SCIENTIFIC AMERICAN

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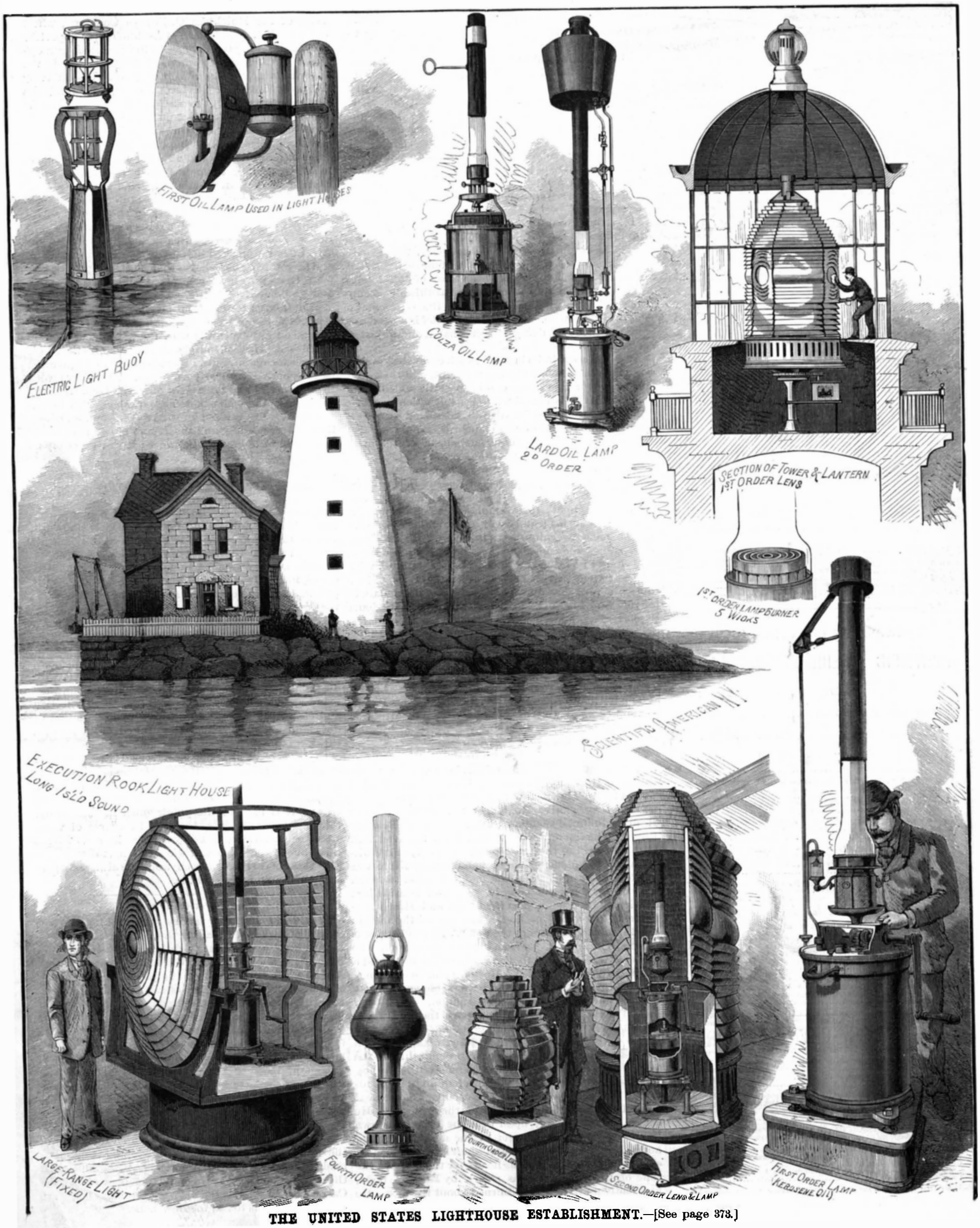

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SCIENTIFIC AMERICAN SUPPLEMENT

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For the Week Ending June 11, 1892.

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ANOTHER NEW PATENT BILL.

Among the various bills introduced at the present Congressional session for the modification of the patent laws is H. R. 601, which is understood to embody the views of the present Commissioner of Patents, the Hon. W. L. Simmonds.

The bill contains several excellent features which if adopted would improve the existing law; it also presents some objectionable clauses that ought never to pass.

The proposed amendment of the section relating to caveats, giving the privilege to foreigners as well as citizens, is a good one; so, too, is the section which prevents a foreign patent from nullifying an American patent, provided the application for the American patent was filed prior to the issue of the foreign patent.

One of the most radical changes proposed by this bill relates to those cases where two or more different parties claim a patent for the same invention. These are called interfering applications. The present law provides that proofs of priority of invention shall be presented to the Commissioner of Patents by all the contestants, and he awards the patent to the original and first inventor, as proved by the testimony placed before him.

The change proposed in this new law does away with this presentation of proofs and authorizes the Commissioner to issue a patent to the party who first files his application, irrespective of the real date of his invention.

The true inventor may be thus driven away from the Patent Office; but he is allowed the forlorn remedy of seeking redress by a bill in equity. The general idea or aim of this section is to relieve the Patent Office from the burdensome litigations of interference questions, which now so often and fruitlessly occupy time and cause prolonged delays in the settlement of Patent Office cases. The idea of relief is a good one, but the mode of doing it seems harsh and unjust to inventors.

It would seem to be better in such cases that each of the claimants should receive a patent, and then go to the courts as in other cases to settle which of the claimants is the rightful patentee and which patent is valid. But to authorize the Commissioner to issue a patent only to one of the claimants, simply because he filed his case a second of time ahead of the other claimants, seems unfair and unnecessary.

Another objectionable section (13) of the bill is that which deprives the patentee of remedy in case of infringements. By the terms of the bill, anybody who buys a telephone, for example, of a vendor on the streets, may set it up and freely use it, and the patentee has no remedy against such infringer. He must proceed against the maker, who, perhaps, lives in Canada and cannot be reached. This is in effect a nullification of the patent laws. Another section of this bill requires a poor inventor to pay a fee of ten dollars to enable him to ask the high and mighty Commissioner to correct a blunder made by one of his subordinates. The inventor must pay or keep his mouth shut.

These are poor methods of encouraging inventors and promoting the useful arts. On the whole we think the law as it stands is better than it would be if all the proposed changes were enacted.

The bill has been formally reported by the Patent Committee, and we trust will have careful attention and full discussion by the Congress.

A Benzine Explosion.

A sad accident occurred in Philadelphia recently, resulting in the death of two men, and in serious injurious to another. The men were repairing a leak in the boiler of locomotive No. 618, of the Philadelphia & Reading Railroad Company, known as the "Reading Flier." The top of the dome had been removed, and at the moment of the explosion the men were still working about the dome. The foreman, whose name was Hoster, was inside the boiler, and the other two men were on the top of it outside. A can of benzine had previously been taken into the boiler, and Hoster, apparently forgetting this fact, asked one of the men to hand him a light through the dome. As the lamp was passed to him, the vapor from the benzine ignited. The flame spread instantly to the body of the fluid, and a terrific explosion followed. Hoster, being in the dome, blocked up the only vent, and he was blown violently into the air like a shot from a cannon. His body lodged in the truss work that supports the roof of the building. A ponderous electric crane was moved across under the hanging form of the injured man, and from it workmen reached Hoster and brought him to the floor. He was still living, and was removed to the hospital, where he soon died. Within half an hour of his death he talked cheerily to the occupant of the next cot, telling him what he knew of the explosion. He congratulated himself upon what he called his own "close call," expressed regret at the death of Jordan, and said he hoped Kenney and himself would soon recover. Jordan, who had his head over the dome at the time of the explosion, was struck by Hoster's body, and badly mutilated and burned about the face. He was thrown to the ground, and died in a few minutes. Hoster was a skilled mechanic and a careful workman, well aware of the danger of working about benzine with a light; and when he called for the lamp, he must have forgotten, for the moment, that the can was in the boiler.

Accidents of this character sometimes happen when a light is brought to the open handhole or manhole of of a boiler in which kerosene has been used to remove scale, though we do not know of an accident of this kind whose results were so terrible.—*The Locomotive.*

Magazine Guns.

While the magazine gun board is concluding its tests of submitted weapons at Springfield it is interesting to notice, says the *Army and Navy Register*, that Mr. Very, of the Hotchkiss Ordinance Company, whose residence in Europe has afforded him ample opportunities of watching the ravages of the magazine gun epidemic, believes the Springfield single loader is the superior of any of the magazine guns. Undoubtedly half a dozen shots or whatever the magazine holds can be fired more rapidly from a magazine gun than from the Springfield rifle. But Mr. Very judiciously observes that the critical period, during which a great rapidity of firing will be important in battle, will last three or four minutes and a soldier can fire more shots in three or four minutes from a Springfield single loader than he can from a magazine gun. Mr. Very also makes the curious but important criticism of the magazine guns, that no soldier in the excitement of combat will keep count of his shots and that he will go through the motions of firing at an advancing enemy after he has exhausted his magazine. Even in practice and target firing he believes that most soldiers fire once more than they have cartridges, and amid the noise and excitement of battle, especially in the face of a charge from the enemy, he believes that a large portion of the troops would forget all about the magazines and go on automatically with the motions of loading and firing. Most of the officers of companies that were a few years ago supplied experimentally with magazine guns reported adversely on them. They have with them a careful and intelligent observer fresh from the Continent, where all armies are equipped with magazine guns. The investigation now going on is of exceptional thoroughness, and the report of our small arms board will be of great importance; it will probably be conclusive.

Wire Pillows and Cushions.

Recently I had brought under my notice, says a writer in the London *Illustrated News*, a new invention, which I think should be made widely known in view of the sanitary benefits likely to accrue from its use. I refer to the braided wire pillows, mattresses, and like articles which, I understand, are being introduced into this country by an American firm. The pillows I saw and examined are made of braided wire; they are perfectly resilient, accommodate themselves to every movement, and are, of course, always cool. The chief point to which public attention should be directed, I think, is the possibility of such an invention superseding the ordinary stuffed pillows and cushions, which, with the lapse of time, become loaded with dust and germs, saturated with perspiration, and demand—what they seldom get—thorough disinfection and cleansing. Do we ever think of the amount of dust and microbes which the stuffed cushions of a theater, church, hall, or other public place absorb, with no speedy prospect, as far as I can judge, of cleansing and renewal? If managers and others would only fit their seats with the braided wire cushions I saw, not only would they be much more comfortable, but, what is more to the point, much more healthy. Railway carriage seats, too, get, in course of time, most uncomfortable, as every traveler knows. Fitted with the wire cushions and wire padding, railway seats (and those of carriages as well) would be always shapely and practically indestructible.

Paper Friction Hoist.

Consists of a pinion having the rubbing surface formed of paper. In making the disk a great number of thin sheets of paper are tightly compressed together by bolts passing through the central core of iron. Although the first cost of the paper arrangement is somewhat greater than that of cast iron, it is claimed that this is more than counterbalanced by the advantages secured. As the friction between iron and paper is greater than that between two metal surfaces, less force is required on the hand cord of the operating lever to set the machine in motion. The paper will also adapt itself to the contact with the large iron wheel, and the latter will therefore, it is said, run true and require no facing, while the paper disk itself does not wear so rapidly as those constructed of iron.

A VESSEL which is intended to be an exact copy of the Santa Maria, on which Christopher Columbus made his first voyage to America, is being built with the greatest activity at the government yard at "La Carraca." As soon as the Spanish centenary feasts are over, the vessel is to sail for New York.

The Proposed Railway Through the Grand Cañons of the Colorado.

A very interesting paper was lately read before the American Society of Civil Engineers, in this city, by Robert Brewster Stanton, giving some of the results and conclusions drawn from his remarkable explorations of the cañons of the Colorado, in 1890, from which we make the following abstracts:

The Grand Cañon of the Colorado has been pronounced by those who have carefully studied it to be "by far the most sublime of earthly spectacles." The Grand Cañon is 218 miles long—from the Little Colorado to the Grand Wash—and in cutting its way through the Kaibab Mountains the river has formed a chasm from 5,000 to 6,200 feet deep, and from 6 to 13 miles wide on top. Taken as a whole, the river runs through quite a wide valley.

As compared with other well known cañons in the Rocky Mountains through which railways have been built—the Royal Gorge of the Arkansas and Clear Creek Cañon—this has a form peculiar to itself. Its walls start from the water's edge with generally a few feet—10 to 50—of vertical cliff, and then slope back in a ragged, irregular slope 300 to 1,200 feet or more, at an angle varying from a few degrees to 45 degrees from vertical, with some small patches jutting out boldly into the river and towering hundreds of feet high, forming almost perpendicular cliffs, or, more accurately speaking, they form buttresses and towers to the general slope of the wall. Above the granite rise the sandstone, limestone, marble, and higher sandstone ledges in cliffs, benches, and slopes, stepping up and back till the chasm is from 6 to 13 miles wide.

From the end of the granite to the Grand Wash cliffs the cañon is but a repetition of the lower end of Marble Cañon. The lower 100 or 200 feet of "the walls" consist of great slopes of the softer limestones, covered with loose debris. For miles these slopes extend to a height of 500 to 800 feet. In this section of the cañon are numerous streams of clear water coming in from immense springs in every direction and at different heights above the river. This water is strongly impregnated with carbonate of lime, and in running over the cliffs and slopes has left deposits of lime which in places stand up 100 feet high.

The line would start from the town of Grand Junction, Col., situated in a large and rich agricultural valley.

At this point it would connect with the Denver and Rio Grande Railway and the Colorado Midland, and all their railroad connections from the east, and the Rio Grande Western Railroad from Salt Lake City and the west. By its recently built line, the Rio Grande Western road comes down to the Grand River at a point about 22 miles below Grand Junction, and practically follows the river for a distance of 30 miles farther.

Starting from the town of Grand Junction it is possible to build a railway with a continuous down grade the whole length of the line to the Gulf of California, and to have a returning grade with a maximum not exceeding 12 feet per mile, except for a distance of 20 miles, and then it need not exceed 20 feet. It would be neither economical nor advisable to construct such a line. From the surveys made it is believed that in no place would it be necessary to use a grade in either direction to exceed one-half of 1 per cent or 26·4 feet per mile. A careful location may make it advisable to increase this maximum.

The question of falling rock and loose material from above is not different here from what obtains on hundreds of miles of operated railroads through the Rocky Mountain region. The immense width of the cañon on top prevents the great mass of rock loosened from above by storms reaching the inner or lower gorge in a way to do any damage. The lowest gorge is of a harder material and not so easily affected.

One feature largely affecting the maintenance of way, and also the traffic of such a road, is the almost entire absence of snow and hard freezing from so large a portion of the line in the great cañons. During the winter of 1889-90, the expedition experienced only two hours of snow storm at the level of the river, while the whole upper plateau was covered with from 3 to 6 feet of snow. It may be remembered that the winter of 1889-90 was one in which the transcontinental railroads through the Western mountains suffered more from snow blockades than they had for years previous.

Taking, then, the whole line into consideration, when once properly built it would not only be not highly expensive to maintain, but in many points would be far below the average of mountain railways, and in the matter of winter transportation would have advantages over any line crossing the country from the Rocky Mountains to the Pacific coast. The scarcity of water through this same section that so affects the present transcontinental roads would be entirely done away with, the supply from the river being the best possible when allowed a little time for the settlement of the sand.

What, then, would be the advantages of a railway line which over the very roughest portion of the section traversed by all these roads would have 1,000 miles of its distance with grades not to exceed one-half of one per cent. or 26·4 ft. per mile? And what advantage would it also have for the whole year's business, when this 1,000 miles, the very worst for winter travel, would be almost entirely free from frost and snow? Such a line would, of course, cross the Sierra Nevadas, but so far south and so low that it would have but little to fear in winter.

It is here only estimated for a line to Grand Junction and across the Rocky Mountains by existing roads. The crossing of the Continental Divide has never yet been accomplished so as to secure the best advantages. This cañon road carried up the Grand River through Middle Park and across the range on a line located by the writer more than ten years ago, it is believed would secure many advantages and reduce the rigors of winter travel and transportation to a minimum.

The initial point of this proposed railway is at the town of Grand Junction, Colorado, the largest and most prosperous agricultural center in the western part of the State. Mesa County, in which it is situated, and which at this point contains a valley of nearly 500,000 acres of the finest agricultural and fruit land, has also varied and extensive mineral resources. Its coal fields are considered inexhaustible. Many large bodies of coal have been discovered and developed. Some extensive deposits lie in close proximity to this proposed route. Many of the extensive anthracite coking and steam coal fields of western Colorado are connected with Grand Junction by rail. This point is practically the western terminus of all the railroads coming into Denver from the east. The section of country around Grand Junction is rapidly settling up. Following the Grand River, 75 to 80 miles, is the Little Castle Valley. This, with the Little Grand and other valleys along this river, forms a large tract of rich, though only partially developed, agricultural land. Anthracite coal has been discovered within 7 miles of Richardson on the Grand, and other large deposits of coal have been located at various points. The present cattle interest in this section is considerable. It is estimated that there are in the valleys and on the mountain ranges tributary to the Grand and Colorado Rivers 1,500,000 head of cattle, between this point and the Kaibab Mountains.

The line from here to Dandy Crossing, through the lower part of the Grand River and through Cataract and Narrow Cañons, does not encounter any productive land near the river. Back at the heads of many of the side cañons are large tracts of grazing land, many of them occupied by herds of cattle.

From Dandy Crossing to Lee's Ferry, a distance of 150 miles, the gold placer deposits are almost continuous the whole way. In past ages, while the river was cutting its way down the red sandstone of Glen Cañon, there were deposited on the successive levels of the stream vast beds of fine and coarse gravel, into which has settled great quantities of fine gold dust. Whence this gold has come is a question on which there is a great difference of opinion; this is of but little importance to the present investigation. These beds of placer gravel are found all along this whole extent of 150 miles, on the benches of the cañons, at various heights, some being 100 ft. and more above the level of the water, while the larger amount of the deposit is from 10 to 50 ft. above low water, with very extensive bars in the bed of the river, which are overflowed during high water.

From personal examinations the writer considers these gold deposits not only very extensive, but very rich and valuable. On account of their situation, so much above the level of the stream, and the fact that through this section the river has so little fall, these bars can only be worked by using more machinery and much more extensive plants than are usually necessary in such cases. This is the reason why these bars have not been more extensively worked up to this time. With a railroad through this cañon these mines would be largely and profitably handled. The transportation of machinery, lumber, mining supplies, provisions, and all the traffic incident to such a population as would be engaged in even placer mining, extending as it would along the river for 150 miles, could not but create quite a local business through this section. From some measurements and estimates made on particular bars, it would be difficult to wash out these deposits within the next one hundred years.

Through this section of Glen Cañon at various distances from the river many other valuable mineral deposits have been discovered. These are, as yet, undeveloped. The mineral and coal deposits of the Henry Mountains are within twenty-five miles of the river. Coal has been found at several other points from six to twenty miles back in the side cañons above Lee's Ferry. In the neighborhood of the San Juan and Escalante rivers are well defined deposits of petroleum.

The great variety of building stones through all the cañons, sandstones, limestones, marbles and granites, would undoubtedly create some considerable business for the road. The fact that the largest building being erected to-day in the city of Denver is being built of the same stone that forms the upper walls of the Grand Cañon, and that this stone, shipped from Flagstaff, Arizona, is carried as far east as Kansas City and Chicago, shows that a traffic for this road in building stones is not beyond the probabilities.

Some fifteen miles above the head of the Grand Cañon begins the great mineral belt that extends all the way through and on either side of this great chasm. In the lower end of Marble Cañon, as the sandstones and limestones rise and recede from the river, there come up other strata of limestone, sandstone and quartzite, which lie above the granite, and between these are extensive veins of mineralized matter. At the head of the Grand Cañon, above the granite, are immense veins, mostly horizontal, of iron ore and silver, lead and copper deposits; and at one point a large bed of roofing slate has been located. As the granite rises, quartz veins of various sizes are seen in every direction and running at every angle, while the horizontal veins of mineralized matter—silver, lead, copper and iron—above the granite extend all the way to the Grand Wash cliffs.

Below the great cañons is found an entirely different country. Taken as a whole, it is a broad and open valley. At the mouth of the Rio Virgin connection is made with the old settled and richly cultivated country of southwestern Utah. Along the valley of the Rio Virgin and its tributaries are rich agricultural lands. At the mouth of the river are raised to-day, besides grain, all the varieties of European and native grapes, peaches, plums, pears and nectarines, limes, pomegranates, figs and almonds.

It is believed that there is awaiting the opening of such a road as is herein described both a local and through business in excess of what was ready for many of the lines when built that now are in operation through the western part of the United States, and that a local business would be developed far larger than can ever be expected on some of our great Western railways.

Progress of the National Gun Factory.

Forgings for the first one of the twelve 13 inch guns which are to be placed on the battleships Indiana, Oregon, and Massachusetts have been received at the Washington gun foundry, and the labor of finishing the tubes and jackets and assembling the various parts will be prosecuted with vigor, and, when completed, this gun, with a diameter of bore of thirteen inches and a weight of sixty tons, will be the heaviest and most powerful gun yet made in this country.

Up to date there have been completed at the Washington gun foundry eighteen 10 inch guns, nineteen 8 inch and 129 6 inch high power rifled guns, while under construction, but practically completed, there are four 10 inch and two 8 inch guns, the whole number being intended for the primary batteries of the new vessels of the navy. As secondary batteries of the battleships, or as primary batteries of certain other vessels, particularly those of the gun boat and smaller cruiser class, there are completed, or nearly so, twenty-nine 5 inch and thirty-five 4 inch rapid-fire guns, from which excellent results are expected.

When it is remembered that only a few years ago many of the forgings for our guns were shipped from England, as were all our armor plates, it is a satisfaction to know that we have a plant where we can turn out a great number of high power rifled guns which, caliber for caliber, equal in range, velocity, penetration and accuracy those manufactured in any other country.

Fall of an Enormous Aerolite.

A dispatch from St. Petersburg says: What is believed to be the largest aerolite ever known to have fallen is lying in the Caspian Sea, a short distance from the peninsula of Apsheron. The aerolite made a terrific noise as it rushed through the air, and the white-hot mass made a light that illuminated the country and sea round about for a great distance. When it struck the water immense clouds of steam arose, and the hissing could be heard for a great distance. Huge masses of water were thrown upward, and the sight to those who were not frightened was an exceedingly beautiful one. So enormous is the aerolite that it projects twelve feet above the water, and, save for its fused black crust, which gives it the appearance of having been varnished, it has every appearance of being one of the usual rock formations met with along the coast. Scientists are deeply interested in the phenomenon, and several of them are making preparations to visit the peninsula to examine the aerolite. Further information is needed before credence can be given to the above.

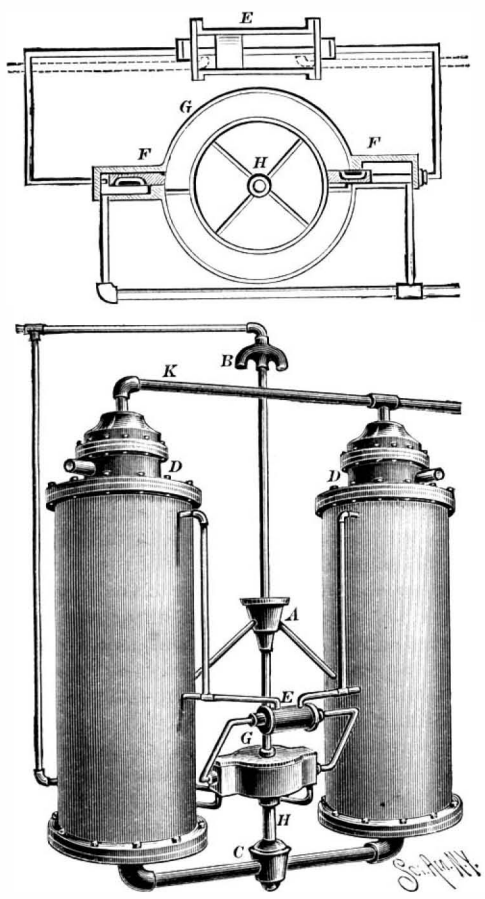
New Argentine Salt Industry.

The Rio Negro Salt Company, in the Argentine Republic, now supplies the market with more than 50 tons of salt a day. It is brought to the company's stores at the Boca, where, immediately on being landed, it is dried in large kilns. Afterward it is purified, and separated into different classes—viz., fine table salt, refined salt in barrels, common salt, and salt specially prepared for the "saladeros," or meat-curing establishments, for which purpose it is considered quite equal to the foreign salt, and is much cheaper.

AN HYDRAULIC AIR COMPRESSOR.

The illustration represents an air compressor which is automatic in operation, and designed to utilize the force of the water with the greatest advantage directly on the air to be compressed. It has been patented by Messrs. John H. Henderson and Emile Schutz, of Sierra City, Cal. It has two vertically arranged cylinders connected with pipes leading to a valve, A, the valve plug of which alternately connects with the ends of each pipe. The upper end of the valve plug also connects at all times with a pipe leading upward into a nozzle, B, arranged to draw in air and water for charging the cylinders. Into the top of the nozzle discharges a conical spout from a water supply pipe connected with a suitable source of supply, the arrangement being such that the force of the water sucks in air through valves in the side arms of the nozzle, and both water and air pass down into the valve, A, and thence into one or the other of the main cylinders. The lower ends of these cylinders have water discharge pipes leading to a valve, C, the valve plug of which has an L shaped opening adapted to alternately connect with the pipe from either cylinder, and this valve plug is on a hollow stem, H, a solid upper extension of which carries the valve, A, so that both valves are operated simultaneously, and when one cylinder is filling with water and air, the other is discharging its water.

At the upper end of the main cylinders are auxiliary cylinders, D, containing pistons, and having in their walls ports to alternately connect or disconnect with downwardly extending pipes opening into opposite



HENDERSON AND SCHUTZ'S AIR COMPRESSOR.

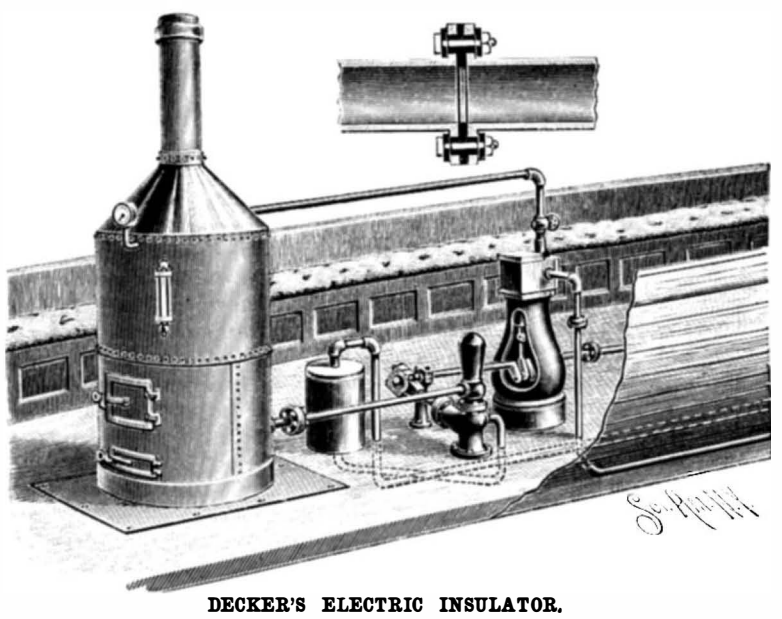
ends of the horizontal cylinder, E, located between the two main cylinders, and shown also in the sectional plan view. In this cylinder is a piston held on oppositely extending U shaped piston rods carrying valves in water chests, F, connected by branch pipes with the water supply pipe, and also with the cylinder, G, on the central valve stem, H. In the cylinder, G, is a water wheel mounted to revolve, and having on its rim a port leading to an opening in the hollow valve stem, H, whereby water is discharged from the cylinder, water from the cylinder, E, being discharged by valved branch pipes to the main cylinders near their lower ends. In the pistons in the auxiliary cylinders, D, are floating ball valves, allowing the escape of compressed air into the cap connected by the pipe, K, with a compressed air reservoir, the valves closing to prevent the escape of air and water as the cylinder is nearly filled. In operation, the air and water flow into one cylinder until it is almost filled, the lifting of the piston in the auxiliary cylinder, when the float valve closes, allowing the water to flow from the main cylinder to the cylinder, E, to act on its piston and move the valve in the water chest, F, establishing communication with the cylinder, G, whereby the central valve stem is turned and the position of the upper and lower valves changed. The water in the cylinder which had been filled then discharges, while water and air accumulate in the other cylinder. A modified form of the improvement is provided for use in case the water has not sufficient fall and pressure to counterbalance the required pressure of air per square inch.

Large Electric Mining Plant.

One of the largest electric mining plants yet installed in the United States has been put in the Virginia group of mines near Ouray, Colo. The water power plant is located nearly four miles from the mines, and consists of a small duct from which an iron pipe is extended a distance of about 4,000 feet along the side of the cañon, producing an effective head of 485 feet. Two Pelton water wheels, one 5 feet and the other 6 feet in diameter, are used, capable of developing 500 horse power and 720 horse power respectively, or a total of 1,220 horse power. The wheels are connected independently, so that the entire station may be run with either one. The electric generating plant consists of one 100 kilowatts and two 60 kilowatts Edison dynamos, giving a total output of 295 electrical horse power. The machinery, which is operated by this current at the mines, consists of one pump of 60 horse power capacity and another of 25 horse power, one 25 horse power hoisting machine, two 60 horse power Edison motors running stamp and concentrators, and one 15 horse power blower. The hoisting engine is an Edison motor of standard type, the winding and controlling switch being the same as used on street cars. This motor is geared to the drum through a friction clutch. Coal at the mines, it is stated, costs $18 per ton, and before this plant was put in the power cost the mining company nearly $40,000 per annum, and they are expecting by the use of this system to practically do away with this expense.

AN ELECTRIC INSULATOR FOR BOILERS AND CONDENSERS.

An extremely simple and inexpensive insulating appliance, for use in connection with all kinds of boilers and condensers, is shown in the illustration. The improvement forms the subject of two patents issued to Mr. Peter Decker, of 53 West Avenue, Norwalk, Conn. As applied to land and marine boilers, the appliance prevents the excessive oxidation of the interior parts of the boiler by electrolytic action resulting from currents of electricity pervading the water and generated by friction of working parts of the engine, an electric circuit being established between the boiler and engine through the steam pipe and feed water pipe. This difficulty is obviated by the introduction in one of the pipes of the electrical insulator, shown in detail in the sectional view. The pipe is divided into two parts, and at the opposing ends is provided with a radial flange on each terminal, the flanges being perforated for the reception of securing bolts. A washer is introduced between the flanges, made of any good non-conductor that will constitute a water-tight joint, and around each of the bolts is a sleeve, there being washers between the flanges and bolt heads and nuts, and the sleeves and washers being formed of non-conducting material. In the application of the improvement in connection with condensers, the condensing apparatus shown is a tubular conduit extending from the steam chest of the engine around the keel and terminating in a connection with the hot well, from which the condensed water is pumped back into the boiler. The rapid oxidation of exposed iron portions of the shaft, propeller wheel and fittings is frequently caused by galvanic action from the exposure to salt water of the copper condensing tube, which is in direct electrical circuit with these parts and to obviate this difficulty the insulator is inserted between adjacent portions of the exhaust steam pipe and the copper condensing tube. The manner of connecting the pipes is not limited to the exact form shown, and the place where the insulating joint should be inserted will vary with different engines and according to the disposition of the connected parts.



DECKER'S ELECTRIC INSULATOR.

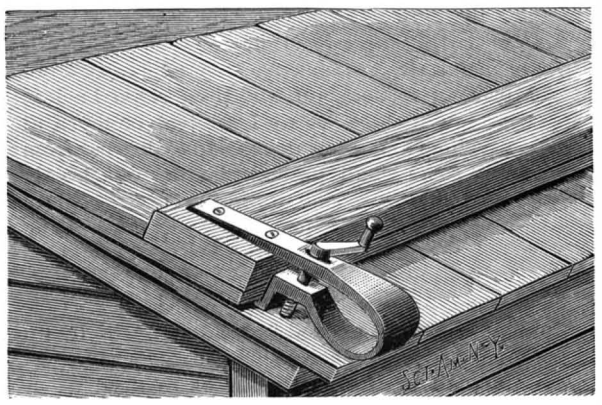
The New Star in Auriga.

Dr. William Huggins in a recent lecture on the above subject said that an object glass as wide in diameter as that theater would do less in revealing the nature of the suns around us than has been done by the prism. The latter has revealed much about their motions in space, but picks out alone that part of their motion which is in the direction of the line of sight; notwithstanding this, what with improvements in instruments and the sensitiveness of the gelatine plate, it is now possible to give the motion of the stars referred to our sun.

The new star in Auriga was of about the fifth magnitude, and it remained undiscovered for about five weeks, when it was first observed by Mr. Anderson with a small pocket telescope and a star chart. Photographic records prove that for six years there has, until recently, been no star in that position, but it was found later on in some photographs taken shortly before Mr. Anderson first discovered its existence in December last. In February and March the light of the new star died out with rapidity, and at first with great irregularity. On the 26th of April last it had fallen to about the sixteenth magnitude. It was not a nebulous star to any appreciable extent. In throwing out any suggestion as to the possible cause of the phenomenon, he felt like a blind man treading on red hot plowshares. Possibly two bodies were now moving away from each other in space after a casual meeting, so that there had been a partial grazing rather than direct collision. One of these bodies seemed to consist largely of a cool absorbing gas. The spectroscope revealed the presence of hot and cold hydrogen.

AN IMPROVED SHINGLING GAUGE.

The illustration represents a simple and inexpensive tool, designed to greatly expedite the work of shingling a roof, no other tool but a hatchet being required after the eaves course is laid. The improvement has been patented by Mr. Chancy Avery, Pleasant Lake, Ind. The main portion of the device consists of a single piece of steel, bent to form a bow spring, from which extend two lateral members, the lower one of which is wedge-shaped at its outer end and has an angled portion tapped to receive a screw shank. The upper member is attached to a straight edge made equal in breadth to the weather exposure to be given to the shingles, and of a length convenient to handle, which may be five or six feet, one of the metal pieces being secured to the straight edge near each end. The inner one of the two screws by which the attachment is made to the straight edge has its point projecting slightly below the straight edge, and when the gauge is inserted in position for service, as shown in the illustration, this point is driven into a shingle whereon the straight edge is imposed. The upper and lower members of the metal piece are connected by a screw having on its upper end a crank handle, by rotating which the bow springs are compressed, thus clamping the straight edge upon the row of shingle butts after the wedge portion of the lower member has been fully inserted, the roofer then applying a row of shingles upon the parts of the shingles exposed above the straight edge, the gauge supporting them until they are nailed in place, and the gauges being removed and replaced for laying and securing the successive rows. When a

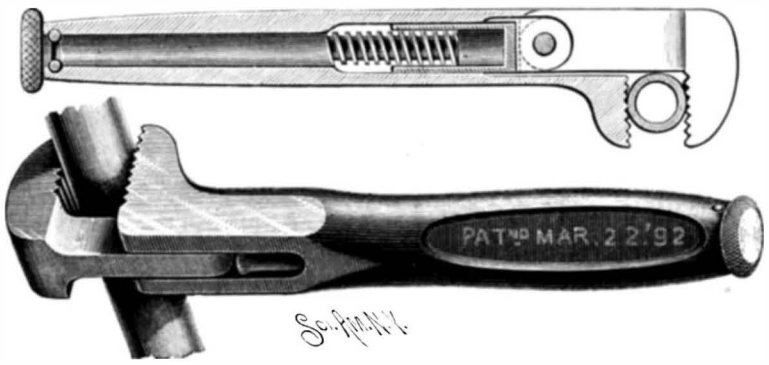


AVERY'S SHINGLING GAUGE.

long roof is to be shingled an intermediate gauge strip is provided, one of the gauges being then fixed on each outer end of two straight edges whose inner ends are held in alignment with the intermediate gauge strip, the arrangement giving greater length to the device and affording more room for roofers to work in a line. The tool is designed to enable roofers to lay more shingles per day than can be done in the usual way, or one workman may place the shingles in position while another nails them, the gauge supporting the shingles in proper position until they are nailed.

AN IMPROVED PIPE WRENCH.

A simple and durable tool, not liable to get out of order, and arranged to securely grip the pipe and readily release it when desired, is shown in perspective and in section in the accompanying illustration. It has been patented by Mr. A. L. Engelbach, of the Eagle Foundry and Machine Shops, Leadville, Col. A swinging jaw is movable opposite the fixed jaw, and is formed on the outer end of an arm pivoted in the forked end of a nut sliding in the hollow handle. The forked end of the nut is rectangular, fitting a similar opening in the handle, so that the nut is free to slide longitudinally, but will not turn in the handle, and the nut has an internal screw thread engaged by a screw rod, the longitudinal movement of the rod being prevented by pins in the handle, which engage an annular groove near the rear end of the rod. The screw rod is turned by means of a knob on its outer end, abutting against the rear end of the handle, thus causing the nut to slide and carrying the swinging jaw toward or from the fixed jaw, as may be desired, according to the size of the pipe to be gripped. The opposite faces of the jaws are serrated, to insure a firm hold of the jaws on the pipe.



ENGELBACH'S PIPE WRENCH.

SIPHON FOR DOMESTIC USES.

Every one is familiar with the hydraulic ram and the services which it has rendered in this country for raising water for use in agriculture, gardening, domestic service, etc.

It seemed difficult to simplify this method, still the problem has been solved in a satisfactory manner by the siphon system of M. Le Michel, which is described in a recent issue of *La Nature*, to which we are indebted for our cuts and article. A model of his system was exhibited at an agricultural exhibition at the Palace of Industry, in Paris, last February.

The siphon has advantages over the ram in being able to cause a considerable flow of water over a long distance, and it occupies very little space, as the cut will show, while on the other hand it is only able to raise water a distance equal to the atmospheric pressure, and is not able to pass above 32 feet of elevation.

As its name indicates, the apparatus is founded upon the principle of the siphon. Fig. 1 represents the apparatus entire and Figs. 2 and 3 represent the detail and interior construction.

The siphon consists of two vertical pipes, A and H (Fig. 2), a distributing chamber, B, and a regulator, G. A valve, C, which moves in a horizontal axis, is mounted on the interior of the arc, and a plug, D, is located above this, and is held closed by a spring. A lever bears against the valve to keep it in position, and serves as a counterweight.

These various parts are so simple that they require no attention to insure satisfactory service. The regulator, which is called the "lungs," owing to the function that it performs, consists of a cast drum and two undulating metallic plates, or diaphragms, 2 millimeters in thickness approximately. By their vibrations they maintain the flow of the water and prevent the siphon from becoming empty.

The siphon should first be filled with water through the orifice, K (Fig. 3), which should then be closed by the plug. As soon as both columns are filled, the water begins to flow as in an ordinary siphon. The water from the spring, well or river, under the atmospheric pressure, rises in the pipe, A, passes through the chamber, B, the regulator, G, and passes out through the return pipe, H. During this action the water bears against the valve, C, raises it up and closes it over the mouth of the pipe. As there is no other escape for the water, it forces open the valve, D, and flows out through this opening, whence it passes into the distributing pipe. In the meantime the column, H, is partially emptied and the water in the chamber, G, begins to fall and the diaphragms regain their normal position. The pressure also on the outer face of the valve, C, is also diminished and the lever carries it back and opens the mouth of the pipe, which allows the water to flow again into the regulator, G. During this action the diaphragms have regained their second position, and the same functions take place again in such a manner that there will be found to be from 150 to 400 pulsations a minute, according to the height, and the water will flow out in a steady stream. Cocks are connected with the two pipes so that the flow of water may be stopped when desired. It is only necessary to fill the siphon once by means of the opening, K, in order to set the apparatus in action. The apparatus shown in Fig. 1 raised water a height of 4 meters, with a fall of only 1·80 meters. Thus it could raise 60 cubic meters every 24 hours, the water delivered being about one-third of the amount which passes through upper chamber.

Thus $\frac{4}{3.1{,}8} = 0{,}74$ or 74 per cent, which is a very satisfactory result, considering the feeble pressure. The great simplicity of this apparatus, which operates without any attention or care, renders it particularly adaptable for agricultural purposes and for those having small country places and gardens.

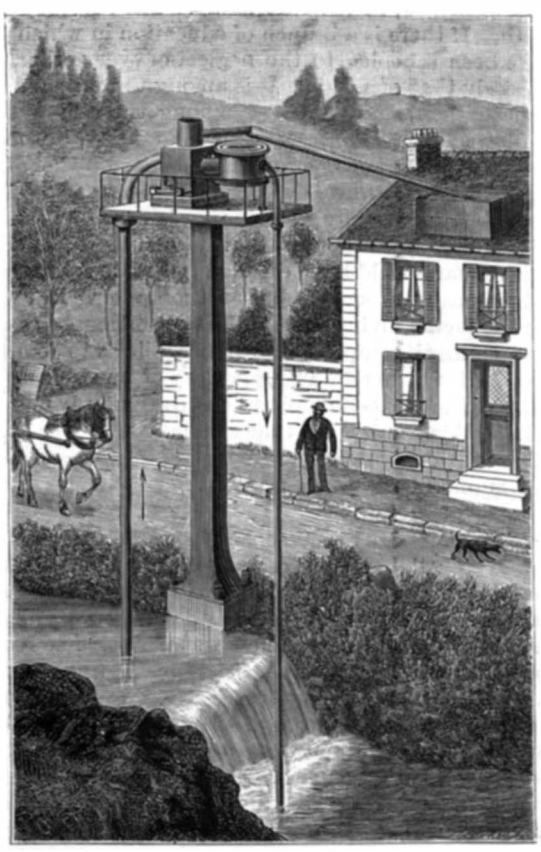


Fig. 1.—THE SIPHON APPLIED TO DOMESTIC USES.

World's Fair Notes.

The reproduction of Columbus' caravel, the Santa Maria, is being built by the Spanish government at the Carraca yard at Cadiz. The keel was laid on March 1. The caravel's dimensions are: Length at keel, 62 ft. 4 in.; length between perpendiculars, 75 ft. 5 in.; beam, 22 ft.; draught, 14 ft. 8 in. Great care is being taken with details, and the instruments and appliances of the time of Columbus will be in their places aboard the caravel. The Pinta and Nina, it is announced, are being reproduced by American capital. So visitors to the exposition will be able to see the Columbus fleet complete. The Spanish government will provide crews for the three caravels, dressed as were Columbus' sailors, and the trip across the Atlantic will be made under escort of a Spanish man-of-war. After participating in the naval review in New York harbor, the caravels will proceed to Chicago. After the fair closes they will remain the property of the United States.

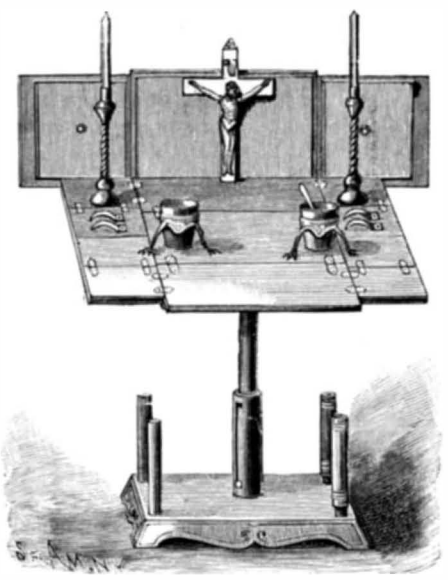
A $50,000 monument to Columbus, designed by Sculptor Howard Kretschmar, of Chicago, will be erected in Lake Front Park, which has been termed the "Gateway to the Exposition." It will be a statue in bronze 20 ft. high, surmounting a granite pedestal 30 ft. high. The monument will form the design for souvenirs of the exposition.

Visitors to the exposition will be able to go comfortably and expeditiously from one part of the grounds to another and obtain advantageous views of the buildings. They may do this either in electric boats through the lagoons or by the intramural elevated electric railway. The contract for the latter has been awarded. There will be five miles of double track, and stations at convenient points. The route, as mapped out, runs from one end to the other of the grounds in a sinuous course. The fare will be five cents, and the capacity of the road about 20,000 an hour.

The exposition, probably, will not have an Eiffel tower or anything approximating it in height, except the elevation to which the captive balloons will ascend. There will be, however, three observation towers about 300 ft. high, for the accommodation of visitors who want to take a bird's-eye view of the grounds and buildings. These towers will be of elaborate design and beautiful in appearance, and will cost about $200,000 each.

A SACRAMENTAL ALTAR FOR HOME USE.

The illustration represents a compact and ornamental altar table, which may be folded to form an inclosing box or cabinet holding the necessary adjunctive candelabra and vases when the altar is not in use. It has been patented by Mr. Leo C. Beaudet. Upon the base is a center column, made of tubular sections sliding together telescopically, locking pins projecting from an inner tube section into the slot of an enveloping section, and adapted to enter lateral notches of each slot, to hold the table at the desired height. The table is composed of a rectangular center piece, to which are hinged two main leaves, there being hinged to the ends of the latter opposite supplementary leaves, the edge portions and hinges being so arranged that when all are in open adjustment the table will have a level top surface and the leaves will mutually support each other. A foldable wall piece is secured to the outer edge of the back leaf, and to it is attached a crucifix by a swivel-jointed clip, which holds the crucifix erect when the table is open for use, as shown in the illustration, or horizontally when the table is folded up. The sacramental service ware of cups or vases, candelabra, etc., is arranged on the table, as shown, the liquid-holding vessels being preferably held in bracket stands upon the table. To prevent injury to the candles when the device is packed for transportation and the table folded, a case is provided for each candle, and a holder piece, the cases removed when the candles are lighted being supported on the four corners of the base. The number and style of pieces used in the altar service will vary, of course, according to the desire or means of the user, but the improvement affords an easily portable device which may be readily taken to a sick chamber or set up in the most convenient place in any household.



BEAUDET'S HOUSEHOLD ALTAR.

For further particulars with reference to this invention address Mr. L. H. Beaudet, No. 91 Sixth Avenue, New York City.

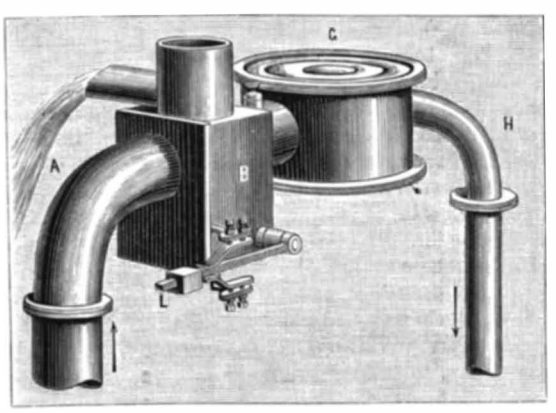


Fig. 2.—DETAIL OF SIPHON APPARATUS.

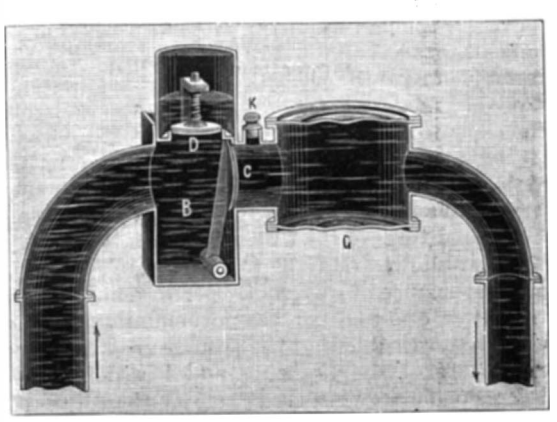


Fig. 3.—INTERIOR CONSTRUCTION—SIPHON APPARATUS.

Proposed Aquarium in New York.

Castle Garden, New York City, is an ancient stone fortress that stands on the extreme point of the southern end of the city, where the waters of the Hudson and East Rivers unite and flow into the Bay of New York. The fortress is circular in form and its walls inclose about four acres of ground space. After a long and checkered career, Castle Garden is about to enter upon another period of usefulness. It has been a fort, an amusement hall, and a depot of immigration. Now it is to be an aquarium, where people may watch fish and marine forms disporting themselves in surroundings like their native haunts.

At the last meeting of the board of park commissioners, Architect Julius F. Munckwitz, Jr., submitted the preliminary plans, which were approved and sent to the board of estimate and apportionment. The Legislature passed a bill permitting $150,000 to be used for an aquarium, and all that is necessary is for the board to order the issuing of the bonds.

Mr. Munckwitz's plans provide for the building of a gallery around the inside of the building. The tanks will be arranged in two tiers, one on a level with the floor, the other on a level with the gallery. There will be about 150 tanks, each separated from the next by a brick partition. A solid brick wall will form the back of all the tanks, and the front will be of glass. The light will come through skylights in the roof.

In addition there will be a big pool 50 feet in diameter and four or five feet deep, in the center of the main floor, built up so that people may look down into it. In a circle around this pool will be six others somewhat smaller in diameter and of about the same depth.

The pools are for very large fish, the lower tier of tanks is for small fish, both of fresh and salt water, and some of the most interesting forms of marine life, both animal and vegetable. The upper tier of tanks are for the more common forms of fresh water fish and the smaller and more frequent forms of marine life.

The pools will be the great feature of the aquarium. In the circle of pools will be sharks and other fish of the large and dangerous types. In the central pool there will be a grampus whale, not of the largest size, of course, but big enough to be impressive.

From the roof over the tanks and in the unoccupied floor space there will be skeletons and stuffed specimens of all kinds of huge and unusual fish and sea animals. These will form about the only decorations to the hall. Near the entrance will be a restaurant.

The cost of the fittings and furnishings will be about $80,000, which with $30,000 for repairs will bring the total cost to about $110,000, leaving a good margin to the $150,000 of the appropriation for the getting of fish, animals and plants.

The park commissioners hope to have the aquarium open to the public in the early fall.

The Canadian Pacific Railroad.

The Canadian Pacific had on the 5,766 miles of railroad which it worked last year a traffic equivalent to the movement of 76 passengers and 330 tons of freight daily over the whole system, which is a very light business, as was to be expected. We must not suppose, however, says the *Railroad Gazette*, that the Canadian Pacific is wholly in a wilderness, or was when it was first built, as were most of our Pacific railroads. On the contrary, it has 2,800 miles east of the Great Lakes, just north of New England and the Middle States; and there, where nine-tenths of the population of the Dominion is, doubtless it finds its chief traffic and earnings. The inclusion of these lines prevents any fruitful comparison with our Pacific railroads. Fully 3,300 miles of its lines are east of the eastern terminus of the Union Pacific. A great part of its eastern lines, however, are in a very thinly populated country, and very few parts of its line, doubtless, have what would be considered a large traffic on lines so far east on this side of the border.

In the whole system the gross earnings last year were $3,570 gross and $1,390 net per mile. The latter is 5 per cent on less than $28,000 per mile; but the Canadian Pacific Company had the good fortune to have a large part of its cost paid by the Dominion, and it has unusually light fixed charges, amounting last year to only $800 per mile of road. Its great land grant yields but small direct returns, but a great increase in sales is reported for the first four months of this year. The traffic and earnings have grown with considerable rapidity. Per mile of road the passenger traffic has grown nearly 30 per cent since 1888, and freight traffic 52 per cent. The expense of maintenance of way last year was $437 per mile of road; the cost of motive power, $7,958 per locomotive; of maintenance of cars, $46 per car—all very small amounts, as may be seen by comparison with the expenditures of the Union Pacific in the same year, which we showed (May 13) to have been $710 per mile for maintenance of way, $9,110 per locomotive for motive power, and $107 per car for maintenance of cars. It is also noticeable that the average gross earnings per mile ($3,936) of the branches and leased lines of the Union Pacific are 12 per cent greater than those of the Canadian Pacific, trunk lines and all; but the net earnings of the latter were $1,390, against $974 on the aforesaid lines of the Union Pacific, or 43 per cent greater. If the fixed charges of the Union Pacific were as light per mile as those of the Canadian Pacific it would have paid nearly 4 per cent dividend on its large share capital.

Molasses and Sirups.

The common notion of molasses or sirup is a product derived wholly from sorghum, sugar cane, or maple sap. The popular idea of an adulterated molasses or sirup would be one made from other materials or compounds than those mentioned. It is true that the word molasses, in a more limited and technical sense, should be applied only to the liquid material draining from granulated cane sugar made from sugar cane, either by natural percolation or by being treated in centrifugal machines. The commercial term molasses, however, applies to a larger number of products. It includes the molasses made from sorghum, and this is no mean product when the whole country is considered.

Perhaps the best distinction to be made between the term molasses and the term sirup is this:

Molasses is the natural product of the manufacture of sugar cane, sorghum, or maple sap, or any product from which a part of the sugar has been removed. Sirup is the product of the refining of these articles or the mixing of various other articles together.

It has long been known that a large part of the maple sirup sold in the market is made from glucose, understanding by this term the liquid product of the conversion of starch into sugar. It is also well known than large quantities of maple sirups are sold on the markets which are fabrications made up of other sweets, to which a little maple molasses is added for the purpose of giving it flavor, or, as is often the case, being entirely free from any addition of maple product whatever. The maple flavor is imparted to sirups by mixing with them an extract of hickory bark, and this product has been made and sold under the term of mapeline." It is safe to say that perhaps the greater quantity of maple molasses or sirup sold on the market is an adulteration in the true sense of the word. These definitions, however, are only of a popular nature, and a sirup could not be said to be adulterated, legally, unless some statute is enacted establishing a standard by which these products could be judged.

For the purpose of this report a molasses or sirup is adulterated whenever it contains glucose or any other substance which would not be a natural product of sorghum, sugar cane, or the maple tree. Molasses or sirups which are made exclusively of the products of sorghum, sugar cane, and maple sap cannot be said to be adulterated in the strict sense of the term, no matter what the method of their preparation may be.

The presence of chloride of tin in molasses in any large quantity is declared to be highly objectionable. Molasses, therefore, which is the natural product of the sugar cane, but which contains tin as a result of washing the crystals in the centrifugal with that substance, should be considered adulterated. In looking for tin in a number of instances copper also was found in the molasses. This copper doubtless comes from the copper pans and copper coils used in evaporating the juices and sirups. Its presence being merely accidental, it could not be considered as an adulteration. Copper salts are, however, not palatable, and their presence in a molasses or sirup is highly objectionable.

In regard to glucose, it may be said that its presence in molasses or sirup is an adulteration, unless the article containing it is distinctly so marked. A few years ago, when sugars and molasses were higher priced than they are now, the manufacture of sirups from glucose was very profitable. The price of genuine molasses, however, has at the present day fallen so low as to make the manufacture of glucose for the above purpose much less profitable than before. The advantage of using glucose, nevertheless, is very great, aside from its cheapness. It gives to a sirup a fine body and a light color. A molasses or sirup, therefore, made chiefly of glucose and flavored with the refuse molasses of a refinery, makes a very attractive article for table use, in so far as appearance goes. In regard to wholesomeness, also, it is not possible to condemn glucose.

When properly made it is as wholesome an article of diet as cane sugar. In fact, the starches which are consumed in our foods are all converted into glucose during the process of digestion. A glucose food, therefore, is a starch food already partially digested. The use of acids in converting the starch into glucose would prove detrimental to health unless they were carefully removed. Glucoses are, therefore, often made with ferments for the purpose of converting the starch into sugar rather than by the use of acids. Diastase is sometimes used for this purpose, and other ferments are also employed. At the present time the use of glucose in the manufacture of molasses and sirups cannot be said to be a fraud, from a commercial point of view, inasmuch as the glucose costs quite as much as the other materials of which the molasses and sirups are made.

The department does not approve of the addition of bleachers in the treatment of molasses, and was unsuccessful in getting samples of the bleaching agents for analysis. The secret of their preparation and method of their use are carefully guarded by the makers and users. Following is a list of the bleaching agents supposed to be most commonly used:

(1) Sulphur fumes; (2) chloride of tin, about one ounce of a saturated solution to each barrel of molasses; (3) sulphites and sulphuric acid; (4) sulphite of soda and zinc dust, afterward oxalic acid to precipitate the zinc.

Sugar is so cheap that the housekeeper can substitute it for molasses and make her sirup, and thus avoid all risk of adulteration.—*American Grocer.*

Remarkable Mines.

There are many coal mines of which the galleries extend under the water of rivers, such as the mines near Liege, in Belgium, of which the galleries form a connection of the mines situated on both sides of the river, regular subaqueous tunnels; but more remarkable are those mines of which the galleries extend under the ocean, as is the case with some coal mines in England. More remarkable still is one of the coal mines at Nanaimo, on Departure Bay, beyond Victoria, British Columbia. This mine is known as the Wellington, and its galleries are situated 600 feet under the surface of the ocean, which here surrounds an archipelago of islands, very similar to the Thousand Islands, at the head of the St. Lawrence River. The length of the galleries of this mine is continually increasing, and extends at present six miles under the bottom of the waters of the Pacific Ocean. Nearly the whole population of the town of Nanaimo, amounting to nearly 1,000, is engaged in the mines, and earns as much as $3 to $6 a day. Liberal as this appears to be, the cost of living in that inhospitable region is so high that the miners can only make ends meet. A great drawback in these mines is the excessive amount of combustible gases, by an explosion of which, three years ago, 100 miners lost their lives.

It appears that the coal mines here are more profitable than the gold mines, even in Alaska (where they are numerous), for the simple reason that they can be worked the whole year round, while the gold mines can only be worked four months in the year, so that the miners must live in idleness eight months, and that in a country which cannot produce the necessities of life, which are all brought from the United States, and therefore burdened with heavy freightage. As the miners cannot be left to starvation during these eight months, the parties to whom the mines belong have such an enormous continual expense to bear that the ore has to be of a very high grade to make it pay, so that low grade ores are not worked at all, except when other circumstances compensate for it. Such is the case in the Treadwell mine, on Douglas Island, which is situated near the shore, where water is convenient, and for which the owners ask $20,000,000; while a small mine, "The Bear," situated on the same island, was sold recently for $1,000,000, while the "Mexico" is so profitable that it is not for sale, but the owners are erecting an 80-stamp mill.

Sex and Music.

There is no room for the contention that, as compared with the boy, the girl has not had fair play—that opportunities for cultivating the art have in her case been few, in his case many. The reverse is the truth. If there is a branch of education in which girls have been schooled to the neglect of every other, it is precisely that of music. It is among the primary subjects to which she is put, and among the very last she is allowed to leave off. Not one hour a day, but many hours out of the twenty-four are consumed by her at the piano, to say nothing of other instruments, while singing lessons are usually given in supplement to these. It might have been thought that if practice gives perfection woman would have excelled her male counterpart not only as an executant but as a composer. But what are the facts? In instrumental performance she cannot for a moment compare with him, while as to composition she is nowhere. The repertory of music from the dawn of the art to the present day owes simply nothing to her. Considering the time she has spent over it, her failure to evolve new harmonies or even new melodies is one of the most extraordinary enigmas in the history of the fine arts. It has been remarked, but never explained, by such accomplished æsthetic writers as Lady Eastlake in her celebrated essay on "Music," and by such keen psychological analysts as Mr. G. H. Lewes in his "Life of Goethe;" it is, indeed, a problem still awaiting solution, unless we can solve it by an appeal to such facts as Sir J. Crichton-Browne adduced in his recent oration—the inferiority of woman to man in the cerebral substratum of ideo-motor energy. Why with such a record of "no results"—so far, at least, as the production of a female Handel or Beethoven or even a female Gluck or Bellini is concerned—music should usurp such a preponderant place in girls' education it is difficult to divine.—*Lancet.*

LIGHTHOUSE ILLUMINATION.

IN the present day, the majority of lighthouses in the United States or practically all depend upon kerosene oil as their illuminant. In old times, the first representatives of warning lights on shore may be supposed to have been bonfires, succeeded in their turn by braziers. It is believed that the Colossus of Rhodes held in his upstretched hand a brazier in which a fire was maintained to guide vessels into the harbor. His modern successor, the Goddess of Liberty, in the harbor of New York, carries an electric torch, in virtually the same position that her prototype is supposed to have held his brazier. Candles also played their part in the illumination of lighthouses, but in modern days everything has given way to the oil lamp, with very few and isolated exceptions.

A representative of the early oil lamp is shown in the cut. This was adapted to burn lard oil, and in order to prevent the oil from chilling, a curved copper rod extended from a point well above the chimney down into the oil, and terminated above the chimney in a small ball. The waste heat of the flame thus maintained the oil in a heated state. Eight to twenty-four of these lamps were mounted on a single armature. In Montauk Point light, twenty-four of them were used, and were removed in 1853. They originally burned sperm oil, which was afterward changed to lard oil. This lamp was fitted with a reflector illustrating the reflecting or catoptric system of lighthouse illumination.

Its successor was a French mechanical lamp for colza, sperm or lard oil, which was used in lenticular burners. In this machinery pumped the oil up to the wick, whence it continually overflowed. The machinery was objectionable and the lamp was superseded in time by Funck's hydraulic float lamp, in which the oil was carried in a reservoir surrounding the upper part of the prolongation of the chimney, thus being kept warm and fluid by the waste heat. In its course to the wick the oil passed through a chamber containing a float. The float was adjusted so as to rise and close by a valve the oil inlet as soon as the oil reached the proper height in the wick reservoir, thus maintaining the oil always at the same level. Lard oil was the fuel of this lamp. Professor Joseph Henry, who took the most active interest in the lighthouse establishment of the United States, and who was constantly experimenting in the laboratory and field upon the subjects of night and fog signals, introduced lard oil, thereby saving $100,000 per annum. The year 1864 is the date of this change. He was greatly interested in the development of the Funck lamp just described. As kerosene has improved in quality the time came, about 1873, when it naturally superseded the more expensive lard oil. For its combustion in the smaller lighthouses the lamp known as the Funck-Heap lamp was devised. This is the product of the ingenuity of Mr. Joseph Funck and Major D. P. Heap.

It is a standard Argand lamp with single wick. The feed of the wick is effected by a screw thread on the wick-carrying tube, as in the student's type of lamp. The chimney is carried in a gallery, which furnishes a support for it, and in which it can stand erect when removed from the lamp. A brass deflecting cap surrounds the wick, and around its base this cap is perforated with a number of holes. The holes admit cold air, which, forming a mantle around the flame, protects the chimney from intense heat, which would whiten or might even melt it. A deflecting button is carried by a spindle in the center of the flame. This button gets nearly red hot, and the air rising and impinging upon it becomes undoubtedly materially heated, so that a certain amount of regenerative effect ensues. This lamp is rated at fifty candle power. Its wick is 1⅛ inches internal and 1¼ inches external diameter. Its flame is so white and intense that it is almost painful to look at. It burns 1⅛ gills of oil per hour, 202 gallons being allowed for its annual consumption.

For the larger lights larger lamps are used. In the drawings we show the first order five-wick burner, rated at 500 candles, which is used in the first order lighthouses. Next to it is shown the first order kerosene lamp, on which such burner is mounted. This lamp is a float lamp embodying the float valve already described. To force the oil up from the reservoir below, a weighted piston is used. This piston, with leather packing, tightly fits the cylindrical oil chamber below the burner. It is weighted, and contains a valve opening downward. Its weight forces the oil up to the chamber and thence into the wick chamber. As required, the piston is drawn up by turning the handle, the downward opening valve permitting this to be done, and is then again released when its weight again comes into play, and the oil is forced upward.

In practice, the piston is raised once a night and feeds ½ gallon per hour. Its total feeding capacity is 8½ gallons. The annual supply of oil to such a burner is 2,156 gallons. In the float lamps the oil is maintained constantly at a level of 1½ inches below the top of the wick.

To trim the wick the valve is shut in the supply pipe, and the lamp is allowed to burn out, which it does very soon. After cooling, the wicks are then brushed off, no attempt being made to cut them. In the Funck-Heap lamp the trimming is effected also by rubbing off the wick after the oil has been burned out.

The lenticular apparatus in which these lamps are burned is universally of the Fresnel order of construction. Where the entire horizon is to be lighted, it is obvious that the lamp might be surrounded by a species of cylinder whose longitudinal section as regards each side would be lenticular. This construction would exact an immense thickness of glass for the center part. To avoid this the lens is broken up into a series of prisms, with the exception of a small portion of the center. These prisms are bent around to the shape of the lens chamber, and are so cut as to represent sections of a lens as it would be at each position of a prism. Thus immense structures are built up, the first order lenticular apparatus, which we show in one of the cuts, being large enough to contain a number of men, while the second order and fourth order lenses, which we also show in the cut, are, of course, of considerably smaller size. The smallest regular lighthouse lens used is the fifth order, and below this, for special purposes, come special lanterns; some with true Fresnel lenses, others with as near an approach to them as can be got in pressed glass.

The lenses may be disposed in annular segments, in which case their concentration of the rays of light is altogether in the vertical direction, the light, as it were, being converted from a sphere of dissemination to what is almost a disk. Sometimes flash lights are required. These are produced by having the prisms and glass of the lenses so ground and mounted as to represent a number of true lenses, which send the light out, not in discoid distribution, but in a definite number of radiating beams. If such a lenticular apparatus is rotated, it will carry with it around the circle of the horizon these beams, producing for the onlooker the effect of a corresponding number of flashes per revolution of the lens. For color effects colored glass chimneys were at one time used, but proved expensive on account of their fragility. They have been replaced by colored glass shades.

An application of the circular lens to lamps is shown in the range light, one of the largest in the world, and which is to be one of the exhibits at the Columbian fair. As regards its refracting apparatus the drawing speaks for itself. The back of the light is the characteristic part of the apparatus. This consists of a set of totally reflecting prisms cut at such an angle and so set as to reflect back all the light which falls upon them. Thus this range light utilizes a great part of the light which would otherwise be totally wasted. It is open at the sides so as to give the most convenient access possible to the lamp.

In the cuts showing the first order light, the section of plate glass lantern in which the light and great lenticular apparatus is maintained are also exhibited.

To show the type of building in which these lights are placed, a view is given of Execution Rock lighthouse. This is situated on Long Island Sound, a little north of a line connecting Glen Island with Sands Point, about twenty miles from the Battery. It is one of the older structures, and in former days the keeper used to live in the lighthouse itself. Since those times a very substantial stone house has been built for his accommodation and a powerful fog signal is established to warn approaching vessels while still far from it. The light, formerly a stationary one, is now a flashing light, while the Sands Point light a mile distant is fixed.

The oil used by the Lighthouse Department must conform to the following test: It must be of 140° flash test, 154° fire test, about 0·800 sp. gr., and free from acid, and, burnt in an Argand burner of the Funck-Heap style, light must show 18 candles illuminating power on a consumption of $\frac{10}{16}$ of a gill per hour. In 1873 the use of kerosene was commenced on a small scale; its use is now universal in the United States.

The electric arc lamp, apparently very powerful, is found to be very unsatisfactory in fogs, owing to its slight penetrative power. The Board do not regard its use with much favor on this account. The incandescent electric lamp, however, does meet with some applications, and probably will meet with more on lightships and similar places. Recently a number of electric-lighted buoys have been established to mark Gedney's Channel, in the lower bay of New York. Each of these carries a small Fresnel lenticular apparatus, with a 50 candle power incandescent lamp inside it. The whole are maintained by current supplied by cable from the shore. The installation, while on its face of the most perfect type, has really given a great deal of trouble, and its behavior has not been such as to entitle the system to be very favorably regarded.

Our thanks are specially due to Major D. P. Heap, U. S. A., engineer in charge of the third district, for courtesies received in connection with this article.

Photography in Colors.

Mr. Frederick Ives, of Philadelphia, recently delivered his second and concluding lecture on "Photography in the Colors of Nature," before the members of the Royal Institution, London, and showed some remarkable views of Yellowstone Park produced in colors by means of his composite process. Mr. Ives first explained in detail the principles upon which the three colored screens which he uses in producing his triplicate negative are selected, illustrating the theory by means of magic lantern views of the spectrum, but the greater part of his lecture was devoted to the mechanical aspects of his invention—in particular, the means by which the three images are superimposed. With the subject of the production of permanent color prints by his process Mr. Ives dealt very briefly; indeed, he frankly admitted that such prints could only be produced by a complicated process which required a considerable scientific knowledge of the laws of color sensation on the part of the operator, and at a cost which precluded the possibility of profitable manufacture. He claimed, however, that by the application of his invention to the helio-chromoscope he had actually solved the problem of photography in the colors of nature, since the illusion thus produced was more perfect than could possibly be obtained by means of a photographic print. He promised that his camera, in which the triple negative is produced on a single sensitized plate by means of a single lens with a single exposure, would shortly be obtainable everywhere by amateurs, who would thus be enabled by a process as simple as that of the production of an ordinary photograph to make a transparency which, on being placed in position in the helio-chromoscope or behind the triple objective of a specially fitted magic lantern, would perfectly reproduce the colors of nature.

In conclusion, Mr. Ives showed by means of the magic lantern some half a dozen views in Yellowstone Park, and one or two portraits, the colors of which were wonderfully natural, though the lecturer explained that tints could only be reproduced in their full brilliancy by a lantern illuminated by sunlight or the electric light. A photograph of flowers of most brilliant hues was shown in the helio-chromoscope.

Professor Hofmann.

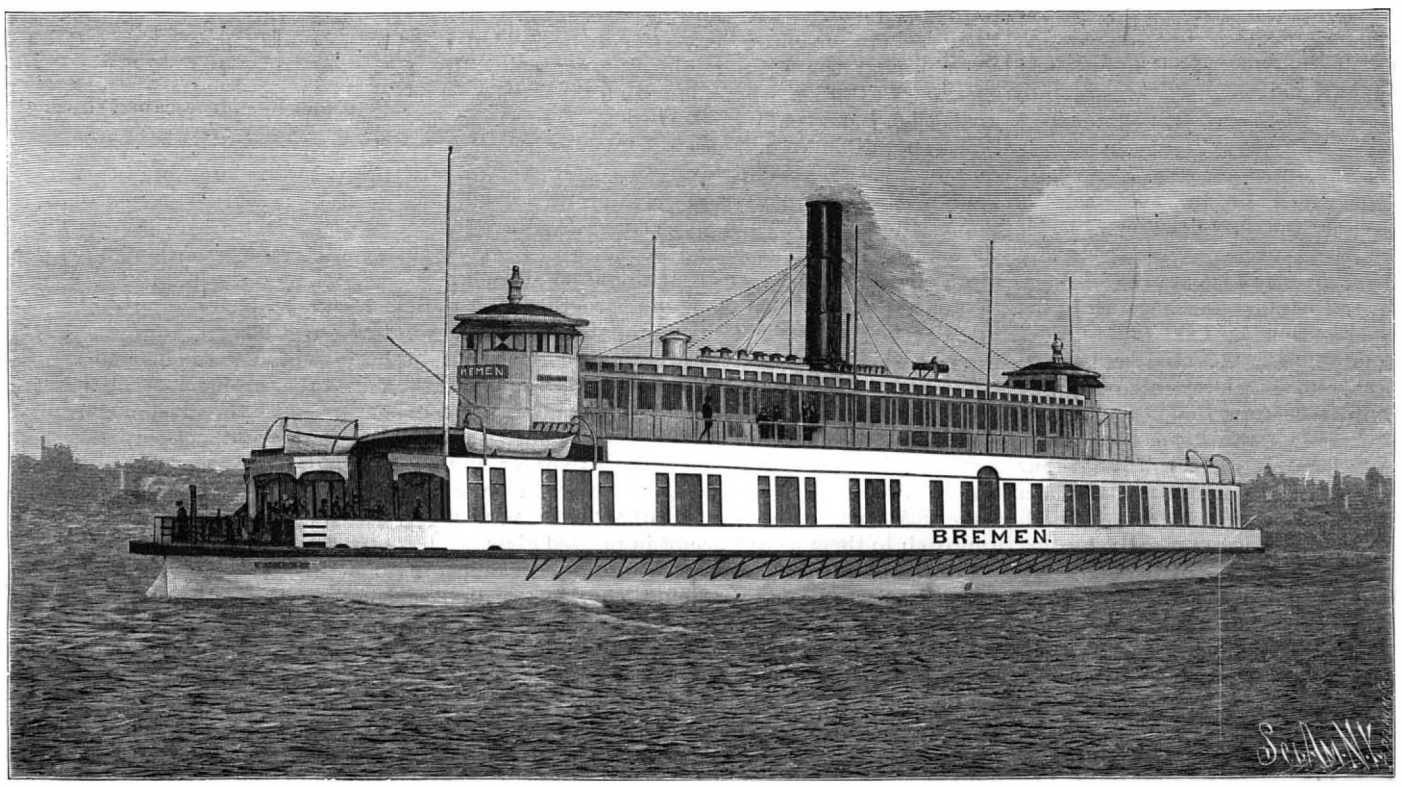
We regret to have to record the death of the illustrious chemist August Wilhelm Hofmann. He died on May 5. Prof. Hofmann, says *Nature*, was well known in England, where he spent many of his best years. On Liebig's recommendation he was appointed in 1848 Superintendent of the Royal College of Chemistry, in London. This institution, which made great progress under his care, was in 1853 merged in the Royal School of Mines as the Chemical Section. He became a Warden of the Royal Mint in 1855. In 1864 he accepted the chair of chemistry at Bonn, and in the following year he was called to Berlin, where he spent the rest of his life as professor of chemistry. He made many contributions to the *Annalen der Chemie*, to the Transactions of the Chemical Society, and to the Philosophical Transactions of the Royal Society, of which latter institution he was made a fellow in 1851, in recognition of his services to science. In 1854 he was awarded a royal medal for his "Memoirs on the Molecular Constitution of the Organic Bases." Some of his discoveries led to industrial results of the highest importance. The high respect in which Prof. Hofmann was held in Germany was shown at his funeral, which took place recently. It was very largely attended, and, according to the Berlin correspondent of the *Standard*, "was in all respects worthy of a prince of science." The correspondent says: "The Empress Frederick, immediately on receiving the news of the professor's death, telegraphed to his widow, 'My deepest sympathy in your great, your irreparable loss. I am deeply shocked by the quite unexpected news of your dear husband's death.' Her imperial majesty sent a splendid laurel wreath bearing her initials, to be placed on the coffin, and a court chamberlain represented her majesty at the funeral. The minister of education and numerous officials of his department, all the members of the Berlin Academy, and almost all the professors and students of the university, accompanied the funeral procession to the cemetery."

Workmen Killed by an Electric Shock.

An accident recently occurred at the Edgar Thomson Steel Works at Braddock, Pa., by which two men were killed and several others rendered unconscious. A number of men were working on a traveling crane in the blacksmith shop. The boom came in contact with the electric light wire and cut through the insulation. In an instant the full force of the current was conducted along the iron framework of the crane, and all the men in contact were knocked insensible. A panic ensued among the other employes, but as soon as the cause was ascertained the current was shut off, and a rush was then made to assist the prostrate men. All except three of the men soon recovered. The others were carried outside the shop and restoratives promptly administered. Two died in a few minutes.

THE NEW BOATS OF THE HOBOKEN FERRY COMPANY, NEW YORK.

Two new boats have lately been constructed for the Hoboken Ferry Company which are noticeable for the improvements and new arrangements of parts which greatly add to the speed and to the accommodations for passengers. Their names are the Bremen and the Hamburg. They ply on the Hudson River, between New York and Hoboken, on the opposite shore. At Hoboken the docks of the famous German steamships are located, hence the names of these new ferry boats. They are sister vessels, and a description of one will answer for the other. We are indebted for the following particulars to a letter given in *Engineering* by a correspondent of that journal.



GENERAL VIEW OF THE FERRY BOAT BREMEN.

The Bremen is a steel hull, double deck, screw ferry boat, and is fitted up in a tasteful and effective manner. Another of the same type is called the Hamburg. The hulls of the two boats were built by T. S. Marvel & Co., Newburg, N. Y. They are of steel. The length of each over all is 222 feet; length on water line, 218 feet 6 inches; breadth over all, 62 feet; breadth on water line, 35 feet; draught, light, 10 feet 6 inches; draught, loaded, about 11 feet; depth of hold, 17 feet. These boats are double decked. The upper saloon is 97 feet long by 36 feet wide, and 10 feet high. It has a promenade hood extending all around it, butting against the pilot houses, giving the whole a pleasing appearance.

The lower saloons are 157 feet long, with an average width of 15 feet; height, 13 feet. A double stairway leads from each lower saloon to the upper one. The total seating capacity in each boat will accommodate about 450 persons. Her engines are the work of W. & A. Fletcher & Co. The engines are two in number and compound.

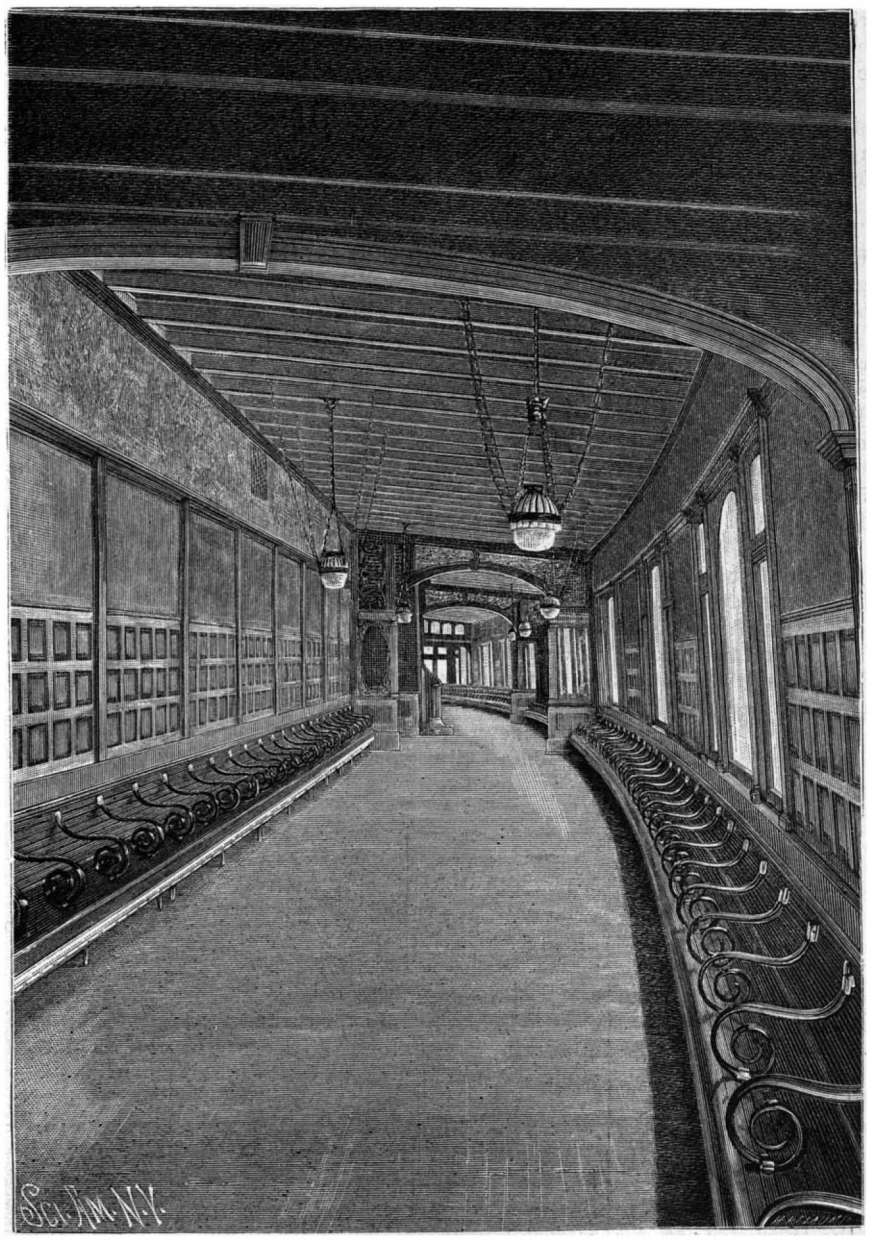
The high pressure cylinders are 20 inches in diameter; low pressure cylinders, 36 inches in diameter; stroke, 28 inches. The initial steam pressure in the main engines will be 125 pounds, furnished from two horizontal boilers, 9 feet 1 inch in diameter, and 21 feet long. Each has two corrugated furnaces, 44 inches in diameter. Total grate surface 100 square feet. The boilers were tested to 250 pounds hydrostatic pressure. The diameter of the crankshaft is 9½ inches. The cranks in each engine are set opposite to each other, and when the engines are coupled, the center line of cranks in one engine will be perpendicular to that of the other, so that the cranks practically stand at 90° apart. Each boat is provided with an independent air and circulating pumping engine of the Blake system, with compound steam cylinders. They are of the following dimensions: High pressure cylinder, 7 inches in diameter; low pressure cylinder, 14 inches in diameter; stroke, 16 inches. These work two single-acting vertical air pumps 17½ inches in diameter and 14 inches in stroke, and one double-acting horizontal circulating water cylinder, 17 inches in diameter, 16 inch stroke. The seats for the salt water valves in the circulating pump are formed in solid composition plates.

The vessel is steered by Williams' steam steering gear. The Bremen and her sister boat, the Hamburg, are practically deck truss bridges from fantail beam to fantail beam, the hull of the boat being built around this truss, the circular ends being merely overhangs to connect the boat with the ferry bridges.

The Bremen has exerted 1,450 horse power in the short trip across the river, making a speed of 14 miles per hour against a strong wind and tide. Probably there are no finer river ferry boats in the world than the two vessels here illustrated.

Marmont B. Edson.

Marmont B. Edson died in Brooklyn, N. Y., on the 2d of May. He was born in Otsego County, N. Y., seventy-nine years ago, and was buried from old Trinity church, New York City. His golden wedding was celebrated on October 7, 1891. Mr. Edson was of an inventive turn, and was chiefly known in connection with the pressure recording gauge which bears his name. He was a man of sterling integrity, of broad mind and warm heart.



THE FERRY BOAT BREMEN—LOWER SALOON.

THE FERRY BOAT BREMEN—STAIRWAY BETWEEN UPPER AND LOWER SALOONS.

MANTIDAE.

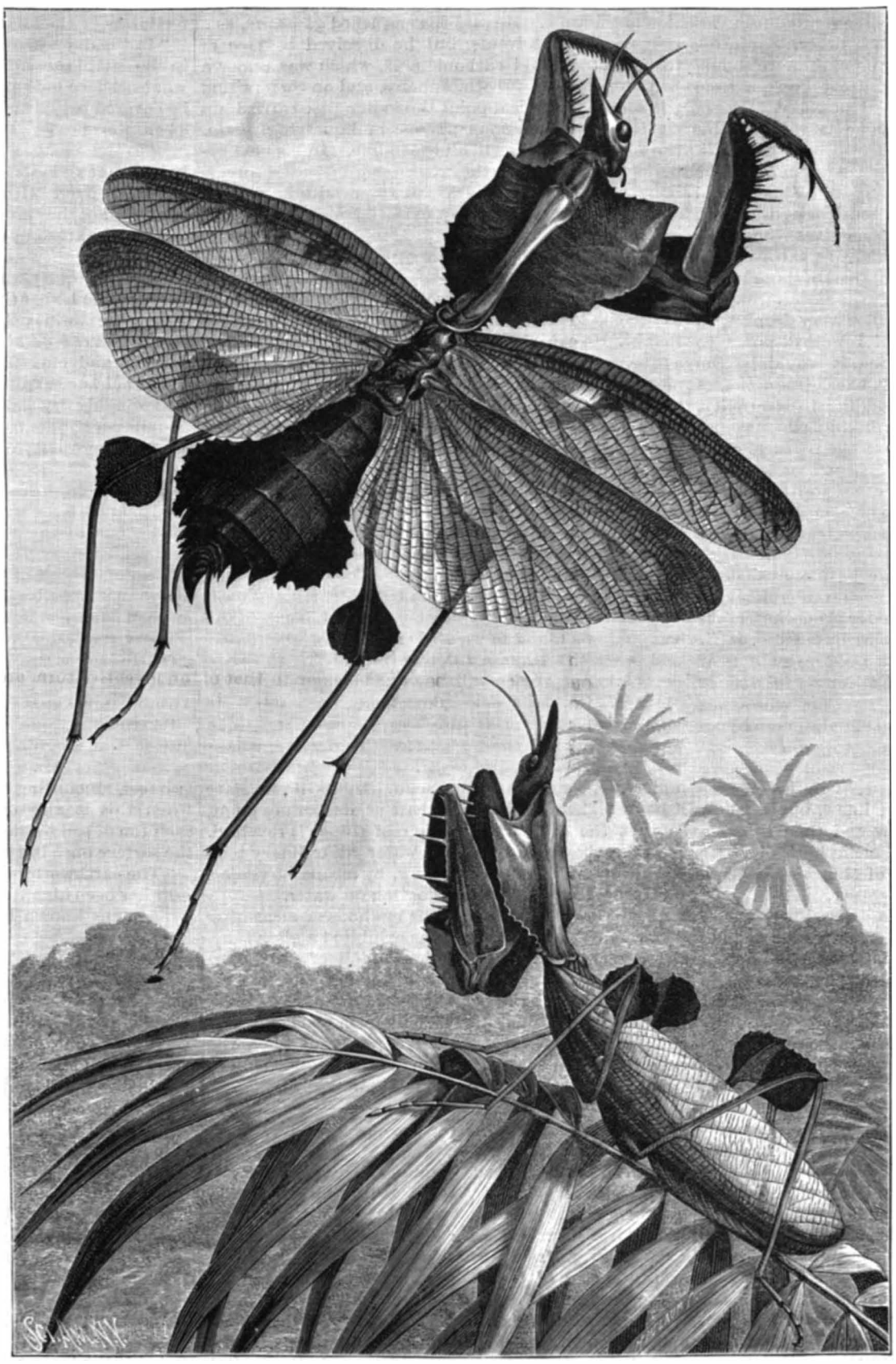
When we hear the word "locust" we immediately think of devastated fields, famine, and despairing human beings, and we also remember what we were taught during our first years at school about Moses, Pharaoh, and the seven plagues. But we are unjust when we class all the genera of orthopter together, as they are not all "vegetarians," to be dreaded by the farmer and gardener. We must divide them into two groups, the jumpers and the walkers. The members of the former group, to which the ill-famed migratory locusts and the common green grasshopper belong, live on plants, although they do not scorn an occasional fat caterpillar; and they are quick in their movements, flying and jumping, for their long legs permit this latter movement. The males make a peculiar whirring or chirping sound. Those of the second group, which includes the praying mantis and the specter or walking stick, are not musical. They move deliberately, fly little or are entirely incapable of flying, and live exclusively on insects or exclusively on plants. The mantis is one of the insect eaters.

The mantidae are voracious creatures of prey, and like all of this character, live alone. They are the oddest of insects. Their wings lie close, the posterior wings overlapping slightly instead of meeting like the parts of a roof, as do those of the grasshopper; the foremost breast wing is lengthened considerably and carries the little head with its great eyes and short feelers; but their fore legs constitute their most noteworthy feature. There is nothing peculiar about the two other pairs of legs, they are simply rather slender limbs which permit a slow movement; but the fore legs, which are never used in going from place to place, are so constructed as to serve as formidable weapons. The hip portions are unusually long, and the thighs pressed together sidewise and furrowed lengthwise underneath. The sharp edged second joint fits into this furrow, that is provided on the edges with pointed prickers, as the blade fits into the handle of a pocket knife. These legs are their graspers, and the only creature that has anything similar is the lobster. The mantis does not touch these legs to the ground, but holds them closed in such an amusing attitude (see the lower figure in the accompanying cut) that he has received a long list of undeserved names from the people; such as, Gottesanbeterin in German, Louvadios in Portuguese, Preque dieu or Precheur in French dialect, and in English praying mantis or soothsayer. All of these names indicate a misunderstanding of the object with which the creature holds its fore legs folded and raised; it would seem as if it were praying, but, in reality, this is only the mean mask of Tartuffe, or the artifice of the robber. I have only had opportunity to observe in Trieste the common green mantis (Mantis religiosa L.), which now reaches its northern limit near Vienna or Brunn, and in the neighborhood of Freiburg in Breisgau, but in the last century was found, according to Leydig, near Wurzburg and Frankfort a. M. All communications received in regard to the habits of those that live in the temperate and tropical countries of both hemispheres, however, agree with my observations. The creature sits as shown in the illustration, the only movement being in the head, which it turns back and forth as it looks on all sides. These motions would seem very strange to a naturalist who had only observed other insects. Now one of the flies which I put in the glass for the mantis approaches it and settles on its green wing, which, to the fly, does not look different in any way from a leaf. The expectancy of the spectator and of the hungry mantis increases; the victim crawls heedlessly forward, now it comes within reach of the graspers, the knife opens and snaps together, the struggling, confiding fly is caught and soon every particle of it has disappeared. The mantis assumes its former attitude and waits, greedy fellow that he is, for a new victim.

It is stated on good authority that the tropical species (one of which is shown in our illustration) will overpower and eat lizards three times as long as themselves, and even small birds are surprised while sleeping and devoured. The little Mantis religiosa of Southern Europe, although less than three inches long, will defend itself against man, and the gigantic species of hot countries cause bloody wounds in the human skin with their saber-like legs. But the worst characteristic of the mantis is the amazon-like trait which it shares only with some spiders. The female mantis is larger and stronger than the male, and she murders her mate in cold blood, when she can get him, and eats the father of her future children without the least compunction. The creatures are always quarrelsome among themselves, the stronger kills the weaker, and brothers and sisters wage war against one another from the first.

A creature of prey which is capable of only a slow movement, and cannot capture its victims by rapidity of pursuit or suddenness of attack, must have some other means of taking them by surprise, and such a means is invisibility. Let me be rightly understood. I mean relative, not absolute invisibility, which the mantis obtains by the coloring and form of its body, more especially of its fore wings, which are of such a nature that the creature does not seem to stand out from the ground on which it awaits its prey and is not distinguishable from the leaves and other parts of plants. Some are bright green, like the Mantis religiosa of Europe, so that they resemble fresh leaves; others are yellow, like faded foliage; and still others are a brown or leather color, with dark spots and glassy, transparent places on the fore wings, so that they look like an old weatherbeaten leaf to which fungi have attached themselves, and parts of the epidermis of which have been removed by insects and the influence of the weather, so that its ribs and nerves resemble the veins of the mantis wings.

Scientists who have explored tropical countries and other travelers that understand nature—there are, unfortunately, few of the latter—agree that the mantis is wonderfully protected by its resemblance to foliage. This fact has not escaped the notice of the masses in those hot countries and has given rise to all kinds of superstitions. The noted painter, Marie Sibylle Merian, of Frankfort a. M., who remained in tropical South America specially to paint insects and flowers, says that in Surinam it is supposed that the creature grows, as leaves do, on trees, falls off after a time, and then flies or crawls away. A superstition which is just the opposite of this is related by Wilhelm Piso (1658) in his "Naturgeschichte Brasiliens" (Natural History of Brazil). He says the creature changes to a plant; fixing its feet in the ground, roots are caused to grow by the influence of moisture.



MANTIDAE.

The species shown in our engraving is named Idolum diabolicum, and is a native of the interior of Africa. Its most remarkable features are the sidewise widening of the thorax, which is sharp edged, and of the abdomen. The lower ends of the second joints of the legs are also broadened out in leaf shape. A glance at the fore feet with their armature of spines will show us what terrible weapons they must be. The helmet-shaped projection on the head is peculiar to several tropical species. — *Illustrirte Zeitung.*

Importance of Bacteria.

"We must not think too hardly of bacteria," says Dr. H. W. Conn, of Middletown Wesleyan University. "It is true that they are the causes of evil, that they produce disease; but it is also true that they do good. They are our enemies, but they are also our closest allies. It is true that without them we could not have our smallpox nor our yellow fever, we could not have our diphtheria nor our scarlet fever, neither should we have any of the epidemics. But when we remember that it is through the agency of these organisms that we bake the loaf of bread that comes to our table; that the immense brewing industries connected with the manufacture of alcoholic liquors are possible; that without them we could not get our vinegar or our lactic acid; that without them we could not make our ensilage; that these bacteria give the butter maker the aroma of his butter; that it is the decomposition products of the bacteria that the cheese manufacturer sells in the market; when we remember their agency as scavengers, how it is that they keep the surface of the earth clean and in a constant condition for the growth of plants; their value to the soil in decomposing the dead bodies of animals and plants, and thus enabling the same material to be used over and over again for the support of life; and lastly that it is only through their agency that plants were originally enabled to get hold of nitrogen at all, and that we may hope for a continuance of a supply of nitrogen to the soil—we will recognize that the power of bacteria for good far outweighs their power for evil."

THE largest telephone switchboard in the world is that in the Exchange at Berlin, Germany, where 7,000 wires are connected with the main office.

Squinting Brains.

All of our brains squint more or less. There is not one in a hundred, certainly, that does not sometimes see things distorted by double refraction, out of plumb or out of focus, or with colors which do not belong to it, or in some way betraying that the two halves of the brain are not acting in harmony with each other. You wonder at the eccentricities of this or that connection of your own. Watch yourself, and you will find impulses which, but for the restraints you put upon them, would make you do the same foolish things which you laugh at in that cousin of yours. I once lived in the same house with the near relative of a very distinguished person, whose name is still honored and revered among us. His brain was an active one, like that of his famous relative, but it was full of random ideas, unconnected trains of thought, whims, crotchets, erratic suggestions. Knowing him, I could interpret the mental characteristics of the whole family connection in the light of its exaggerated peculiarities as exhibited in my odd fellow boarder. Squinting brains are a great deal more common than we should at first sight believe. Here is a great book, a solid octavo of five hundred pages, full of the vagaries of this class of organizations. I hope to refer to this work hereafter, but just now I will only say that, after reading till one is tired the strange fancies of the squarers of the circle, the inventors of perpetual motion, and the rest of the moonstruck dreamers, most persons will confess to themselves that they have had notions as wild, conceptions as extravagant, theories as baseless, as the least rational of those which are here recorded.

I have not ventured very often nor very deeply into the field of metaphysics, but if I were disposed to make any claim in that direction, it would be the recognition of the squinting brain, the introduction of the term "cerebricity" corresponding to electricity, the idiotic area in the brain or thinking marrow, and my studies of the second member in the partnership of I-My-Self & Co.

Whether we shall ever find the exact position of the idiotic center or area in the brain (if such a spot exists) is uncertain. We know exactly where the blind spot of the eye is situated and can demonstrate it anatomically and physiologically. But we have only analogy to lead us to infer the possible or even probable existence of any insensible spot in the thinking center. If there is a focal point where consciousness is at its highest development, it would not be strange if near by there should prove to be an anæsthetic district or limited space where no report from the senses was intelligently interpreted. But all this is mere hypothesis.

There is a great good to be got out of a squinting brain, if one only knows how to profit by it. We see only one side of the moon, you know, but a fellow with a squinting brain seems now and then to get a peep at the other side. I speak metaphorically. He takes new and startling views of things we have always looked at in one particular aspect.

There is a rule invariably to be observed with one of this class of intelligences: Never contradict a man with a squinting brain. I say a man, because I do not think that squinting brains are nearly so common in women as they are in men. The "eccentrics" are, I think, for the most part of the male sex.

Are not almost all brains a little wanting in bilateral symmetry? Do you not find in persons whom you love, whom you esteem, and even admire, some marks of obliquity in mental vision? Are there not some subjects in looking at which it seems to you impossible that they should ever see straight? Are there not moods in which it seems to you that they are disposed to see all things out of plumb and in false relations with each other? If you answer these questions in the affirmative, then you will be glad of a hint as to the method of dealing with your friends who have a touch of cerebral strabismus, or are liable to occasional paroxysms of perversity. Let them have their head. Get them talking on subjects that interest them. As a rule, nothing is more likely to serve this purpose than letting them talk about themselves; if authors, about their writings; if artists, about their pictures or statues; and generally on whatever they have most pride in and think most of their own relations with.

Perhaps you will not at first sight agree with me in thinking that slight mental obliquity is as common as I suppose. An analogy may have some influence on your belief in this matter. Will you take the trouble to ask your tailor how many persons have their two shoulders of the same height? I think he will tell you that the majority of his customers show a distinct difference of height on the two sides. Will you ask a portrait painter how many of those who sit to him have both sides of their faces exactly alike? I believe he will tell you that one side is always a little better than the other. What will your hatter say about the two sides of the head? Do you see equally well with both eyes, and hear equally well with both ears? Few persons past middle age will pretend that they do. Why should the two halves of a brain not show a natural difference, leading to confusion of thought, and very possibly to that instinct of contradiction of which I was speaking? A great deal of time is lost in profitless conversation, and a good deal of ill temper frequently caused, by not considering these organic and practically insuperable conditions. In dealing with them, acquiescence is the best of palliations and silence the sovereign specific.—*Dr. O. W. Holmes.*

The Chemistry of Gases.

Professor Dewar recently delivered a lecture on the above subject at the Royal Institution, London, of which the *Engineer* gives the following abstract. He began by explaining that the critical density of a substance is about one-third that of its fluid density. He performed various experiments with carbonic acid gas at and near its critical point, and made the results visible by projection on the screen; the liquid acid was contained in a glass tube, and the critical point was reached by cautiously pouring hot water over the outside of the tube. He said that liquefied gases are, as a rule, not good solvents; but he dissolved a trace of iodine in the liquid carbonic acid, which was under a pressure of about 100 atmospheres, and on then raising the acid to its critical point the iodine was carried up the tube by convection currents; in liquefying again, the acid carried down all the iodine. In his next experiment he raised to the critical point some liquid carbonic acid to which a trace of essential oil had been added—he did not say what essential oil. On liquefying again, the solution separated into numerous layers, each of different relative composition.

Professor Dewar then spoke of the solidification of a body by cooling itself, and said that water can be made to become solid by the evaporation of a quarter of its weight. He exhibited 5 inches of liquid carbonic acid in a tube, and on opening the capillary end of the tube by means of a small blowpipe flame, the rapid evaporation of the acid caused the formation of about one-half inch of solid carbonic acid in the tube, or not more than 10 per cent. He then drew attention to a great inverted iron gas bottle, suspended under a strong tripod, and said that it was three-quarters full of liquid carbonic acid; the total weight of the bottle and acid was 108 pounds; that of the acid alone was 4 pounds. The nozzle of the bottle was inserted in the mouth of a long narrow bag, and tap turned on. The escaping carbonic acid then by evaporation froze a portion of itself into carbonic acid snow, which deposited itself in the bag, and was found to weigh 30 per cent of the liquid acid used; this Professor Dewar stated to be an excessively large yield, the ordinary yield being but 15 or 20 per cent. Carbonic acid snow floats on water. He compressed some of it into ice, and then it sank in water, of which it had 1½ times the density; it was nearly transparent. It evaporated slowly, and without liquefying, for it is a boiling solid. In its liquid state it has a higher temperature than at its boiling point, so that the ordinary condition of things is reversed. Liquid carbonic acid floats on water at ordinary temperatures, and Professor Dewar, by means of projection apparatus, exhibited it floating on water.

As an instance of one of the methods of measuring abnormally high pressures, he exhibited a glass tube, closed at one end, silvered inside, full of air, and inverted over mercury. All this was put inside a vessel subjected to the action of the hydraulic pump until a pressure of 500 atmospheres had been reached. The rising mercury ate away the silver; so that when the tube was taken out and examined it could be seen into what compass the air had been compressed.

Work of Earth-Worms in Yoruba Country, West Africa.

In the "Proceedings of the Royal Geographical Society," October, 1891, Mr. Alvan Millson gives the following account of the extraordinary work done by West African earth-worms:

"Northward from Ibadan, which may be described as the center of the chief military and commercial power in Yoruba, two days' journey—about forty miles—through many villages, and a landscape dotted far and near with oil palms (*Elais guineensis*), along a road thronged with travelers, brings one to the capital of central Yoruba, Oyo (Awyaw). On leaving Ibadan, I passed in the course of our morning's march over 4,700 men, women, and children, hurrying into the great city from the farm villages, with loads of maize, beans, yams, yam flour, sweet potatoes, fowls, pigs, ducks; or driving cattle, sheep, and goats; or mounted on small native horses which amble quickly along under the combined influence of an Arab ring bit and an armed spur, which leaves its traces in deep scores along the flanks of the poor animals.

"Far and wide the land has, for generations, and indeed for centuries, been cultivated by these industrious natives. The hatchet, the fire, and the hoe have removed all traces of the original forest, save indeed where a dark trail of green across the landscape shows where the valley of some narrow watercourse or larger river is hidden among trees.

"For two or three years at most the land is allowed to lie fallow, while for three or four years double or treble crops are raised with no further cultivation than an occasional scrape with a hoe, and during its fallow time no further care is taken of it than to let a rank growth of reedy grass spring up some six or eight feet in height. Among this grass can be seen the seedlings and young plants of a new forest which would rapidly take possession were the land to be permanently deserted.

"In spite of this careless and exhausting method of cultivation the crops maintain an excellent average, and the same plot of ground serves for generations to support its owners.

"The following extracts taken from notes taken at the time will serve to explain the apparently inexhaustible fertility of a soil which does not at first sight show any signs of unusual richness.

"Were one to visit Yoruba during the early part of the rainy season only, it would appear impossible to account for these facts, . . . while under our feet, unnoticed, was going on the ceaseless labor of the real fertilizers of the land.

"In the dry season the mystery is at once solved, and in the simplest and most unexpected manner. The whole surface of the ground among the grass is seen to be covered by serried ranks of cylindrical worm casts. These worm casts vary in height from a quarter of an inch to three inches, and exist in astonishing numbers. It is in many places impossible to press your finger upon the ground without touching one. For scores of square miles they crowd the land, closely packed, upright, and burned by the sun into rigid rolls of hardened clay. There they stand until the rains break them down into a fine powder, rich in plant food, and lending itself easily to the hoe of the farmer. Having carefully removed the worm casts of one season from two separate square feet of land at a considerable distance from one another, and chosen at random, I find the result to weigh not less than ten and three-quarters pounds in a thoroughly dry state. This gives a mean of over five pounds per square foot. Accepting this as the amount of earth brought to the surface every year by these worms, we get somewhat startling results. I may say, speaking from the result of numerous experiments, that five pounds is a very moderate yearly estimate of the work done by these busy laborers on each square foot of soil. Even at this moderate estimate, however, of the annual result of their work, we have a total of not less than 62,233 tons of subsoil brought to the surface on each square mile of cultivable land in the Yoruba country year after year, and to the untiring labors of its earth-worms this part of West Africa owes the livelihood of its people. Where the worms do not work, the Yoruba knows that it is useless to make his farm.

"Estimating one square yard of dry earth by two feet deep as weighing half a ton, we have an annual movement of earth per square yard to the depth of two feet, amounting to not less than forty-five pounds. From this it appears that every particle of earth in each ton of soil to the depth of two feet is brought to the surface once in twenty-seven years.

"The earthworm which produces such surprising results has been identified as a new species of *Siphonogaster*, a genus known hitherto only in the Nile Valley."

Arizona Onyx.

Arizona onyx is fast gaining a reputation in the East, and the day is not far distant when most of the onyx used in the United States will come from this Territory. The great beds of this precious stone in Yavapai and Maricopa Counties alone, when sufficiently developed, will supply a greater part of the demand. Even now from two to five car loads are shipped from the Yavapai beds, and arrangements are being made to increase the output, and by the 5th of May, teams will be moving several tons a day from the Cave Creek mines.

The Yavapai onyx beds, owned by W. O. O'Neil and partners, are probably the most extensive mines of the kind known, being almost a solid body one mile by one mile and a half in extent. At present about forty men are engaged in taking out the stone that is being shipped to Chicago, New York, Cincinnati and other Eastern cities, where it is worked into table tops, etc. Probably the largest slab of oynx ever taken out in one piece was dug out of the O'Neil ledge, it being 23 × 10 feet, and 26 inches thick. The stone from this claim is very fine grain and takes a much higher polish than the celebrated onyx of Mexico, and it contains colors that were exhausted many years ago in the Mexican mines. Then, too, the mines of that country never turned out pieces larger than five or six feet square. So far as developed, the Cave Creek onyx beds do not seem to be as large as the Yavapai beds, though the stone is as fine, but even as they are, they will produce large amounts and in blocks of very satisfactory size. J. B. Dougherty, of New York, is doing a great deal of development work, and as soon as the road is completed, which will be in a few days, he will put teams to hauling and loading it on to the cars at Phenix, for shipment to New York.—*Phenix Gazette.*

THE recent performance of the steamer City of New York was 20·06 knots per hour throughout the voyage from New York to Queenstown, 2,896 miles.

Modern Aerial Navigation.

Captain J. D. Fullerton lately read a paper at the Royal United Service Institution on "Modern Aerial Navigation," concerning which *The Engineer* makes the following observations:

The paper was a fairly complete *résumé* of the whole subject of ballooning, especially for military purposes, while reference was made at some length to the problem of flight. It is well known that Mr. Maxim, of gun fame, has for some years directed his attention to this problem. He has spent nearly £10,000 on experiments, and is confident of ultimate success. Captain Fullerton quoted the following utterance of Mr. Maxim: "If I can rise from the coast of France, sail through the air across the Channel, and drop half a ton of nitroglycerine upon an English city, I can revolutionize the world. I believe I can do it if I live long enough. If I die, some one will come after me who will be successful if I fail. . . . It can be done as sure as fate. I have spent $45,000 already upon it, and I did not enter upon the work until I was convinced that the idea was practical." This is a sufficiently alarming prediction. But it is not necessary that a flying machine should be employed. Lord Dundonald proposed during the Russian war to send up a balloon, in the car of which was to be carried a few hundredweights of iodide of nitrogen. When the balloon was over Sebastopol, the explosive was to be suffered to fall into the town. It is doubtful if the necessary quantity of iodide of nitrogen could have been got together or handled in any way, seeing that small quantities of it are exploded by tickling them with a feather in laboratory experiments. But in the present day there are, of course, available far more manageable and more powerful explosives. Captain Fullerton believes, as does Mr. Maxim, that the flight problem would be solved at once if only a sufficiently light and powerful motor could be obtained. This is possible; but it is worth while to consider whether such a motor is actually needed, and why it is that flying machines have not yet been made a success.

Any one who has spent a day or two at sea can scarcely have failed to observe the flight methods of gulls. They will follow a steamer for hours together with very little effort, if only the ship is going head to wind, or nearly so. For long periods individual birds will advance at ten miles or fifteen miles an hour without flapping a wing. With a little trouble the observer can easily pick out individual birds in a flock, and he will soon see that some of these fly with much less effort than others. In the structure of the birds there is no difference. If he pursue his investigations, he can scarcely fail to arrive at the conclusion that flight of this kind is not at all a question of power, but of individual skill. Strange as the statement may appear, we have not the smallest hesitation in saying that in order that a gull may fly with very little effort indeed it must be exceedingly skillful, and that certain individuals in every flock are masters of the art of flying, while others are very poor performers indeed. If we take a dead gull, we can have it stuffed, with its wings extended and stiffened with wires. We can put it into precisely the same attitude as that assumed in life, and we can then try to make it fly against a breeze and fail. All the conditions are present save one—volition on the part of the bird. In the same way, we can put a pair of skates on a man, and set him up on them on the ice, but he cannot skate. He has to learn the art, and the more skillful he becomes the less is the muscular effort that skating demands. It would not be impossible to make the similitude of a bird, and to place a man in its body. All the conditions for flight against a breeze might be present, but the man could no more fly than an untaught individual could skate. Birds, no doubt, acquire the art of flying very quickly, because of their inherited gifts in that respect; and the world may yet see men who have acquired the art through the efforts of long generations of flying ancestors. We direct attention to this aspect of the question, because we believe that it is an entire mistake to suppose that any great amount of power is needed. If a flying machine were made on bird-like principles and tried, it would certainly fail, and as certainly we should hear that the failure was due to want of power. It is far more likely that the failure would be due to want of skill. In Eastern fairy tales we are told now and then that men have been transformed into birds. If we suppose that Mr. Maxim was turned into an eagle by some beneficent fairy, he would find very great difficulty in even shuffling over the ground, and flight would be to him an utter impossibility. His energy would no doubt induce him to try his wings, and after some time, if he did not kill or maim himself during the first month, he would perhaps be able to flap about in the air in an ungainly fashion, greatly, no doubt, to the surprise and amusement of the real eagles. In a word, it is not so much the want of means of flying as the want of knowledge of how these means are to be used that stands in the way and prevents mankind from disporting itself in the air.

If we return to our gulls, it will be found that their proceedings well deserve observation. The whole art and mystery of flying against a breeze consists in maintaining an accurate balance. The wings and tail are incessantly in motion, but the motion is very small. A gull will sit on a fifteen miles an hour breeze, and go ahead at ten miles an hour, and it will turn its head and bend its neck and peck at a neighbor in the most unconcerned fashion. In the crowd of gulls, however, one is jostled. The least thing seems sufficient to upset the delicate balance. With a scream of annoyance the bird drops. There is a quick flapping twist, and the gull goes whirling down the wind for a hundred yards or so. Then with an indescribable effort it turns round, head to wind, spreads its pinions, and comes sailing up at thirty miles an hour, without an effort, to resume its place in the crowd looking out for scraps thrown overboard. When the breeze is steady all goes well, but gusts greatly disconcert the gulls. The gusts literally upset them, and the birds scream incessantly with vexation. At last they give up sailing and take to flapping, and then they must be very hungry or scraps very plentiful to keep them in the track of a steamer.

But it will be asked, How is it that a bird can advance against a head wind? Dozens of answers have at various times been given to this question, and pages of formulæ have been devoted to the subject. It cannot be said, however, that a perfectly conclusive answer has yet been supplied. A theory was advanced in our pages by a correspondent some years ago which deserved, we think, far more attention than it received. His explanation is very simple. A bird is, according to it, in precisely the same condition as a fore-and-aft rigged boat sailing close-hauled. In the case of a boat, or, better still, of an ice yacht, the plane of the sails is vertical. But a little reflection will show that much the same result would be got if the plane was not vertical but horizontal. Indeed, cutters when racing sometimes heel so much that the sails, instead of being vertical, stand at an angle of 50° or so with the horizon. It is essential, however, to a boat sailing close-hauled that she shall have a second force besides that of the wind acting on her. This is supplied by the water, which holds her up to the wind. If she did not, in sailor's phrase, get a good hold of the water, she would be pushed sideways before the wind, and would make leeway. In the case of the bird we have a horizontal instead of a vertical sail. The action of the wind on the inclined plane tends to lift it up and drive it back. The equivalent of the water to the boat is supplied in the case of the bird by gravity, its own weight holds it down, and it goes ahead just as a close-hauled boat does. But considerable skill is required to get the best result out of the boat; and the same truth holds good, as we have endeavored to show, of the gull. The theory is ingenious, and in many respects satisfactory; but it does not account for the soaring of birds in a calm. Nor can it without some trouble be made to explain how birds can sail right in the wind's eye, which no boat, not even an ice yacht, can manage.

It is stated that Mr. Maxim has got so far with his motors that he has obtained steam equal to 100 horse power with one square foot of grate, or rather of the equivalent of a grate, for he burns liquid fuel. But the heat generated is so intense that no boiler plate yet made will endure it. We venture to think, however, that he may ultimately find that by working the plane system properly he will need very much less power than now seems to be required. No matter what the machine, however, which ultimately flies, it will be found that the real difficulty will lie in providing the skill necessary for its management. This skill will, of course, be different in kind from that needed by the gull, but it will be none the less necessary and difficult to obtain at first.

Rock Elm.

The growing scarcity of hickory and white ash has prompted wagon builders to look about for substitutes. The makers of common carriages are with them to a certain extent, while the builders of high-class carriage work still adhere pretty generally to the old woods, finding, as yet, nothing that satisfies them where lightness, strength, and elasticity combined are required.

Agricultural implement makers have substituted steel and iron for wood in a large number of places where it was formerly used exclusively. The implement factories are using less than one-half the lumber they did only a few years ago. The light forged or cast steel plow beam has taken the place of the clumsy wooden one of our fathers, that formerly absorbed a large amount of the finest white oak, while the airy spring tooth harrow, entirely of steel, has superseded the old time V-shaped implement that formerly vexed the bosom of Mother Earth.

But while the others have reduced the amount of lumber more or less required in their special lines, the makers of farm and road wagons and heavy trucks are still forced to use nearly the same amount of wood as formerly. White oak, white ash, and hickory have thus far been the chief woods used in wagon construction. Other woods have been used for certain parts in certain localities, for instance, rock maple for bolsters and bed pieces, and locust, birch, elm, and even black walnut, for hubs.

But the three woods named have been the chief reliance for good work, and now that hickory and white ash are becoming so scarce, especially the former, and good, tough white oak is no longer found in great abundance north of the Ohio River, while it is called for for so many other purposes as to greatly enhance its value, substitutes of as nearly equal value as possible, in strength, durability, and elasticity, are eagerly sought after, that may be furnished cheaper than the old stock.

Of all the woods tried, probably rock elm has proved the most satisfactory for many uses in wagon building, where one of the three, oak, ash, or hickory, has heretofore been almost exclusively used. Its elasticity and general toughness should recommend it for axles, bolsters, and reaches. Indeed, it is being sawed for these purposes to a large extent in some sections, a number of the Wisconsin and Michigan hardwood mills having large orders for future sawing.

While it may be true that the bulk of such stock at present goes to the small wagon makers and repair shops, it is also true that some of the largest manufactories in the country are ordering a good deal of rock elm for their season's stock, while the bending factories are taking a large increase over a year ago.

This should be good news to the hardwood men of the extreme North, where the timber is found of the best quality and in greatest abundance. They will be gainers from the fact that it will allow them to clean up another kind of timber when logging a piece of hardwood land. If they can market their rock or gray elm for wagon stock at a fair price, and their soft elm for furniture and hoops, and can add beech to the list of flooring stocks, they will have less to complain of than now.

The elm is a noble tree, in its native habitat, but is by no means so abundant as is thought by many, and while it can be marketed at present at a profit at a much less price than white oak, the general free use of it for wagon and carriage building would, in a few years, greatly enhance its value, by producing a comparative scarcity.—*N. W. Lumberman.*

Agriculture—Flax and Hemp.

Census Bulletin No. 177, relating to the production of flax and hemp in the United States, has been prepared by Mr. John Hyde, special agent in charge of the statistics of agriculture. It shows the total area of land devoted to the cultivation of flax in 1889 to have been 1,318,698 acres, the production of flaxseed 10,250,410 bushels, the production of fiber 241,389 pounds, the amount of flax straw sold or so utilized as to have a determinable value 207,757 tons, and the total value of all flax products $10,436,228. While flaxseed is reported from 31 States, Minnesota, Iowa, South Dakota, and Nebraska produce 80·06 per cent of the total amount, or 1,035,613 bushels in excess of the entire production of the United States at the census of 1880. South Dakota had the largest acreage devoted to flax, and Minnesota the largest production of seed. Of the States containing 1,000 acres or upward in flax, Wisconsin had the highest average yield of flaxseed per acre, 11·42 bushels, and highest average value per acre of all flax products, $13.39. The average yield for the entire country was 7·77 bushels per acre. Throughout the greater portion of the principal flaxseed-producing region flax straw is of little or no value, and much of the so-called fiber is only an inferior quality of tow, used chiefly for upholstery purposes. There are indications, however, of the revival in the United States of a linen industry that will afford a market for fine flax fiber of domestic production, and revive a branch of agriculture that has for many years been almost extinct.

The total area of land devoted to the cultivation of hemp in 1889 was 25,054 acres, and the production of fiber 11,511 tons, valued at $1,102,602 to the producers. This branch of agricultural industry is confined almost exclusively to the State of Kentucky, which produced 93·77 per cent of the total hemp crop of the country. The average yield per acre for the United States is 1,029 pounds, and the average value per acre $44·01, or $95.79 per ton.

Electrical Supplies.

The extent to which the business of furnishing electric light and power supplies has developed within a comparatively brief period is something quite phenomenal, and does not readily receive full appreciation by those not having direct connection with this line of business. Something of its magnitude may be learned by looking over a handsome catalogue of nearly 500 pages recently issued by the Electrical Supply Co., of Chicago, having also factories at Ansonia, Conn. The book is profusely illustrated, and contains so much that has been specially prepared for its pages that the publishers have protected their rights therein by a copyright.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING. — Edward P. Eastwick, Jr., New York City. Two patents have been granted this inventor on an improved coupling device of the vertical plane type, in which the drawbar is provided with an interior buffing plate or surface in the line of buffing force, and adapted to be engaged by a knuckle pivoted in the drawhead, the inner end of which is in engagement with the buffing surface when the knuckle is in its coupled position. The movable buffing plate or surface is provided with means of cushioning, whereby the force of the buffing strain will be mitigated and the shock to the drawbar and the car will be lessened. A headless locking pin is also provided, which will drop to its seat in the drawhead, no matter whether or not the mouth of the opening in which the pin slides be surrounded by snow or ice. An arrangement of openings is provided in the side and end of the drawbar shank through which the tail bolt is passed to obtain proper position and adjustment; and to economize in metal and facilitate annealing in the construction of the knuckle, it has a vertical opening extending from top to bottom, and located adjacent to its pivot point.

CAR COUPLING. — William A. Mayhall, Gloster, Miss. This coupling is designed to be simple, durable, and inexpensive, and capable of coupling with an opposed higher or lower link coupler. The coupling pin when in uncoupled position is held elevated by a spring-pressed latch, and the coupling is automatically effected by the drawheads being brought sufficiently close together to operate the latches, releasing the pin, and through the assistance of a spring-controlled rock shaft connected with it. An operating lever is connected with the rock shaft at the side of the car, the lever hanging down and being at all times out of the way, and the connection of the shaft with the coupling pin is such that the drawhead may move laterally without affecting the connection.

SPARK ARRESTER AND DRAUGHT REGULATOR.—Walter M. Letts, Sedalia, Mo. In the smoke box of the locomotive, in its upper portion, an imperforate partition is arranged to embrace the steam draught nozzle, while a deflector flue is secured to the flue sheet of the boiler and extends forward above the flues to a point adjacent to the partition, the attachments being so constructed and arranged that the sparks and cinders will be retained in the smoke box, and the locomotive may be given any necessary amount of draught.

Miscellaneous.

FORE HEARTH.—Adam J. Schumacher, Butte City, Montana. This invention relates to fore hearths for smelting furnaces, for use in connection with a discharge trough patented by the same inventor. It consists of an inclined tank with outlet spouts in the upper edges of its ends, a lining of refractory material, a transverse water partition dividing the tank into two compartments, and there being a continuous discharge of slag and bullion through the spouts, there being no need of ladles to dip out the bullion. The construction is simple and durable, and the slag is completely separated from the molten metal, there being a formation of a cover from the slag for the molten metal contained in the device.

NEWSPAPER FOLDING MACHINE. — Cyrus N. Walls, Taylorville, Ill. This invention provides a feeding attachment adapted to deliver newspapers to the machine as they come from the press. It consists of a series of movable carrying tapes extending over pulleys at one end of the slotted folding table and over large wheels at its opposite end, a series of diagonal guide tapes having their lower ends carried by rollers arranged within the loops of the carrying tapes. The feeder may be adapted to any kind of folder, and will carry the papers sidewise as they come from the press and place them in position to be folded with the aid of any gripping mechanism or any hand-operated machinery.

DUMPING APPARATUS. — Philip Imig, Minier, Ill. This improvement relates more especially to apparatus for use in unloading ear corn or other grain into a crib, providing therefor a track adapted to support a wagon, a movable inclined platform being mounted on the track, and a chute to fit upon the track behind and under the wagon box. It is an extremely cheap and convenient apparatus for application to any grain crib, by means of which a farmer may unhitch his team, run his grain wagon over the crib, and quickly dump the load into any desired part of the crib.

PHOTOGRAPHIC SHUTTER. — Julius R. Albrecht and Emil Ortmann, New York City. A lens shutter and connected operating mechanism are provided by this invention, the shutter being easily regulated and conveniently applied to lens tubes of different sizes, and being adjustable for use in making instantaneous photographs or for time exposures. It can be operated with the greatest rapidity and will show the largest possible opening for a shutter of its size, being operated by the simple pressure of an air bulb.

AUTOMATIC ELECTRIC TIME CHECK.—Charles K. Jardine, Georgetown, British Guiana. This is a device for receiving the checks or tickets of employes in manufacturing establishments, offices, etc., and consists in the combination with a compartment drawer of an electrically operated deflector, for guiding the tickets into one or the other of the compartments of the drawer, according to whether the ticket is dropped into the apparatus early or late. Combined with the deflecting apparatus is an indicating plate to display the words "early" or "late," so that it may be seen by the employe when the ticket is dropped.

PROPORTIONAL FLUID METER. — Donald McDonald, Louisville, Ky. This is an improvement in meters adapted for measuring water or other liquids as well as gas, and in this meter both the main conductor and the small conductor that leads off to the meter are provided with partitions or diaphragms having perforations through which the fluid passes. The diaphragms are differential, and a pressure regulator and liquid gauge are interposed between and connected with the meter pipe and another pipe of like diameter, the latter leading off from the service pipe on the outflow side of its diaphragm.

CHECK BIT.—Lester C. Swift, Plano, Ill. This is a double check bit, comprising upper and lower bits and a strip having an eye loosely embracing the upper bit and extending therefrom across the lower bit and rigidly secured thereto, the two bits being connected so as to be held in a fixed position in relation to each other. The bit is adapted to prevent the horse from hogging on the check, and also to prevent tongue lolling and stumbling.

MEASURING REEL.—Herbert L. Stull, Stoddartsville, Pa. This is a device especially adapted for measuring cloth in the web and automatically registering the length of cloth measured. It comprises a case in which is mounted a spool having a measuring cord, an indicating wheel driven from the spool, a dial parallel with the wheel having an aperture through which the numbers on the wheel are successively visible, its face having a spiral line with a scale and an indicating hand. A spring-propelled shaft parallel with the axis of the spool is geared to it by a train of multiplying gearing for rewinding the spool.

TAIL PIECE FOR STRINGED INSTRUMENTS.—Charles J. Cook, Montreal, Canada. This improvement is adapted for use with violins, guitars, banjos, and all kinds of stringed instruments, and consists of a tail piece provided with independent cam levers for pinching or holding the tail ends of the strings of the instrument, instead of securing them by tying knots or otherwise.

SKATE. — Ubel Wierda, Winsum, Netherlands. This improvement provides a detachable blade which is preferably made reversible and formed with two different styles of running edges, and also provides a novel means of holding the blade to the skate body or foot plate, whereby blades suitable for all styles of skating and for hard or soft ice may be interchangeably employed in connection with one common body, and the latter may be fashioned to suit individual tastes as to the means of securing the skate on the shoe or adjusting the blade.

FASTENING DEVICE. — Charles Liebe, New York City. This is an improvement on a former patented invention of the same inventor, providing a fastening device which may be used to attach together two pieces of furniture, to fasten a door, or to fasten adjacent pieces of almost any rigid substance. It consists of a face plate having a slot and mortise with oppositely inclined end walls, a bed plate having a swinging latch entering the face plate slot, while a locking cam lever is pivoted above and swings upon the latch.

ICE CAN.—Charles E. Struck (address Struck & Fischer, 649 and 651 West 42d Street, New York City). This is an ice-making can or vessel having its bottom and two of its adjacent sides jacketed or insulated and its two remaining adjacent sides non-jacketed or non-insulated, whereby the water will be frozen gradually and mainly from one side, the refrigeration being checked on the other side. By this means the impurities contained in the water are prevented from becoming fixed in the main body of the ice and are driven over to the warmest surfaces or corners, where the ice containing such impurities may be afterward readily broken off, leaving a block of pure or crystal ice.

CLOTHES LINE. — David F. Covert, Rapid City, South Dakota. This is a wire clothes line having holders integral therewith for securing the clothes on the line. It is composed of a series of links bent at their ends to form opposing spring loops over the main body part, and terminating in coils adapted to shut over or receive within them the main body part of the links, the line being readily shut up close when not required for use by sliding or folding the links one upon or within the other. The line may be easily lengthened or shortened by adding or removing links, each link being readily engaged by simply lifting the spring loops of the links.

WHIRLIGIG.—Alfred Moe, Jersey City, N. J. This is an advertising device comprising a windmill carrying a series of figures, with means for imparting a rotary movement to the figures independent of the movement of the wheel. The construction is very simple, but the device is capable of imparting unique and apparently erratic movements to various figures to attract attention, and is also adapted for use as a toy.

GAME BOARD. — George Stackhouse, Pittsburg, Pa. This is a toy in imitation of a ten pin alley with an automaton arranged to bowl, the bowling alley having suitable troughs around its sides and ends for receiving the balls, a tilting returning trough carrying the balls to the point of starting, while an automaton with a swinging arm is connected with the tilting trough and an inclined plane receives and projects the ball. Combined with the alley is a wheel of fortune to receive and project the ball.

DESIGN FOR A HINGE. — Sidney L. Stiles, Watseka, Ill. The leading feature of this design consists in the curve or bend and the edge contour of the leaf.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention and date of this paper.

NEW BOOKS AND PUBLICATIONS.

GEOLOGICAL SURVEY OF NEW JERSEY. Annual Report of the State Geologist for the Year 1891. Trenton, N. J. 1892. Pp. 270.

The drift or Pleistocene formations and the economic geology of the State are the main topics of the geological section of the 1891 report. The glacial deposits, moraines and extra morainic formations are considered at length, and characteristic illustrations are given, in economical geology. The oak and pine land belts are described. Water supply and water power, the latter utilized and unutilized, artesian wells, Passaic River drainage (the works at Little Falls), iron mines and mineral statistics are the principal subjects treated. A useful feature of the report is a list of the publications of the survey, including Professor Cook's unrivaled series of topographical maps. The maps are supplied at 25 cents per sheet—a strictly nominal price, when the value and accuracy of the series is considered. There are now twenty sheets, each twenty-seven by thirty-seven inches.

BATEAUX ET NAVIRES. By Le Marquis de Folin. Paris: Librairie J. B. Bailliere et Fils. 1892. Pp. viii, 328. Price 75 cents.

This work, with 132 pretty little sketchy illustrations, treats principally of the smaller boats of all nations, in which craft indigenous peculiarities are most largely developed. We note some omissions, however, the United States craft being excluded in great part, while the shores of the European continent are largely drawn on for subjects.

ANLEITUNG ZU DEN LABORATORIUMSARBEITEN. By Alexander Lainer. 243 illustrations. 99 pages. Price 3 marks. Halle a. S., Germany: Wilhelm Knapp, publisher.

The handsomely illustrated little book gives full instructions for performing laboratory work, and is more specially intended for the use of professional and amateur photographers, to enable them to carry out experiments and other laboratory work in the most effective manner and with simple, inexpensive apparatus.

WITH EDISON AT SCHENECTADY is the title of a unique volume of photographs illustrating the plant of the general Electric Company at Schenectady. There is portrayed in a graphic manner the interiors of various machine shops. Shows groups of employes at work, and, in fact, shows in as clear a way as possible how the electric machinery is constructed and handled, A feature of the book is the frontispiece. Here are portraits with their autographs of Edison, Insull, Kruesi, Turner, and other Schenectady officials. The book is withal artistic, and will be of interest to any one interested in electricity. The photographs are of the highest order and reflect great credit upon the compiler and publisher, Mr. W. H. Butler, of Schenectady, N. Y., to whom subscriptions should be sent. The price is $6 for half-seal binding and $10 for all-seal leather and gold edge cords.

Business and Personal.

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

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

INDEX OF NOTES AND QUERIES.

(4402) P. B. asks: What are the methods of grounding rails of a single-wire trolley road? A. The rails of a trolley road are grounded at intervals by means of wires extending downward from the track to large earth plates. An uninsulated return wire laid in the earth is sometimes used.

(4403) F. W. says: The firm I am with are desirous of drawing water from a creek 600 feet distant from factory, and up an elevation of 24 feet; is it practicable? If so, what size pump will they require to pump say 400 barrels, or 16,000 gallons, in a working day of 10 hours? Would it not be much better to lower the pump in a well say 8 or 10 feet? A. You can draw the water 24 feet with great difficulty, from the separation of the air from the water and the large clearance usual in pumps. Instead of your proposed well, we recommend the raising of your supply level as much as possible by a ditch from up stream, or by sinking the upper part of the suction pipe 5 feet or more, and also the pump to the same level, when there will be no difficulty in drawing a full supply. The suction pipe should have a tight foot valve and be charged with water to start with, and have easy means of recharging. You will require a pump with 8 inch water cylinder running at the piston speed of 80 feet per minute with a 5 inch suction pipe. Size of steam cylinder to meet the pressure pumped against.

(4404) I. M. M. asks: 1. How long does it take for there to be an entirely new brain formed, also body? We mean an entire change of every atom in both brain and body. If physiologists have ever ascertained the length of time, I have not seen it. A.

About seven years has been claimed for an entire change in the material of the human body. 2. Would it do to use sheet iron instead of plastering in a dwelling house? Our idea would be to cover it with two or three thicknesses of paper. A. Sheet iron will make a poor finish for the interior of a house. We cannot recommend it. 3. What power would be required to lift 160 pounds, using an 8 inch and a 4 inch drum on the same shaft, so that the rope winds up on the large drum while it inwinds from the small? I am an invalid and am trying to invent an apparatus to lift me. A. It requires 80 pounds at periphery of the larger drum. 4. How many pounds will a ¼ inch, also a ½ inch rope lift without breaking? A. The breaking strain of a rope ¼ inch diameter is very uncertain, from the value of material, and make ¼ inch from 75 to 100 pounds, ½ inch from 300 to 400 pounds.

(4405) N. W. asks: 1. What use is made of old steel rails? Can they be rerolled into good new rails? I asked this question about three months ago, but no reply. A. There is a good market for old steel rails for rerolling and for forgings for heavy machinery. 2. Is there any good coking coal or anthracite coal in sufficient quantity for extensive mining purposes in the United States west of the Mississippi River? If so, where located? A. Good coking coal is found in Missouri, Kansas, Indian Territory, Colorado, New Mexico, Montana, and Washington. The coke manufacture is fast increasing in those States. There are small beds of anthracite in Colorado and Arkansas.

(4406) C. W. N. writes: Tell F. W. S. No. 4337 that if he will take an ordinary three-cornered file and grind it to a point, keeping the edges sharp a little way back of the point, he can bore a hole in plate glass with it by simply turning it with a brace and lubricating it with turpentine. Operate as though about to bore a hole in a bit of wood. I have a single gas burner that reaches out into the room from the wall and have made a queer discovery while playing with it. When turning off the gas very slowly the other evening, and when the flame had almost disappeared, only a thin line of blue remaining, it commenced to buzz like a big fly. What was the cause of the noise? Ask your readers the significance of the peculiar shape of the prow of the gondola. A. The gas burner produced what is known as the musical flame. The sound is due to a series of explosions occurring regularly.

(4407) O. S. J. asks: Are there any cheap substances which might be used for bleaching bagging, which do not require to be washed out afterward? Permanganate of potassium is said to be used, and the color of the manganese oxide discharged by means of sulphurous acid. A. Gaseous chlorine largely diluted with air might do the bleaching. It should be followed by treatment with gaseous sulphurous oxide. 2. Are there any cheap preparations besides rubber and gutta-percha which when applied to bagging would make it waterproof and at the same time flexible? A. To make it really waterproof under the conditions stated, India rubber is about the only effectual application. 3. I should also like to know of a substance like the above, but white. A. Palmitate of aluminum has been recommended for waterproofing, but seems to have met but limited application.

(4408) E. R. J. asks: By what formula may I find quantitative analysis of a silver 25 cent piece, knowing the qualitative contents of the alloy, without the slightest injury, or altering of, by cutting or scratching the silver piece? I worked out a very simple specific gravity and algebraic formula, but lost it years ago. A. If only two constituents and of known specific gravity are in the coin, proceed as follows: Weigh the coin in air and then in water.

Let a= weight in air in grammes.
b= " water "
c= specific gravity of silver.
d= " " copper.
x= weight of silver in coin.

Then we have $x=\frac{dca-dcb-ac}{d-c}$

(4409) E. E. L. asks: What can I add to crude coal tar naphtha that will effectually disguise its odor or will deodorize it, and will not be expensive? A. Deodorization will be difficult. One method is to distill, rejecting the first and last portions of the distillate. Another is to treat it with a mixture of oil of vitriol and potassium bichromate, decant, wash and distill if necessary.

(4410) J. P. says: Please let me know what is the velocity of light and the velocity of electricity? Which travels faster, as I would like to know on account of a dispute which arose on that subject? Could you let me know how it is proved, and by whose theory? A. Light has a velocity of about 187,000 miles per second. Electricity is supposed to be a phase of ether disturbance and its velocity as a current is the same as that of light. It however takes some time for a current to attain full strength at the end of a length of conductor, and hence arise the different estimates of its so-called velocity. See Ganot's "Physics," $5 mailed, for experiments and theory.

(4411) W. D. H. asks how draughtsmen make white letters on black ground. A. Take flake white and mix with water to the thickness of ink. Use with a pen.

(4412) A. L. W. asks: Which will bear the most weight, a hollow bar of round iron or a solid bar, each of the same size in diameter? If the hollow iron is the strongest, why is such the fact? A. The solid bar of iron is the strongest and will bear the greatest load. Pipe is only strongest for equal weights. The additional size required for equal weight gives a pipe greater stiffness and stability for almost any use.

(4413) I. L. W. says: I desire to obtain a rule which is simple and practical, without recourse to trigonometry, for the measurement of the pitch of a propeller wheel of the screw pattern. I am unable to find two rules alike, or two persons who use like rules, or who obtain exactly the same results in similar cases. A. To measure the pitch of a propeller screw approximately and near enough for all practicable purposes for small boats, take a carpenter's rule and lay one leg on the outer edge of the propeller blade and move the other leg parallel with the shaft and with this angle strike off two lines which shall represent the angle of the blade. Then multiply the diameter of the screw by 3·1416, which will be the circumference of the revolving blades. With this distance, measure at right angles to the line representing the shaft, to meet the angular line representing the track of the blade. The distance from this line along the line of the axis to the angular intersection first drawn is the pitch of the screw.

(4414) W. L. K. asks: Is there a way to print in bronze, or gold gilt direct, without having to use a brush or bronzing pad? I see a great deal of such work which looks as though it had been printed direct from type or rule. What puzzles me the most is to know how to print badges and do a nice job. A. We know of no way to print in bronze or gold gilt without using the bronzing pad. Most badges are printed in gold leaf on a bookbinder's press. You can make a fair-looking job by printing with a good quality of gold ink.

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