improvement in ice cream beaters, which consists in a novel construction and combination of a vertical barred beater and an automatic scraper for removing the ice cream from the interior surface of the can.

Mr. Emil P. Raether, of New York city, has patented an improved bottle stopper especially adapted to bottles containing sirups, bitters, and other fluids used in restaurants

An apparatus for filling casks and bottles with lager beer or other liquid impregnated with air or gas under pressure, so constructed that the pressure may be regulated as desired and without wasting the liquid, has been patented by Mr. J. C. G. Hüpfel, of New York city.

A simple and efficient apparatus for extinguishing fires has been patented by Mr. Lewis A. Folsom, of Dalton, Ga. The invention consists of two barrels or other vessels, set one within the other, the outer one containing sulphuric or other acid, and the inner one carbonate of soda or other alkaline carbonate, and into the latter vessel a third vessel, containing gunpowder or other explosive, is introduced, the explosive vessel having a fuse or tube filled with powder connected with it and extending upward through the cover of the other vessels, so that fire applied to the tube or fuse will be communicated to the explosive in the interior vessel, and cause an explosion which will burst asunder the containing vessels, and thereby cause their contents to mingle, generating a sufficient volume of carbonic acid gas to extinguish the fire.

Mr. Gennaro Rossi, of New York, has patented a paint composition for woodwork, walls, and the bottoms of vessels, to produce a waterproof surface, and on vessels to prevent the adherence of barnacles and grass.

Mr. William L. Gerard, of Junction City, Kan, has patented an improved tether, which permits of keeping the animals within a limited space without requiring a long rope or strap or strong and insurmountable fences. The invention consists in an anchor or like device attached to the halter strap of the animal, so that if the animal steps over the low fence surrounding its pasture the anchor catches on the top wire of the fence, thus holding the animal.

An improved holder for tape, braid, etc., has been patented by Mr. Edward P. Haff, of New York city. It is formed of a U-shaped spring clamp, with a double slitted cross piece and roughened or serrated shanks adapted to clasp the sides of the material.

Messrs. Jules and Charles Schmerber, of Paterson, N. J., and Jules A. Arrault, of New York city, have patented a machine for grinding and mixing plastic compositions or substances, such as pyroxyline compounds or others of which the solvents or part of the ingredients, being volatile, require working in closed apparatus to prevent loss of the volatile portions The inventors make use of a hollow cylinder for receiving the plastic material, formed with a steam jacket and fitted with a piston that is to be reciprocated by suitable power, and the cylinder is connected by passages at its opposite ends with the grinding machine, so that by the movement of the piston the material is forced back and forth, through the grinder until the operation of mixing and grinding is completed.

Messrs. William Cornwall, Sr., William Cornwall, Jr., and Aaron Cornwall, of Louisville, Ky., have recently patented an improved machine for mixing materials suitable for making soap, also for mixing other plastic or pulverulent materials for other purposes. The improvement consists in the construction and arrangement of the rotating arms employed for creating currents, which move in opposite directions, but in different parts of the materials placed in the mixing vessel or receptacle.

Mr. Hollis C. Trout, of Minneapolis, Minn., has patented a receptacle for mail matter, so arranged that its interior can be quickly and easily inspected without opening the cover. The sides of the box are formed of wire gauze or of glass, or glass protected by an exterior covering of wire gauze or any material that will permit a quick inspection of the box through the sides. The box is intended principally for the use of residences and stores as a receptacle for newspapers, but it may also be used as a receptacle for other mail matter.

YELLOW AND RED PHOSPHORUS IN THE MANUFACTURE OF MATCHES.

BY DR. E. EICHLER.

Phosphorus is an element, that is to say, a simple chemical substance. The ease with which it ignites and the fact of its shining in the dark (to which it owes its name, from the Greek words signifying "light bearer"), have made it at all times an object of general interest. Uncombined phosphorus does not occur in nature, its chemical properties rendering it impossible for it to remain in a free state during the formation of the solid crust of the earth. Its occurrence is limited to compounds of its acid, "phosphoric acid," with alkalies, especially with lime. Apatite, which occurs in the oldest formations, is chiefly composed of phosphate of lime; then, too, there is wavellite, a hydrous phosphate of alumina, and pyromorphite or phosphate of lead.

In 1669, Brand, of Hamburg, accidentally discovered phosphorus while experimenting with urine, and Kunkel first described a method for its preparation from the same material. Until the middle of the last century urine was the only source of making phosphorus; hence it could be prepared only in small quantities, which made it very expensive. In 1737 Hellof obtained from 3 oxhoft (about 700 liters) only 1 ounce of phosphorus, which was then worth 10 ducats in England and 16 in Amsterdam.

In the second half of the last century Scheele discovered that bones consist for the greatest part of phosphate of lime, and thus opened an abundant source for phosphorus, which is still in use to-day. In recent times, too, important beds of phosphate of lime have been discovered.

Since phosphorus has found much technical use it is prepared on a large scale in chemical works. In its manufacture either bone-ash or the natural phosphate of lime from the mineral kingdom is employed. Its preparation depends on the reduction of phosphoric acid by means of coal at a white heat. The neutral phosphates furnished by nature cannot be directly employed, since only the acid phosphates are reducible by carbon. To obtain such a reducible acid phosphate the ordinary phosphate is covered with dilute sulphuric acid and warmed. The sulphuric acid deprives the phosphoric acid of two-thirds of its lime, forming with it an almost insoluble sulphate of lime (gypsum), while the acid phosphate formed goes into solution and can be separated from the gypsum by decanting and pressing. The solution is concentrated in leaden vessels, and then mixed with pulverized wood charcoal and heated in clay retorts, at first gently, then to a strong red heat. These retorts are connected with earthen receivers containing water, in which the gaseous phosphorus is condensed and collected under water. The crude product thus obtained is still very impure, and is purified by repeated distillation in iron retorts. Phosphorus generally comes into market in sticks formed by sucking the phosphorus, which has been melted under warm water, into conical glass tubes, which are then closed at both ends and dipped into a cylinder of cold water. The phosphorus soon solidifies and can be pushed out of the tubes.

Phosphorus as it comes into commerce in sticks (the yellow white, or common form) is colorless, or yellowish, and translucent; at ordinary temperature it can be cut with a knife, and exhibits a waxy luster on the cut surface. It is insoluble in water and alcohol; ether, ethereal, and fatty oils take it up in small quantity. The best solvent for it is sulphide of carbon; chloride of sulphur and sulphide of phosphorus dissolve it readily. It melts at 44° C. (111° Fah.), expanding considerably, and then refracts the light strongly. It boils at 290° C. (554° Fah). When heated in the air but little above its melting point it burns with a very luminous flame to phosphoric acid (anhydride). Exposed to the air at lower temperatures its also oxidizes and burns without flame to phosphorous acid, which forms a luminous vapor in the dark, and the phosphorus gives out an alliaceous odor; hence it must always be kept under water.

We have already said that phosphorus is luminous in the dark, hence its name. All the last mentioned properties are due to its great affinity for oxygen.

Phosphorus belongs to the most violent poisons, even very small quantities proving fatal. Burns on the skin may result fatally if the wound is not well washed out and caused to bleed freely. Employment in phosphorus factories is highly detrimental to the health of workmen, but especially for those that have bad teeth. The phosphorus necrosis caused by its vapor produces a destruction of the jaw bone.

If yellow phosphorus is exposed to the action of light, especially direct sunlight, under all circumstances and in all media, it gradually turns red. This red substance is not a compound of phosphorus; it is nothing but pure phosphorus, the so-called *red phosphorus*, *i. e.*, an allotropic modification of phosphorus. By allotropy we understand an unexplained property that certain elements possess of assuming different conditions with totally unlike properties.

Schroetter first made the observation that *heat* effects the same change of common phosphorus into the red that light does. When the former, or yellow, is heated for a long time in an atmosphere of carbonic acid to 240° or 250° C. it is gradually converted into the latter, or red. This conversion takes place far more rapidly by heating common phosphorus to 300° C. in closed iron vessels; no increase or decrease of weight takes place. The substance thus obtained has the following properties:

Red phosphorus does not change in the air, hence it is non-luminous; it is *insoluble* in sulphide of carbon; if perfectly free from common phosphorus it is not poisonous. In its tendency to chemical union it is far behind the other kind; rubbed with oxidizing substances it takes fire only at high temperature; except with chlorate of potash it explodes easily and with violence. Heated in carbonic acid at ordinary pressure to 261° C., it is reconverted into ordinary phosphorus; near this temperature it ignites by access of air.

Red phosphorus is now made in large quantities by continued heating of the yellow phosphorus. To obtain it perfectly pure the unconverted yellow phosphorus is dissolved out with sulphide of carbon, which leaves the red form uneffected.

Both modifications find their chief use in match making. The yellow is used in common matches, the red in so-called Swedish (or safety) matches.

In the former case the phosphorus is on the head of the match, which ignites by rubbing it on any rough surface, the slight heat thus generated being sufficient to ignite the phosphorus. As conveyance to carry the flame to the wood they generally use sulphur, which is applied to the wood beneath the phosphorus.

In the second case the match heads contain no phosphorus, but substances that readily yield oxygen and favor combustion (chlorate and chromate of potash with sulphide of antimony). These matches do not ignite on every surface, but only on such as are covered with red phosphorus.

Against ordinary matches the very justifiable charge can be made that they are very hazardous as regards fire, and that the mass is highly poisonous. Even the health of operatives employed in their manufacture is injured; the strictest precaution of excluding all workmen with defective teeth is but little use; in all match factories there are frequent cases of phosphorus necrosis, often attended with fatal results. Besides, how many children have been poisoned by phosphorus matches? Then there are cases where pieces of burning phosphorus fly from a match head and cause dangerous or fatal burns.

To show the amount of damage done in the last ten years by the careless use of phosphorus matches we give the estimate made by the *Chemiker Zeitung*, that in the years 1862 to 1871 inclusive, in Germany alone, the damages paid by public insurance companies for injury done to buildings through carelessness with matches amounted to $2,120,000. Add to this damages to furniture and to uninsured buildings the probable sum of $2,250,000, we have for the grand total of damage from careless use of phosphorus matches in ten years $4,370,000.

None of these evils and dangers accompany the use of so-called Swedish matches (invented by Prof. Boettger in 1848), since they are not poisonous and only ignite on prepared surfaces. (They ignite when rubbed on smooth porcelain or glazed paper.—*Trans.*) Although the use of these is already very large (in Germany), they are still very far from having totally displaced the old sulphur match. That the latter are somewhat cheaper causes many people to use them and many factories make them. It can be suppressed only by law. On December 23, 1879, Switzerland passed a law forbidding the introduction and sale of matches and tapers on which the common yellow phosphorus is used. In spite of all the agitation against this law it has been strictly enforced. Germany, too, is taking action in the matter, and the German Parliament of June 27 of this year proposed to check the use of yellow phosphorus by increasing the tax thereon.—*Badische Gewerbezeit.*

[The American parlor match is as little known in Germany as the Swedish match is here. The parlor match possesses so many advantages of being convenient and certain that our people seem willing to incur the extra danger rather than inconvenience themselves by the use of a match that will ignite only on the box, involving the inconvenience for smokers of always carrying the prepared surface in the pocket. One of the chief objections to parlor matches is the ease with which the heads fly off, carrying a spark perhaps to some dark corner, where it smoulders for hours, or lies innocently on the pavement until exploded by the foot of the unsuspecting pedestrian, who, if a lady, is in danger of having her skirts set on fire thereby.—ED.]

Hydraulic Pumping on the Comstock.

News from the Comstock announces that the Requa shaft is to be supplied with hydraulic pumping apparatus, a fact which marks just as great a change in the engineering of the famous lode as any which has preceded it.

The present system of pumping is by direct-acting compound engines, using steam at 100 to 110 pounds, and a vacuum of 26 or 27 inches. The Davey differential valve gear is used with the poppet valves introduced by Mr. Patton, the able designer of all the new Comstock machinery, and superintendent of the northern group of mines. Steam cylinders of 32 and 64 inches diameter, and pump cylinders of 13, 14, and 15 inches diameter and 7 to 10 foot stroke, complete this splendid system of drainage. One of the series of pumps—in fact, the one which is now doing duty in the Requa shaft—has a double line of pump cylinders, 14 inches by 10 feet.

It is a sign of the remarkable difficulties which are presented in mining at the depth of 3,000 feet, that the immense powers of this pump should have proved unequal to the task of draining the mine, and tanks have lately been running that raised the water to the surface, while the pump lifted it only from the 2,400 level to the Sutro tunnel, 800 feet above. Together, the two modes of drainage are reported to have raised 2,000,000 gallons, or 8,000 tons, of water daily, a quantity which is probably exaggerated. Even with this extraction of water, the work of the mine has been seriously impeded by the fear of flooding. It is true that the Requa shaft is now handling that remarkably persistent "water bonanza" that flooded the Savage so long.

At these great depths it has been found extremely troublesome to maintain the ponderous spear rods which the old system of pumping required. They are made of Oregon pine, in sections 80 feet long, and usually 14 x 14 inches in section; but with all their strength, they have broken repeatedly in the Comstock mines. Especially when the water is most abundant, and in those up-cast mines where labor is most severe in the shaft, are the breaks likely to occur.

Hydraulic pumping has been proposed for years as a remedy for these difficulties, and we are glad to see that the step of introducing it is to be taken at last. The details of the scheme have not reached us; but it is reported that the new pumps will be much more powerful than the old. In any event, it is probable that it will be more effective in the peculiar circumstances of the Comstock than the present system. The new apparatus will be ready, it is said, before the end of the year.—*Eng. and Min. Journal.*

Iron Tops not a Protection for Oil Tanks.

To the Editor of the Scientific American:

In your paper of July 17, is an article written by D. B. Mason, of Pittsburg, Pa., in which he states the remedy for protecting oil tanks from being struck by lightning has long since been solved—the use of iron tops instead of wood—and adds there has never been a tank of oil with iron top burned by lightning. This was believed to be true until this season. Mr. M. is sadly mistaken. There were three oil tanks in this vicinity (all iron tops) struck by lightning and burned, as well as others in other sections of the oil regions. We would be only too glad to learn of some method other than the old theory by which we could protect our property from lightning, as that has been demonstrated beyond a doubt to be a failure. We want information on the subject. J. C. M.

Bradford, Pa., August 5, 1880.

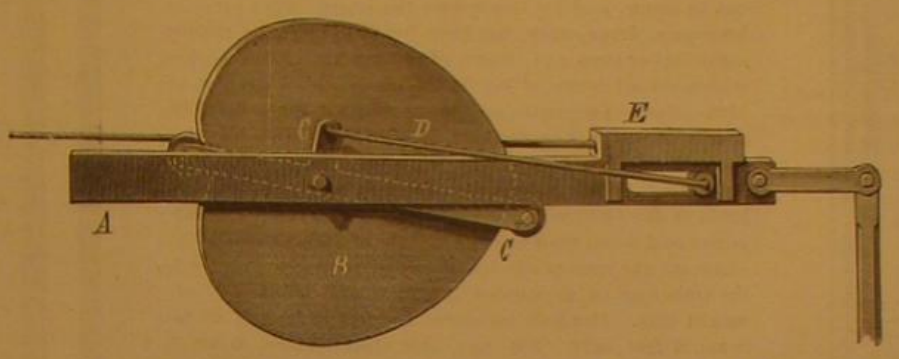
Mr. Daniel C. Beard tells us of a remarkable feat in gastronomy performed by the huge batrachian whose portrait we presented to our readers some time since. Then his tidbit was a common mouse, but now his epicurean taste is to be satisfied only with alligators, not of the largest size to be sure, but alligators nevertheless. Mr. Beard placed an alligator 11¼ inches long in the aquarium occupied by the bull frog. After a brief battle—the bull frog being the victor—the process of swallowing the vanquished began, and in due course the alligator passed from view.

A SUBSTITUTE FOR THE CRANK.

The engraving shows a device recently patented by Mr. Samuel W. Hanson, of West Union, West Virginia, intended to replace the crank in steam engines and other machinery where the crank is now used. On the end of the shaft, in the place usually occupied by the crank, there is a heart cam, B, across the face of which, and at right angles with the shaft, a bar, A, slides in suitable guides. The bar carries a lever, C, whose pivot is parallel to the main shaft and in the same horizontal plane. This lever has at each end a friction roller which rolls on the periphery of the heart cam, and from one side of the lever projects an arm which is connected by a rod, D, with a pin working in a slot in bar, A. A slide, E, on the bar, A, is provided with two pins projecting downward on opposite sides of the pin connected with the rod, D. The slide, E, is connected with a hand lever, by which it may be moved lengthwise on the bar, A.

The bar, A, is connected with the piston rod of a steam cylinder or any other prime motor either directly or by means of a lever. The bar being reciprocated exerts a pressure on the periphery of the cam though the medium of the lever, C, and its rollers. It will be noticed that one end of the lever, C, is below the center line of the bar, A, while the other end is above. This arrangement insures the rotation of the cam in one direction, and to reverse the motion of the cam all that is required is to reverse the position of the lever, C, by moving the slide, E.

The inventor claims that the cam has no dead points, that the power and motion are equal throughout the stroke, and that for this reason a flywheel is unnecessary. He also states that he gains a great deal of power over the crank, that it will run either very slowly or with any desired velocity, that it is capable of withstanding jars or shocks it is likely to receive, and is not liable to get out of repair. Further information in relation to the invention may be obtained by addressing the inventor as above.



HANSON'S SUBSTITUTE FOR CRANKS.

Tobacco Smoke Products.

MM. Le Bon and Noel presented, the other day, in the French Academy, three flasks containing the following products extracted from tobacco smoke: 1. Prussic acid; 2. An alkaloid of agreeable odor, but dangerous to breathe and as poisonous as nicotine; 3. Aromatic principles still undetermined, but contributing, with the alkaloid mentioned, to give tobacco smoke its perfume. The alkaloid in question is thought to be identical with a compound—collidine—the existence of which has been observed in distillation of various organic substances, but whose physiological and toxical properties have been overlooked.

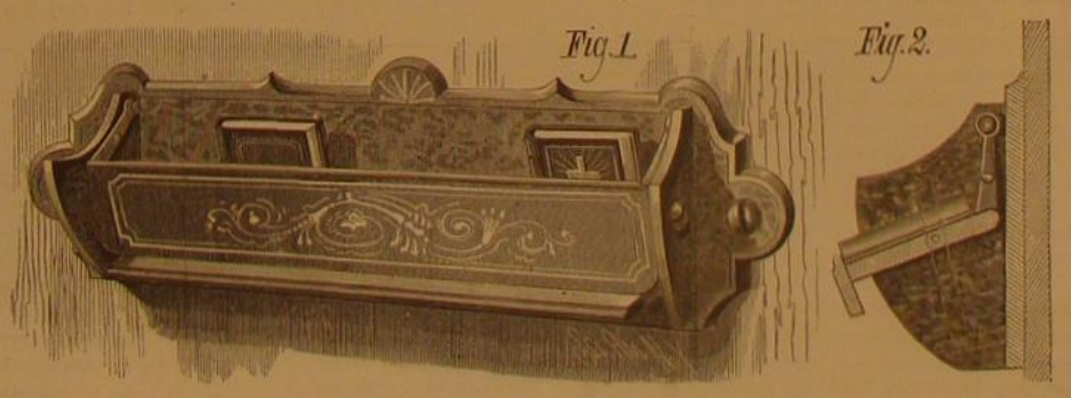
IMPROVED BOOK-RACK.

A novel book-rack which can be readily changed into a book-rest is shown in the engraving. It is designed more particularly for application to church pews, but there are numerous other uses to which it may be applied with advantage.

Fig. 1 is a perspective view showing the device when used as a book-rack, and Fig. 2 is a vertical transverse section showing the device in use as a book-rest. The front of the rack is pivoted at the ends so that it may be readily arranged either as a book-rack or book-rest.

On the inner surfaces of each end piece there is a latch which is adapted to hold the front of the rack securely in either of its positions. Ordinarily the front of the rack is in the position shown in Fig. 1, but it may be instantly changed to serve as a book-rest by raising the latches at the ends and turning the front of the rack on its pivots and bringing the latches against the upper edge of the front piece. The ends of the movable piece are rendered noiseless by rubber washers. The rack is neatly made in suitable designs and of suitable wood to match its surroundings, and it is readily secured in its place by two ornamental screws. It may be made in different lengths and widths to suit the different uses to which it is applied.

Further information in regard to this invention may be obtained by addressing the patentee, Mr. James Murphy, of San Antonio, Texas.



MURPHY'S BOOK-RACK AND BOOK-REST.

New York City as a Summer Resort.

Compared with other cities which furnish tables of mortality, New York may claim a condition of public health better than the average. In the latest published returns for June the weekly statement for New York represents an annual death rate of 23·5 per 1,000 inhabitants. But in Concord, N. H., it was 26; in New Bedford, Mass., 34·7; Marblehead, Mass., 27·8; Sing Sing, N. Y., 62·6; Plainfield, N. J., 26; Wilmington, Del., 26·6; Baltimore, Md., 25·7; Cincinnati, Ohio, 24·7. These are localities generally deemed healthy, and would probably resent the insinuation that a residence there is less conducive to longevity than one in New York. But here are the best and freshest figures we have at hand, and they tend to confirm that impression. Going well South we come upon statistics exhibiting even a more favorable contrast for New York. The death rate of the District of Columbia for the period mentioned was 29·4; Norfolk, Va., 29·4; Charleston, S. C., 32; Savannah, Ga., 31·4; Augusta, Ga., 29; Selma, Ala., 44·2; New Orleans, La., 37·2; Brownsville, Texas, 28·4; Nashville, Tenn., 33·4; Clarksville, Tenn., 43·4. A heated term in those cities, such as is scourging the Northern and Eastern States at the present time, would probably raise these percentages. New York need not fear to challenge comparison with foreign cities. She is the healthiest of all the crowded centers of population from which we have the tabulated returns, except London. The British metropolis reported a death rate of 18·5. But in Berlin it was 26·6; Hamburg, 25·4; Vienna, 25·8; Buda-Pesth, 41·1; Copenhagen, 25·8; Stockholm, 35·9; Geneva, 25; Amsterdam, 28·5; Rotterdam, 29·8; Cadiz, 32·9; Havana, 43·5; Shanghai (the foreign settlement), 104·4; and Kobe (Japan), 34·9. In Liverpool the rate was 23·4, closely approximating that of New York, and in the other large English towns it was but slightly less. These figures are fairly taken from the official data, and their accuracy cannot be impeached. They make out New York, if not exactly a grand sanitarium, yet a place where one's chances of health are good enough to warrant the selection of this city as a reasonably safe resort for the summer months—in fact, a good watering place. So it is regarded by the thousands of Cubans and South Americans who come here to pass the hot weather. For this comparatively salubrious state of things we have to thank our natural environments of ocean and rivers, owing little to the city authorities. If they would keep the streets clean and suppress some of the still flourishing nuisances so prejudicial to the public health, they could reduce the death rate still further and make New York incontestably the healthiest of the great cities of the world.—*New York Journal of Commerce.*

Measuring the Velocity of Light.

Professor Newcomb is engaged at Fort Whipple experimenting with the velocity of light. The distinctive feature of his method is a four-sided revolving mirror erected upon iron pillars. The mirror revolves at from one hundred and fifty to two hundred and fifty revolutions a second. The light reflected from an ordinary mirror outside is forced through a tube which strikes the revolving mirror and is reflected across the Potomac River, a distance of two miles, where it strikes a mirror on Observatory Hill. It is reflected back again, and the point upon which it strikes is noted by a telescope attached to a graduated scale. By this means the exact time is easily secured, and arrangements are being made by which the velocity can be noted at much greater distance. The new station will be near the Government Insane Asylum.—*Washington Star.*

DANGERS OF ELEVATED RAILWAYS.—In this city recently, on the Metropolitan Road, a locomotive and an empty passenger car were, by some stupidity of the train men, backed off the track and fell into the street twenty feet below. Fortunately no passengers were on board, the engineer and brakemen escaped, and no person was hurt.

MISCELLANEOUS INVENTIONS.

Mr. Mark L. Mount, of Pearsall's, N. Y., has patented an improved matched hook, made of two parts, one of which carries a square stemmed pivoted button and locking springs, the other part being slotted to pass the head of the button.

A simple and convenient machine for cutting potatoes and other vegetables into uniform slices and strips has been patented by Mr. Jessup Whitehead, of Leadville, Col.

An improved adjustable attachment for carriages, which furnishes a good support for baggage, has been patented by Emma J. Osborne, of Anderson Court-House, S. C. The invention consists in a frame or platform pivoted at its outer end between two arms, the inner ends of which are pivoted between two arms connected by a transverse rod and having the upper ends curved so as to form hooks, by means of which they are hooked on to the spring bar of the vehicle.

Mr. Daniel F. Hallahan, of Philadelphia, Pa., has patented a machine for trimming and burnishing the edges of soles of boots and shoes. It consists of two spiders of equal diameters and having an equal number of arms that are fixed upon a shank or shaft between two circular disks or guides, which guides are of slightly greater diameters than the spiders, together with the cutters or burnishers that the spiders carry on the ends of their arms; and it further consists of tangential cutters or burnishers (the cutters and burnishers being interchangeable) adjustably fixed upon the ends of the spider arms by means of screws that pass through slots in said arms, the spiders being so arranged that the cutters or burnishers on the one fit into or opposite the interspaces between the cutters or burnishers upon the other, and so that while one of the spiders remains fixed the other may be approached or withdrawn from it, whereby the device may be adjusted and applied to soles of any thickness.

An improvement in extension settee tables has been patented by Mr. Morgan Gossett, of Russellville, Ohio. The invention consists of a table having stationary legs and a movable leg and a pivoted extension top that can be horizontally or vertically adjusted, as may be desired, by a novel arrangement of devices, while between the legs seats are arranged.

A car for transporting live stock by railway has been patented by Mr. Francis Rieber, of Callicoon Depot, N. Y. It consists in novel details of construction and arrangement of stalls, feed racks, water troughs, hay lofts, and water tanks, and devices connected therewith, whereby provision is made for securing the comfort and preserving the health of the animals occupying the car.

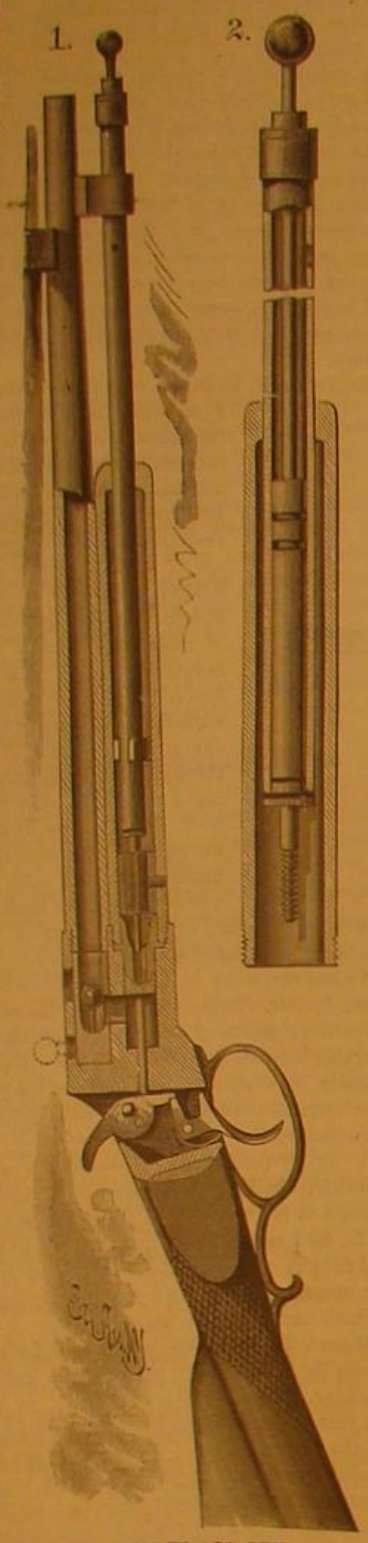
Messrs. Jacob A. Swinehart and Lafayette Jourdan, of Rushville, Ohio, have patented an improved drag sawing machine, which consists of a beam or bench supported at the rear by legs and in front by a guide block, which rests on the log to be cut. Two levers are pivoted in and extended downward through mortises in the beam, and are connected at their lower ends by a pitman, and to the forward one of these levers is pivoted the saw shank, the saw extending forward and through a cut in the guide block.

The curative properties of an electric current may be adapted to the treatment of different diseases by taking advantage of its different qualities as developed under varying conditions. The current may have great intensity and little quantity, or it may have great quantity and little intensity. It may be continuous or intermittent, or it may be made to alternate, so that electrical impulses of different name will rapidly succeed each other. There are two methods of generating electrical currents for curative purposes—one by chemical means, as in the various forms of battery, the other by the direct conversion of mechanical energy into electrical energy, as in the magneto-electric machine. Magneto-electric machines have not generally been considered as efficient for curative purposes as batteries, on account of the difficulty experienced in constructing a machine capable of yielding the different qualities of current required for the treatment of different subjects. Mr. Thomas W. Livingston, of Ainsworth, Iowa, has invented a magneto-electric machine capable of yielding currents varying in their character, so that its range of application will be wider than that of batteries, while it is more compact, more manageable, more easily adjusted, and operated by either skilled or unskilled persons.

VERY promising results are obtained with the eight-inch chambered rifle, converted from the old-fashioned ten-inch smooth bore, in the tests at Sandy Hook. The new gun bears a charge of 55 pounds of powder, carries a shot weighing 180 pounds, and penetrates 10 inches of iron at 1,000 yards. Originally, as a smooth bore, it was fired with 16 pounds of powder and carried a shot weighing 120 pounds.

NEW AIR GUN.

The engraving shows a very simple and effective air gun recently patented by Mr. A. G. Hyde, of this city. It is constructed so that the air may be compressed to a high pressure, and its entire volume released at each shot.



NOVEL AIR GUN.

In a cavity in the breech of the barrel, there is a tube of the same caliber as the barrel, closed at its rear end, and provided with a pin for preventing the backward movement of the ball. This tube is provided with a handle by which it may be turned, and which projects through a slot in the breech. There are two holes in the tube, one for receiving the ball, which is dropped in through an opening in the top of the barrel, and the other for communicating with the air chamber, located below the barrel. The holes in the tube are arranged relatively to each other, so that when one is open the other will be closed.

The air chamber contains a valve which is pressed against a packing at the end of the air reservoir, and is held in place by a dog, which, in turn, is retained by the trigger. The air-condensing pump projects into the air reservoir, and is provided with a single valve at its inner end, which prevents the air from re-entering the barrel after having been compressed. The air enters the compressing pump through a small aperture near its outer end. No valve is placed here, as communication between the external air and the space below the piston is shut off after the latter has moved inward a short distance. The piston rod of the air compressor is provided with a ball handle at the outer end.

The arrangement of the barrel and air reservoir may be clearly seen in Fig. 2.

When it is desired to use the gun it is only necessary to move the pump piston out and in a few times, when sufficient air will be compressed to project the ball with great force.

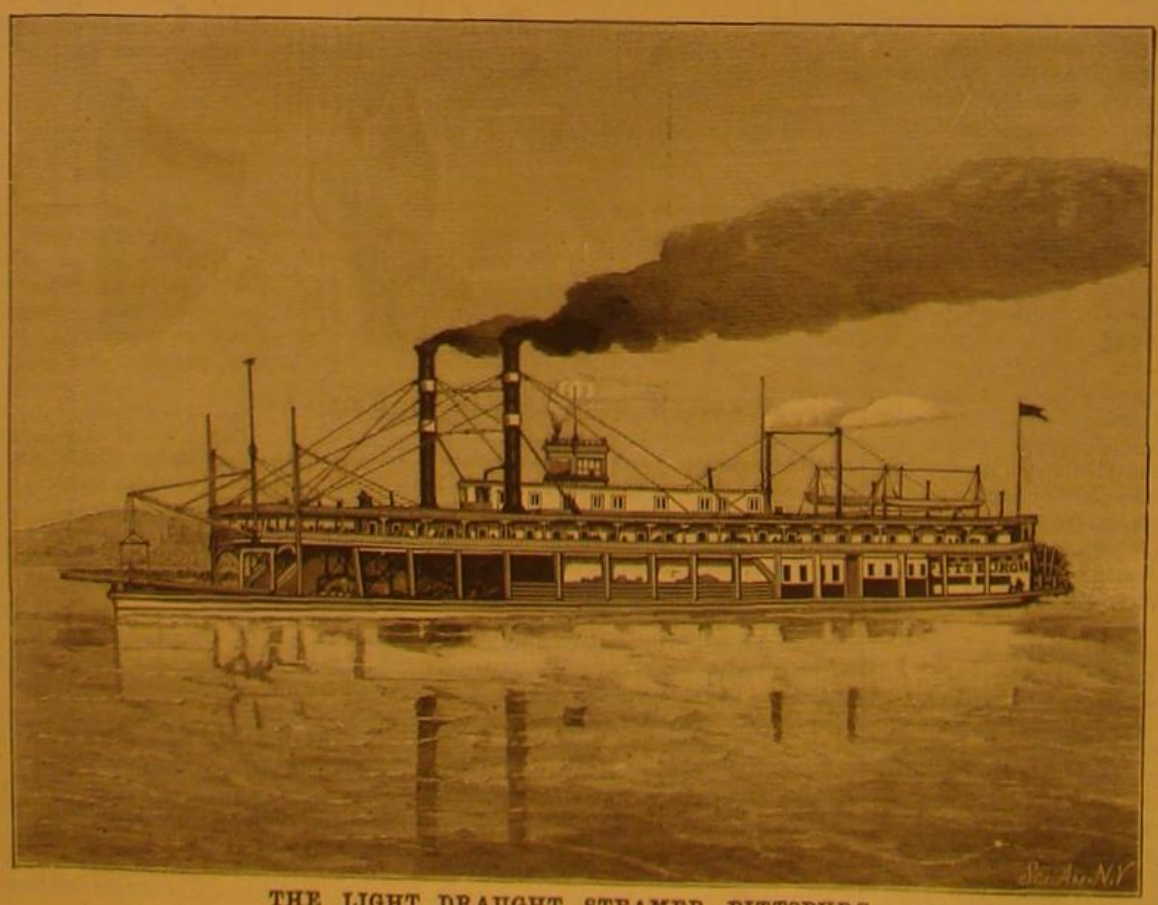
THE STEAMER PITTSBURG.

The light draught stern-wheel steamer, now the predominant type used on the Ohio and Mississippi rivers and their tributaries, is peculiar in many respects to the West. In former years the stern-wheeler was considered, on account of slowness, unfit for the river traffic, but the rapid strides in its perfection which have been made on the Ohio in recent years have placed it almost beside its rival side-wheeler in point of speed. The exterior appearance of these boats is strikingly graceful, the long unbroken lines from stem to stern, together with their very slight sheer, giving them great beauty. The boilers are located on the main deck, about one third the boat's length from the bow. The wheel is never housed, but remains open. The engine room aft occupies but a small space, and the remainder of the deck room is devoted to freight. The cabin is on the upper deck, and on all of the boats in the passenger carrying trades is complete and elegant in every respect. The officers' cabin occupies the hurricane deck. The saloon extends nearly the entire length of the boat, and on many steamers is palatial in its appointments.

The desideratum, of course, in all steam vessels is economy of power. In Western steamboats the very extreme of light draught is necessary. The hulls must be flat bottomed, and built as lightly as practicable with the requisite strength for large cargo carrying. The machinery must be as light as can be made, and for this reason the simple, high pressure, horizontal, lever engine has been found to meet the requirements better than any other. The long return-flue boilers, which, on all boats of late build, are made of steel of the highest tensile strength, are better adapted for several reasons to these boats on account of mud, etc. Besides, their shape distributes their weight over a larger area. There is no doubt that, for the weight of machinery used, the improved boats of the Ohio and Mississippi rivers develop a greater power and speed than any other class of steam vessels.

Among the remarkable specimens of the stern-wheeler on the Ohio may be mentioned the Pittsburg, build at Cincinnati in 1879. Her hull measures 252 feet in length, 39 feet beam, 6 feet hold. She has three steel boilers, 70,000 lb. tensile strength, 47 inches diameter, 28 feet long, 6 flues. Engines, 21 inches diameter, 7 feet stroke, working a wheel 21 feet diameter, 28 feet face. With fuel on board and steam up this boat draws only 24 inches water, and will carry 1,000 tons. She is one of the fastest steamers on the river. The large Golden City, plying between Cincinnati and New Orleans, is 276 feet long, 40 feet beam, 7 feet hold, and carries 1,600 tons. The steamer Buckeye State, of the Upper Ohio, is 240 feet long, and can carry a large cargo on 4 feet water.

These boats are complete with all the modern appliances of steam stages, capstans, windlasses, headlights, etc. The electric light has been applied with great success to several steamers during this year.



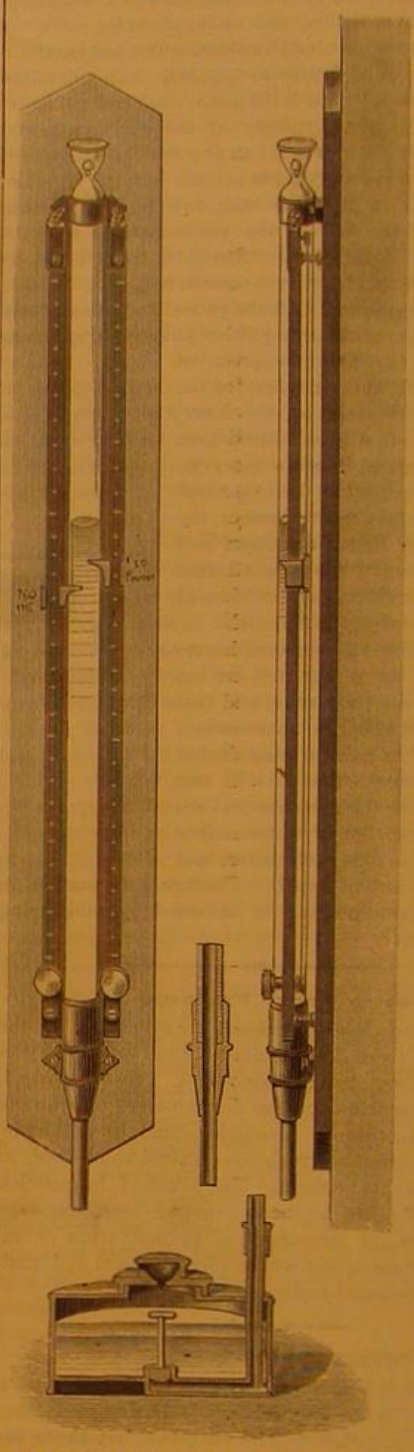
THE LIGHT DRAUGHT STEAMER PITTSBURG.

They Had all Had It!

A health officer writes to a Canadian medical journal as follows: "Inspected a house in the country at the request of the attending physician, as the general health of the family had been bad for a long time, they having suffered from a class of complaints that would indicate bad drainage, etc. Found under the floor a wooden drain with rotten cover, and soil saturated with sewage; trap on water-closet non-effective; water-closet foul; situation very bad; ventilation so arranged as to poison the room above it, a sleeping apartment occupied by a young man suffering for a long time from general ill health. No trap on kitchen sink; water supply, cistern connected directly with the sewer without traps in the overflow pipe. On my reporting the latter fact to the family, and expressing my surprise that they had not all had typhoid fever, they exclaimed in chorus, 'Oh, we have all had it!'"

THE GLYCERINE BAROMETER.

The marked influence of the variations in the pressure of the atmosphere upon the disengagement of carbureted gases in coal mines, has led the English engineers to devise a new barometer that will not only indicate the most minute variation of atmospheric pressure, but will indicate it so plainly that miners and others not experienced in making barometric observations can readily detect the variations.



THE GLYCERINE BAROMETER AT THE KEW OBSERVATORY.

Among the instruments of this class one of the most interesting is the large water barometer constructed for the Royal Society by Prof. Daniell, in 1830, which, however, was not a success, as the effects of the pressure were annulled by the effect of the temperature upon the vapor found in the Torricellian vacuum.

Mr. B. Jordan, a member of the office of the English mining archives, has spent several years in studying the different liquids that might possibly be applicable in constructing an accurate and highly sensitive barometer, and finally found that glycerine produced the best results. A glycerine barometer constructed by Mr. Jordan, 1870, is still in use. The glycerine, which is very pure, is manufactured by Price & Co., and has a specific gravity of 1·26, and on account of its high point of ebullition the vapors have no perceptible tension at the ordinary temperature, and it will only congeal at a very low temperature. The height of a column of glycerine is 26 feet 9 inches, and a variation of 1-16th of an inch of mercury corresponds to a variation of about 1 inch in the column of glycerine. As glycerine is very apt to absorb the moisture of the air, it is covered with a thin layer of prepared thickened petroleum in the cistern of the barometer. Mr. Jordan has constructed barometers for the South Kensington and Jermyn Street Museums; both have given perfect satisfaction, and to show the scientific value of the instrument the Royal Society has built one at the Kew Observatory.

This instrument is shown in the annexed engraving, and consists of a cylindrical cistern of tinned copper, about six inches high and ten inches in diameter, provided with a screw cover or cap, having a small opening leading into a recess containing cotton to act as filter and keep out the dust. The large barometric tube is made of

ordinary gas pipe, about three quarters of an inch in diameter, and is rigidly attached to the cylindrical cistern or cup. The upper end of this tube fits into a piece of bronze, into which a glass tube, three quarters of an inch in diameter and about four feet high, is securely cemented. This tube terminates in a cup inclosing a rubber packing. Graduated scales provided with indicators are placed at each side of the glass tube, the one on the left side indicating the inches and tenths of inches, and the right-hand scale shows the equivalent measure of a corresponding column of mercury. The scales are attached to an oaken plank, which is fastened to the wall of one of the upper stories of the observatory, and the large tube passes down to a room situated twenty-six feet nine inches lower. The glycerine in the barometer is colored with aniline red. Before putting the glycerine in the tube it is boiled at a temperature of about 180° to expel the air and to make it purer. The air is exhausted from the barometric tube by means of an air pump. Regular observations are made with the instrument at the Kew Observatory under the surveillance of Mr. Whipple, who considers the apparatus to be a scientific instrument of the greatest precision.

TAGUAN FLYING SQUIRREL.

The beautiful and active group of animals of which the English squirrel is so familiar an example, are found in almost every portion of the globe, and, with one or two exceptions, live almost exclusively among the branches of trees. In order to enable them to maintain a firm clasp upon the branches and bark, they are furnished with long, finger-like toes upon the fore-feet, which are armed with sharp curved claws.

In the flying squirrels, of which the taguan is a good example, the skin of the flanks is modified in a method similar to that which has already been noticed in the petaurists of Australia and the colugo of Java.

This skin is so largely developed, that when the animal is sitting at its ease, its paws but just appear from under the soft folds of the delicate and fur-clad membrane.

When the creature intends to make one of its marvelous leaps, it stretches all its four limbs to their fullest extent, and is upborne through the air on the parachute-like expansion which extends along its sides. This animal is a native of India, where it is tolerably common.

It is rather a large species, as its total length is nearly three feet, the tail occupying about one foot eight inches, measured to the extremity of the long hairs with which it is so thickly clothed. The general color of this animal is a clear chestnut, deepening into brown on the back, and becoming more ruddy on the sides. The little pointed ears are covered with short and soft fur of a delicate brown, and the tail is heavily clad with bushy hairs, grayish black on the basal portions of that member, and sooty-black toward the extremity. The parachute membrane is delicately thin, scarcely thicker than ordinary writing paper, when it is stretched to its utmost, and is covered with hair on both its surfaces, the fur of the upper side being chestnut, and that of the lower surface nearly white. A stripe of grayish-black hairs marks the edge of the membrane, and the entire abdomen of the animal, together with the throat and the breast, is covered with beautiful silvery grayish-white fur.

TAGUAN FLYING SQUIRREL.—*Pteromys Petaurista.*

Sharks in New York Bay.

A remarkable school of sharks was recently met with between the Narrows and Bay Ridge shore, in the lower part of New York Harbor. According to the story of Captain Alec Robertson, a well known fisherman of Fort Hamilton, there were thousands of them. His attention was first attracted to a dark spot in the water, moving toward the Long Island shore, and expanding rapidly. On sailing for the spot he suddenly discovered that it was a school of sharks, which snapped angrily at the boat's sides, and lashed the water into a foam. One fish, larger than the rest, leaped toward the stern and crushed the back strip and rudder between its jaws. It appeared to be fully ten feet in length. The water seemed alive with black fins, which darted in all directions. George Morris and John Haffey, the companions of Robertson, rushed to the forward part of the boat. Morris had been sitting on the stern seat, and narrowly escaped the bite of the infuriated fish. Robertson tore up one of the seats, with which the little craft was fitted, and used it effectively on the hard black snouts of more than one of the sharks. The breeze filled the sails and carried the boat steadily through the danger. Not until Bay Cliff was reached did the boat get clear of its pursuers.

Palm Fossils in Colorado.

Mr. E. Johnson, the expressman, brought into the *Gazette* office recently some very interesting fossils, which he had just discovered. In speaking of his discovery he said: "A year ago my son reported that he had found upon the bluffs northeast of the town a petrified fish tail, but embedded in too large a rock for him to carry. He has often urged me to go with him and get it. I finally went, and to my astonishment found that he had discovered a very fine impression of a palm leaf, and I soon found three other perfectly printed leaves of the same variety. The leaves were of enormous size, the ribs diverging from the base just like palm fans, but upon a very much larger scale. The estimated size of one leaf, calculated from reliable data furnished by the ratio of divergence, is found to be eight feet long by six feet wide." Mr. Johnson also found several sections of palm tree trunks, one of which he brought to the *Gazette* office, together with the impressions of the leaves.—*Colorado Springs Gazette.*

A North Carolina Industry.

During recent years the collection of medicinal and other plants has become a large and profitable industry in North Carolina. The trade centers at Statesville, where an enterprising firm have established one of the largest botanical depots in the world. Their stock comprises 1,700 varieties of roots, herbs, barks, seeds, flowers, and mosses, and all sorts of plants for herbariums, some of them peculiar to the flora of the State, and others found more abundantly there than elsewhere. The quantities now on hand vary from 50 to 35,000 pounds of each kind. They pay the collectors either in cash or goods, and last year they disposed in this way of $400,000 worth of merchandise. Their warehouses have 270,000 square feet of flooring, which will give an idea of their capacity for storage of the products they are collecting from all quarters. Their shipment last year, as given in the Raleigh *News*, amounted to 1,800,000 pounds. The collectors are largely Cherokees.

New Polarizing Prism.

M. Crova commends, for photometric purposes, in the *Journal de Physique*, M. Prazmowski's polarizer, which is a Nicol, with faces normal to the axis of a prism, the two halves of which are joined with linseed oil. It requires large pieces of spar, and the joining is long and difficult, but there are several advantages. Thus the layer of oil (unlike Canada balsam) causes hardly any loss of light; its index, 1·485, being nearly equal to the extraordinary index of spar, the polarized field is limited on one side, as in Nicol's, where the total reflection of the ordinary ray commences, by a red band; but the second limit, corresponding to total reflection of the extraordinary ray, is thrown out of the field of vision; the angular value of the polarized field is thus increased. The increase of field, the angular separation of the only colored band, and the direction of its bases, normal to the axis, are qualities to be appreciated in certain cases.

Spread of Disease by Earthworms.

Recent researches by M. Pasteur appear to throw considerable light on the origin of anthrax, or splenic fever, and allied diseases, which attack cattle, sheep, etc. When an animal dies of anthrax it is not uncommonly buried on the spot. The conditions of putrefaction prove fatal to the small parasitic organism, or *bacteridium*, which is abundant in the blood at death. The gas given off causes it to break up into dead and harmless granulations. But before this can occur not a little of the blood and humors of the body have escaped into the ground about the carcass, and here the parasite is in an aerated medium favorable to the formation of germs. These corpuscular germs M. Pasteur has found in the soil, in a state of latent life, months and years after the carcass was buried; and by inoculation of guinea pigs with them, has produced anthrax and death. Now, it is specially notable that such germs have been met with in the earth at the surface above the place of burial, as well as near the body. The question arises: How came they there? And it would appear that earthworms are the agents of conveyance. In the small earth cylinders, of fine particles, which these creatures bring to the surface and deposit after the dews of morning or after rain, one finds, besides a host of other germs, the germs of anthrax. (The same process was proved also by direct experiment; worms kept in ground with which *bacteridium* spores had been mixed were killed after a few days, and many of the spores were found in the earth cylinders in their intestines.) The dust of this earth, after the cylinders have been disaggregated by rain, gets blown about on the neighboring plants, and the animals eating these thus receive the germs into their system. It is suggested that possibly other disease germs, not less harmless to worms, but ready to cause disease in the proper animals, may be in like manner conveyed to the surface in cemeteries. This would furnish a fresh argument for cremation. The practical inference as to anthrax is, that animals which have died of this should not be buried in fields devoted to crops or pasturage, but (wherever possible) in sandy, calcareous ground, poor and dry—unsuitable, in a word, for worms.

To Moisten the Air in Cotton Mills.

A device for moistening the air in cotton mills is suggested by Mr. L. E. Bicknell, of West Cummington, Mass., in a communication dated July 1. It consists of a line of steam pipes running under the rows of looms, with perforations under each loom. The pipes should be laid in grooves in the floor to prevent tripping, and should be laid upon asbestos paper to prevent the overheating of the floor. Under each loom the steam pipe should carry a perforated slide or sleeve, with holes corresponding with those in the pipe, by means of which the jets of steam could be regulated. The rising steam would act directly upon the extended warp above, and afterward by diffusion would secure that humidity of atmosphere essential to the satisfactory working of cotton mills.

American Cements.

At the recent convention of the American Society of Civil Engineers, an interesting paper on American natural cements was read by Mr. F. O. Norton, from which we condense the following:

The principal deposit of the magnesian limestone producing a cement possessing hydraulic energy occurs in the town of Rosendale, Ulster Co., New York. It was first brought into use about the year 1823, in the construction of the locks and other masonry of the Delaware and Hudson Canal, which passes through that county. Its production has gradually increased until there are now made from one million to one million and a half barrels in each season, of about eight to nine months, or during the period of navigation on the Hudson River between Rondout and New York. It is the chief industry of a large section of country, its reputation is extended, and it is sold in most of the large markets of the United States.

There has been a general impression that the use of a very small amount of water in mixing cement gave greater resulting strength than when sufficient water was used to form a paste of the consistency of stiff mortar. The tests recorded prove that the dry mixture does give decidedly higher tensile strength in twenty-four hours after mixture, and that it continues to be stronger than the stiff mortar for some three months. But after that time the reverse becomes true; the curve of strength of the stiff mortar rises to and passes above that of the dry mixture, and the strength of the cement mixed as a stiff mortar continues greater than that mixed with very little water, and this is the case continuously thereafter.

The strength of Portland cement, unmixed with sand, is, of course, very great. It develops a large proportion of its ultimate strength in the first seven days, say from one-half to two-thirds.

Rosendale cement of the best qualities develops great hydraulic energy in twenty-four hours, being at that time equal to the Portland. The Portland then gains very rapidly upon it up to seven days, the difference between the two then being the greatest; at the end of a month, however, the strength of the Rosendale cement begins to approach nearer to that of the Portland, and the difference between the two seems to be continually reduced after that time, this referring to mixtures of pure cement.

For practical purposes, however, neither of the cements is generally used without an admixture of sand. The addition of sand to Portland cement reduces its strength rapidly.

This reduction of strength is, in round numbers, as follows: One part of sand gives mortar one-half as strong as pure cement; two parts, one-third; three parts, one-fourth; four parts, one-fifth; five parts, one-sixth.

This reduction of strength of Rosendale cement by the admixture of sand seems to be somewhat less. The strength of the mortar of Portland cement in the proportion of one of cement to two of sand is, at the end of six months, say 224 pounds to the square inch. The strength of a mortar of Rosendale cement in the proportion of one of cement to one of sand is, at the end of six months, say 257 pounds to the square inch.

Careful experiments made by General Gillmore, and published in the appendix to the last edition of his treatise on "Limes, Hydraulic Cements, and Mortars," give the quantities of mortar produced from the mixture of cement, sand, and water, in various proportions, and using different kinds of cement. Adopting these results, and assuming the cost of the Rosendale cement at $1.10 per barrel, and the best English Portland at $3 per barrel (the market prices, May, 1880), and the cost of sand at 5 cents per barrel, we find that a mortar of Portland cement, in the proportions of one of cement to two of sand, will cost per barrel $1.22.

We also find that a mortar of Rosendale cement, in the proportions of one of cement to one of sand, will cost 68 cents per barrel.

Summarizing the comparison, we find that a mortar of Rosendale cement, in the proportions of one of cement to one of sand, has a tensile strength of 257 pounds to the square inch, and costs 68 cents per barrel; and that a mortar of foreign Portland cement, in the proportion of one of cement to two of sand, has a tensile strength of 224 pounds to the square inch, and costs $1.22 per barrel.

Therefore, the mortar of Rosendale cement, one to one, is 34 pounds per square inch stronger, and 54 cents per barrel less expensive, than a mortar of foreign Portland cement one to two.

This seems to show that for all uses which will be served by a mortar of the tensile strength of 257 pounds per square inch, the Rosendale cement is economical.

The remaining question is, whether this mortar of Rosendale cement, one to one, is strong enough for the practical purposes to which it may generally be applied.

The facts which answer this question are that for fifty years past, and up to within a very short time, *all* the important masonry in this country has been laid with American cement. The great fortifications on the coast, the Croton aqueduct, the Boston aqueducts, both old and new, all the government dry docks, the lighthouses, the locks, culverts, and aqueducts on the Erie and other canals; all the masonry of railroad bridges, viaducts, and culverts, the sewers of our cities, the masonry of our gas works, many hundreds of miles of wrought iron water pipe lined and laid in cement; the mills and mill dams in various localities; in fact, nearly all the masonry built under water and out of water in the United States up to within a few years has been constructed with American cement.

Professor Kirchhoff's Views on Connecting Lightning Rods with Gas and Water Pipes.

The city gas company of Berlin, having expressed the fear that gas pipes may be injured by lightning passing down a rod that is connected with the pipes, Professor Kirchhoff has published the following reply:

"As the erection of lightning rods is older than the system of gas and water pipes as they now exist in nearly all large cities, we find scarcely anything in early literature in regard to connecting the earth end of lightning rods with these metallic pipes, and in modern times most manufacturers of lightning rods, when putting them up, pay no attention to pipes in or near the building that is to be protected."

Kirchhoff is of the opinion, supported by the views of a series of professional authorities, that the frequent recent cases of injury from lightning to buildings that had been protected for years by their rods, are due to a neglect of these large masses of metal.

The Nicolai Church, in Greifswald, has been frequently struck by lightning, but was protected from injury by its rods. In 1876, however, lightning struck the tower and set it on fire. A few weeks before the church had had gas pipes put in it. No one seems to have thought that the new masses of metal which had been brought into the church could have any effect on the course of the lightning, otherwise the lightning rods would have been connected with the gas pipes, or the earth connection been prolonged to proximity with the pipe.

A similar circumstance occurred in the Nicolai Church in Stralsund. The lightning destroyed the rod in many places, although it received several strokes in 1856, and conducted them safely to the earth. Here, too, the cause of injury was in the neglect of the gas pipes, which were first laid in the neighborhood of the church in 1859, shortly before the lightning struck it. The injury done to the schoolhouse in Elmshorn, in 1876, and on the St. Lawrence Church, at Itzehoe, in 1877, both buildings being provided with rods, could have been avoided if the rods had been connected with the adjacent gas pipes.

"If it were possible," says Kirchhoff, "to make the earth connection so large that the resistance which the electric current meets with when it leaves the metallic conducting surface of the rod to enter the moist earth, or earth water, would be zero, then it would be unnecessary to connect the rods with the gas and water pipes. We are not able, even at immense expense, to make the earth connections so large as to compete with the conducting power of metallic gas and water pipes, the total length of which is frequently many miles, and the surface in contact with the moist earth is thousands of square miles. Hence the electric current prefers for its discharge the extensive net of the system of pipes to that of the earth connection of the rods, and this alone is the cause of the lightning leaving its own conductor."

Regarding the fear that gas and water pipes could be injured, the author says:

"I know of no case where lightning has destroyed a gas or water pipe which was connected with the lightning rod, but I do know cases already in which the pipes were destroyed by lightning because they were *not* connected with it.

"In May, 1809, lightning struck the rod on Count Von Seefeld's castle, and sprang from it to a small water pipe, which was about eighty meters from the end of the rod, and burst it. Another case happened in Basel, July 9, 1849. In a violent shower one stroke of lightning followed the rod on a house down into the earth, then jumped from it to a city water pipe, a meter distant, made of cast iron. It destroyed several lengths of pipe, which were packed at the joints with pitch and hemp. A third case, which was related to me by Professor Helmholtz, occurred last year in Gratz. Then, too, the lightning left the rod and sprang over to the city gas pipes; even a gas explosion is said to have resulted.

"In all three cases the rods were not connected with the pipes. If they had been connected the mechanical effect of lightning on the metallic pipes would have been null in the first and third cases, and in the second the damage would have been slight. If the water pipes in Basel had been joined with lead instead of pitch, no mechanical effect could have been produced.

"The mechanical effect of an electrical discharge is greatest where the electric fluid springs from one body to another. The wider this jump the more powerful is the mechanical effect. The electrical discharge of a thunder cloud upon the point of a lightning rod may melt or bend it, while the rod itself remains uninjured. If the conductor, however, is insufficient to receive and carry off the charge of electricity, it will leap from the conductor to another body. Where the lightning leaves the conductor its mechanical effect is again exerted, so that the rod is torn, melted, or bent. So, too, is that spot of the body on which it leaps.

"In the examples above given it was a lead pipe in the first case, a gas pipe in the last case, to which the lightning leaped when it left the rod, and which were destroyed. Such injuries to water and gas pipes near lightning rods must certainly be quite frequent. It would be desirable to bring them to light, so as to obtain proof that it is more advantageous, both for the rods and the building which it protects, as well as for the gas and water pipes, to have both intimately connected.

"Finally, I would mention two cases of lightning striking rods closely united with the gas and water pipes. The first happened in Dusseldorf, July 23, 1878, on the new Art Academy; the other August 19, last year, at Steglitz. In both cases the lightning rod, the buildings, and the pipes were uninjured."—*Deutschen Bauzeitung.*

A Sea-going Steam Pilot Boat.

Unlike the Pilot Commissioners of New York and New Jersey, the Baltimore Pilots' Association have taken kindly to the use of steam pilot boats, and are having built for their use a first-rate sea-going steamer. The new vessel is intended to carry sea pilots, with fuel, stores, and accommodations for a month's cruise. The hull will be of iron, with close iron bulwarks at each end, and, with iron siding, forming a quarter deck for about 68 feet of the middle run of the boat. The quarter deck will stand 3¼ feet above the main deck, which will extend about 30 feet from the stem and 20 feet from the stern. Both the main and quarter decks will have iron deck beams, and will consist of heavy pine deck stuff. The pilot house and captain's room will be on the quarter deck, where the boarding yawls will be carried. The length will be 113 feet between main posts, and 122½ feet over all; extreme moulded beam, 23 feet; depth, 12¾ feet; from base line to the top of quarter deck, 18 feet. There will be one iron athwartship collision bulkhead ⅜ inch iron, braced, and one forward of the boiler. Coal bunkers on either side of the boiler hold 40 tons each. Below the quarter deck will be the main cabin, with 20 sleeping berths, wash room, mess room, kitchen, pantry, chief-engineer's room, and store rooms. The forecastle will contain 10 bunks, store rooms, etc. The vessel will be heated throughout by steam. She will have two masts, schooner-rigged, two 17 foot yawls, two 1,000 gallon water tanks, three anchors of 800, 500, and 175 pounds weight, 120 fathoms chain cable, and a pump brake windlass.

The machinery will consist of an inverted direct-acting compound engine, with 22 and 36 inch cylinders, 26 inches stroke, fitted with tubular surface condenser, and air, feed, bilge, and circulating pumps, one cylindrical return tubular boiler, to carry a working pressure of 70 pounds of steam to the square inch, an independent feed pump to supply boilers, wash decks, fire service, etc.

This pioneer sea-going pilot steamer is now building at Wilmington, Del., by the Harlan and Hollingsworth Company.

CLOTHING IN ITS RELATION TO HEALTH.

The ideas and scientific views of Prof. Dr. Gustave Jaeger, of Stuttgart, regarding the properties of animal wool, gain more and more in popularity with German scientists, and in one of the latest numbers of the *Homœopatische Monatsblatter* (Homeopathic Monthly), which appears in Stuttgart, Dr. E. Schlegel, a well known physician of Tübingen, has published an essay, in which he speaks of Professor Jaeger's theories as follows:

Among the discoveries that have been made during the last few years in medical science, some facts brought to light by Dr. Gustave Jaeger regarding the amount of water contained in the human body may prove to be of the utmost importance. In his paper concerning "The resistibility of the human body against epidemic diseases and the power of constitution," * Professor Jaeger has proved that the specific gravity of several individuals is very different, and that the state of the health of those individuals is closely connected with their specific gravity. The greater the weight of the human body in comparison to the space which it occupies, *i. e.*, the greater its specific gravity, the more it is able to resist epidemic diseases. Persons of a low specific gravity are taken ill from very insignificant causes, such as a cold, and are very susceptible to contagious diseases. Such persons have usually a certain fullness of body, and are even corpulent, but just that which gives them a great size is useless ballast, namely, fat and water. These substances endow the heaviest bodies with a comparatively low specific gravity, giving at the same time to the constitution little power of resistance.

Very different is the case with bodies of high specific gravity. Here neither fat nor water is superabundant, the flesh feels solid, and the bodily constitution possesses a high power of resistance. Professor Jaeger has investigated these differences of constitutional resistibility by comparing the specific gravity of a number of persons with their state of health. An accumulation of water in the tissues of the body he calls "Hydrostasis chronica," an expression which, as the whole discovery itself, reminds us of the teachings of the homeopathist Von Grauvogel respecting hydrogenoid constitutions, while the theory that a chronic accumulation of water in the body is the cause of many sicknesses is in perfect accord with the "Sykosis" described by Hahnemann, and afterward by Wolf.

The investigations and measurements of Jaeger are of an entirely new date, and we would not mention them here had not this discovery proved to be of the highest value for hygiene, and had not the conclusions of Professor Jaeger already been corroborated in a most remarkable manner.

If it is true, namely, that the specific gravity of the body is the measure of its resistibility of disease, and if it is also true that few bodies have this resistibility, because of an overabundance of fat and water, then the question arises, Have we any means of counterbalancing this superabundance and therewith heightening the specific gravity? The

* "Seuchenschutz und Constitutionskraft."

homeopathists know a number of remedies for so-called hydrogenoid constitution, the most important of which is "Thuja." These remedies have to be chosen according to the individual constitution, and have proved to be of more or less benefit, sometimes even effecting a perfect cure. Allopathists use also several medicaments which are useful in cases of "Sykosis," but none of these remedies are entirely satisfactory.

Professor Jaeger has now, by his careful investigation, discovered a simple and natural expedient for preventing the accumulation of fat and water in the system, which is suitable alike for rich and poor. It consists in adopting a new sort of clothing, we might call it a normal clothing.

The Professor has tested the value of his discovery upon his own person and members of his family, and so has the writer of these lines, who, after having the honor of making the acquaintance of Professor Jaeger in 1879, adopted, at his suggestion, the normal clothing, and recommended it to some thirty or forty persons since. The experiments made by wearing the clothing in the heat of summer and the cold of winter has proved highly satisfactory.

The normal clothing has two essential properties:

1. It consists exclusively of wool, avoiding all materials woven from plant fiber (cotton or linen).

2. It makes a strong point of keeping warm the middle line of the front of the body.

The principal peculiarity of Professer Jaeger's clothing is the exclusive use of sheep's wool, even avoiding pocket and other linings of cotton.

To every thoughtful person it will be a source of satisfaction to know that Professor Jaeger has chosen for the warming of the body only those means which nature has given for the same purpose to those mammals which are the most nearly related to man. The fittest and the most suitable always predominates in nature, and if, in this case, we inquire why hair and wool clothing are the best protection against cold, the answer will be found in the physical properties of these matters. A cover of wool is far more porous than that of plant fiber. The latter, if exposed to moisture, becomes thoroughly soaked with the liquid and sticks to the body, so that no air remains between, and only one smooth evaporating surface is formed, whereas a hair or wool cover being never entirely soaked does not cling closely to the body, but forms a surface which is broken by air bubbles, permitting a great quantity of moisture to pierce to the outside, where it can evaporate. Moisture from the outside is prevented from piercing through the cover to the body on account of the layer of air between the cover and the body, which offers a kind of resistance.

These properties of hair and wool clothing are very important, for the skin of each animal is a source of evaporation, and continually renders moisture to the air.

That difference which exists between plant fiber and wool in regard to the conductibility of heat, renders the superiority of wool clothing in regard to health still more evident. Wool is a bad conductor of heat, therefore wool clothing conserves the heat produced by the body, while cotton, and still more linen, permits this heat to quickly escape and eradiate. This fact accounts for the cool, chilly feeling produced in putting on linen clothing, while in putting on woolen no loss of heat is felt.

The conservation of the heat of body produced by woolen clothing has the consequence that the skin remains in a blood-rich state, and may perspire more freely than when exposed to a quick refrigeration by cotton or linen clothing.

To these important properties of wool, which are sufficient proof of its suitability for clothing, a new one has been added by Professor Jaeger's latest investigations, which we will only mention briefly, as an explicit description would occupy too much space.

Jaeger has proved that in our organism there are certain gaseous volatile substances, called by him "Duftstoffe" (odorous substances), which play a very important part, as yet undivined. He endeavors to show that the actions of our mind are mediated by these substances, and that they are continually rendered free in the acts of breathing and perspiring. He discerns two different groups of odorous substances—"Lust and Unlust Stoffe" (substances of pleasure and disliking). The first ones are exhaled during a joyful and agreeable state of mind, and produce this state of mind if inhaled. Just the reverse is true of the second ones. Whoever will take the pains can discover for himself that the evaporation differs according to the condition of the mind as well as the condition of the body. During joy and happiness the odor of perspiration is not disagreeable, while during anguish and great nervous excitement it is offensive. The substances of disliking have, therefore, a bad odor. In an atmosphere of these substances the vitality is lowered and disadvantageously influenced. This accounts for the fact that in a state of anguish and fear the body is more susceptible to contagious diseases. The inhaling of the "substances of pleasure" heighten the vital actions and improve the resistibility of the body against sickness. Jaeger has now discovered that "sheep's wool" attracts the "substances of pleasure" [this property must not be confused with the great capacity of wool for absorbing odors in general], while clothing made of plant fiber favors the accumulation of the offensive "substances of dislike," with all their evil consequences.

Even with healthy persons, cotton and linen clothing, after long wearing, takes a distinctively repulsive odor, while woolen clothing, even in summer, when evaporation is strong, takes only the sour smell of perspiration, and never accumulates other offensive smells. This seemingly unimportant fact, the mention of which may be ridiculed by many, is, nevertheless, of the greatest value to medical science, and has proved of the highest importance for the "resistibility of the human body against contagious diseases."

Thus far Dr. E. Schlegel. The full responsibility of this report of the hypothesis of odorous substances we have to leave to the editor of the "Homeopathic Monthly," in Stuttgart, and its learned contributor, but we believe that the facts are very interesting and of great value, as they are based upon exact scientific investigation. Especially deserve to be mentioned the several thousand experiments regarding odorous substances which have been made with the "chronoscope," an instrument by which the celerity of nervous conduction is recorded.

ENGINEERING INVENTIONS.

Mr. Joseph W. Putnam, of New Orleans, La., has patented an improvement in the class of pile drivers in which the hammer guides or leaders are hinged to permit their inclination, for the purpose of driving piles at various angles.

Messrs. Martin E. Morningstar and John W. Roberts, of Arkona, Ontario, Canada, have patented an improved car coupling of the class called self-couplers; and the improvement consists in the peculiar construction of the link holder.

Mr. Peter Josserand, of Hockley, Texas, has patented an improved valve gear for engines, which consists of a lever, a shaft, and two friction wheels of different diameters for receiving motion from the crank shaft and transferring the motion at an increased velocity to the valve shaft.

Mr. Hans Knudson, of De Forest, Wis., has patented a dynamometrical engine governor, by means of which the work performed by the engine and the strain upon the driving wheel regulates and controls the steam supply.

Mr. Tiry S. Pylant, of Ridge Spring, S. C., has patented improvements in turbine water-wheels of that form in which a horizontal wheel is inclosed by a case having upon the top oppositely opening trunks or conduits for delivering the water to the wheel, which trunks have flaring mouths and taper downwardly into the plane of the wheel.

An improvement in well boring apparatus has been patented by Mr. Harry Samuel Gail, of Waukegan, Ill. The object of the invention is to provide means for holding the auger to the rotary shaft in such a manner that they may be easily disconnected to allow of the withdrawal of the auger without disturbing the shaft.

Mineral Veins.—How they were Filled.

We have examples that seem to settle the question in favor of chemical precipitation from ascending hot water and steam. In the Steamboat Springs of Western Nevada, for example, we in fact catch mineral veins in the process of formation. These springs issue from extensive fissures which have been or are filling with silicious veinstone that carries, according to M. Laur, oxide of iron, oxide of manganese, sulphide of iron, sulphide of copper, and metallic gold, and exhibits the banded structure so frequently observed in mineral veins.

In regard to the precise chemical reactions which take place in the deposition of ores in veins, there is much yet to be learned, and this constitutes an interesting subject for original investigation, which I earnestly commend to those who are so situated that they can pursue it.

It may be noticed, however, that the thermal springs which are now forming deposits like those in fissure-veins, contain alkaline carbonates and sulphides, and we have every reason to believe that highly carbonate alkaline waters containing sulphureted hydrogen under varying conditions of temperature and pressure are capable of taking into solution and depositing all the metals and minerals with which we meet in mineral veins.

To these necessarily brief notes on the filling of mineral veins should be added some interesting examples of the mechanical filling of fissures which have been recently brought to light in Western mining. These are furnished by the remarkable deposits of gold and silver ore in the Bassick and Bull Domingo, near Rosita, Colorado, and the carbonate mine at Frisco, Utah. All these are apparently true fissure-veins, filled to as great a depth as they have yet been penetrated, by well rounded pebbles and bowlders which have fallen or been washed in from above. The porous mass thus formed has been subsequently saturated with a hot ascending mineral solution, which has cemented the pebbles and bowlders together into a conglomerate ore. In the Bassick this ore consists of rich telluride of silver and gold, free gold, and the argentiferous sulphides of lead, zinc, copper, and iron. In the Bull Domingo and Carbonate mines the cementing matter is argentiferous galena. That the pebbles and bowlders have come from above is distinctly shown by the variety in their composition and the organic matters associated with them. In the Bull Domingo and the Bassick the pebbles consist of various kinds of igneous rock, mingled with which in the latter are masses of silicified wood and charcoal; while in the Carbonate mine the pebbles are mainly trachyte; but with these are others of limestone and quartzite.

Fossils and other foreign bodies have before this been found in mineral veins, and Von Cotta mentions the occurrence of quartz pebbles extending to the depth of 155 fathoms in the Grüner Lode at Schemnitz, Saxony; but no conglomerate veins like those mentioned above are known to exist elsewhere, and they constitute another of the many new forms of ore deposit which the exploration of the rich and varied mineral resources of the United States has brought to light.

In regard to the ultimate source of the metallic matters which give value to our ore deposits but little can be said with certainty. The oldest rocks of which we have any knowledge, the Laurentian, contain gold and copper, which are indigenous, hence as old as the rocks that contain them, and have been simply concentrated and made conspicuous in the process of their metamorphism. These rocks are all sediments and the ruins of pre-existing continents. By their erosion they have in turn furnished gold, copper, iron, etc., to later sediments by mechanical dispersion and chemical solution. We now find gold everywhere in the drift from the Canadian Highlands, and we have every reason to believe that all the sedimentary strata more recent than the Laurentian have acquired a slight impregnation of several metals from them in addition to what they have obtained from other sources, and we may conclude that the distribution of many of the metals is almost universal. Sea water has been proved to contain gold, silver, copper, lead, zinc, cobalt, nickel, iron, manganese, and arsenic; and there is little doubt that all the other metals would be found there if the search were sufficiently thorough. Hence, sedimentary rocks of every age must have received from the ocean in which they were deposited some portion of all the metals, and for the formation of metalliferous deposits some method of concentrating these would alone be required. A pretty theory to explain such concentration through the agency of marine plants and animals has been suggested by some German mineralogists, and amplified by Professors Pumpelly and T. S. Hunt. Plants have been credited with the most active agency in this concentration; but evidence is still wanting that either plants or animals have played any important part in the formation of our mineral deposits. The remains of sea weeds are found in the greatest abundance in a number of our Palæozoic rocks, and it is almost certain that the carbonaceous ingredient in our great beds of bituminous shale has been derived from this source; yet we find there no unusual concentration of metallic matter, and none of the precious metals has ever been detected in them.

The metallic solutions which have formed our ore deposits have been ascribed to two sources. One theory supposes that they have drained highly metalliferous zones deep in the interior of the earth; the other, that they have leached diffused metals from rocks of different kinds comparatively near the surface. The latter view is the one that commends itself to the judgment of the writer. However probable such a thing might seem, no evidence of the existence of distinct metallic or metalliferous zones in the interior of the earth has been gathered. On the contrary, volcanic emissions, which may be supposed to draw from a lower level than water could reach, are not specially rich in metallic matters, and the thermal waters which have by their deposit filled our mineral veins must have derived their metallic salts from a zone not many thousand feet from the surface. The mineral springs, which are now doing a similar work, are but part of a round of circulation of surface water, which, falling from the clouds, penetrates the earth to a point where the temperature is such as to drive it back in steam. This, with fluid water under pressure and highly heated, possessing great solvent power, may be forced through vast beds of rock, and these be effectually leached by the process. Should such rocks contain the minutest imaginary quantity of the metals these must inevitably be taken into solution, and thus flow toward or to the surface, to be deposited when, by diminished temperature and pressure, the solvent power of the menstruum is diminished. It is evident from these facts that we cannot trace the history of the metals back beyond the Laurentian age. And since we find them diffused in greater or less quantity through the sedimentary rocks of all ages, and also find processes in action which are removing and redepositing them in the form of the ore deposits we mine, it is not necessary to look further than this for a sufficient theory of their formation.—*Prof. J. S. Newberry.*

Steam Cable Towing in Erie Canal.

The Belgian cable towing system, as applied to several sections of Erie Canal, is giving strong evidence of success in arousing the strenuous opposition of those who are interested in the maintenance of the old system of towing. At a meeting of opposition boat owners and boatmen in Buffalo, August 3, it was resolved:

"That the New York steam cable towing system, as being operated on the Erie Canal, does greatly interfere with other ways and modes of towing boats on said route, and therefore it has forfeited its charter; that it is dangerous to boat property interests by reason of collision and delays, and is wholly impracticable. It is not a mode of rapid transit; it is not a cheap and economical method; it is not an improvement over other ways of towing; it is not necessary and it is not wanted in the canal, in consequence of which we unite in asking the Superintendent of Public Works to cause the New York steam cable towing system to be removed for obstructing navigation on the Erie Canal."

THE FASTEST TROTTING.—At Rochester, August 10, the fastest two-mile heat on record was trotted by the horse Steve Maxwell in 4 min. 48½ sec. Flora Temple's previously unequaled record was 4 min. 50½ sec.

FACTS ABOUT CHEESE.

The Mohawk Valley has lost its rank as the center of the cheese industry of the United States. The new head center is at Wellington, Ohio. The surrounding country abounds in cheese and butter factories. The principal cheese man in the State, Mr. C. W. Horr, has his establishment there, and it is one of the largest in the country. In a recent interview with a correspondent of the Cleveland *Leader*, Mr. Horr reported a very active demand for cheese at satisfactory prices. The home consumption has been greater this year than last, and the demand for export has been much increased.

The April milk this year netted about 100 per cent more than last year, the May milk about 80 per cent more, the June fully 40 per cent more, and for July the estimate was 50 per cent more than for last year. The prospect for the remaining four cheese months was very good. The yield per cow has also been more than last year, though not quite so many cows have been milked.

The chief American cheese districts comprise a small portion of New York, part of the Western Reserve in Ohio, a few counties in Illinois, Kansas, Michigan, Iowa, Vermont, and Pennsylvania, and a good many counties in Wisconsin. New York, Ohio, and Wisconsin, lead in the order named. Wellington, Ohio, is the largest country market, as shown by last year's statistics. Little Falls and Utica, N. Y., stand next. Wellington shipped 1,500,000 pounds more butter and cheese than Little Falls last year, the total shipment amounting to about 9,000,000 pounds.

During the past five years about 110,000,000 pounds have been exported annually; the rest is consumed in the United States. Most of that exported goes to Great Britain, which in 1878 took over 120,000,000 pounds, and last year a much larger quantity. The foreign demand for American cheese is increasing, but not so rapidly as it did ten years ago. From 1860 to 1865, owing to the introduction of the cheese factory system in this country, the increase was tremendous. Since then it has not been so rapid, but it has been steady. The export this year has been larger than the last, but not so large as in 1878. Commencing with the last week in May, there were exported during the following eight weeks of 1878, about 807,000 packages of cheese; during the corresponding weeks of 1879, about 528,000 packages, and of 1880, about 635,000 packages.

The foreign trade in American cheese is almost exclusively for what is called factory cheese, and covers every grade and quality, from the poorest skim milk cheeses to the richest full creams. The bulk of the poorest grades of cheese made in America goes to England, where the poorer classes use it in place of meat. Were it not for the market thus furnished for the cheaper grades of cheese the enormous May, June, and July makes of American cheese would have to be thrown to the fishes or sold at nominal prices.

The export of butter is also increasing rapidly. During the past two or three years there is an increasing demand for the very best creamery butter. "We have within the past six weeks sold nearly $7,000 worth of the finest creamery butter to one Liverpool house," said Mr. Horr, "and such a sale as this, until within the last three years, was unheard of in Ohio. This butter is shipped on a through bill of lading from Cleveland to Liverpool."

ARTIFICIAL COLD.

While sweltering under the relentless summer's sun people delight to talk about the production of cold, as if cold were a real substance, and just now a very desirable one. Not many years ago, when the caloric theory prevailed, we were told that heat was a substance, and cold was merely the absence of heat. The present generation of philosophers tell us that heat and cold are only sensations due to a more or less rapid vibration of the molecules. Although we willingly accept Tyndall's assertion that heat is only a mode of motion, which seems to be confirmed by the fact that the more we move about the hotter we get, yet it scarcely makes us any more resigned to our sweltering fate to know that the difference between summer and winter is merely a question of velocity in molecular motion. We read of the numerous icebergs that float down this way, and wish we had built our summer residence on top of one.

A correspondent at Council Bluffs sends us a refreshing account of a car which came in on the Chicago and Northwestern Railroad, the axle laden with icicles several inches long and the running parts covered with solid ice, which had formed there with the thermometer at 86° in the shade. The mystery is soon solved when he tells us that the car was loaded with gasoline, which was leaking through the bottom of the car. Gasoline, being extremely volatile, of course evaporated with great rapidity, and thus produced, as every volatile liquid does, a diminution of temperature, a principle made use of in all ice machines.

When a solid body passes into the liquid state a large quantity of heat is rendered latent, hence when any two solids (like salt and ice), which form a liquid when brought into contact, also reduce the temperature, on melting this heat is again set free.

A similar amount of heat is rendered latent when a substance passes from the liquid state to that of gas or vapor. This quantity of heat must be derived from surrounding bodies, and their temperature is correspondingly lowered. As a general rule the lower the boiling point of a liquid the lower the temperature that can be produced by its evaporation. Rhigolene, a petroleum product more volatile than gasoline, has been used with success in ice making. Ammonia and sulphurous acid gases, which are not combustible and therefore not explosive if mixed with air, are generally preferred. Nitrous oxide and carbonic acid gases, which are condensible only by very high pressure, are employed for obtaining very low temperatures. The former of these gases is now sold in large quantities in liquid form, and when allowed to escape often freezes in the escape pipe, beside covering the surroundings with ice, as did the gasoline at Council Bluffs. The evaporation of liquid carbonic acid produces a sufficient degree of cold to freeze the remainder of the acid, which then melts very slowly at ordinary temperatures and is at once volatilized. Liquid oxygen and hydrogen produce the most intense cold known by their evaporation.

The production of ice by the evaporation of gasoline is not so rare, however, as our correspondent supposes. A barrel of gasoline exposed to the air on a warm summer day frequently has a crust of ice or snow around the bung and wherever any escape of the gasoline can take place. A current of air blown over the surface of a volatile liquid causes it to evaporate more rapidly, and in the case mentioned above such a current was caused by the motion of the train. As soon as the surfaces were cooled below the dew point, moisture from the air began to be deposited, which was frozen when the temperature reached 32° Fah.

Many of our dwellings, our offices, our schoolhouses, and public buildings are supplied with complete sets of pipes and radiators for steam heating. In our climate these are seldom used from May to October—nearly half of the year. Will not some of our inventors devise a method of utilizing these costly pipes for cooling the air in summer? It could not be done by forcing a stream of gasoline through them, because this only reduces the temperature where it escapes into the air, and to allow it to escape would be to fill our houses with a poisonous, explosive, and bad smelling demon. Preferable would be a system whereby air could by any of the well-known principles circulate in our radiators and finally escape if pure, but return to boiler if impure. Perhaps some neutral liquid, which would neither freeze nor attack the radiators, could be made to flow through the pipes. This liquid passing through a coil of pipe surrounded by a suitable refrigerating substance would carry its cold freight to every part of the house. As cold liquids sink it might be necessary to put the refrigerating machinery in the garret instead of the cellar. If cold air were used this would be unnecessary.

We shiver with pleasure at the thought of being able to break off icicles from the dining room radiator, or scrape off enough snow from our office radiator to make a snow ball to throw at the luckless small boy or delinquent subscriber and merciless devil. We could laugh at the ice cream dealer, for we could bake our own cream in our cold oven, and ice would be an unnecessary luxury, for we need only set the water pitcher on the radiator to convert the croton into sparkling spring water.

The quantity of coal required to cool a house in summer need not exceed that required to warm it in winter, while the saving in doctor's bills, in profanity, and traveling expenses would be no small item, to say nothing of being able to freeze out the mosquitoes and benumb the flies.

Where is the genius who will solve the problem of house cooling and eclipse the fame of Carré, Pictet, and the rest of the ice makers? What delightful essays would our daily editors write in their cooled sanctums, and how many free puffs would they unconsciously bestow on this lucky inventor! New York would no longer be depopulated in summer and business would flourish the year round.

Effects of Lightning.

Mr. J. Johnstone writes to the Edinburgh *Daily Review*: "On the 7th of July, about 4:15 P.M., the lightning struck the craig which is named on the plan of Edinburgh "The Dasses," which overhangs the Hunter's Bog on the east. The rock struck is of the hardest basalt, commonly called whinstone. The lightning did not strike the sharp, serrated front edge of the craig, as might have been expected, but, on the contrary, it struck the flat top covered with sod at a distance of three feet from the present edge, and that must have been between six and eight feet from the edge before the accident, for the lightning detached several tons of the rock from the front of the craig, and sent six large masses of rock down into the Hunter's Bog; the largest of these measures four feet long by three feet broad and one foot thick, but of irregular shape. On the edge of the craig the lightning detached a mass of rock, which now stands in a very precarious position. This large mass measures four feet nine inches long by three feet broad and one foot four inches thick. The top of the craig, a short distance from the front of it, is covered with a coating of angular pieces of basalt, and on the top of these a covering of sod. It was on the sod the lightning struck, and made a hole two feet six inches long by one foot six inches broad. On placing a compass near the hole made by the lightning I found that the needle deviated from the N. to the E., and when the compass was in the hole the needle stood at E.S.E., instead of N., proving that the rock is still powerfully electrical at the spot where the lightning struck it. But, except in the vicinity of the hole, the craig does not affect the needle."

The American Science Association.

The annual meeting of the American Association for the Advancement of Science will begin at Boston, August 25, in the Massachusetts Institute of Technology.

RECENT INVENTIONS.

An improved railroad rail, intended to prevent the noise produced by its vibrations, has been patented by Messrs. Henry V. Piaget, of Jersey City, N. J., and Frederick A. Piaget, of New York City. The invention consists in applying a thick layer of cement or like material to the sides and bottoms of the rails, and fastening strips of wood to the sides and bottoms of the rails by means of the cement, thereby preventing the emission of sound by the vibrations of the rails.

Mr. John L. Taylor, of Las Vegas, Territory of New Mexico, has patented a telegraph pole that is more durable and lighter than ordinary poles, while having the requisite strength.

Mr. Nicholas Boren, Jr., of Haubstadt, Ind., has patented a novel arrangement of a churn dasher rod and a series of shafts and band wheels, and a drum and weight, whereby provision is made for obtaining a rapid movement of the dasher.

Mr. John H. Hodges, of Attleborough, Mass., has patented a separable button, which consists in a curved wire catch combined with a cup having a short beveled end lip and a protruding end, with opposite springs arranged between the side of cup and the curved parts of catches.

An improved ladies' dress guard, which will prevent the dress from clinging to and exposing the form when walking against the wind, has been patented by Tom O. Memery, of Key West, Fla. It consists of a rounded garment, stiffened by a number of flexible strips running from top to bottom. It is worn over the abdomen, and is held by bands passing around the waist.

An improved car coupling has been patented by Mr. Jesse T. Rice, of Grand Rapids, Mich. The invention consists of a novel combination of devices, which cannot be clearly described without engravings.

Mr. Abraham F. Denlinger, of Jamton, O., has patented an improved gate, so constructed that it can be opened and closed by the wheels of a passing vehicle. It is simple in construction and not liable to get out of order.

An improved blacking brush holder has been patented by Mr. Henry B. Perham, 665 West Lake street, Chicago, Ill. The invention consists in securing blacking brushes for transportation or packing in trunks with wearing apparel by an incasing crossbelt, which not only retains them in a compact form, but incases them so as to prevent the surrounding articles from being soiled.

A light, strong, and durable fence, which is easily set up, taken down, and moved from place to place, and is inexpensive in manufacture, has been patented by Mr. Henry E. McWhorter, of Blooming Grove, Ind.

The combination, with a map, of index sheets secured by their upper edges to the map roller and pendent on the side of the map, has been patented by Mr. Orson S. Haskell, of Evanston, Ill.

Hell Gate Improvements.

During the past year 15,195,561 gross tons of rock, the *débris* of the Hallett's Point explosion of 1876, have been removed under contract by the Atlantic Dredging Company, making in all 72,084,078 gross tons. The reef, for one-third of its extent, has a depth of twenty-six feet at low water. Over the remaining area there are a few shoal points still to be removed, some of which, near the shore, have only about seventeen feet at low water above them. The work is approaching completion, and progress is necessarily slower. The contract of the Atlantic Dredging Company has been extended to December 31, 1880, when it is supposed the work will be finished.

The work on Flood Rock, suspended since 1878 for lack of appropriations, has been resumed and is progressing satisfactorily. It is expected that the entire excavation will be completed within three years. A part of the rock taken from the galleries has been deposited in a deep hole off Ninety-second street, and another portion dumped in a dike closing the interval between Great and Little Mill Rocks, thus forming the western side of the new channel, improved by the removal of the reef at Flood Rock. This dike formed a part of the original project.

The drilling scow, recently employed on Diamond Reef, will be used on Frying Pan, Heel Tap Rock, and Pot Rock, which, with Flood Rock, forms the only barrier to a free use of the channel at Hell Gate.

A Natural Gas Well near Boston.

A notable discovery is reported from Ocean Spray, a new summer resort near Boston, Mass. While a driven well was being sunk, July 22, a vein of natural gas, which burns with a clear brilliant light, was struck at the depth of 122 feet. Being so near the house of Deacon Augustus Reed as to endanger its safety, the blaze was smothered and the well abandoned.

The adjoining lot was owned by Mr. J. H. Jessop, who, thinking the gas worth boring for, had another well driven. Gas was struck July 30, and since then the flow has been abundant and strong. Mr. B. R. Sturges, of South Boston, writes us that the pressure of the gas was measured August 5 by the State Gas Inspector, and found to be that of 31¾ inches of water. Photometric tests made by the Superintendent of the East Boston Gas Works showed the gas to be of 14 candle power, giving a pure and brilliant light with various styles of burners. An attempt will be made to utilize the gas for illumination, cooking, and heating.

NEW BOOKS AND PUBLICATIONS.

THE BOOK OF ENSILAGE; OR, THE NEW DISPENSATION FOR FARMERS. By John M. Bailey. Billerica, Mass.: Published by the author. 8vo, cloth, pp. 202. Price $2.

In this very enthusiastic volume Dr. Bailey relates his experience with ensilage at "Winning Farm." He frankly admits that the method of preserving fodder in pits under pressure is not so much a new dispensation as one of the lost arts, which, after the lapse of centuries, has just been rediscovered and improved. It is, however, "destined to be the means which shall produce a revolution in modern agriculture." For his part he has simply put into practice in America a system which M. Goffart has demonstrated to be practical in France. How far Dr. Bailey's zealous championship of silos leads him to exaggerate—if at all—the importance of the system of ensilage, only time and wider experience can determine. It is certainly to be hoped that he is not mistaken in his estimate of its advantages. At all events experimental silos are not expensive, and farmers will run no great risk in cautiously giving the system a fair trial. For this work the information furnished by Dr. Bailey's experience will be of value.

THE VOICE.

This is a sixteen page paper, issued monthly, at Albany, N. Y., and devoted to voice culture, special attention being paid to stammering and other defects of utterance. The Voice is the official organ of the Music Teachers' National Association, and seems to be admirably adapted to aid the professional work of teachers of singing, reading, and elocution, as well as physicians who make a specialty of the diseases of the vocal organs, Edgar S. Werner, editor and publisher. $1 a year.

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. If not then published, they may conclude that, for good reasons, the Editor declines 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) J. K. writes: In your answer No. 6, R. R. W., which of course is perfectly correct, it would be of great interest to the readers and R. R. W. to state that when in a storm the rain descends slantingly the resultant increase of lineal speed occasioned by the wind brings exactly the same quantity into the vessel. A. Suppose the wind strong enough to blow the rain horizontally, how much then?

(2) T. E. A. asks: 1. Will a telegraph sounder work on a line 600 feet long with ground wires without relays? 2. A. Yes. What makes the annunciators drop when it is tightning in a telephone exchange? Is it the free electricity in the air? A. The current induced in the line by lightning. 3. Should not Leclanche batteries be closed at night when not in use? A. No; the Leclanche should not be kept on a closed circuit longer than is absolutely necessary, as it soon polarizes. 4. Is it not dangerous to use the telephone during thunderstorms? A. Yes, unless a very good lightning arrester with a very good ground is provided. Even then severe shocks may be expected.

(3) O. W. E. asks: Will water explode by continued use in a boiler after all the air has been boiled out of it? If so, what prevents the boilers of ocean steamships from exploding where surface condensers are used? A. No; but the ebullition will be very irregular and the boiling point be raised. In ocean steamers a certain small amount of fresh (or new) water is added from time to time, or the water submitted to aeration before being returned to the boiler.

(4) J. F. E. writes: I want to belt from a twenty inch pulley on to a two inch pulley, and want to find the material that will be the most positive or will not slip, the distance between the pulleys being only about two feet. What can I find as the best thing? A. A woven cotton or canvas belt would be best, but no belt can work successfully under the conditions given, if much power is to be carried.

(5) W. F. L. asks: What is the cheapest and best way to transmit one horse power four to ten rods—speed of shaft from which the power is to be taken twenty-five revolutions per minute? A. By a wire rope three-eighths inch diameter, if you can use large pulleys say about five feet diameter, on your shaft.

(6) E. T. asks: What size engine would be required to drive a side wheel, iron hull yacht, 30 feet long, 7 feet beam, fifteen miles per hour? A. It is not practicable to drive a boat the size you name fifteen miles per hour with side wheels. To accomplish it with a propeller, everything else must be sacrificed to speed.

(7) F. M. D. asks (1) for the best and cheapest way of making electric batteries. A. See SUPPLEMENTS 157, 158, and 159. 2. How much pressure will a copper boiler, 6 inches in diameter, 8 inches long, stand? A. It depends on the thickness of copper of which your boiler is made. 3. Where can I obtain a small cheap engine that will run a three foot boat? A. You might find one at an instrument or toy store.

(8) W. O. G. asks: What power can be obtained from 250 cubic feet of water per minute having 4 feet fall? Also, the diameter of undershot wheel which would give best results, and size of buckets for same? A. Your fall of water will give you about one horse power. The velocity of the periphery of the wheel should be about five feet per second. A good diameter for mill purposes would be 9 to 10 feet outer diameter, and the diameter inside the buckets 6¼ to 7¼ feet.

(9) E. T. writes: On page 57 of the "Wrinkles and Receipts" it says: It may be fairly assumed that a non-condensing engine has on an average at least 2 lb. per square inch back pressure on the piston. By the application of a condenser it might be expected that there would be a negative pressure of 10 lb. per square inch on the back of the piston, so that the piston pressure would be increased by 12 lb. Question. How can there be a negative pressure of 10 lb. per square inch when there was only 2 lb. per square inch in the first place? In the example the piston pressure is increased 12 lb., whereas I can only make it 2 lb. increased. Which was taken from the back pressure? A. There is no such thing as negative pressure; we suppose you mean by 2 lb. back pressure, that much more than the atmosphere, or 14·75 lb. + 2 = 16·75 lb. If now by the use of the condenser you reduce this total back pressure to 3 lb., it is evident you have removed 13·75 lb. back or resisting pressure to the work of the piston.

(10) S. B. asks: 1. What rule must I work by to figure out the horse power transmitted by belts and pulleys? A. For belts the formula $\frac{WS}{600}$ = horse power, is a very safe and and convenient rule where W = width of belt in inches; S = speed of belt in feet per minute. With very short or narrow bolts divide by 800 instead of 600. 2. What do you consider to be the best book on the subject? A. Cooper on Belts and Belting. 3. Does Haswell treat on the subject in his pocket edition? A. Yes, briefly.

(11) H. W. S. writes: Our land is from three to five feet lower than the Hocking Canal, from which we wish to irrigate by means of underground pipes and hydrants. Could a hydraulic ram be used with success to force the water through the pipes? Suppose the main pipe is three inches, what size should the pipe next the canal be? Would it be better to run the water in an elevated tank. Could steam or wind power be used cheaper to produce the same or better effect? A. A hydraulic ram could be used with success; but of course the quantity of water taken from the canal will be very much greater than that discharged. If the discharge pipe be 3 inches diameter, the receiving pipe should be 7 inches to 7½ inches diameter.

(12) F. R. W. asks: 1. Can steel wire be galvanized in the same manner as iron wire? A. Yes; the steel wires for the Brooklyn bridge are galvanized. 2. Is there any way by which I can apply lead in solution to a tin roof so that it will adhere and prevent rust or leaking? A. We know of no way of doing this. Apply two coats of some good paint.

(13) F. A. D. asks: 1. Can a catamaran be built of solid logs or hulls, instead of hollow ones; say either of wood or cork, and of sufficient buoyancy for all practical purposes in rough or smooth water? A. Yes, but the hollow cylinders are to be preferred. 2. Can I melt brass for casting any small article without a regular furnace? A. Brass may be melted in an ordinary coal stove. Give it plenty of time and a good fire.

(14) D. B. asks: 1. What pressure per square inch will an upright copper boiler stand, shell No. 22, head sheets, No. 16, with four stays; boiler 16 inches diameter and 30 inches long, with 40 three-quarter brass tubes? A. 25 lb. per square inch. 2. Will the above boiler be large enough to drive a double engine, cylinder 2x4? A. No, except the engines are run very slow, say not more than 60 or 70 revolutions per minute. 3. Will it be safe and strong enough? A. Yes.

(15) L. S. writes: A friend and myself want to build a yacht 50 or 55 feet long. Have not had any experience in that line, and would like to get hull model, or drawings, if possible. We want something to work from, want it for speed. A. A model would cost about $30 to $40. 2. Which shall I use, iron or steel, for the hull? A. Steel would be the lightest and best. 3. What size engine do we require? Do you think the boat too small for double engine; if not, what size; also, size of boiler, shaft, and wheel? A. A double engine, 6 inch cylinder by 8 inch stroke. The dimensions of boiler would depend upon the kind. Wheel about 3 feet 8 inches diameter; shaft 2¼ inches diameter.

(16) T. W. C. asks at what temperature a low pressure engine uses its feed water, and if a high pressure engine uses any hotter; or, in other words, does a high pressure engine use hotter feed water than a low pressure engine? Also, how does the steaming qualities of anthracite coal compare with Pittsburg coal? A. For low pressure engines about 100°, for high pressure from 160° to 300°, according to efficiency of heater. Pittsburg coal a little the most efficient weight for weight.

(17) H. C. S. asks: 1. Should small spiral springs be made from right to left or left to right? A. They may be wound in either direction. It is generally more convenient to make them right-handed. 2. What is used to prevent small steel spiral springs from rusting, same being applied after spring is made? A. Dip them in boiled linseed oil and allow it to dry on. 3. Can shellac be used in place of glue in cementing wood joints? Is it as strong, and how long does it take to set? A. Shellac will not replace glue. It takes a long time to set in the middle of a joint, and is not as strong as glue.

(18) H. A. B. asks: 1. Does the magnetic needle point direct to the North Pole and the North Star? A. On certain lines on the earth's surface the needle points toward the pole. Such a line now passes near Wilmington, N. C., Charlotteville, Pa., and Pittsburg, Pa. 2. Are there magnetic poles 23 degrees out of line of the geographical poles? A. The magnetic meridian in some localities varies from the geographical meridian 23° or more. 3. Which is the nearest star, and its distance? A. So far as is known the nearest fixed star is Alpha Centauri, in the southern hemisphere. It is more than twenty millions of millions of miles distant. No other star is known to be within double the distance.

(19) A. H. asks: How can I make a strong paste for fastening bills in a file book? A. Rice or starch paste is best. The following is well recommended: 4 parts (by weight) of fine glue are allowed to soften in 15 parts of cold water, and then moderately heated until the solution becomes quite clear; 65 parts of boiling water are now added, with constant stirring. In another vessel 30 parts of starch paste are stirred up with 20 parts of cold water, so that a thin milky fluid is obtained without lumps. Into this the boiling glue solution is gradually stirred, and the whole kept at a boiling temperature for a short time. After cooling, a few drops of carbolic acid are added to the paste. This paste is exceedingly adhesive, and may be used for leather as well as for paper and cardboard. It should be preserved in corked bottles to prevent evaporation, and in this way will keep good for years.

(20) J. A. S. inquires: 1. How to make a cheap and serviceable emery wheel. A. Turn wheels from well seasoned pine, of the form desired; place emery upon an iron plate heated to 200° to 212°; coat the wheels with glue prepared as for uniting wood, and roll the wheels in the warm emery. After the glue dries, the surplus emery is brushed off and another coating of glue is applied and the wheels are again rolled in the warm emery. The wheels should be allowed to become thoroughly dry before use. 2. How can I make emery sticks? A. Prepare sticks of such forms as you may require, and coat them as directed for emery wheels, or attach to them emery paper by means of glue or paste.

(21) G. H.—To prepare good cider, choose ripe, sound apples, sweat them in small heaps for a few hours, and wipe dry. Then grind them, place the pomace between layers of clean straw, or preferably hair cloth, in a suitable screw press, and apply the pressure. As the juice runs from the press strain it through a hair cloth sieve into a large open cask capable of holding all the juice to be expressed in one day. In a day, or sometimes less, the pomace will rise to the top and grow very thick. When little white bubbles break through it draw off the liquid through a spigot placed about 3 inches above the bottom, leaving the lees behind. The cider must be drawn off into very clean casks, and repeatedly racked off until the first fermentation is over, which is known by no more of the white bubbles, before mentioned, forming. Then add a gobletful of sweet oil to each cask, fill it up with cider in every respect like that contained in it, and bung up tight. Sugar or glucose is sometimes added at this stage—8 to 15 pounds to the barrel, according to the character of the apples used—sweet or sour. When the cider has attained the proper taste, add one-quarter to one-half pound of isinglass dissolved in some of the cider, and then about one-quarter pound (not more) of freshly prepared sulphite of lime (common preserving powder), and draw off, after shaking and allowing to settle, into very clean barrels, or bottle. The sulphite (which must not be mistaken for *sulphide*) preserves the cider perfectly.

COMMUNICATIONS RECEIVED.

On a Natural Gas Well. By R. B. S.

On Curious Meteorological Phenomenon. By T. J. F.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

July 27, 1880,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1836, 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. We also furnish copies of patents granted prior to 1836; but at increased cost, as the specifications not being printed, must be copied by hand.

Acid, apparatus for the recovery of waste sulphuric, A. G. Sébillot 230,501
Agricultural implement, J. B. Gracey 230,414
Asphalt road and pavement, E. J. De Smedt (r) 9,325
Axle turner and screw cutter, T. B. Black 230,395
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