SCIENTIFIC AMERICAN

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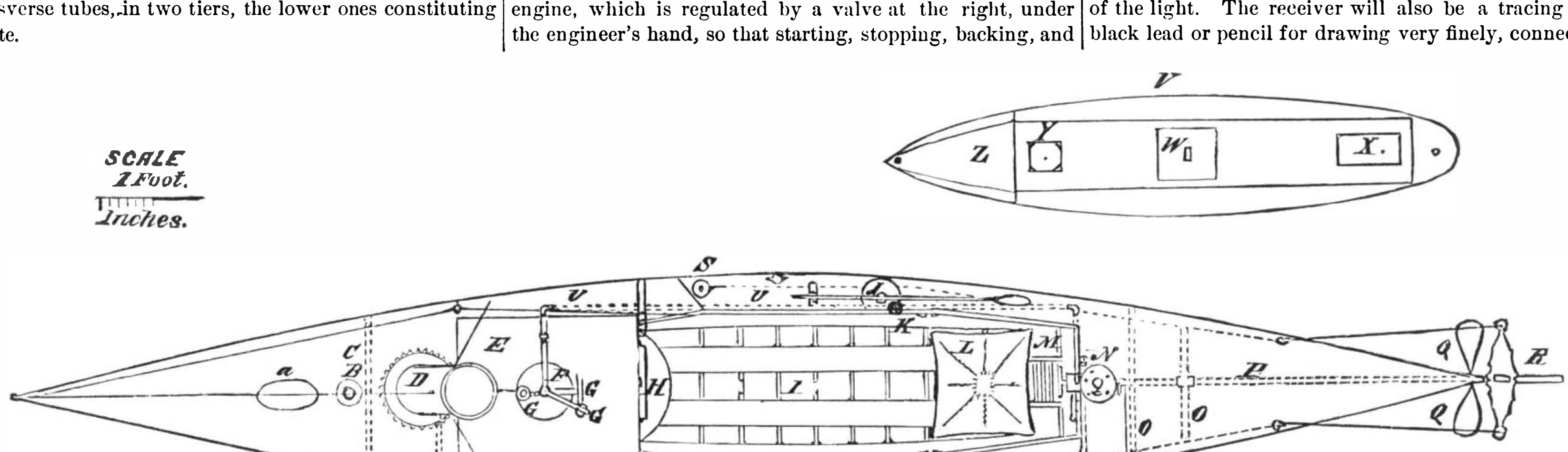
THE SMALLEST STEAMBOAT IN THE WORLD.

We illustrate herewith the steam canoe Nina, designed and constructed by Mr. J. Davidson, of this city, at Fordham, N. Y. Several unsuccessful attempts have been made in England to construct a steam or electric craft designed to carry one person, but all failed in some essential point, and it was left for an American to solve the problem, and it has been done in an original manner

The keel length is 13 ft., over all 14 ft.; width, 28 in.; draught at bow, loaded, 6 in.; aft stern, 8 in. The boiler is circular, of copper, felt-covered, 20 in. long by 17 in. diameter; fire-box, 10 in. diameter, of cylindrical form, with 22 transverse tubes, in two tiers, the lower ones constituting the grate.



PLAN OF THE STEAM CANOE NINA.

Stroke of engine 2¾ in. The feed pump is worked by hand. There are two propellers, three-bladed, of 9 and 14 in. diam., for shoal or deep water; 1½ buckets of fine coal a day is required. With steam at 50 lbs. it runs very smoothly at 4½ miles per hour, but with a steel boiler, now planned to carry 100 lbs., a speed of 5½ miles will easily be obtained.

The hull is of the Nautilus pattern, built of hickory, oak, and cedar, copper-fastened throughout, a marvel of strength and lightness. Two water-tight bulkheads float it if swamped or capsized. A rubber pipe with live steam quickly clears any accumulation of water in the hold. The funnel is jointed, to turn down when running under low bridges or while in the boat house. When on an extended cruise all extra fuel, tools, provisions, etc., are carried in the small air-tight tender, which is towed behind, or fastened alongside by a simple contrivance, to serve as an outrigger in rough water; it also carries, in sections, a small truck, on which the boat can be drawn ashore or launched.

The weights are as follows: Hull, 90 lbs.; boiler, 80 lbs.; engine, 25 lbs.; piping, shaft, propeller, pump, steam gauge, etc., 20 lbs.; total, 215 lbs. Forty pounds of fine coal in 5 lb. canvas bags can be stowed each side of the boiler. The steering gear consists of a stirrup on the port side, and spring coil on the starboard; wires run under the deck to the rudder yoke, so that steering is done with the foot, leaving the hands free to manage the furnace and tend the engine, which is regulated by a valve at the right, under the engineer's hand, so that starting, stopping, backing, and steering are all accomplished without moving from the seat.

For quiet river or bay cruising this boat is admirably adapted, and would prove a source of pleasure and study to any one fond of machinery and desirous of being his own captain, crew, and engineer. The cost of this neat little steamer is $250, but much of this can be saved by the designer doing portions of the work himself.

A Novel and Curious Instrument—The Telectroscope.

M. Senlecq, of Ardres, has recently submitted to the examination of MM. du Moncel and Hallez d'Arros a plan of an apparatus intended to reproduce telegraphically at a distance the images obtained in the camera obscura. This apparatus will be based on the property possessed by selenium of offering a variable and very sensitive electrical resistance according to the different gradations of light. The apparatus will consist of an ordinary camera obscura containing at the focus an unpolished glass and any system of autographic telegraphic transmission; the tracing point of the transmitter intended to traverse the surface of the unpolished glass will be formed of a small piece of selenium held by two springs acting as pincers, insulated and connected, one with a pile, the other with the line. The point of selenium will form the circuit. In gliding over the surface, more or less lightened up, of the unpolished glass, this point will communicate, in different degrees and with great sensitiveness, the vibrations of the light. The receiver will also be a tracing point of black lead or pencil for drawing very finely, connected with a very thin plate of soft iron, held almost as in the Bell telephone, and vibrating before an electro-magnet, governed by the irregular current emitted in the line. This pencil, supporting a sheet of paper arranged so as to receive the impression of the image produced in the camera obscura, will translate the vibrations of the metallic plate by a more or less pronounced pressure on that sheet of paper. Should the selenium tracing point run over a light surface the current will increase in intensity, the electro-magnet of the receiver will attract to it with greater force the vibrating plate, and the pencil will exert less pressure on the paper. The line thus formed will be scarcely, if at all, visible; the contrary will be the case if the surface be obscure, for, the resistance of the current increasing, the attraction of the magnet will diminish, and the pencil will leave upon it a darker line.

THE STEAM CANOE NINA THE SMALLEST STEAMBOAT IN THE WORLD.

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(Illustrated articles are marked with an asterisk.)

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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 166,

For the Week ending March 8, 1879.

Price 10 cents. For sale by all newsdealers.

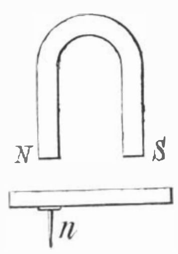
GARY'S MOTOR.

He who credits the statements concerning Gary's motor, contained in an article in the March number of *Harper's Magazine*, can readily believe in the wonders of that division of China where the rivers run up the mountains, the moon outshines the sun, and the cats have the power of elephants. He can, moreover, add to this belief a feeling of utter contempt for scientific men. Faraday, Rumford, Joule, and Helmholtz have lived in vain. Their work can be demolished by the simplest use of tenpenny nails and a few magnets combined with the use of a piece of sheet iron.

It would be difficult to find such utter ignorance of the first principles of science as is contained in this article on Gary's motor; it encourages men to spend time and money in fruitless effort, and at the same time to despise all training. The allegation is made that scientific men are slower than the general public to acknowledge a new step in advance; and the discovery of the neutral line, the principle of Mr. Gary's motor, together with the near possibilities of the grand discovery, are affirmed in an *ex cathedra* manner by one whose own statements show that he has no knowledge of the subject of which he speaks.

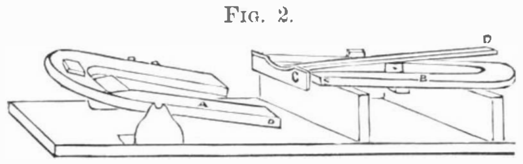
Mr. Gary's discovery of the neutral line is not a discovery. There is no neutral line in the sense that the polarity changes when Mr. Gary moves his piece of sheet iron with its attached shingle nail across the pole or near the pole of a magnet. The most delicate instruments fail to detect such a change of polarity. Mr. Gary is perfectly right in his description of the behavior of the nail: at a certain point it leaves the sheet iron and falls to the ground, simply because, by reason of its approach to the attracting pole, it tends to fly to it; but in leaving the piece of sheet iron, the force of gravitation acts more strongly than the force of attraction of the pole of the magnet, and the nail consequently falls to the ground. It is well known that the force of magnetic attraction decreases very rapidly with the distance. A small nail can fall across the pole of a very strong magnet within a quarter of an inch of the pole, and yet the force of gravitation asserts its stronger claim and the nail will not be diverted to the magnet. It will be noticed that Mr. Gary's models, which are figured in the article in *Harper*, are so arranged as to take advantage of the attracting force of gravitation. Hold a horseshoe magnet in a vertical position, and move a piece of sheet iron with an attached nail to and from the poles of the magnet. It will be found that there is no neutral line where the nail drops off. Vary the experiment by substituting an iron wire for the piece of sheet iron, and with an attached nail explore the space in front and beside the poles, and it will be found that the nail shows no evidence of a neutral line. Slip a small coil of wire along the wire or sheet iron, and connect its terminals with a delicate galvanometer; if there is any change of polarity, the galvanometer needle should be diverted first in one direction, then in another, as you move the sheet iron or the wire away from complete contact with the poles; no such change of deviation will be perceived.

Fig. 1.



In Fig. 2 the magnets are set in motion by vibrating, with the aid of a lever, a piece of sheet iron, so that it may "move

FIG. 2.



on the neutral line," as the writer in *Harper* expresses it. This act as a cut-off, and one of the two opposing horseshoe magnets drops from its former position, where it was held by mutual attraction. Let us see what is the cause of this action. Place a horseshoe magnet on the table, and bring a compass needle directly in front of one of the poles of the horseshoe magnet. The compass needle will be strongly attracted to the neighboring pole. Now bring a thin piece of iron in front of the poles of the horseshoe magnet and between them and the compass needle; the latter will immediately dip, and will have its attraction for the pole of the horseshoe magnet diminished, not because the sheet iron acts as a cut-off for magnetism, but because the poles formed by induction in the thin sheet iron are nearer the end of the compass needle, and accordingly exert their influence. Here we see again the effect of proximity. Magnetic action acts through very short distances, and the nearest magnetic mass exerts more influence than a remoter one, which may nevertheless be the stronger magnetic body. Mr. Gary experiments with a box compass. The indications obtained in this way are apt to be very misleading, and the use of such a method was abandoned by scientific men more than forty years ago. The friends of the new magnetic motor have only to consult the experiments of Jamin, of Dub, and a host of others to discover that what are claimed to be new facts have long been known and discussed under the head of distribution and redistribution of magnetism caused by armatures to magnets and the presence of iron in the neighborhood of magnets. Abundance of time and patience to look up the subject will be needed, for the literature of the subject is immense.

Let us now consider the possibilities of the application of these well known facts; for it may be said, "Explain the neutral line as you may, there is still an important application of the force of magnetism in the invention of Mr. Gary." It is said that this little motor requires a careful adjustment of the fine pivots upon which the movable magnet turns, and particles of dust are sufficient to bring it to rest. The excursions of the so-called cut-off are limited to the one twentieth or one thirtieth of an inch, and a fine adjustment is also needed here. This is the motor which is to produce the electric light and to drive locomotives across the continent. The line of argument of the inventor's friends is very striking, and deserves notice. In the article in *Harper*, which we have taken as our text, the writer says: "To gain a large amount of power the inventor would place groups of compound stationary magnets above and below the beam at each side, and the soft iron induced magnets, in this case four in number, connected by rods passing down between the poles of the stationary magnets. A 'pitman' connecting the beam with a flywheel to change the reciprocating into a rotary motion would be the means of transmitting the power. With magnets of great size an enormous power, he claims, could be obtained in this way."

This is the old, old fallacy; and is always stated in this way: "A small magnetic motor will run and produce a comparatively great result, a large one will necessarily give a corresponding increase of power." This is not true; there is a limit beyond which one cannot pass. One can see this even in magnetizing pieces of steel of various sizes and in the construction of dynamo-electric machines. In regard to the use of Mr. Gary's motor in producing the electric light we have no hesitation in pronouncing upon its utter incompetency for such a purpose. It is in the discussion of the possibilities of the new motor that the writer in *Harper* is most eloquent, and we do not know which to wonder at most, the exuberance of his imagination, his moral courage in the contempt of the authority of science, or the naïveté of his utter ignorance. He says, speaking of the electric light which is produced by this motor: "An enormous volume can be secured with an expenditure of force so diminutive that a caged squirrel might furnish it. With the employment of one of the smallest of the magnetic motors, power may be supplied and electricity generated at no expense beyond the cost of the machine." This statement requires no comment. The writer further says: "Professors from Harvard and from the Massachusetts Institute of Technology called, examined, and were impressed." It is true that only one professor from Harvard called, examined, and was *not* impressed; for the motor had just been taken to pieces and was not in a condition to run; moreover the professor does not believe that it will run except for a short space of time. The only way that it could run would be by weakening it or using up the potential energy of the permanent magnets, and allowing the earth's magnetism to replace it. If such a toy could be made it would have great scientific interest; it would not contain the idea of perpetual motion, for it would be the employment of the magnetism of the earth, just as we employ the force of the winds. We should be delighted if Mr. Gary has done this; and a scientific reputation would be within his grasp. There is no evidence, however, that he has really made such a toy. We have called it a toy; for as a motor it could not do any appreciable amount of work except in a romance of Jules Verne.

SENATE PATENT BILL NO. 300.—SHALL IT PASS THE HOUSE OF REPRESENTATIVES?

The term of the present Congress is rapidly drawing to a close, and little time is left for the friends of industrial progress and the rights of inventors to express their disapprobation of the obnoxious clauses of the new Patent Bill (Senate Bill 300).

We are informed, by parties whose knowledge and integrity cannot be questioned, that the concerted plan of the promoters of the bill is to allow no further discussion of it, but to await a favorable moment for their scheme, and rush it through during the last days of the session in the hurry and excitement preceding adjournment—a period noted for hasty and ill-considered legislation.

We are confident that, were time enough allowed for all the members to become thoroughly informed in regard to the mischievous tendency of several of its provisions, the bill would be overwhelmingly defeated; but there would seem to be no time for that now. It is too late for extended arguments against the impolicy of crippling and discouraging the class of men who (as all parties acknowledge) have been and are one of the great motive forces of national progress: too late for elaborate protests against the threatened invasion of the constitutional rights of inventors, and the disorganization of our industries by the legalizing of infringements.

But it is not too late, we trust, for an effective expression of popular disfavor—by telegraph. Disregarding the slow formalities of memorials and like communications by mail, all who regard the inventor as more worthy of encouragement and protection than the infringer, should promptly avail themselves of the means which invention has provided for such emergencies, and telegraph their disapproval of Senate Bill 300. No member not already known to be opposed to the bill should be left a moment in doubt as to the feeling of his constituents. The changes which the bill would make in the spirit and the ruling of the patent system, should it become a law, are fatal; and no surer means could be devised for preventing its passage than an electric expression of popular will against it.

Hitherto the inventor has enjoyed, so far as the courts could secure it, the exclusive control of his invention which the Constitution guarantees. His patent has been regarded in the courts as presumptive evidence that his claim to the invention covered was a just claim. Under the proposed amendments of the law, all this will be reversed. The patentee's right will be burdened by needless penalties in the shape of heavy fees, and laid open to invasion by any one who chooses to infringe it. And when his case is brought into court the inventor, not the infringer, will be treated as the culprit.

Every inventor feels that the bill is aimed against him; and should it become a law, we fear that there will result a disastrous fulfillment of the prediction of a hard-working and hitherto successful inventor, who says:

"One thing I have decided upon. If the law is changed, so as to lessen my rights as an inventor, I am through, I quit the field, and thousands of others will be compelled to do the same."

The country cannot afford to have such men quit the field. Policy, as well as justice, forbids any measure tending to compel them to quit the field; and the members of the lower house should not be left to enact the proposed wrong unwarned.

Let every citizen, who has the great question of justice and wise policy at heart, use the telegraph freely, and encourage his friends to do likewise. The cost will not be great, while the good that may be done in preventing hasty or underhanded action may be enormous.

In case our suggestion arrives too late, or the telegraphed advice fails to stay the passage of the bill, then by the same means the popular will might be brought to bear directly and successfully upon the President. In either case use the telegraph.

THE SAWYER-MAN ELECTRIC LIGHT.

It will be remembered that in our issue of December 7th, 1878, we gave illustrations of this novel and promising form of electrical apparatus. Since that date the inventors have been busy with endeavors to perfect the invention, and on the evening of February 20 a public exhibition of the light was given in this city by the Dynamo-Electric Light Co. Several improvements in details of construction have been made, but no radical changes. The chief improvement is in the bearing of the upper carbon holder, to allow for expansion; the lamp has also been made slightly taller. The light exhibited was soft, pure, and steady, and susceptible of perfect regulation. Any lamp in the circuit could be turned up or down, from a dull glow to brilliant incandescence without affecting the rest. An important improvement has also been made in the switch.

The dynamo machine used was about half the size of the one previously employed; there were more lights in the circuit, and the illumination was more brilliant and satisfactory. Comparison was made with gas light, and also with the voltaic arc, clearly demonstrating the superiority of light by electric incandescence for ordinary uses. The carbons used in the Sawyer-Man lamp are now proved to be comparatively indestructible. If, however, the lamp should be broken or otherwise injured by accident, it can be as easily and cheaply removed and repaired as an ordinary gas-burner. As regards economy, tests upon a large scale have not yet been feasible. With the power at command the indications are that the production of light by this system will range between one-fifth and one-half the cost of gas.

A NEW FORM OF CARBON.

In describing the Sawyer-Man electric light, last December, mention was made of the peculiar carbons employed, the manner of their production being a secret which Mr. Sawyer did not choose at that time to disclose.

We have now been favored with an exhibition of the process, and a very pretty experiment it makes. The carbons in question are about half an inch long, with the diameter of one-sixteenth of an inch. Their color is steel-gray, and the surface is hard as steel; within the carbon is tolerably soft.

In his earlier experiments Mr. Sawyer employed as the source of incandescence slender pencils of gas retort carbon in an atmosphere of illuminating gas. The carbons were slowly destroyed, but at the same time they took on a superficial deposit, evidently of carbon, but unlike in luster and hardness any carbon that Mr. Sawyer had seen. Inferring that a more rapid deposit would be made in a denser hydrocarbon, Mr. Sawyer experimented with a great variety of such liquids, finding olive oil most satisfactory. His method is simply to heat the carbon to an extremely high temperature, by passing through it an electric current, while it is immersed in the oil. The best results are obtained by the use of a pencil of willow charcoal, upon which an intensely hard deposit of carbon rapidly forms as the hydrocarbon is decomposed by the heated pencil.

Life Saving Mattresses.

The Navy Department has been experimenting with a mattress designed for use on vessels at sea, with results said to be favorable. The mattress is filled with cotton, but the process of preparation to which the cotton has been subjected makes it impervious to water for many hours, and renders it capable of sustaining a heavy weight—that of a man without any difficulty. It possesses other properties which, it is claimed, make it a most comfortable bed; the cotton being free from all oils and impurities, not liable to knot or pack, and proof against vermin of every kind.

THE GARY MAGNETIC-MOTOR DECEPTION.

In the latter part of November last the New York *Times* printed a column letter from Boston describing, as a fact accomplished, a magnetic motor which was to supersede steam; a contrivance which produced motion "by no external agency, simply from the magnetic power of the machine." It was a great discovery, sure to revolutionize the world. There was a lot of talk about polarity, magnetism, "the neutral line," and the usual story of humble genius upsetting all the established laws of science. The inventor had not been a student; knew nothing of philosophy from the books; "had I studied or read books," he said, "I should never have experimented, as the books told that what I was after was an impossibility, that there was no such thing;" but he kept on—and got it!

The world is too full of perpetual motion mongers to justify the SCIENTIFIC AMERICAN in noticing them until they become obtrusive. Toward the middle of December, the *Times* gave another lift to the deception. This time the Gary Magnetic-Motor was about to startle the world by producing the electric light out of—nothing. In the words of the writer: "By the simplest of devices, which he exhibited to me to-day, Mr. Gary utilizes his own newly discovered principle in such a way as to generate electricity for the light at absolutely no expense beyond the cost of the machine, which itself is automatic." After listening to a pretended description of the working of the machine, the *Times* writer remarked to Mr. Gary: "Your new invention, then, is simply a practical application of the principle, which you have discovered, of the existence of the neutral line, at the point of the magnetic field where the polarity changes, and which is antagonistic to the heretofore universally accepted theory that magnetism is a static force?"

"Precisely," was the reply. "It is only on this principle that the thing is possible."

In its March issue, *Harper's Monthly Magazine* comes to the aid of the *Times*, by printing without comment, as a regular article, a long and cleverly written account of "Gary's Magnetic Motor," with several illustrations, which will be found on another page in this issue of the SCIENTIFIC AMERICAN.

We may be mistaken, but the internal evidence is extremely strong that the same hand that wrote the first (possibly also the second) *Times'* article, also wrote the account in *Harper's*. It was shrewdly done; and the manifest attempt to insinuate more than his words really implied, in regard to the quasi-indorsement of the machine by scientific men, raises the suspicion that the writer may not have been so thoroughly deluded as he seems. Be that as it may, THE SCIENTIFIC AMERICAN is in position to say that the assertions in regard to the exhibition of the Gary motor in motion by self-generated force are not true; that the assertion that "professors from Harvard and from the Massachusetts Institute of Technology called, examined, and were impressed" is not true; that apparatus constructed according to the drawings in *Harper's* will not do what the writer says they will do; in short, that the pretended motor is a deception, to be classed with the Keeley motor and like contrivances.

It is very much to be regretted that the editors of periodicals so worthy of esteem as the New York *Times* and *Harper's Magazine* should give place to such assertions, unsupported by the most positive, competent, and conclusive evidence.

The world is full of snares for capitalists, always prompt to snatch at delusive promises of sudden profit; and the fact that the pretensions of the Gary motor have been accepted without a question by a magazine like *Harper's* may be the means of inducing many to put money into projects that are sure to result in disappointment and loss.

THE PRESERVATION OF FORESTS.

In an article with the above title in the *North American Review*, Felix L. Oswald, after reviewing the disastrous effects which have followed the wholesale destruction of forests in various countries of the world, remarks that since the year 1835 the forest area of the western hemisphere has decreased at the average yearly rate of 7,600,000 acres, or about 11,400 square miles; in the United States alone this rate has advanced from 1,600 square miles in 1835 to 7,000 in 1855, and 8,400 in 1876. Between 1750 and 1835 the total aggregate of forests felled in South and Central America (especially in Southeastern Mexico), and in the Eastern, Southeastern, and Southwestern States of our republic, may be estimated at from 45,000,000 to 50,000,000 acres. In other words, we have been wasting the moisture supply of the American soil at the average ratio of seven per cent for each quarter of a century during the last one hundred and twenty-five years, and are now fast approaching the limit beyond which any further decrease will affect the climatic phenomena of the entire continent.

If we consider how the agricultural products of the eastern continents become from year to year more inadequate to the wants of their still growing population, we may foresee the time when the hope of the world will depend on the productiveness of the American soil; but that productiveness depends on the fertilizing influence of the American forests. If they are gone we shall have on earth no newer world to hope for—no future Columbus can alleviate the struggle for existence. To stay such a catastrophe the author suggests that in every township, where the disappearance of arboreal vegetation begins to affect the perennial springs and water courses or the fertility of the fields, a space of say 50 acres should be appropriated for a "township grove," an oasis to be consecrated for ever to shade trees, birds' nests, picnics, and playing children. In all new settlements, where a remnant of the primeval forests has survived, let the woods on the upper ridges or on the summit of isolated hills be spared by mutual agreement of the proprietors. In the treeless regions of the great West not only amateur societies, but every grange and farmers' union of every county, should devote themselves to the work of tree culture; and every landed proprietor should see to it that the boundaries of his estates be set with shade trees, and that wooden fences be supplanted by quickset hedges. Let fruit trees be planted wherever there is a piece of ground neither otherwise occupied nor absolutely barren; and be sure that their influence on the atmosphere in summer and their fertilizing leaves in fall will more than indemnify the adjoining fields for the modicum of sunlight they may intercept. Any State where these precautions should be generally adopted, would soon be so unmistakably distinguished by the unfailing humidity and freshness of its fields and the abundance of its crops, that the sheer necessity of competition would induce backward neighbors to try the same experiment; and before long the maxim would not only be generally recognized, but generally acted upon, that husbandry and tree culture are inseparable.

THE TROUBLE WITH WIRE BINDERS.

So far as their utility at harvest time is concerned the self-binding machines cover one of the greatest improvements of the time. Their immediate money advantage is estimated as high as 20 cents on each bushel of wheat grown. The presence of bits of wire in the wheat when it reaches the mill is, however, a serious offset to the gain by automatic binding. The wire injures the stones, is liable to strike fire and explode the mill, cuts the bolting cloths, and is otherwise so mischievous that many millers have protested against wire bindings, and threaten to retaliate with special charges for grinding wire bound wheat.

It has been the practice of farmers to run wire and all through the thrashing machines. So long as the wire is bright and tough no harm is done; but if the wire is rusted and brittle, fragments remain with the grain, and serious trouble may result.

The conditions seem to call for a new invention, an attachment to the thrashing machine which shall cut the wire binding and remove it while the straw passes on to the thrasher. The work of removing the wire would seem to be nowhere near so difficult as the original task of putting it on the sheaf. If rusted wire cannot be entirely removed before thrashing, it would seem to be quite feasible to separate the bits of iron that remain in the wheat by a train of magnets in the cleaner. In either case we are sure that our inventors can overcome the difficulty by some cheaper means than the abandonment of automatic binders.

THE WASTE OF FIRE.

During the past year, without the occurrence of any remarkable fires, it has cost the United States about $200,000 a day to furnish employment to our town and city fire departments. What the fire departments cost we do not know; it is a good round sum at the least calculation. Architects say that 10 or 15 per cent of the cost of any building, properly expended, will make it practically fireproof. Our daily fire losses would therefore fireproof from $1,000,000 to $2,000,000 worth of new structures a day, or upwards of $300,000,000 worth a year. At this rate it would not take many years to reduce the daily fire losses to comparative insignificance.

It might not be a bad thing to forbid in towns and cities the erection of houses upon which less than 5 per cent of the total cost should be devoted to approved plans for preventing the spread of fire. In view also of the increased indifference to fire risks incident to fire insurance, it might be good policy to require that, for every dollar spent for insurance, a proportional sum should be expended upon means for preventing fires, or upon appliances for securing the prompt extinction of such as might be started. If preventive measures were thus made imperative for a decade or so, the country would soon be able to save a considerable portion of the $100,000,000 a year now directly or indirectly sacrificed to the "fire fiend"—an item certainly worth taking account of.

Neptune Favors Eads.

The opponents of Capt. Eads' jetty system at the mouth of the Mississippi used to threaten all sorts of disaster to that work by storms. There are indications now that storms may in reality act as an efficient co-operator and ally to Eads. During the severe storms of January a ridge of sand was raised some feet above high water mark, and half a mile long, across the jetties at an angle of 45°, about 100 yards back of the wing dams. Though broken in two by the jetties the ridge continues throughout of the same height and thickness. Captain Brown, who has charge of the works at Eadsport, says if the ridge remains as at present the triangles formed by it on either side of the jetties—the one being acute and the other obtuse—will eventually fill up with sand, and thus the jetties be greatly strengthened.

A correspondent, writing from Guilford, Conn., protests against the classification of the oriole among mischievous birds. He says that he has frequently seen them tear open the nests of apple worms and devour them, and thinks that birds with pluck enough to destroy such disagreeable pests ought to be fostered rather than destroyed.

Bleaching Vegetable Fibers.

The processes usually employed for bleaching fibers that are to be spun, especially linen and flax, consist essentially in boiling the fibers strongly for several days with alkaline lyes, which dissolve the gelatinous vegetable matter and other impurities that surround the fiber, and thus expose it, so that it is susceptible to bleaching with chlorine, which is to follow. The chlorine bleaching itself consists in putting the substance to be bleached alternately in chlorine baths and in hydrochloric acid or sulphuric acid, also in soda baths. The bath in which it is put at first is the strongest, and those that follow are successively weaker and weaker. The object of the acid bath is to release the chlorine that remains in the fiber and neutralize the lime with which the hydrochloric acid is combined, while the alkali baths neutralize the acid in the fabric or yarn, and prevent its destructive effects. During this treatment the goods are purified several times with a great deal of water, and to obtain a purer kind of white are put upon the lawn so that the actions of the chemicals shall be aided by the sunlight.

The disadvantages which this old process carried with it are somewhat as follows: The repeated operations with large quantities of water and of chemicals, partially with the aid of heat, require a considerable outlay of capital for works and utensils, a large outlay for the coal and chemicals used, as well as for labor, besides the time consumed. Besides this, the production of a perfectly pure white requires the aid of grass bleaching, limiting it to certain seasons, and necessitating a certain area of grassground, which increases the capital required. Finally, the chlorine baths, by the present process, are in winter frequently inactive, or of very feeble action. These are said to be overcome by a new method of bleaching invented by Beyrich, in Arnsdorf. The principles upon which this new process is based are briefly as follows:

Hypochlorite of lime develops much greater bleaching power when it acts in combination with oxalic acid or oxalate of potash than alone, or with any other acid.

Oxalic acid and its potassium salt do not attack the fibers as powerfully as the strong acids previously employed for bleaching.

The vegetable slime and woody cellulose which had to be removed by previous bucking, do not hinder the bleaching action of chlorine when oxalic acid or its salts are present. Beyrich is of the opinion that the great superiority of the process depends upon the circumstance that a part of the oxalic acid unites with the lime of the bleaching powder dissolved in the water, as is shown by the clear solution turning milky, and thus liberates the hypochlorous acid, which, in a free state, rapidly separates into its separate constituents, chlorine and oxygen, which act very energetically in this nascent state, hence the outer woody fiber does not check their action. Probably another part of the oxalic acid releases the fiber from the slimy portions owing to its own solvent properties.

The method of applying this new process depends somewhat upon the goods or fiber, but is in general as follows: They are placed at once, without previous boiling or bucking, in a chloride of lime bath containing oxalic acid for five or six hours, the time depending upon the fiber and on other circumstances. The temperature of the bath varies between 20° C. (68° Fah.) to 25° C. (77° Fah.). It is well washed and put into a weak sulphuric acid bath, or this may be omitted. It is better not to add all the oxalic acid at one time, but after putting in the larger part of it the fibers are put in very quickly, as the chlorine and oxygen are more active at that time. A while after the remaining acid is put in, and fresh chlorine and oxygen are produced and used. The weak acid bath that follows has as its object not merely the liberation of the hypochlorous acid that remains in the goods, so as to make it more active, but also to convert the lime salts (carbonate and hypochlorate) that are still in the goods into sulphate, which has a whiter color and does not diminish the luster of the fiber. The operation ends with washing well, passing through a soda bath to neutralize any acid that remains in it, and then wringing out well. These operations are repeated in this order a greater or less number of times, according to the quality of the goods, the baths being weaker each time, until the goods are a beautiful white.

It is advantageous, even in this process, to put the goods upon the grass a few days after the second course of baths, as it not merely imparts a purer white color, but makes them more durable, owing to the escape of the chemicals into the free open air. This airing must, however, follow the alkali baths, for otherwise it would produce a contrary effect to the one desired.

All vegetable matter, linen and hemp yarn and cloth, can be treated in the manner briefly described above; but those which are greasy, like raw cotton, and are not wet by water when immersed into it, must, of course, first be boiled in soda to remove this fat or grease, whatever it may be, and then when put into the bath of oxalic acid and bleaching powder, bleach much more rapidly, so that in the case of cotton, as well as of linen, hemp, etc., the oxalic acid proves an invaluable addition.—*Poly. Notizblatt.*

The Dode Method of Protecting Iron.

Mr. J. B. A. Dodé, of Paris, has patented a method of protecting iron from rust by a process of "platinizing." He coats the surface to be protected with a thin film of borate of lead, having a little oxide of copper dissolved in it, and suspended in it also bright scales of precipitated platinum. A red heat is employed to fuse the composition, which is either applied with a brush or employed as a bath, in which small articles may be dipped. Its effect is to cover the iron with a thin glassy coating of a bright gray tint, not far removed from that of polished iron itself, and unaffected by sewer gases, dilute acids and alkalies, and the heat of a kitchen fire. Modifications of the composition give the means of imparting different colors to the coating, and these are as easy of application as the platinum gray. The cost of platinizing is said to be about equal to that of applying three coats of paint, and about one tenth of that of electro-plating with nickel, Paris prices. A detailed account of the treatment of eight stoves is as follows:

	Fr.
1 liter preparation (retail)	3·75
1st furnace operation	3·20
Reagents for platinizing	4·00
2d furnace operation	3·20
Manipulation, wear and tear, etc.	1·85
	16·00

This is less than 40 cents a stove. By treating the castings before they cool a still greater saving is said to be possible.

The "Evaporation" of Fruits and Vegetables.

The preservation of apples, potatoes, and the like by evaporating their juices rapidly, is becoming an important industry in Ohio and Michigan. A correspondent of a Detroit paper describes the operation of a factory in Lenawee county, having a capacity of 400 bushels a day. The apples are pared, cored, and sliced at once by hand machinery. The slices are then spread on galvanized screens and placed in the evaporator, a chamber running from the top of a large furnace in the basement upward, out through the roof of a three story building. The current of heated air is kept as near as possible to 240°. The screens of fruit rest on endless chains that move upward at intervals of three to five minutes, when a fresh screen is put in below and one is taken off at the third story completed. The dried or evaporated produce is then packed in pasteboard boxes holding from one to five pounds, and these in turn are packed in cases of 200 pounds each.

A bushel of apples makes about five pounds of the dried fruit; and the process of evaporation is so rapid that the fruit loses none of its freshness and flavor. In some of the factories the cores and peelings are converted into vinegar; in others into apple jelly, out of which every variety of fruit jelly is made by the addition of flavoring extracts.

Sweet corn, potatoes, and other vegetables have been successfully preserved by this process. The chief market for these products is the mining region of the West. Doubtless a large export trade will ultimately result from it.

Effect of Arsenic on the Body.

The London *Lancet* states that C. Gies, in a recently published paper, has given the results of a series of experiments undertaken by him on the effects following the administration of arsenic for a period of four months on pigs, rabbits, and fowls. The quantity given was extremely minute, the rabbits having only 0·0005 to 0·0007 of a gramme; the pigs, 0·005 to 0·05; and the fowls, 0·001 to 0·008 per diem. In all these animals the weight of the body increased, and the subcutaneous fat was augmented. In young growing animals the bones developed considerably both in length and girth, and they presented the peculiarity that wherever in the normal state spongy tissue exists, it was replaced by compact bone. The bones of the carpus and tarsus were in this way converted into solid bony masses. Moreover, a compact layer of bone was found immediately beneath the epiphysial cartilages of the long bone, just as Weigner found to be the case in animals supplied with small doses of phosphorus in their food. This was most distinct beneath the upper epiphysial cartilage of the humerus and the lower one of the femur, and was apparent after the arsenic had been given nineteen days, and where only 0·02 to 0·035 of a gramme had been taken. It was observed that other animals, fed in the same stable, presented the same appearance in their bones, and this Gies ascribes to the air being loaded with the arsenic eliminated by the lungs and skin of the animals to which it was administered, since he found that the changes were also observed in animals kept in a cage, the bottom of which was strewn with arsenic. Besides the changes in the bones, the heart, liver, kidneys, and even the spleen, underwent fatty degeneration. The young of animals fed with the arsenic were invariably born dead, though they attained a large size, and presented remarkable hypertrophy of the spleen and incipient changes in the bones.

Undue Haste in Education.

Barnes' Educational Monthly has an article from the pen of George Harper, in its last number, on the baneful influence of haste in the matter of education, from which we make extracts:

Partly owing to the stimulating nature of the climate, and partly also to the partially developed condition of the western country, which thus supplies to all comers unlimited scope for activity and enterprise, to the visitor from an older country, where things have long got into ruts, and where the wheels of progress, if they revolve at all, move along more slowly and systematically, it always appears as if, in whatever occupation they may be engaged, Americans are generally in a great haste and hurry about it! Thus the cry of "hurry up," in many keys, and in every accent known to the Aryan tongues, is heard in all directions, wafted on the wings of every wind to the newly-arrived immigrant's ears. Indeed, it is usually the first sound that greets his ears on landing on our shores, and the first words of our language that he learns.

Naturally enough, says the writer, this general propensity to hurry and restlessness is not without its influence also upon the character of the common schools; and here, it must be confessed, it really does very considerable harm, by introducing the unnatural brain-forcing, mind-weakening process into education, of which we are now beginning to reap the bitter fruits, as well as to hear not unfrequent complaints. In everything our people seem to be too impatient of results; they want, and must have, immediate returns for their outlay, whether in affairs of business or in education. They cannot afford to wait patiently for the slow progress of mental growth which is the law of the development of the youthful intellect, and consequently teachers must adapt themselves to the popular whimsies, and follow the unnatural cramming system which weakens instead of invigorating the mental powers. It should not be forgotten that, in one sense at least, teachers are just like other trades; they simply supply, or make to order, what is wanted in the educational line. Like other dealers, they must strive to please their exacting customers by furnishing the precise article which they find best suits the market; otherwise, like the unfortunate Moor of Venice, they would very soon find their "occupation gone." And thus it happens that under this false system, the pupil is pitchforked from one "branch" to another, crammed with one text-book after another, and boosted from one grade to another with a rapidity and "business dispatch" which rivals machine-made hard biscuits; with this very important difference, however, that usually when the baking process is completed, the bread is found to be well done; while the minds of the children are (according to natural temperament and mental constitution) often either overdone or underdone, seldom indeed are they done to a turn, which could hardly indeed ever happen under a process so opposed to nature's wise yet unyielding laws—which can never be insulted with impunity. To have got through so many score of wearisome pages in so many different text-books seems to be the one object of attainment. But, although there is only the difference of one small letter between through and thorough, there is a wonderful difference in the educational significance of the two words! To fond, unthinking, ignorant parents, this result may seem highly satisfactory; but to the reflecting mind this brain-forcing process exhibits a melancholy instance of great want of conformity to nature's wise and salutary rules, which it is ever our highest wisdom to discover, and when known, our bounden duty implicitly to obey.

The writer facetiously adds that, in the triumphant progress of mechanical discovery, some ingenious person may come out some fine morning with an invention which will do away altogether with teachers of both sexes. "May we not," says he, "reasonably imagine that, in the pages of some future school journal, there might be found an announcement of the result of such discovery, graphically described as 'a self-acting, self-adjusting, metallic, patent teacher; a wonderful machine, which is warranted to secure at once the most perfect discipline and the highest order of scholarship in all branches; cheap, safe, and expeditious; and adapted to all classes of schools, colleges, and seminaries of learning?' "

Could not a patent metallic teacher, somewhat after the pattern of Frankenstein, be ingeniously put together by somebody, and made to work by the combined action of clock work, steam, and electricity? The complicated mechanism and clock work, combined with steam power, to do the teaching (which would be conducted mainly on the object teaching, or oral method); and the electricity, which is always on hand and ready for business on a moment's notice —the briskest and liveliest spirit of this nether world—just the thing for a teacher of the modern advanced school, would of course be equal to the task of preserving the most perfect order and discipline in the largest school or college, by a simple apparatus of wires attached to the roof, whence, on the least occasion for interference, an invisible hand might instantaneously descend, and slap their cheeks, rap them over the knuckles or elbow, pinch their ears, etc., etc. —the punishment being always exactly suited to the offense, and no favor shown.

To realize all those fond dreams, however, may yet take a long time; possibly may be delayed till the dawn of the millennium, if not a little while longer; but as for mechanical, soulless, routine teaching, where the individuality of the teacher is entirely lost and absorbed in the modern cast-iron system of education, Heaven knows we have enough and to spare of that commodity already, and thus can the better afford to wait patiently for the full fruition of the system—in the advent of the patent metallic, automaton teacher.

Incendiary Rats.

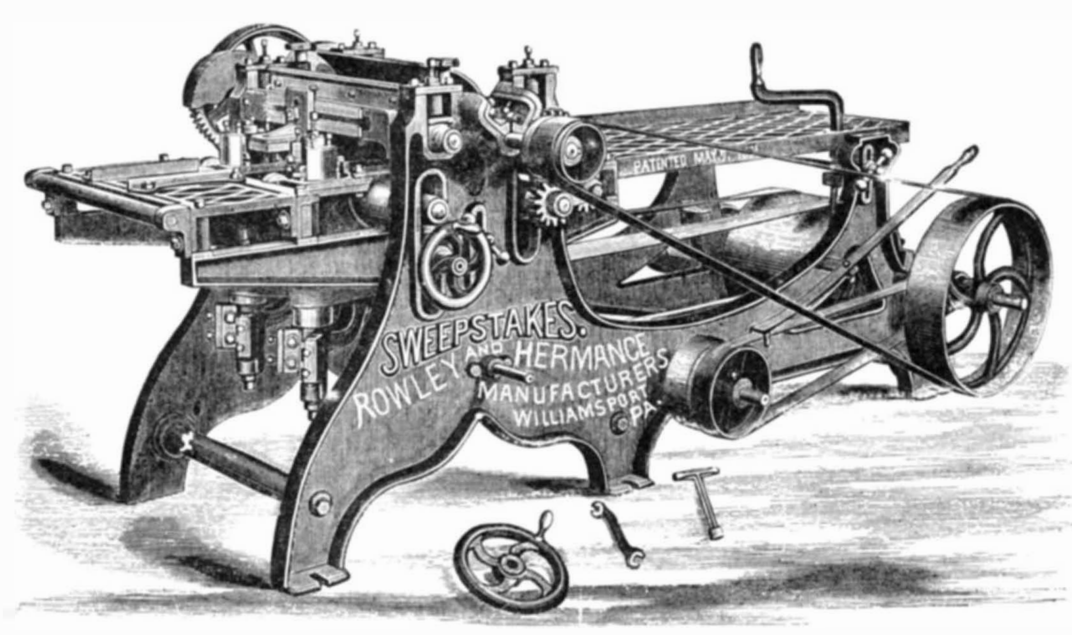
A correspondent calls attention to a fire risk attending open spaces about chimneys and other sources of heat. So long as such spaces are empty they are a protection; but they make admirable nesting places for rats, in case they are accessible to these vermin; and when filled with waste paper and other rubbish dragged in by the rats, the case is materially altered. In a recent fire in a mill, happily extinguished before any serious damage was done, the fire began in the space between the boiler chimney and the sill upon which the flooring was laid, in which the rats had collected a large quantity of broom straw and other inflammable material. Had the fire burst out in the night the single watchman would have had more than he could manage to put it out.

THE SWEEPSTAKES PLANER AND MATCHER.

Good judges of mechanical design will appreciate the well-balanced, light, yet strong construction of the efficient planer and matcher illustrated in the accompanying engraving. With a weight of from 2,100 to 2,500 lbs., according to capacity, it contains all that is essential to a first class machine. It offers also several novel features of great merit, among them its solid forged steel head and steel matcher spindles, running in the Ellis patent journal boxes shown in the lower right hand corner of the engraving. By means of this improvement the journal can be kept central and tight until the box is worn out, thus preventing any tremble and jar of the shaft, a very important gain where smooth work is required. The machine can be quickly and easily changed to a surfacer, simply by loosening two nuts and removing the matcher head, when the spindles will swing below the surface of the table. When required again the spindles can be swung into position without measuring or other delay. A shaft, crossing the machine behind the matcher heads, carries a head with cutters, to be used in making California rustic siding, beaded ceiling, small mouldings, and the like.

The machine has four 4½ inch feed rolls, connected with expansion gear, securing a powerful feed of 45 feet a minute. It has two pressure bars, one in front and one back of the head; and the rolls are held down by forged steel coil springs. The long table makes room for the long gauge indispensable in a good flooring machine. The countershaft is heavy, and is fitted with tight and loose pulleys 10 inches in diameter and 6 inches face. It should run 900 revolutions a minute.

Further information, if desired, may be had of Messrs. Rowley & Hermance, Williamsport, Pa., who also manufacture a large variety of other wood-working machinery.



THE SWEEPSTAKES PLANER AND MATCHER.

An Educated Seal.

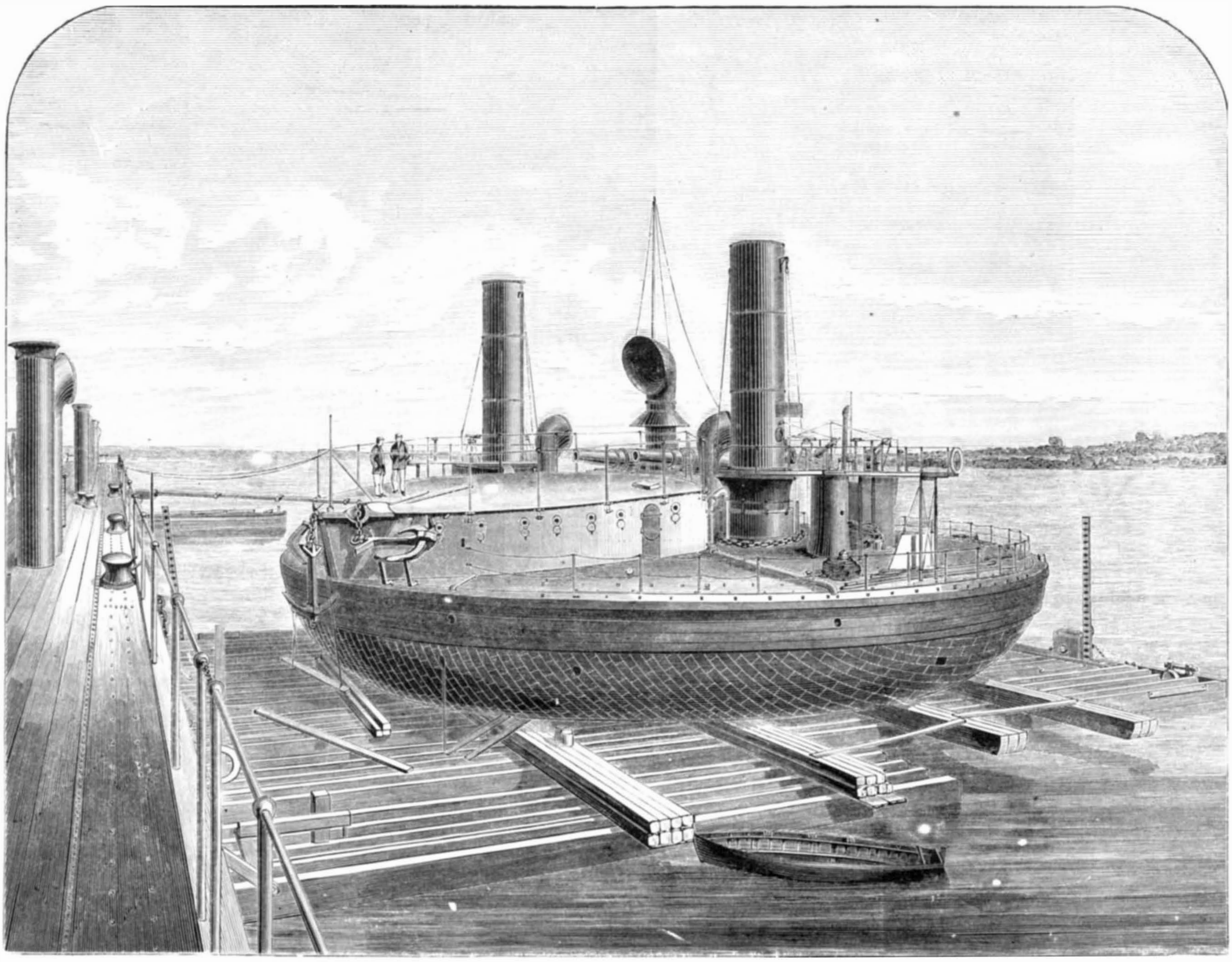
The naturalist of the Westminster Aquarium has been experimenting on a young seal, training it to perform many curious tricks. A London exchange says the seal now goes through a performance which includes plucking the strings of a guitar, beating a tambourine, climbing a flight of steps, taking a "header," smoking, or pretending to smoke, a pipe, firing a revolver, and drawing a boat to which it is harnessed.

The performance to meet public taste is made more sensational than anything M. Leconte did, who had some trained seals at the Zoological Gardens; but the way in which the seal enters eagerly into the fun, with a keen eye on the fish given to it now and then in its performance, is a good illustration of how these animals can be educated.

NICOLAIEFF DEPOSITING FLOATING DOCK.

The accompanying perspective view, which we take from *Engineering*, represents the Nicolaieff floating dock, a structure which, from the novelty and boldness of its design, possesses more than ordinary interest. The engraving shows the dock carrying one of the Russian circular ironclads, the Novgorod. This ironclad is 101 feet in diameter, and weighs 2,450 tons. The dock has also been successfully used for raising the other ironclad, the Vice-Admiral Popoff, which is 121 feet in diameter, and weighs 3,850 tons.

This dock consists of a series of pontoons, each 72 feet long, 18 feet deep, and 15 feet broad, placed 5 feet apart, and connected with a pontoon, 280 feet long, 44 feet 6 inches high, and 12 feet broad. The structure resembles a comb, the larger pontoon forming the back; the smaller ones the teeth. An outrigger connected with the larger pontoon opposes and counteracts the oscillations of the smaller ones. The smaller pontoons are submerged by allowing the water to enter, the vessel is floated over them, when the water is pumped out by machinery carried by the longer pontoon. The keel takes its bearing on the blocks, and the bilge blocks are hauled into place by chains in the usual manner. This dock appears to have met very successfully the difficulty of dealing with exceptionally broad vessels. It can deal with vessels of 150 feet beam, and the system upon which it is constructed is such that it can be very readily extended to take any greater widths or lengths required. It is capable of depositing the vessels lifted by it on fixed stages erected along the shore. In these days when there are decided indications of growth in the beam of our ironclads, this system of dock promises to be of much value, as when a dock of this kind is available, the restrictions in width which ordinary graving docks impose are at once removed. The facility with which this system of dock can be extended, and the manner in which the sections of which it is composed admit of variation of arrangement to suit different conditions, are also many points in its favor, and altogether the dock at Nicolaieff deserves to be the forerunner of many others.



THE NICOLAIEFF FLOATING DOCK.

Railway Notes.

A LOCOMOTIVE electric light has been constructed in England for railway use. It consists of a light six horse power four-wheel locomotive, with a dynamo-electric machine attached. Any electric light can be used. When the engine is moving along the line, the electric machine rotates at its proper speed, and when it is necessary to stop in order that the light may be directed on some particular spot, the driving wheels are thrown out of gear by means of the disengaging handle attached to the pinion on the crank shaft, and the machine ceases to be locomotive, while the engine continues to move the dynamo machine at its proper velocity. The engine is furnished with sensitive governors, so that the speed of the dynamo machine may be accurately regulated, which is very important in order to insure a bright and continuous light. If required, this engine is sufficiently powerful to drive two electric machines. The arrangement is compact, and the engine may be used during the day for pumping, sawing, drilling, or any other purpose for which this type of engine is usually employed.

THE engineers of Europe are watching with considerable interest the behavior of the American locomotive exhibited at Paris by the Reading Railway Company, and since then a working exhibition on the Northern Railway of France. The *Continental Gazette* states that recently Messrs. Delbec and Bandasalli, of the Northern Railway, accompanied by a party of gentlemen, among whom were Messrs. C. Geshardt and A. Mensier, of the Eastern Railway; Henry Mathieu, of the Midi Railway; David Woeflin, of the Orleans Railway; B. Meissonnier, Inspector-General of Mines; and a number of other eminent engineers, made a journey with it to Persan-Beaumont, passing over the heaviest grades and shortest curvatures of the line, and were enthusiastic in their praise of the powerful effort of the engine, and the very great smoothness and steadiness with which it passed around the shortest curves. Mr. Wootten, the General Manager of the Reading Railway Company, who was also of the party, has since taken the locomotive to Switzerland and Italy, for the purpose of demonstrating the desirability of anthracite coal for fuel for locomotives in those countries.

THE *Railroad Gazette* discusses the possible displacement of wooden cars by cars of iron. The question of economy, based on relative cost and endurance as determined by actual experience, is figured out as follows, assuming the mileage of freight cars to be 15,000 miles a year, which is about the average on most American roads. From data in hand the cost of maintaining a wooden car at 0·5709 cent per mile is found to be $85.63 per year. If it costs 0·0922 cent less to maintain an iron car, the cost per year would be only $71.80, or $13.83 less than the cost of maintaining a wooden car. The latter sum is 7 per cent interest on $197.57. Let us assume now that a wooden car costs $450, and an iron one $197.57 more, or $647.57, and let us then calculate the cost of service on this basis, and if we leave out of the account the interest on the money expended, at the end of 10 years the wooden car would have cost $1,306.30, and the iron car $1,365.57. Supposing, though, that the life of the wooden car is 10 years, and that of the iron car 15, then the whole cost of the service per year of the former would be $130.63, whereas that of the latter would be $114.97. It should be said that these figures are not given as representing anything except the possibility that the economy they indicate may be realized by the use of iron cars.

GERMANY has 20 locomotive shops, with an aggregate capacity of 1,922 a year. The largest of these, Borsig's, at Berlin, had turned out 3,750 locomotives at the close of 1878; the second in capacity had made in all 2,600; the third and fourth, 1,700 each; the fifth, 1,250; and four others from 90 to 980 each. Speaking of the first named, a German contemporary says: "One of the proudest monuments of the iron trade of Germany, the Borsig locomotive and machinery works, are, it is reported, about to be closed for an indefinite period. For some time past they have had to be kept going out of savings, and this the trustee of the Borsig estate declines to continue to do any longer. The works have been conducted at a loss for so many years in succession that they threaten to swallow up the entire estate. The late Borsig kept the works open for the purpose of finding bread for his numerous workmen, the thought of whose dispersion and distress was painful to him." There are 5 locomotive works in Austria-Hungary, and 3 in Switzerland, though one of the latter has turned out no locomotives since 1867. One of the Austrian works belongs to a railroad company; it has built 1,560 engines, and can turn out from 80 to 100 yearly.

THE received opinion, as to the relation between the hardness of steel rails and their wearing capacity, has been that, barring the tendency of a hard steel to be brittle, the harder the rail the better it would wear. Dr. Dudley, Chemist of the Pennsylvania Railroad, finds the experience of that road to be different, and is rather of the opinion that under the conditions of wear to which a steel rail is subjected, namely, rolling friction, unlubricated surfaces, and great weight with small bearing surface, the quality of the metal necessary to most successfully withstand the disintegrating forces is best expressed by the word toughness, and not by hardness. He says: "Some two years ago the Pennsylvania Railroad Company, in view of the unsatisfactory wear it was obtaining from its steel rails, asked to have more carbon put into its rails, with a view of making them harder, to resist wear. Before the increase the limits of carbon for rails to be used on Pennsylvania Railroad was from 0·30 to 0·50 per cent. After the increase the limits were from 0·40 to 0·50 per cent, thus securing on the average, perhaps, about a tenth of a per cent more carbon in the steel. Now Mr. W. H. Brown, Chief Engineer Maintenance of Way, Pennsylvania Railroad, informs me that these rails of higher carbon are giving poorer wear than before the lower limit of carbon was raised. This opinion of Mr. Brown is based on his observation of the wear of these higher carbon rails, and on the number of renewals of these rails rendered necessary by the condition of the track." This experience appears to be in harmony with that of the General Manager of the Barrow Hæmatite Steel Works, England, Mr. J. T. Smith, who, as early as 1875, expressed the conviction that, contrary to what might have been anticipated, greater hardness has not conduced to the longevity of the rails, and the softer ones show the minimum of wear.

IN their report for 1878, the Executive Committee of the Western Railroad Associations deprecate any movement to repeal or to seriously impair the integrity of the patent system, and say:

We believe that the gradual and continuous reduction in the rates of fare and freight which has taken place would have been impossible without the economy of the labor-saving and operative devices which invention has furnished. It is evident that while "railroading" is being gradually more and more reduced to an exact though unwritten science, and while its masters are members of a profession that is growing in wisdom and importance, still, that further reduction in fares and freights, which the logic of events will make necessary in the future, is dependent largely upon further improvements which the inventive genius shall furnish. It is seriously doubted by some whether invention has not been stimulated too much in some of the arts—as that of agricultural implements. It is, however, difficult to see how the inventor can in any way do too much in the matter of reducing the cost or increasing the facilities of transportation. If, then, it is in any sense good policy for the government, by arbitrary means and the offering of special inducements, to stimulate invention, so much more is it wisdom for transportation companies to use every proper means toward the same result.

Again, the right of the inventor to his invention, though a statutory right, is also a property right, and entitled to respect as such. The spirit which would knowingly deprive an honest, original inventor, or his assignee, of his right, or of the reward due for its use by another, simply because it is a patent right, is the same as the spirit which plunders a railroad corporation simply because it is a railroad corporation.

Labor in New York City.

The *Herald* is responsible for the following table giving the number of unemployed mechanics and laborers in the city in 1873, the first year of "hard times," and the corresponding figures for the present time; also the average wages received by each class of workmen then and now.

The *Herald* remarks that, when it is remembered that the present number of idle men is not far in excess of the average in ordinary prosperous years, it will be understood how encouraging is the prospect for the coming spring season.

	1873		1879	
	Average wages per day.	No. unemployed.	Average wages per day.	No. unemployed.
Laborers (all kinds)...	$2.00	10,000	$1.10	3,000
Carpenters...	2.50	2,000	1.75	1.000
Masons & stone-cutters	3.50	1,500	3.00	1,000
Bricklayers...	3.50	2,000	2.25	800
Plasterers...	3.50	1,500	2.00	600
Painters...	3.50	1,000	2.00	800
Roofers...	3.00	300	2.00	100
Moulders...	2.50	250	2.25	150
Sawyers...	2 50	50	1.90	25
Harness makers...	3.00	50	2.50	40
Blacksmiths...	3.00	300	2.00	100
Longshoremen (ship work)...	4.50	1,000	2.50	100
Cabinetmakers...	2.55	500	1.75	200
Boxmakers...	2.75	200	1.80	150
Printers...	3.50	800	2.00	600
Wagonmakers...	3.00	200	2.50	100
Brass finishers...	3.50	200	2.50	50
Engineers...	3.00	500	2.00	400
Ironworkers...	2.50	1,500	2.00	1,000
Tailors (custom)...	4.50	200	2.50	50
Jewelers...	3.25	50	2.25	30
Shoemakers...	3.50	500	2.00	200
Capmakers...	2.50	200	1.70	50
Cigarmakers...	3.00	500	1.75	300
Weavers...	3.00	100	2.00	50
Total...		25,400		11,395

The Welding of Metals at Low Temperatures.

Some time ago, in order to estimate the amount of hydrocyanic acid in a solution, Mr. Charles A. Fawsett, of Glasgow, Scotland, precipitated it with silver nitrate. After having filtered and washed the precipitate, he reduced it to the metallic state by heating to the required temperature. Just as he was about to allow it to cool he noticed a small piece of dirt among the reduced silver. In order to separate them he took a thin platinum wire and pushed the silver to one side, but on attempting to take the wire away the silver remained in contact with it. As he thought this curious, he tried the following experiment: He took a piece of silver foil, about one centimeter square, placed it in an inverted porcelain crucible lid, and heated it to about 500° C.; then he brought into contact with it the extremity of a thin platinum wire, and to his astonishment the wire raised the silver from the lid, and it remained in contact when cold.

The silver being so much below its melting point its behavior puzzled him, so he wrote to Sir W. Thomson for an explanation. On witnessing the experiment Sir William pronounced it a remarkable case of "cohesion," the two metals, in fact, "welding," although the temperature was far below the melting point of silver. Mr. Fawsett says that the experiment can be performed successfully at lower temperatures than 500° C. if smaller pieces of foil are taken; and that other metals, for instance copper and aluminum, cohere to silver in the same manner as platinum, but less strikingly.

A Universal International Exhibition of One.

Signor Louis Josue Raynusso, of Santa Clara Mill, Lima, Peru, proposes a grand universal contest, to take place in Rome, Italy, during the month of October, 1879. His experience and study have inspired him with the profound conviction that water power is not so widely nor so wisely employed as it might be; also that he has unequaled plans for obtaining the following results, to wit:

To canalize any waterfall; to elevate the water of any river so as to employ it in the irrigation of high grounds; to perfect the system now in use for grinding corn and other grain; to modify advantageously the current mode of making bread, biscuits, and vermicelli.

To test the question, he proposes the competition above named, with prizes to be furnished by himself. The first prize of 100,000 francs is offered for the best three plans of works, edifices, and machinery, as follows:

I. Of a large establishment to contain four manufactories, as follows:

1st. A model mill to grind wheat and other kinds of grain, with its proper machinery moved by hydraulic power, and stores to keep the grain, flour, and bran.

2d. A factory for the manufacture of bread, with all the necessary facilities and advantages for this industry.

3d. A factory for the manufacture of crackers, with the above conditions.

4th. A factory for the manufacture of vermicelli with the same conditions.

II. To employ the water of a river, by means of a new system of canalization, in irrigation, and for the factories worked by hydraulic power.

III. A new system to control any fall of water, regulate it, and employ the same as motive hydraulic power in factories.

If only two plans among all those exhibited shall equal his, he will pay 50,000 francs; if only one, 25,000 francs. A further reward of 2,000 francs is offered for each piece of machinery, either cast, in wood, or drawn, of a new pattern and useful to the mill industry, provided it be superior to those exhibited by him.

Also a reward of 1,000 francs for each improved piece of machinery, either cast, in wood, or drawn, of those actually employed in the mill industry, provided it be superior to those employed by him.

The jury is to be formed from judges selected by the candidates. The contest is open to all the world.

The plans of the several candidates will be accepted at Rome by a commission appointed *ad hoc*, until the 1st day of September, and none afterward.

Reporting Machine.

Among apparatus which may be called literary aids—writing, calculating, and other machines—seen at the Paris Exhibition, was one which attracted much attention, and which has not yet been introduced into this country. It is known as *La Machine Sténographique Michela*, the name of its inventor. The claims made respecting it are very broad. In the first place, it is declared that after a fortnight's practice, any person of ordinary ability can take down in shorthand characters any speech, however rapidly delivered. It is a small instrument, piano like in form, with twenty-two keys, white and black, and the stenographic characters are small and impressed on slips of paper. Signor Michela claims to have classified all the sounds which the human organs of speech are capable of producing, and to have so constructed his machine that it shall report with unerring fidelity whatever is said, German, French, Italian, and Spanish, and it may be taken for granted that English is also included, as the exhibitors announce their intention of introducing the machine into this country. The inventor even believes that his machine will do much towards the realization of that philosophic dream, an universal language. To what extent the hopes of the inventor may be realized, of course remains to be seen, but the machine is certainly highly ingenious, and seems to work satisfactorily.

A New Method of Planting Telegraph Poles.

A new method of planting telegraph poles has been introduced in Pennsylvania. The ground is staked off at distances of 200 feet apart; a man starts off with cartridges of "electric powder," and with a crowbar in his hand. The bar is driven four or five feet into the ground, a cartridge with a lighted fuse is dropped into the hole, and the man proceeds to the next stake, but before he reaches it the cartridge has exploded, making a cavity as big as a flour barrel in the ground, and a gang of men who follow plant a telegraph pole in the spot. In this way four men will set up 100 to 150 poles per day, and at a cost two thirds less than by the old way.

Simple Mode of Silvering Metals.

Small articles may easily be coated with silver by dipping them first into a solution of common salt, and rubbing with a mixture of one part of precipitated chloride of silver, two parts of potassa alum, eight parts of common salt, and the same quantity of cream of tartar. The article is then washed and dried with a soft rag.

WHAT WE FIND IN HONEY.

Among objects familiar to all, honey may be mentioned as one capable of affording the microscopist considerable entertainment. Before enlarging on this, however, perhaps it will prove of interest if we take a rapid glance at the composition of honey.

During the growth of flower buds, copious deposits of starch take place in their receptacles and disks. When the flowers open, this starch, by the absorption of oxygen and evolution of carbonic acid, becomes converted into sugar, to aid in the rapid development of the delicate floral organs. The excess of sugar thus formed, and naturally deposited in nectaries of flowers, is extracted from the latter by working bees. These deposit it in their crop or honey bag, and from this receptacle again disgorge it when they return to the hive. But during this short interval the sugar, by admixture with the liquids secreted in the mouth and crop of the insect, becomes somewhat altered; so that the honey we obtain from the comb is perhaps not exactly of the same chemical composition as when it was sucked from the flower by the industrious bee. The solid crystallizable portion of honey consists of grape sugar (also called glucose or dextroglucose), which is abundantly diffused throughout the vegetable kingdom, being more especially a product of those plants or fruits which possess distinctly acid or sour juices. Another constituent of honey is an uncrystallizable, colorless sirup, as sweet as cane sugar, and called lævulose. A mixture of lævulose and glucose in equivalent quantities constitutes fruit sugar or inverted sugar. Honey also contains some cane sugar, which is usually the product of such plants as have little acid in their saps, and which also exists in the nectaries of some flowers, notably in those of cactuses, where the sugar is almost wholly of this kind. In addition to these sugars, we find, as constituents of honey, a small quantity of gum, mucilage, and a little wax. All of the sugars mentioned vary in sweetness; cane sugar, for instance, being popularly distinguished from other varieties by its greater sweetening power; three pounds being equivalent, in this respect, to five of grape sugar. Both the solid and liquid sugars of the honey have the same general properties, the liquid differing from the solid chiefly in refusing to crystallize, and in containing a mixture of various coloring and odoriferous substances characteristic of the flowers from which the bee extracted it. To such foreign matters as these honey owes the varied color, flavors, and odor which it has been recognized as possessing in different districts. To this fact is due the high estimation in which was held by the ancients the honey of Mount Hybla, in Sicily, a locality noted as the habitat of thyme and an abundance of other odoriferous flowers. The fame of the honey of Mount Ida, in Crete, is owing to the same reason. Hence, also, the perfume of the honey of Narbonne, of Chamouni, and of the Moorlands of England when the heather is in bloom. It occasionally happens that these foreign substances possess bitter, narcotic, and poisonous qualities, as is the case with the Trebizond honey, which produces headache, vomiting, and even a kind of intoxication in those eating it; the poisonous quality being derived from the flowers of a rhododendron (*Azalea pontica*). It was probably a honey of this kind which poisoned the soldiers of Xenophon, as described by that general and author in his "Anabasis."

As might be expected from what has been said, then, when we place a small drop of honey on a slide, cover it with a thin glass, and examine it with a high power of the microscope, it will be observed to contain a large quantity of sugar crystals (Fig. 1), which will be found elegant objects when viewed with polarized light and the use of a selenite stage. But in addition to these constituents there are various foreign matters to be found in all honey, and among the most interesting of these are the pollen grains which the bee had detached from the stamens of the flowers in its nectar-gathering visits. By careful investigation, very many different kinds of pollen may be detected in any sample of honey, and the prevalence of one kind over the others will give a clew to the sort of locality the bees frequented in collecting their sweet spoil. In an examination made of a beautifully clear sample of honey, contained in a very white comb, a short time since, we found the varieties of pollen grains figured herewith, each of which is represented magnified 500 diameters. We are at present unable to assign them to the plants from whence they were derived, since no work has been as yet published giving figures of the pollen of our American plants.

Perhaps some of our readers who are microscopists, and who have made the subject of pollen a specialty, will recognize our figures, and be able at once to identify them.

The pollen, Fig. 2, was the prevailing form, and the greater part of the honey had probably been derived from the flowers whence this variety came. The other pollens occurred in less frequency, but all in considerable quantity. In addition to the pollen grains, we found, in more or less quantities, scales from the wings of various butterflies, which had probably been brushed off these insects on their visits to the flowers in search of nectar, and which had adhered to the hair of the bees on the subsequent visits of the latter to the same blossoms. We found many brown fungus spores also, like those in Fig. 14; we are not able to place these definitely, as we are acquainted with several fungi that have spores very similar to this.

A few insect hairs, probably derived from the bee itself, completes our list of what we discovered on a cursory examination of a very nice sample of comb honey. It would be an interesting matter for those who possess microscopes, and who live in the country, to collect pollen grains for themselves, and compare them with those introduced into the honey by the bees.

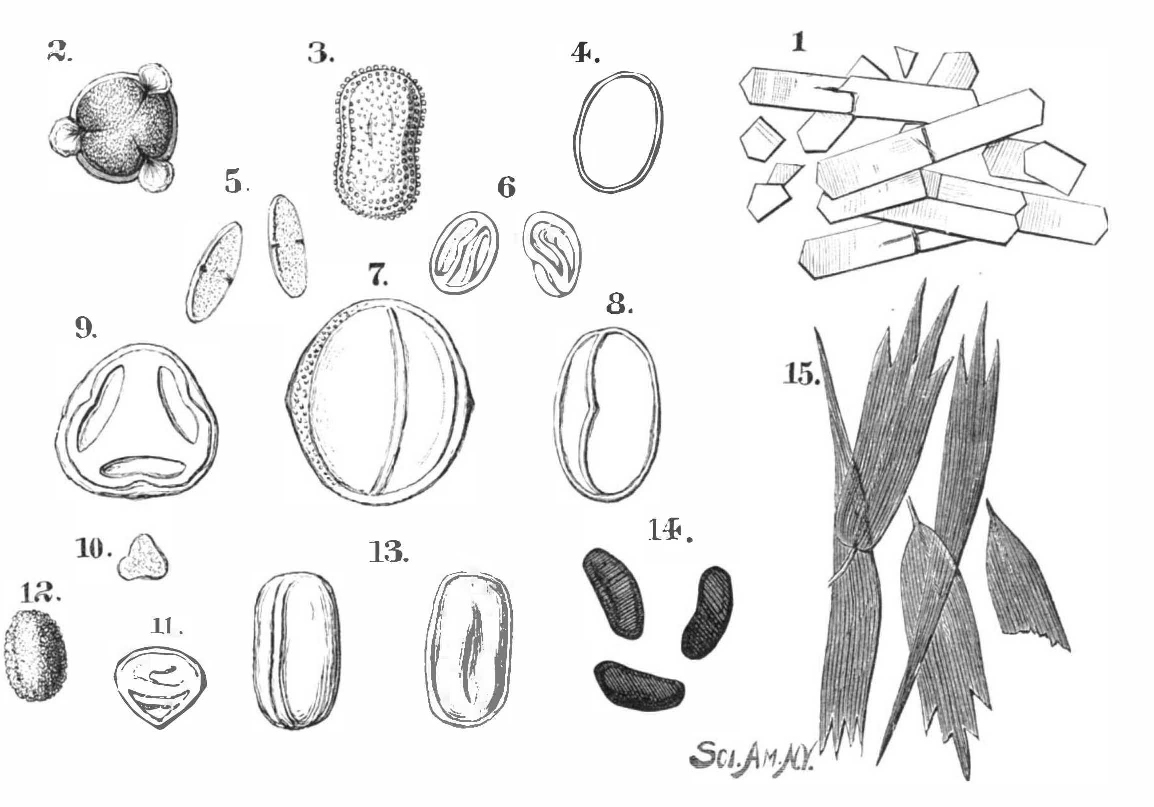


Fig. 1.—Crystals of Grape Sugar in Honey, magnified 100 diameters. Figs. 2 to 13.—Pollen grains, magnified 500 diameters. Fig. 14.—Fungus spores, magnified 500 diameters. Fig. 15.—Scales from Butterflies' Wings in Honey, magnified 100 diameters.

Chinese Rice Paper.

The thick, soft, translucent material called Chinese rice-paper, is commonly supposed to be made of rice, or some sort of fiber obtained from the rice plant. A recent writer says that it is not so made, but is the pith of a *Fatsia papyrifera*, sliced thin. The tree grows about twenty feet high, and its pith is an extensive article of commerce in China, for it is used in the manufacture of many articles, especially toys and artificial flowers. The cylinders of pith exposed on removing the bark and woody fiber are rarely an inch and a half in diameter, and as the substance is delicate and tender, rare skill and practice are required to cut the whole stick from the circumference to center into one continuous sheet. A long, thin, very sharp knife is used for this operation. The largest sheets that can be obtained in this way are about fifteen inches long by ten wide. As soon as the sheets are cut they are spread out, all little holes carefully mended, and then they are pressed under weights until dry. The refuse scraps, etc., go to make pillows; the ordinary sheets are dyed brilliantly and sold to the flower makers, while the largest sheets are destined for the foreign market after being carefully painted by skillful native artists. There is no substance yet discovered that so well represents the delicate texture of the petals of flowers as this paper of pith, and it is exported to some extent by artificial flower manufacturers. The tree could no doubt be grown here, as our climate is much like that of China.

Diversified Industry, and How to Get It.

An Eastern contemporary discusses this question with uncommon force and pertinence. The free trade theory, "get your work done where it can be done cheapest," sometimes leads to painful, humiliating, if not disastrous results. Men are yet living who remember that period of national crudeness or national disgrace, when the United States could not so much as strike a medal in honor of its own victories. At the very moment when, in our diplomacy, we were defying England in a series of measures which led to the war of 1812, we had occasion to strike some medals for our naval heroes. At that time there was no machinery in the country strong enough for the purpose, and we had to ask the British mint, as a favor, to strike our medals for us.

"Nations have other functions than trade, other desires than to buy in the cheapest market. And, as it happened to us in our late war, a nation may find the cheapest market suddenly closed when the need of buying is greatest. Under conditions not dissimilar our Western farmers are learning the same lesson. "They were once bewildered," says our contemporary, "with the simple theory that each nation is for one thing—the United States for food, England for machinery, Italy for fine arts, and Germany for philosophy. How charming it all was, to be sure! We send to England our wheat, and England sends to us our hoes, and shovels, and drag chains. But as the Western farmer gets beyond a pioneer's position; as he finds it necessary to work with tools more useful than hoes and shovels; as the complicated machinery made in gigantic establishments at Springfield and Chicago, and a hundred other places, cuts down for him his grain and stacks it, cuts down his hay and tosses it into the loft for him—the farmer on the prairies has every reason to be thankful that the invention of this machinery was not left to people four thousand miles away, who had never seen a prairie, who knew nothing of an American summer or of the exigencies of an American harvest. He has reason to be thankful that, under the auspices of such men as Henry Clay and John Caldwell Calhoun, a diversified industry was forced upon this country, unwilling enough to accept it; that the foresight of the country's leaders almost compelled the country, against its will, to create the machinery, the machinist, the inventors, and the machine shops which now enable the farmers of this country to feed the world.

"If anybody supposes that the very existence of a great harvest will, by a natural law of evolution, develop the machinery which will reap it, he has only to travel through Southern Russia or through the fertile fields of Poland, and inquire how many centuries the harvests of grain have existed there without developing McCormick's reaper, or such a firm as Whitely, Fasselar & Kelley. The truth is, you must have your inventor, your machinist, and even your machine shop close by the field of their work and their triumph. They must know the need; they must talk with the men who feel it; they must see the early experiment; they must be able to correct, in person, the first mistakes. There must also be that sharp and generous competition between different shops which shall secure to the farmer the best result at the cheapest price, at his own door.

"No person, indeed, who sees the daily operation of agriculture at the West would, for an instant, relegate to Europe the manufacture of any part of the necessary machinery. Suppose a casting gives way in a Louisiana sugar mill. 'Buy where you can buy cheapest,' says Herbert Spencer. 'Telegraph to us in Birmingham the shape of your casting and its size, and in three weeks you shall have it renewed in the best workshop in the world.' To which, of course, the planter replies that at the end of three weeks his cane will be nowhere. He does not want to buy where he can buy cheapest. He wants to buy where he can buy quickest. The nearer the foundry the better. . . .

"It is usual to reply to the repetition of such fundamental principles that, under the great law of accident, under this wonderful law of 'let-alone,' if the farmer wants a reaper he will surely get it somehow, and if the planter wants a cog wheel or a roller it will come to him somehow. Supply, it is said, will always meet demand. Supply meets demand when intelligent men come between and compel the supply. This city of Boston needed an easy highway to the Hudson. And long enough it would have continued to need it, if intelligent men had not forced an unwilling community to legislate, to incorporate, and to subsidize, until at last those railroads were built which Governor Rice so well called 'our open rivers to the West.'

"Every inch of railway in New England has been created by the principles which are at the bottom of the system of protection. If you want a man to establish a ferry, so that you shall be sure to find him there of a stormy night in December, you must encourage that man by certain privileges which you give him in pleasant days in summer. If you want men to establish the workshop which shall, in the end, train your inventors, make your reapers, and repair your sugar mills, you must at the outset give those men certain advantages for which, in the end, you will find you are repaid a thousand-fold."

LICE ON CATTLE.—An immediate and effective remedy for lice on cows and other cattle, also for ticks on pigs, is to wash the affected parts with potato water, or water in which potatoes have been boiled. One application is generally sufficient.

RECENTLY PATENTED INVENTIONS.

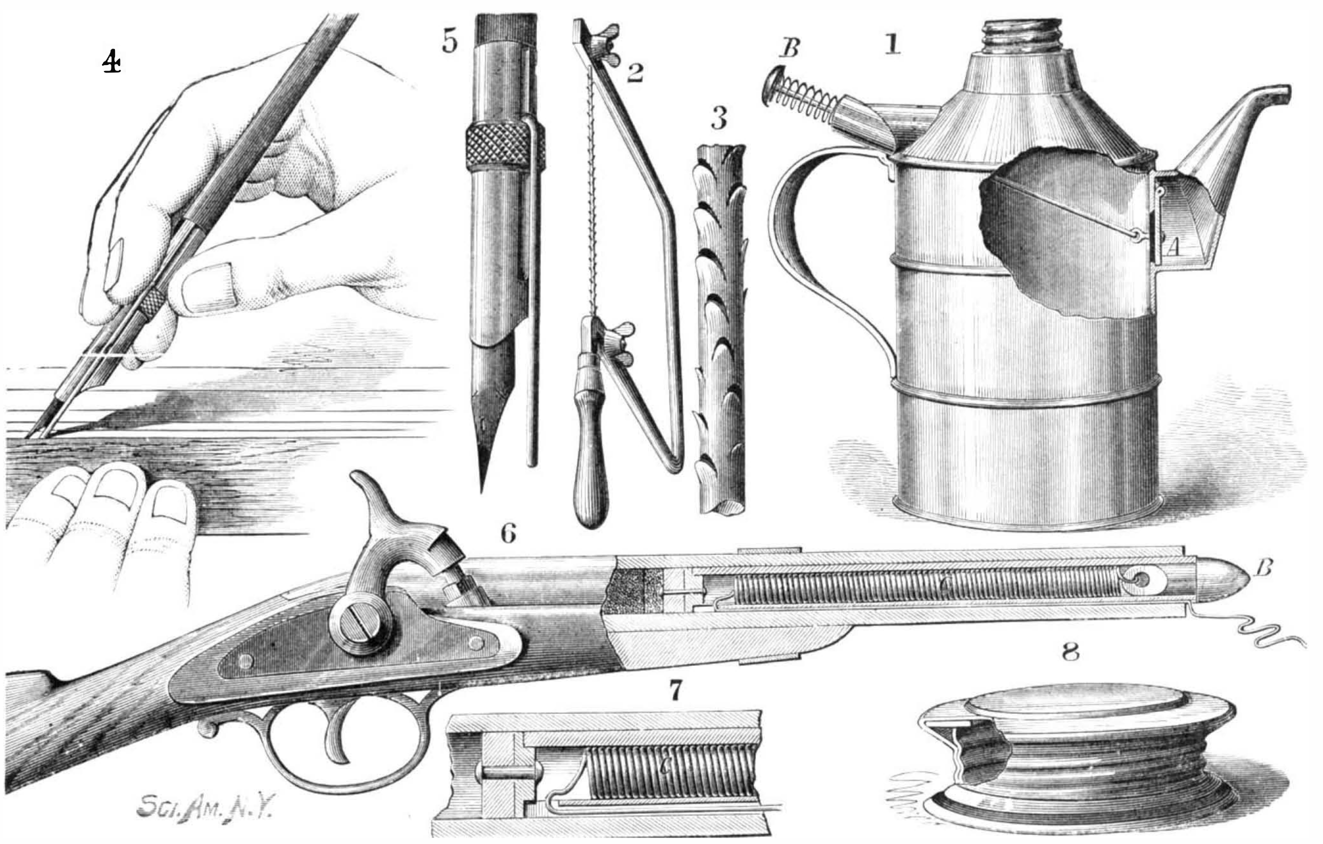
A few novelties are shown in the accompanying engraving which illustrate the versatility of American inventive genius. Fig. 1 represents an improved can for containing common petroleum oil. The spout, which is enlarged at its lower end, contains a hinged valve, A, connected with the rod, B, which extends through a tube projecting from the can just above the handle. The rod carries a piston, which slides in the tube as the valve, A, is operated by pushing the rod. The movement of the piston opens an aperture, through which air enters the can, allowing the oil to flow out freely. On releasing the valve rod the spring returns the parts to their normal position, sealing the can completely.

In Figs. 2 and 3 a saw is shown that is capable of sawing in any direction without being turned. It consists of a bar or wire having struck up burr teeth. The saw is stretched in a frame in the usual way, and is designed to follow the line of the pattern in any direction without the necessity of turning the saw frame.

Figures 4 and 5 represent a simple device for attachment to ordinary pen holders, to enable a common pen to be used in drawing straight lines without danger of smearing the edge of the ruler with ink. The attachment consists of a simple narrow ring, which encircles the pen holder and supports the guide rod which slides in contact with the edge of the ruler as shown in the engraving.

In Figs. 6 and 7 are shown a gun and projectile for throwing lines. It is especially designed for use in cases of shipwreck. The gun is of common construction, but it is of quite large bore. The projectile is a hollow cylinder, closed at one end by a plug, B, and arranged to contain the line, C, which is secured to an eye in the plug and is coiled compactly in the cylinder. The butt of the projectile is stopped and packed by a suitable wad. When the gun is discharged the projectile, in its flight, pays out the line. Should the distance through which the projectile travels exceed the length of line contained in it, a relay line, which is connected with the line, C, supplies the deficiency.

Fig. 8 shows a novel postal envelope, which is made so that it may be easily opened to admit of examining its contents. It consists in a box spun or stamped from sheet metal, having the top and bottom made flaring for the double purpose of receiving packing, and protecting the screw threads by which the two parts are secured together.



1. Moran's Oil Can.—2 and 3. Griffin's Scroll Saw.—4 and 5. Hoffman's Ruling Attachment.—6 and 7. Eggers & Pierce's Projectile for Throwing Lines.—8. Pearson's Metallic Postal Envelope.

SOME RECENT AMERICAN INVENTIONS.

Great Testing Machine.

The great testing machine designed by Mr. Albert Emery, for the United States Commission for testing iron and steel, which has been in process of construction for three years past at the Watertown (Mass.) Arsenal, is now completed. Some experimental tests made with it in the presence of the Commissioners are thus described in the Boston *Traveler:*

"The merit of this new testing machine is its great power united with its mathematical accuracy. In illustration of this a few of the interesting results it has reached in the course of the recent experiments may be cited. A five inch bar of iron was pulled apart, and the strain registered in doing it was 722,000 lbs. To attest its minute exactness, a horse hair was next submitted to the strain, and it yielded to a registered force of 2 lbs. Again, a pine block of four inches thickness and two feet in length was taken and pressed into a board of two inches thickness.

"Then to again ascertain its refinement of accuracy, a hen's egg was taken and inclosed in plaster of Paris, with two small holes at each end, and, the pressure being applied, the contents were forced out of these small apertures at a strain of 32 lbs., and such is the command over the action of the machine that the pressure was stopped in an instant, and the yolk ceased to be expelled, the shell of the egg remaining unbroken. A nut was also cracked by the machine without crushing the kernel.

"No such nicety of regulated pressure, combined with such an enormous range of power and absolutely exact registration of the strain exerted, has ever before been attained. The cost of the machine to the government, under the contract, is $31,000, but Mr. Emery has expended over $100,000 in perfecting it."

How Wooden Shoes are Made.

An industry that cannot last many years more, thanks to the rapid cheapening of leather shoes by means of machinery, is the manufacture of wooden shoes, still the only wear of thousands of French peasantry. A writer in *Chambers' Journal* pleasantly describes the manner in which this industry is carried on. The surroundings are certainly picturesque. An encampment has been formed in the beech woods, and suitable trees are selected and felled. Each will probably give six dozen pairs of wooden shoes. Other kinds of wood are spongy and soon penetrated with damp, but the beech sabots are light, of close grain, and keep the feet dry in spite of snow and mud, and in this respect are greatly superior to leather.

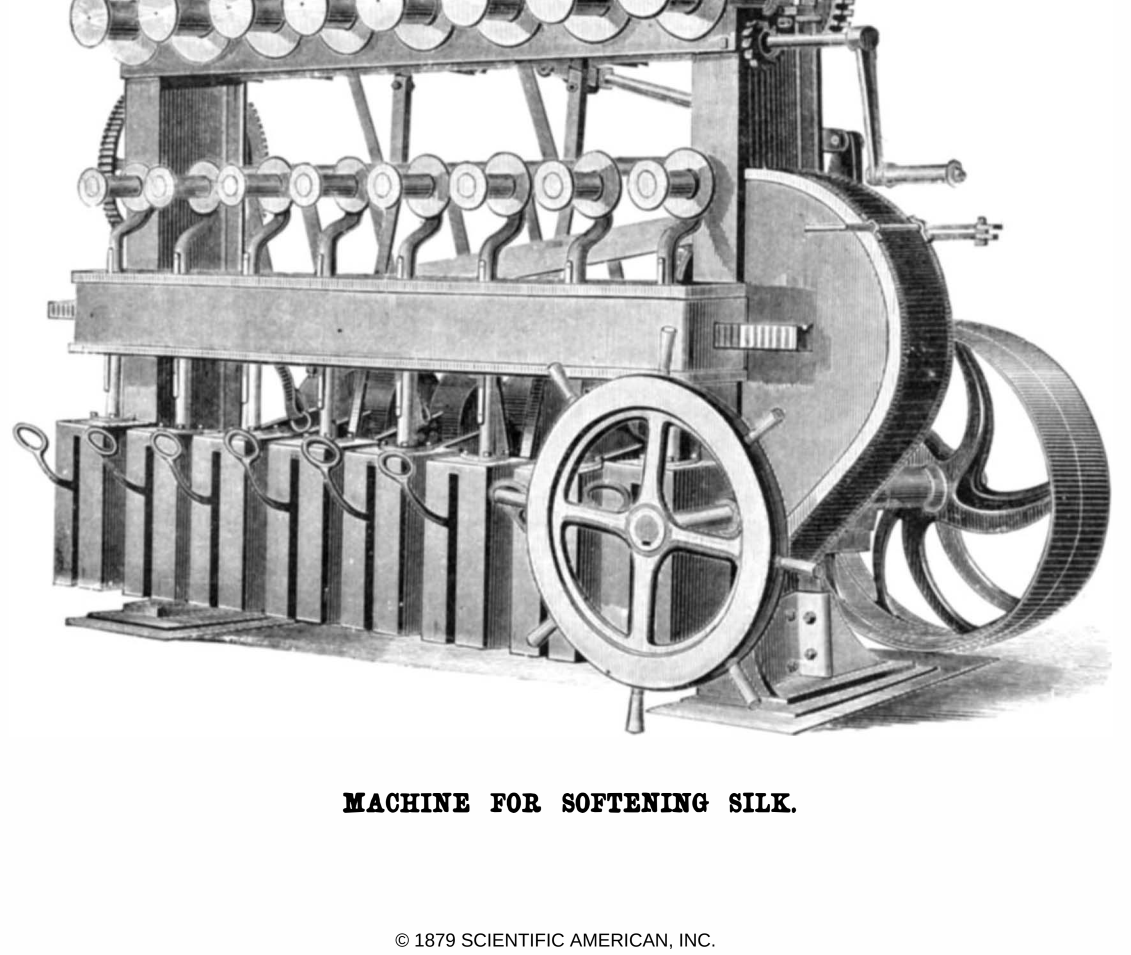
All is animation. The men cut down the tree; the trunk is sawn into lengths, and if the pieces prove too large they are divided into quarters. The first workman fashions the *sabots* roughly with the hatchet, taking care to give the bend for right and left; the second takes it in hand, pierces the hole for the interior, and scoops the wood out with an instrument called the *cuiller*.

The third is the artist of the company; it is his work to finish and polish it, carving a rose or primrose upon the top if it be for the fair sex. Sometimes he cuts an open border around the edge, so that a blue or white stocking may be shown by a coquettish girl. As they are finished they are placed in rows under the white shavings; twice a week the apprentice exposes them to a fire, which smokes and hardens the wood, giving it a warm, golden hue. The largest sizes are cut from the lowest part of the bole, to cover the workman's feet who is out in rain from morning to night. The middle part is for the busy housewife, who is treading the washhouse, the dairy, or stands beside the village fountain. Next come those of the little shepherd, who wanders all day long with his flock, and still smaller ones for the school boy. Those for the babies have the happiest lot; they are seldom worn out. As the foot grows the mother keeps the little sabots in a corner of her cupboard beside the baptismal robe.

MACHINE FOR SOFTENING SILK.

The accompanying engraving represents an improved machine employed by French manufacturers to soften and polish silk after dyeing. The skeins of silk are hung over bobbins, the lower ones being slightly raised for that purpose. The support being withdrawn, the slotted weights suspended from the lower bobbins come in play and stretch the silk.

An ingenious mechanism gives an oscillating motion to a horizontal rack engaging the vertical bars which support the lower bobbins, and the skeins are thereby twisted and untwisted while revolving, every part of the silk being brought in turn under the desired manipulation by the slower revolution of the upper bobbins. In this way the silk is softened and given a glossy finish. The machine takes up but little room, and is said to do its work in a superior manner.



MACHINE FOR SOFTENING SILK.

A Promising Experiment.

Some remarkable experiments in wheat cultivation have been tried in Michigan. Under the supervision of a committee appointed for the purpose, 68 lbs. of seed to the acre were sown in drills 16 inches apart, and the grain was cultivated with a horse hoe once in the fall and twice in the spring. For comparison, another plat of ground was sown with wheat drilled in, in the usual way, 90 lbs. to the acre. The committee reports that the average yield was 69½ per cent greater in the 16 inch drills than in the 8 inch, and while the former did not lodge or crinkle the latter did so badly.

[From *Harper's Magazine* for March, 1879.]

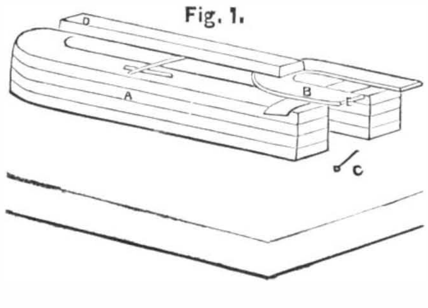
GARY'S MAGNETIC MOTOR.

With an ordinary horseshoe magnet, a bit of soft iron, and a common shingle-nail, a practical inventor, who for years has been pondering over the power lying dormant in the magnet, now demonstrates as his discovery a fact of the utmost importance in magnetic science, which has hitherto escaped the observation of both scientists and practical electricians, namely, the existence of a neutral line in the magnetic field—a line where the polarity of an induced magnet ceases, and beyond which it changes. With equally simple appliances he shows the practical utilization of his discovery in such a way as to produce a magnetic motor, thus opening up a bewildering prospect of the possibilities before us in revolutionizing the present methods of motive power through the substitution of a wonderfully cheap and safe agent. By his achievement Mr. Wesley W. Gary has quite upset the theories of magnetic philosophy hitherto prevailing, and lifted magnetism out from among the static forces where science has placed it to the position of a dynamic power. The Gary Magnetic Motor, the result of Mr. Gary's long years of study, is, in a word, a simple contrivance which furnishes its own power, and will run until worn out by the force of friction, coming dangerously near to that awful bugbear, perpetual motion.

The old way of looking at magnetism has been to regard it as a force like that of gravitation, the expenditure of an amount of energy equal to its attraction being required to overcome it; consequently its power could not be availed of. Accepting this theory, it would be as idle to attempt to make use of the permanent magnet as a motive power as to try to lift one's self by one's boot straps. But Mr. Gary, ignoring these theories, toiled away at his experiments with extraordinary patience and perseverance, and at last made the discovery which seems to necessitate the reconstruction of the accepted philosophy.

To obtain a clear idea of the Gary Magnetic Motor, it is necessary first to comprehend thoroughly the principle underlying it—the existence of the neutral line and the change in polarity, which Mr. Gary demonstrates by his horseshoe magnet, his bit of soft iron, and his common shingle-nail. This is illustrated in Fig. 1. The letter A represents a compound magnet; B, a piece of soft iron made

Fig. 1.



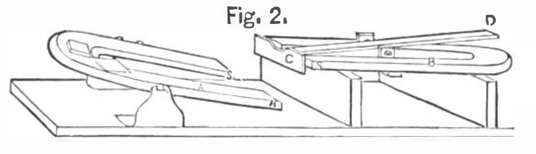
fast to a lever with a pivoted joint in the center, the iron becoming a magnet by induction when in the magnetic field of the permanent magnet; C, a small nail that drops off when the iron, or induced magnet, is on the neutral line. By pressing the finger on the lever at D, the iron is raised above the neutral line. Now let the nail be applied to the end of the induced magnet at E; it clings to it, and the point is turned inward toward the pole of the magnet directly below, thus indicating that the induced magnet is of opposite polarity from the permanent one. Now let the iron be gradually lowered toward the magnet; the nail drops off at the neutral line, but it clings again when the iron is lowered below the line, and now its point is turned outward, or away from the magnetic pole below. In this way Mr. Gary proves that the polarity of an induced magnet is changed by passing over the neutral line without coming in contact. In the experiment strips of paper are placed under the soft iron, or induced magnet, as shown in the figure, to prevent contact.

The neutral line is shown to extend completely around the magnet; and a piece of soft iron placed upon this line will entirely cut off the attraction of the magnet from anything beyond. The action of this cut-off is illustrated in Fig. 2. The letters A and B represent the one a balanced magnet and the other a stationary magnet. The magnet, A, is balanced on a joint, and the two magnets are placed with opposite poles facing each other. The letter C is a piece of thin or sheet iron, as the case may be, made fast to a lever with a joint in the center, and so adjusted that the iron will move on the neutral line in front of the poles of the stationary magnet. By pressing the finger on the lever at D the iron is raised, thus withdrawing the cut-off so that the magnet, A, is attracted and drawn upward by the magnet, B. Remove the finger, and the cut-off drops between the poles, and, in consequence, the magnet, A, drops again. The same movement of magnets can be obtained by placing a piece of iron across the poles of the magnet, B, after the magnet, A, has been drawn near to it. The magnet, A, will thereupon immediately fall away; but the iron can only be balanced, and the balance not disturbed, by the action of the magnets upon each other when the iron is on the neutral line, and does not move nearer or farther away from the magnet, B.

It may not be found easy to demonstrate these principles at the first trials. But it should be borne in mind that it took the inventor himself four years after he had discovered the principle to adjust the delicate balance so as to get a machine which would go. Now, however, that he has thought out the entire problem, and frankly tells the world how he has solved it, any person at all skillful and patient, and with a little knowledge of mechanics, may soon succeed in demonstrating it for himself.

The principle underlying the motor and the method by which a motion is obtained now being explained, let us examine the inventor's working models. The beam movement is the simplest, and by it, it is claimed, the most power can be obtained from the magnets. This is illustrated in Fig. 3. The letter A represents a stationary magnet, and B the soft iron, or induced magnet, fastened to a lever with a joint in the center, and so balanced that the stationary magnet will not quite draw it over the neutral line. The letter C represents a beam constructed of a double magnet, clamped together in the center and balanced on a joint. One end is set opposite the stationary magnet, with like poles facing each

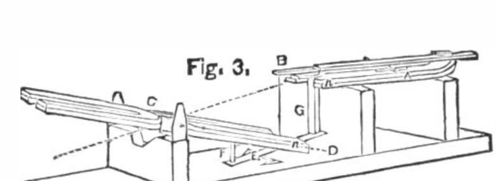
Fig. 2.



other. The beam is so balanced that, when the soft iron, B, on the magnet, A, is below the neutral line, it (the beam) is repelled down to the lower dotted line indicated by the letter D. The beam strikes the lever, E, with the pin, F, attached, and drives it (the lever) against the pin, G, which is attached to the soft iron, B, which is thus driven above the neutral line, where its polarity changes. The soft iron now attracts the beam magnet, C, to the upper dotted line, whereupon it (the soft iron) is again drawn down over the neutral line, and its polarity again changing, the beam magnet, C, is again repelled to the lower line, continuing so to move until it is stopped or worn out. This simply illustrates the beam movement. To gain a large amount of power the inventor would place groups of compound stationary magnets above and below the beam at each side, and the soft iron induced magnets, in this case four in number, connected by rods passing down between the poles of the stationary magnets. A "pitman" connecting the beam with a fly-wheel to change the reciprocating into a rotary motion would be the means of transmitting the power. With magnets of great size an enormous power, he claims, could be obtained in this way.

One of the daintiest and prettiest of Mr. Gary's models is that illustrating the action of a rotary motor. There is a peculiar fascination in watching the action of this neat little contrivance. It is shown in Fig. 4. The letter A represents an upright magnet hung on a perpendicular shaft; B, the horizontal magnet; C, the soft iron which is fastened to the lever, D; E, the pivoted joint on which the lever is balanced; and F, the thumbscrew for adjusting the movement of the soft iron. This soft iron is so balanced that as the north pole of the upright magnet, A, swings around opposite and above the south pole of the horizontal magnets, B, it drops below the neutral line and changes its polarity. As the magnet, A, turns around until its north pole is opposite and above the north pole of the magnets, B, the soft iron is drawn upward and over the neutral line, so that its polarity is changed again. At this point the polarity in the soft iron, C, is like that of the permanent magnets, A and B. To start the engine the magnet, A, is turned around to the last-named position, the poles opposite like poles of the magnets, B; then one pole of the magnet, A, is pushed a little forward and over the soft iron. This rotary magnet is repelled by the magnets, B, and also by the soft iron; it turns around until the unlike poles of the permanent magnets become opposite; as they attract each other the soft iron drops below the neutral line, the polarity changes and becomes opposite to that of the magnets, B, and like that of the magnet, A; the momentum gained carries the pole of A a little forward of B and over the soft iron, which, now being of like polarity, repels it around to the starting point, completing the revolution. The magnets, A and B, now compound or unite their forces,

Fig. 3.



and the soft iron is again drawn up over the neutral line; its polarity is changed, and another revolution, is made without any other force applied than the force of the magnets. The motion will continue until some outside force is applied to stop it, or until the machine is worn out.

The result is the same as would be obtained were the magnets, B, removed and the soft iron coiled with wire, and battery force applied sufficient to give it the same power that it gets from the magnets, B, and a current changer applied to change the polarity. The power required to work the current changer in this case would be in excess of the power demanded to move the soft iron over the neutral line, since no power is required from the revolving magnet under these circumstances, it being moved by the magnets compounding when like poles are opposite each other, three magnets thus attracting the iron. When opposite poles are near together, they attract each other and let the iron drop below the line. The soft iron, with its lever, is finely balanced at the joint, and has small springs applied and adjusted so as to balance it against the power of the magnets. In this working model the soft iron vibrates less than a fiftieth of an inch.

The rotary motion is intended for use in small engines where light power is required, such as propelling sewing machines, for dental work, show windows, etc.

When Wesley Gary was a boy of nine years, the electric telegraph was in its infancy and the marvel of the day; and his father, who was a clergyman in Cortland county, New York, used to take up matters of general interest and make them the subject of an occasional lecture, among other things, giving much attention to the explanation of this new invention. To illustrate his remarks on the subject he employed an electro magnetic machine. This and his father's talk naturally excited the boy's curiosity, and he used to ponder much on the relations of electricity and magnetism, until he formed a shadowy idea that somehow they must become a great power in the world. He never lost his interest in the subject, though his rude experiments were interrupted for a while by the work of his young manhood. When the choice of a calling was demanded, he at first had a vague feeling that he would like to be an artist. "But," he says, "my friends would have thought that almost as useless and unpractical as to seek for perpetual motion." At last he went into the woods a-lumbering, and took contracts to clear large tracks of woodland in Western and Central New York, floating the timber down the canals to Troy. He followed this business for several years, when he was forced to abandon it by a serious attack of inflammatory rheumatism, brought about through exposure in the woods. And this, unfortunate as it must have seemed at the time, proved the turning point in his life. His family physician insisted that he must look for some other means of livelihood than lumbering. To the query, "What shall I do?" it was suggested that he might take to preaching, following in the footsteps of his father, and of a brother who had adopted the profession. But this, he said, he could never do; he would do his best to practice, but he couldn't preach. "Invent something, then," said the doctor. "There is no doubt in my mind that you were meant for an inventor." This was really

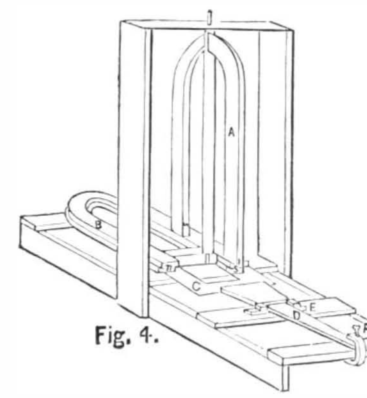


Fig. 4.

said in all seriousness, and Mr. Gary was at length persuaded that the doctor knew him better than he did himself. His thoughts naturally recurring to the experiments and the dreams of his youth, he determined to devote all his energies to the problem. He felt more and more confident, as he dwelt on the matter, that a great force lay imprisoned within the magnet; that some time it must be unlocked and set to doing the world's work; that the key was hidden somewhere, and that he might find it as well as some one else.

At Huntingdon, Pa., Mr. Gary made his first practical demonstration, and allowed his discovery to be examined and the fact published. He had long been satisfied, from his experiments, that if he could devise a "cut-off," the means of neutralizing the attractive power of a stationary magnet on another raised above it and adjusted on a pivot, unlike poles opposite, and so arrange this cut-off as to work automatically, he could produce motion in a balanced magnet. To this end he persistently experimented, and it was only about four years ago that he made the discovery, the key to his problem, which is the basis of his present motor, and upsets our philosophy. In experimenting one day with a piece of soft iron upon a magnet he made the discovery of the neutral line and the change of polarity. At first he gave little attention to the discovery of the change of polarity, not then recognizing its significance, being absorbed entirely by the possibilities the discovery of the neutral line opened up to him.

Here was the point for his cut-off. For a while he experimented entirely with batteries, but in September, 1874, he succeeded in obtaining a movement independent of the battery. This was done on the principle illustrated in Fig. 2. The balanced magnet, with opposite poles to the stationary magnet, was weighted so that the poles would fall down when not attracted by the stationary magnet. When it was attracted up to the stationary magnet, a spring was touched by the movement, and thus the lever with the soft iron was made to descend between the two magnets on the neutral line, and so cutting off the mutual attraction. Then the balanced magnet, responding to the force of gravitation, descended, and, when down, struck another spring, by means of which the cut-off was lifted back to its original position, and consequently the force of attraction between the magnets was again brought into play.

In June, the following year, Mr. Gary exhibited this continuous movement to a number of gentlemen, protecting himself by covering the cut-off with copper, so as to disguise the real material used, and prevent any one from robbing him of his discovery. The publication in the local newspapers of the performance of the little machine, which was copied far and wide, excited much interest. But the inventor was by no means satisfied. He had succeeded in securing a continuous motion, but not a practical motor. He had invented a unique plaything, but not a machine that would do man's work. So he made further experiments in one direction and another, using for a long time the battery; and it was not until some time after he moved to Boston (which was about two years ago) that he was convinced that the points in the change of polarity, with which he was so little impressed when he first hit upon them along with his discovery of the neutral line, were the true ones to work upon. Thereafter his progress was most rapid, and in a little while he had constructed working models, not only to his own satisfaction, but to that of those experts who had the fairness to give them a critical and thorough examination, clearly demonstrating his ability to secure motion and power, as they had never before been secured from self-feeding and self-acting machines. His claim, as he formally puts it, is this: "I have discovered that a straight piece of iron placed across the poles of a magnet, and near to their end, changes its polarity while in the magnetic field and before it comes in contact with the magnet, the fact being, however, that actual contact is guarded against. The conditions are that the thickness of the iron must be proportioned to the power of the magnet, and that the neutral line, or line of change in the polarity of the iron, is nearer or more distant from the magnet according to the power of the latter and the thickness of the former. My whole discovery is based upon this change of polarity in the iron, with or without a battery." Power can be increased to any extent, or diminished by the addition or withdrawal of magnets.

Mr. Gary is forty-one years old, having been born in 1837. During the years devoted to working out his problem he has sustained himself by the proceeds from the sale of a few useful inventions made from time to time when he was forced to turn aside from his experiments to raise funds. From the sale of one of these inventions—a simple little thing—he realized something like ten thousand dollars.

The announcement of the invention of the magnetic motor came at a moment when the electric light excitement was at it height. The holders of gas stocks were in a state of anxiety, and those who had given attention to the study of the principle of the new light expressed the belief that it was only the question of the cost of power used to generate the electricity for the light that stood in the way of its general introduction and substitution for gas. A prominent electrician, who was one day examining Mr. Gary's principle, asked if in the change of polarity he had obtained electric sparks. He said that he had, and the former then suggested that the principle be used in the construction of a magneto-electric machine, and that it might turn out to be superior to anything then in use. Acting on this suggestion, Mr. Gary set to work, and within a week had perfected a machine which apparently proved a marvel of efficiency and simplicity. In all previous machines electricity is generated by revolving a piece of soft iron in front of the poles of a permanent magnet. But to do this at a rate of speed high enough to produce sparks in such rapid succession as to keep up a steady current of electricity suitable for the light, considerable power is required. In Mr. Gary's machine, however, the piece of soft iron, or armature, coiled with wire, has only to be moved across the neutral line to secure the same result. Every time it crosses the line it changes its polarity, and every time the polarity changes, a spark is produced. The slightest vibration is enough to secure this, and with each vibration two sparks are produced, just as with each revolution in the other method. An enormous volume can be secured with an expenditure of force so diminutive that a caged squirrel might furnish it. With the employment of one of the smallest of the magnetic motors power may be supplied and electricity generated at no expense beyond the cost of the machine.

The announcement of the invention of the magnetic motor was naturally received with incredulity, although the recent achievements in mechanical science had prepared the public for almost anything, and it could not be very much astonished at whatever might come next. Some admitted that there might be something in it; others shrugged their shoulders and said, "Wait and see;" while the scientific referred all questioners to the laws of magnetic science; and all believers in book authority responded, "It can't be so, because the law says it can't." A few scientists, however, came forward, curious to see, and examined Mr. Gary's models; and when reports went out of the conversion of two or three of the most eminent among them, interest generally was awakened, and professors from Harvard and from the Massachusetts Institute of Technology called, examined, and were impressed. More promptly than the scientists, capitalists moved; and before science had openly acknowledged the discovery and the principle of the invention, men of money were after Mr. Gary for the right to use the motor for various purposes; one wished to use it for clocks, another for sewing-machines, others for dental engines, and so on.

It is as yet too soon to speculate upon what may result from the discovery; but since it produces power in two ways, both directly by magnets and indirectly by the generation of unlimited electricity, it would seem that it really might become available in time for all purposes to which electricity might long ago have been devoted except for the great expense involved. Within one year after the invention of the telephone it was in practical use all over the world, from the United States to Japan. And it is not incredible that in 1880 one may be holding a magnetic motor in his pocket, running the watch which requires no winding up, and, seated in a railway car, be whirling across the continent behind a locomotive impelled by the same agency.

Astronomical Notes.

OBSERVATORY OF VASSAR COLLEGE.

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

M. M.

POSITIONS OF PLANETS FOR MARCH, 1879.

Mercury.

On March 1 Mercury rises a little before seven in the morning, and sets at 5h. 30m. P.M. Its course is so nearly that of the sun, that it probably will not be seen before the middle of the month. After the middle of the month it should be looked for, in the twilight, some degrees north of the point of sunset.

Mercury is in its best position on March 29. It sets on the 31st at 8 P.M., about a degree south of the point at which Venus sets.

Venus.

Venus will be more and more conspicuous, in the west, during the whole month of March. It sets on March 1 at 7h. 28m. P.M., and on the 31st at 8h. 41m. P.M.

Venus and Saturn will have nearly the same apparent position on the evening of March 2, and with a small telescope, can probably be seen in the field of view at the same time.

Mars.

Mars is not likely to be seen, as it is visible only in the early morning hours. Mars rises on March 1 at 4h. 9m. A.M. far south of east, and sets at 1h. 12m. P.M.

On March 31 Mars rises at 3h. 26m. A.M., and sets at 1h. 3m. P.M.

Jupiter.

Jupiter's path is so nearly that of the sun, that it cannot be seen until the latter part of the month, and at that time for only a short interval before sunrise. On March 31 Jupiter rises at 4h. 23m. A.M., far south of east.

Saturn.

Saturn is now so far from us, and sets so soon after the sun, that only its larger satellites can be seen, even with a powerful telescope.

On March 1 Saturn rises at 7h. 40m. A.M., and sets at 7h. 33m. P.M. On March 31 Saturn rises at 5h. 50m. A.M., and sets at 5h. 54m. P.M. On March 2 Saturn and Venus approach; Saturn will be south of Venus.

Uranus.

Although Uranus has passed its point of opposition, it is still in good position for evening observers.

On March 1 Uranus rises at 4h. 56m. P.M., and sets at 6h. 20m. A.M. of the next day. On March 31 Uranus rises at 2h. 52m. A.M., and sets at 4h. 19m. P.M.

Uranus comes to the meridian at 10 P.M. on March 25, at an altitude (in lat. 42°) of 60°. It is then nearly between Regulus and Rho Leonis, 3° east of Regulus. A telescope of two inches aperture will show the planet with a disk, and it is sometimes seen with the eye. With a powerful glass Uranus appears as a small bluish-white planet, unmarked by spots. Its satellites are not easily found; very rarely are more than two seen.

The Zodiacal Light.

The zodiacal light is a column of soft white light seen after sunset and before sunrise. It has been unusually bright during February, its cone-shaped figure resting upon the horizon; its apex has been seen near the Pleiades. On February 12, at 7 P.M., it was so brilliant that the rest of the sky seemed to be thrown into darkness. The southern boundary was decidedly brighter than the northern. It can probably be seen on any moonless night in March. It is most easily traced by looking a little north of west, and therefore seeing it by oblique vision.

Electro-plating with Zinc.

The so-called galvanized iron is covered with zinc, not by galvanic action, but mechanically, the object being to protect it by galvanic action at the expense of the zinc. If it is desired to deposit a uniform layer of zinc upon iron or other metal by means of a battery the following bath is employed: 10 parts of alum and 1 part of freshly precipitated hydrated oxide of zinc (still moist) are dissolved in 100 parts of water. This bath can only be used cold. The article to be plated is cleaned in an acid bath, attached to the negative pole of a battery, and immersed in the above bath. A large plate of cast zinc is connected with the positive pole. The current need not be very strong, and the zinc is deposited equally well upon all metals. If copper which has been zinc plated in this way is heated, a beautiful and thin layer of brass is produced on the surface. When iron is coated in this way the strength of the coating increases upon warming the article, and the iron is completely protected from rust. The thickness of the coating, of course, is proportional to the time it is left in the bath. It must be borne in mind, however, that the zinc is poisonous, and such vessels should never be used either for culinary purposes or to hold drinking water, which objection does not hold in regard to the more expensive, but likewise more durable, nickel plating. For ornamental and architectural work and some parts of machinery zinc will prove a cheap and useful substitute.

Wise Industrial Legislation not Impossible.

Discussing the memorial with reference to the establishment of a national industrial bureau, lately presented to Congress by Senator Davis, of Illinois, a writer in the Newark *Advertiser* says:

Confessedly the greatest difficulty environing this subject lies in our inability to mobilize labor, so that when any special industry becomes overcrowded, its muscle and brain may be speedily transferred to other employments. If a part of the sad toilers of the coal mines could have been suddenly moved off and transformed into agriculturists at the time of the decline of the iron trade, a long story of privation would have remained untold. But they were miners and miners only, and, mostly of foreign origin, they lacked that transmutability which is peculiar to the American mechanic and laborer, who is usually enough of a jack of all trades to try his hand at something new whenever his present resource has failed him. It is from this latter class that the agriculture of the West has been so amazingly recruited within the last five years, so that Kansas and other trans-Mississippi States have grown in wealth and population while all was idle and retrograde at the East. Still another difficulty is that the trades are now so subdivided that few mechanics know more than some one specialty of their avocation, and the intrusion of a pegging machine breaks up a whole "gang" of shoemakers. The first influence of the introduction of machinery is always to depreciate the value of handiwork. It takes some time to adapt the two so that they can work in harmony, as they always do at last.

That it is not altogether Utopian to look to legislation for some remedy of this evil, is plain in the one fact we have referred to of the vast growth of agriculture during our recent period of depression of trade and commerce. Had it not been for homestead legislation almost thirty years ago this exodus of labor from the East to the West and from the shop to the field would have been impossible. Had it not been for a system of legislation far older than the Homestead act, as it is also more recent because it has been continuous, the new settlers at the West would not have found a School Fund already provided and waiting for them. Given good lands and good schools as a free gift, poverty is inexcusable, and that at least legislation has done for labor. It has done far more. It has given to the emigrant the shelter of established order, the protection of the law, an organized government based on the experience of older States, and put them all at work in waiting for the oncoming flood tide of population. So much then is already proved to be within the easy scope of statesmanship to accomplish.

This achievement suggests that more is possible in the same direction, and not only those who suffer in idleness, not only those who are sentimental philanthropists, but careful and cautious social scientists, who reason calmly and from facts, believe that there is enough of a possible Providence, even in a Congress, to afford cheer and encouragement in the further work of adapting our labor to civilization.

Advice to Young Physicians.

At the thirty-eighth annual Commencement of University Medical College, held at the Academy of Music in this city a few evenings since, Chancellor Howard Crosby performed the duty of conferring the degree of M.D. upon 205 young men, composing the largest medical class ever graduated in America.

The Chancellor afterward delivered an address to the graduating class, which contained much good advice, and was received with great applause.

Among other good things, which we have not room to give, the Chancellor said: The same Faculty who have counted you worthy to receive the Degree of Doctor of Medicine have counted me worthy to address you with words of counsel on this occasion, and if I respect their decision in the one case I am obliged as a reasoning mortal to respect it in the other. Whenever I enter the medical college a new sense of my ignorance bursts painfully upon me, accompanied by a profound feeling of awe, to conceal both of which I have to summon all of my powers of hypocrisy and to appear very knowing and perfectly at my ease. So I walk around the museum and delightedly examine the bottled diseases that ornament that instructive department, and if Dr. Darling is near I drop a Latin phrase of admiration; then I mount to the microscopic apparatus and put histological questions, whose answers, wholly indigestible, I nevertheless swallow with apparent gusto, after which I am thoroughly prepared to visit the Styx, Acheron, and Pyriphlegethon, the region of *monstra horrenda quibus lumina adempta*, a region which, strange to say, in that wonderful edifice occupies the highest story. I descend to the Faculty Chamber, and there serenely talk with men who, I know, look right through me, and see my liver and my diaphragm as plainly as they see my nose. Nor does my presence of mind leave me here; my faith is encouraged to rise to a sublime height, and so when Dr. Thomson tells me that the heat of the healthy body never rises above 98°, I believe him, although I have been baked under an Arabian sun with the mercury about 150°; and when Dr. Arnold tells me that the teeth are not bones, I believe him, while I inwardly wonder what they are if they are *not* bone.

"A rolling stone gathers no moss," which I suppose may be also read, "An itinerant doctor gets no practice." There are some men in this world so impatient that they dodge their opportunities. Their opportunities come along and find them gone. If they had waited the tide would have turned or the wind would have blown from a different quarter. A professional man starting in life will be sorely tempted to this recklessness, wearily. Waiting for clients or patients, it is so very natural to think, "This cannot be the spot: I ought to be in another part of the city, or in another town;" but it *is* the spot, only he isn't the *man* quite. He will be when he has become longer known in the neighborhood, when acquaintance has ripened into confidence, and confidence into experience of his professional ability. Great names, gentlemen, were once very small names, and large fortunes began with a dollar. Identify yourself with one place, and in due time you'll become as well known and well used as the penitentiary.

"The early bird catches the worm." I know malevolent wit has from this wholesome saw drawn an unhealthy conclusion about the stupidity of early worms, but you will not, I'm sure, be misled by those triflers. The adage means promptness, and promptness means self-denial, and self-denial is ugly. For it means getting out of a warm bed in the middle of a cold night to breast the storm for a mile or two; it means letting that smoking dinner go untouched; it means giving up that ride with your sweetheart just as you were going to be so comfortable in the buggy; it means, in short, everything, however disagreeable, when duty calls. If you are ever ready on call, people will be ready with their calls. They always count the prompt doctor the best doctor. Your skill will be of small avail without promptness to use it.

"Pleasant words are health to the bones," which may be also read, "A doctor's cheerfulness is often as good as his physic." I wish some one of you gentlemen would take the leisure of the next year—while you are waiting for patients—in studying the curative properties of cheerful manners in the sick room, and then publish your discoveries in a manual for Dr. Thomson to use with his classes. I don't suppose you could do much with scarlet fever or smallpox; but what a vast array there is of nervous diseases to which pleasant words would be like the breath of spring and the oxygen of the mountain top! Cheer up your patient, and you'll rectify the circulation; cheer up your patient, and you'll augment his nerve power; cheer up your patient, and all the tissues will revive. Medicine must sometimes be disagreeable, but doctors never. A physician's face should be like sunshine and his voice like wedding bells.

"Take care of the pennies, and the pounds will take care of themselves." Now, don't think I am going to preach pecuniary carefulness to you. No. I have quoted the proverb for quite another purpose. It is of time, not money, I would use it. Your whole life is to be given to science; to one of the noblest departments of scientific research and activity. You are therefore to grow in scientific knowledge. Your learned professors have only started you in the paths of exploration. But while you are to study, you are also, I trust, to be very busy in your practice. Of course, then, you cannot sit down and say, "I'll devote this week or this day to study." There's a sore throat over the way, and an erysipelas five miles off, that knock that pretty design in the head. You will have no long delicious sails on the sea of medical learning. But you will have scraps of time, five minutes here and a quarter of an hour there, coming along very tantalizingly, but nevertheless coming along between two calls or between sawing the wood and holding the baby. Now, these scraps of time are your very fortune. Add up the minutes and you are astonished that they amount to whole days, and many of them. Have a valuable treatise on some branch of your profession always open on your table or desk, with your open note book and pencil by its side. Drop into your seat and catch at least one idea. The five minutes are gone and away you go, but you have caught and fastened a new idea. Go on in that way and you'll have a mountain of them in a year. Use diligently your scrap time. Don't lounge. Don't think fifteen minutes are so short that there is no use in applying one's self to anything in particular. Save up these pennies of time, and then hurrah for the pounds.

"*Obsta principiis*," which good old Matthew Henry translated by an English proverb, "Nip mischief in the bud." Begin your medical career with a careful avoidance or abandonment of bad habits, especially such as would harm your standing in the esteem and regard of your patients. A man whose clothes are saturated with stale tobacco smoke is not an agreeable visitor in a sick room. Nor is it reviving to a delicate organization to have stimulants applied through the physician's breath. Neatness in personal apparel and delicacy in manipulation may seem to be small matters, but I can assure you that their neglect may have a weighty influence toward failure.

Now, gentlemen, don't be proud because you are the world's benefactors. Beneficence can afford to be modest because its rank is so high. The real nobility need not be particular about publishing its titles. It leaves self-praise to quacks and mountebanks. Do your full duty as physicians, and you will have all the respect and praise that are your due without any effort to put feathers in your own cap.

THE LURAY CAVERN.

BY H. C. HOVEY.

(Continued from page 58.)

Stalactitic distortion is a new and fascinating study. The grotesque results have been repeatedly described, but the causes have been overlooked.

Consider, first, the normal growth of a stalactite. It is tubular and cylindrical. A drop of lime water, on evaporation, deposits a ring of its own diameter. The next drop makes a second ring exactly equal to the first, and cemented to it. Ring follows ring, in a continually lengthening tube, through which the water drips, never able to lay down its burden of carbonate of lime until it reaches the air. Myriads of these white and fragile tubes are to be seen thickly crowded together, from an inch to a foot in length, and sometimes extending for several feet from roof to floor.

When the flow of water exceeds the capacity of the tube, or the orifice is closed up, a series of layers will be formed by the overflow, thicker above than below. Thus the cylinder is transformed into an elongated cone. The distortion of these simple shapes cannot be due to fluctuations of the air, as in the case of icicles; nor to varied resistance of the medium penetrated, as in roots piercing the soil; nor to parasitic punctures, as in vines and stems, although simulating all these abnormal growths. Such causes are not in operation here. What agencies, then, have produced these extraordinary results?

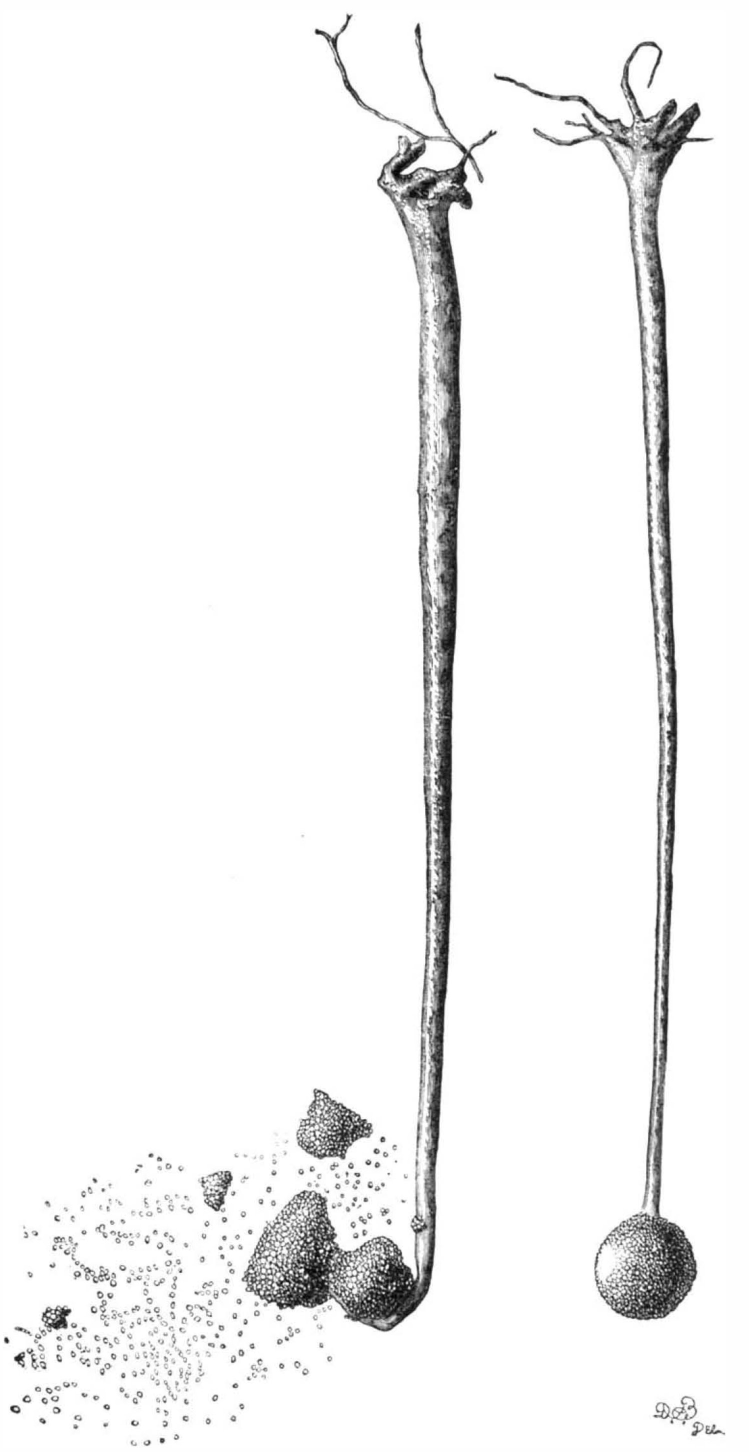


Fig. 1.—MUCOR STALACTITIS.—FROM LURAY CAVERN.

Crystallization is one of the causes sought. A delicate tassel is often formed on the tip of a stalactite; it sometimes envelops the entire tube. The same growth also shoots up from blocks of limestone and nodules of flint, and from its resemblance to petrified moss, it is generally so called. But each pointed leaf is really a brown, yellow, or white crystal of aragonite, occasionally prismatic in shape, and more rarely rounded like delicate fruitage. The indications pointed to a temporary submersion, at some time, of the substance to which the clusters were attached.

On a renewal of stalactitic growth, the fresh deposit would, of course, be exterior to these increments, causing many curious distortions. The tassel, by incrustation, becomes a bulb. The enlargement is often so great as to inwrap contiguous stalactites, whose primary tubes appear, by a transverse section, like pipe stems piercing the excrescence.

Uncouth expansions grow wherever crystals having shot forth are afterwards coated with layers of carbonate of lime. Fungi also play an important and hitherto unnoticed part in stalactitic distortion. Our attention was called to numerous fine, elastic bristles growing on stalactites and other kinds of dripstone in all parts of the cavern. Each carries a little ball at its extremity, usually enveloped by a globule of water. We further observed that the conditions often favored a thin deposit of the carbonate of lime on these bristles, so that their shape remained after the substance had decayed. Many of these black setæ and white filaments were examined by the microscope, and the gradations were traced from the finest hairs up to great knots and tangled outgrowths.

This fungus is a new species of *Mucor*, to which I have affixed the specific name of *Stalactitis* (see Fig. 1), with the following botanical description, namely:

MUCOR *stalactitis*.—Sporangia, globose, membranaceous, dehiscent by a fissure, terminating threads; sporidia, subglobose and separating; flocci, tubular, indistinctly partitional, sometimes branching at the base, but never at the apex. Specific marks: sub-solitary threads; sporangia simple; height, one tenth to one half an inch; color, dark olive green; found on stalactites and other formations in caves; locality, Luray, Page county, Virginia.

My thanks are due to Professor D. C. Eaton, of Yale College, for aid in examining this beautiful fungus; and also to W. H. Miller, M.D., of Luray, for help in collecting specimens.

Among many examples of lateral outgrowths having fungi for starting points, a single one must suffice for description, selected as exhibiting an extraordinary result of this kind of interference. (See Fig. 2, reduced to one fourth natural size.) The distortion is so symmetrical as to argue design. From a large stalactite two tendrils have grown, which we are sure, from careful examination, did not originate with crystals, but with fungi. The trickling lime water was arrested by them in its descent along the surface, and made a thin deposit, which was increased until the projections caught calcareous drippings falling directly from the roof of the cave. A structure was thus built up, of considerable magnitude compared with its slender support, and in which the ordinary relations of stalactite and stalagmite are interchanged, the stalagmite being uppermost.

Luray Cavern continually yields new discoveries of surprising beauty as the reward of perseverance. Explorations have been lately pushed through a long corridor, having a central row of stalagmites running through its entire length, leading from Stonewall Avenue into a splendid hall, about 100 feet in diameter and equally high. It is located, according to our topographical examination, under a sink observed about 100 yards southwest of the mouth of the cave, and within 200 yards of the entrance to Ruffner's Cave at the summit of the hill. We daily expect to hear of the discovery of some communicating passage between these two caverns. There are proofs that the Indians explored these hidden recesses by some other means than the present entrance.

One day we mounted the huge masses of dripstone, near the Double Column, by means of a ladder. Then creeping a long distance, unwinding a ball of twine as a clew by which to return, and breaking hundreds of delicate stalactites that it seemed a pity to disturb, but that barred our way, we emerged on an eminence, whence with some difficulty we descended into a deep ravine. This locality was thought to be the furthest point from the entrance, so far as known. And there, by digging with our knives in the dry bed of an old torrent, we unearthed an arrowhead and a quantity of charcoal. At a later day a party found moccasin tracks near the Double Column, covered by shallow water and incrusted by a thin coating of lime.

In a gulch near the Imperial Spring human bones are visible, including a jaw with three tooth sockets, the femur, the tibia, and the ribs, the latter fractured. The remainder of the skeleton is concealed under dripstone, for whose formation several centuries must have been required.

The conclusion that these are Indian remains would no doubt be confirmed by skillful exhumation, especially should any weapons or ornaments be thus brought to light. The unlucky adventurer, apparently a youth less than 18 years of age, is supposed to have lost his way amid the darkness, and to have fallen from the cliff at whose base his bones now lie entombed in alabaster.

We found in all parts of the cave vestiges of former occupants of the humbler forms of life, and especially observed thousands of tracks once made by rats, rabbits, raccoons, and wolves. In one locality we pursued bear tracks to a spot where bruin had left long scratches on a stalagmite not yet healed over. All these impressions looked fresh, but could not have been so, for it is years since any wild beasts have appeared in the vicinity. Marks in the tenacious clay might remain unchanged for centuries.

Various layers of excrementitious matter were noticed, and also many small bones of mice and bats, along with casts of worms. A few large bones have been gathered up, but not yet identified. We recognized the skeleton of a squirrel, the jaw of a raccoon, the jaw and teeth of a large carnivore (possibly a panther), the skull of a wolf, and the skull of a deer that was probably dragged in from above, as it was gnawed by rodents. All the animal remains thus far met with are geologically recent, although the cavern itself must be older than the Tertiary period.

Scientific cave digging has not yet been begun at Luray. This would require a thorough breaking up of the stalagmitic floor down to the solid limestone, followed by an exhaustive examination of the contents in vertical slices. The process need not injure objects of general interest, if limited to portions not now open to the public; and it would almost certainly be rewarded by valuable archæological discoveries.

The list of living fauna is meager, including one rabbit, twenty bats, and numerous small black spiders. The latter were probably brought in with the lumber and other material used in making walks and stairways.

It was taught by Agassiz, and has long been the popular notion, that the various forms of aquatic life existing in caverns were originally created within the limits over which they now range and with the structural peculiarities now belonging to them. But it is doubtful if there is more variability than can be explained by supposing simple retardation through successive generations. For example: the well-known *Amblyopsis spelæus* has congeners enjoying perfect vision. Cave rivers contain fish with eyes, with sightless eyes, with mere protuberances instead of eyes, and finally those destitute of even rudimentary visual organs. Gradations of color and osseous structure correspond. It is certain, moreover, that subterranean streams feed open rivers, with which many of them are so connected, at high water, as to be easily replenished by familiar fluviatile forms.

Were the old hypothesis correct, we ought to find living objects in the pure and wholesome waters of the Luray Cavern. But, so far as we could learn, those beautiful basins, transparent as air, and lined with white crystals, so that every portion is clearly visible, are totally uninhabited, however broad and deep; and the sole assignable cause for such remarkable barrenness is their isolation from outer streams.

Only six very small gravel-cut domes were found. They are located in Stebbins Avenue, and they seem but copies, on a greatly reduced scale, of those lofty domes of the Kentucky caves that cut clear through from the soil to the drainage level. Yet the cavern floors are traceable, and we satisfied ourselves of the existence of four distinct tiers. The vertical distance from the highest gallery to the lowest pit is about 220 feet. Basins are found at every altitude; all filled by percolation. Our visit was just after very heavy rains, and the walls were everywhere dripping, but no running streams appeared, although dry torrent beds are common. These all belong to the ancient history of the cave.

There is an extraordinary rift near Brodus Lake. We traced it for over 500 feet. Its width varies from 1 to 2 feet, and it seems to have been caused by the settling of the rocks in consequence of having been undermined. Interiorly it slants at an angle of 30° from the perpendicular. Campbell, who is a daring climber, had already, as he informed me, descended by the aid of a rope 50 feet long till the end of it was reached, without touching bottom. In my company two other trials were made at more favorable points, and without a rope; but in each instance the edge of a pit was reached, whose depth was not ascertained, but was thought to be not more than 20 or 30 feet.

Could this lowest floor of all be reached, which must in the nature of the case be nearly down to drainage level, we anticipate the discovery of running streams containing fish, crustacea, and fresh water algæ; and we confidently predict that, allowing for retardation, they will be found to resemble species now existing in the Shenandoah river and its tributaries.

SOME RECENT INVENTIONS.

An improved process of hardening, toughening, and increasing the homogeneous character of metal castings and alloys, has been patented by N. W. Williams, of Philadelphia, Pa. It consists in applying to the surface of the molten metal pieces of horn or other analogous material.

A barbed wire or cable for fences, having a new form of double or interlocked barb, invented by Mr. Joseph Winterbotham, of Joliet, Ill., has double pointed barb sections, bent in a peculiar manner and combined with a duplex cable, so that the barbs cannot loosen or become detached.

An improvement in rubber horseshoe pads, patented by William A. Taylor, of Washington, D. C., has a beveled flange that projects down inside of the shoe to avoid balling, and it is capable of being expanded to suit the size of the hoof.

An improvement in suspenders, which provides for supporting both pantaloons and drawers, or pantaloons and overalls, invented by Mr. William A. Miller, of Martinsville, Ill., is contrived so that both garments will be supported properly without liability to disarrangement.

An improved roofing tile, in which provision is made for rendering the joints secure, has been patented by Mr. Edwin Bennett, of Baltimore, Md. This tile is diamond-shaped, and has marginal ribs at its two upper edges, and is provided with downwardly projecting ribs at its two lower edges for engaging the upper ribs of the adjacent tile; it also has a channel which constitutes a rib seat, and is entirely covered by the tile which overlaps it.

A simple and sure fastening for hames has been patented by Mr. Joseph Frank, of New York city. It consists in the combination of hook plates and a lever for throwing one of the plates into engagement with the other, and a spring-action catch for retaining the lever.

What to Do in Cases of Diphtheria.

From the Circular of the Massachusetts State Board of Health.

In the first place, as diphtheria is a contagious disease, and under certain circumstances not entirely known, very highly so, it is important that all practical means should be taken to separate the sick from the well. As it is also infectious, woolen clothes, carpets, curtains, hangings, etc., should be avoided in the sick room, and only such materials used as can be readily washed.

All clothes, when removed from the patient, should be at once placed in hot water. Pocket-handkerchiefs should be laid aside, and in their stead soft pieces of linen or cotton cloth should be used, and at once burned.

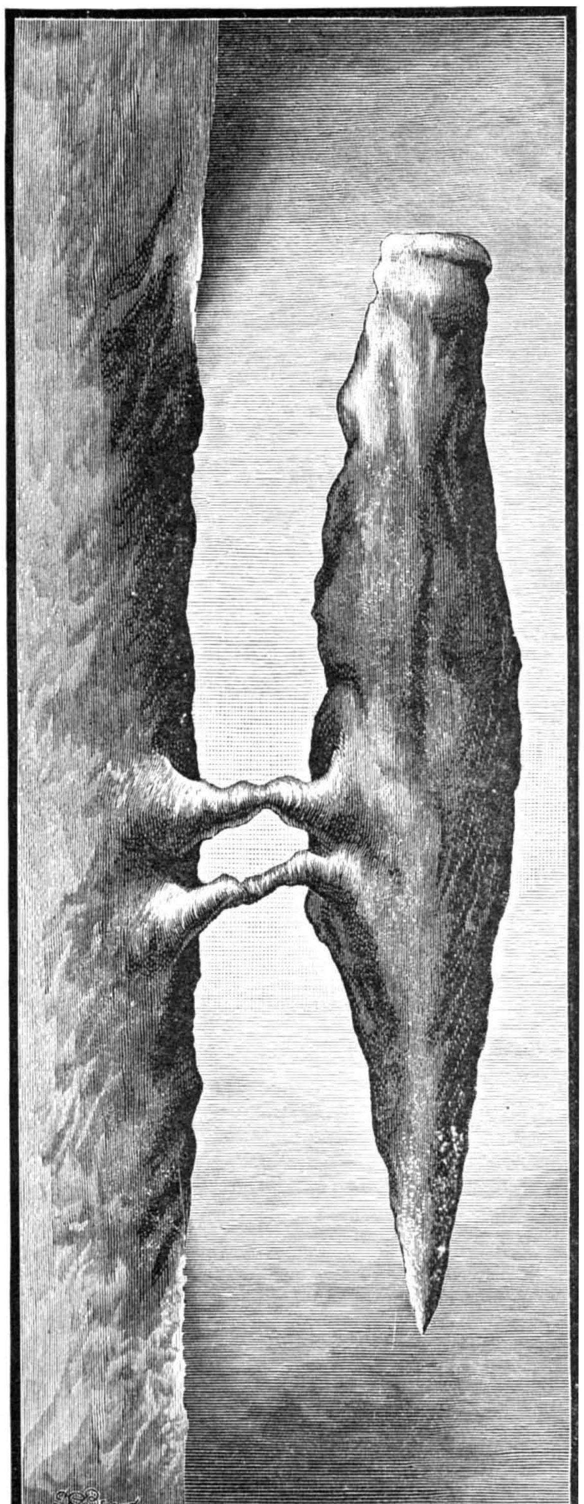


Fig. 2.—CURIOUS STALACTITE GROWTH.—FROM LURAY CAVERN.

Disinfectants should always be placed in the vessel containing the expectoration, and may be used somewhat freely in the sick room; those being especially useful which destroy bad odors without causing others (nitrate of lead, chloride of zinc, etc.). In schools there should be especial supervision, as the disease is often so mild in its early stages as not to attract common attention; and no child should be allowed to attend school from an infected house, until allowed to do so by a competent physician. In the case of young children, all reasonable care should be taken to prevent undue exposure to the cold.

Pure water for drinking should be used, avoiding contaminated sources of supply; ventilation should be insisted on, and local drainage must be carefully attended to. Privies and cesspools, where they exist, should be frequently emptied and disinfected; slop water should not be allowed to soak into the surface of the ground near dwelling houses, and the cellars should be kept dry and sweet. In cities, especially in tidal districts, basins, baths, etc., as now connected with drains, should never communicate directly with sleeping rooms.

In all cases of diphtheria, fully as great care should be taken in disinfecting the sick room, after use, as in scarlet fever. After a death from diphtheria, the clothing disused should be burned or exposed to nearly or quite a heat of boiling water; the body should be placed as early as practicable in the coffin, with disinfectants, and the coffin should be tightly closed. Children, at least, and better adults also in most cases, should not attend a funeral from a house in which a death from diphtheria has occurred. But with suitable precautions it is not necessary that the funeral should be private, provided the corpse be not in any way exposed.

Although it is not at present possible to remove at once all sources of epidemic disease, yet the frequent visitation of such disease, and especially its continued prevalence, may be taken as sufficient evidence of insanitary surroundings, and of sources of sickness to a certain extent preventable.

It should be distinctly understood that no amount of artificial "disinfection" can ever take the place of pure air, good water, and proper drainage, which cannot be gained without prompt and efficient removal of all filth, whether from slaughter houses, etc., public buildings, crowded tenements, or private residences.

Manufacturers' Troubles in England.

A correspondent writes to the *Kidderminster Shuttle* the following account of great ingratitude on the part of some weavers employed at one of the carpet manufactories in Stourport. An important order was received by a firm for immediate execution, and a short time before Christmas information was received that the carpets ordered were urgently wanted. The manager saw the weavers engaged on the order, and urged them to lose no time in the completion of the work, and asked them to work overtime. The men informed the manager that it was against the rules of the association of which they were members to work overtime; and, as there appeared no possibility of the order being completed by the time required, the manager set several young men on some looms to work overtime, and by this means the order was duly executed. The firm, with the view of preventing any bickerings among the men, allowed the weavers engaged on the order to charge full price for all the carpet woven by the young men, while the firm paid the youths handsomely for all the overtime made by them. A few days after the men had received the money earned by the youths a deputation of weavers waited upon the principal of the firm, and protested against the employment of the youths on the looms, and, in addressing his employer, one of the deputation urged that if the person ordering the carpets wanted the order executed in such haste, he should have distributed the order among the several firms in the town!

Large Libraries.

By far the largest library in the world is the National Library at Paris, which in 1874 contained 2,000,000 printed books and 150,000 manuscripts. Which the next largest is, it is difficult to say, for the British Museum and the Imperial Library of St. Petersburg both had in 1874 1,100,000 volumes. After them comes the Royal Library of Munich with its 900,000 books. The Vatican Library at Rome is sometimes erroneously supposed to be among the largest, while in point of fact it is surpassed, so far as the number of volumes goes, by more than sixty European collections. It contains 105,000 printed books and 25,500 manuscripts. The National Library at Paris is one of the very oldest in Europe, having been founded in 1350, while the British Museum dates from 1753, or a time more than 400 years later. In the United States the largest is the Library of Congress at Washington, which in 1874 contained 261,000 volumes. The Boston Public followed very closely after it with 260,500 volumes, and the Harvard University collection came next with 200,000. The Astor and Mercantile, of New York, are next, each having 148,000. Among the colleges after Harvard's Library comes Yale's with 100,000. Dartmouth's is next with 50,000, and then come in order Cornell with 40,000; the University of Virginia with 36,000; Bowdoin with 35,000; the University, of South Carolina, with 30,000; Ann Arbor, 30,000; Amherst, 29,000: Princeton, 28,000; Wesleyan, 25,500; and Columbia, 25,000.

Australian Letters.

E. C. H., Sydney, N. S. Wales, writes: It would be well for all American correspondents to know that unless their letters, etc., addressed to Australasia are marked "via San Francisco," they are sometimes sent by other routes, causing much trouble and annoyance to the recipient. E. C. H. knows several cases where circulars in a sealed envelope have been charged from 40 to 60 cents on delivery in Sydney, because they were received "via Brindisi," no route being marked on the envelope.

The Egg Trade.

The traffic in eggs in this country is estimated by competent authorities to equal $180,000,000 a year. The barreled eggs received yearly at New York reach over 500,000 barrels, valued at $9,000,000, and this is but one branch of the trade. It is said that Philadelphia consumes 80,000 dozen eggs a day. The receipts in Boston for the year 1878 were over 6,500,000 dozen. Between 5,000,000 and 6,000,000 dozen are annually exported from the country. The millions of dozens consumed throughout the country without passing into dealers' hands, it is impossible to estimate.

TO INVENTORS.

An experience of more than thirty years, and the preparation of not less than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. In addition to our facilities for preparing drawings and specifications quickly, the applicant can rest assured that his case will be filed in the Patent Office without delay. Every application, in which the fees have been paid, is sent complete—including the model—to the Patent Office the same day the papers are signed at our office, or received by mail, so there is no delay in filing the case, a complaint we often hear from other sources. Another advantage to the inventor in securing his patent through the Scientific American Patent Agency, it insures a special notice of the invention in the SCIENTIFIC AMERICAN, which publication often opens negotiations for the sale of the patent or manufacture of the article. A synopsis of the patent laws in foreign countries may be found on another page, and persons contemplating the securing of patents abroad are invited to write to this office for prices, which have been reduced in accordance with the times, and our perfected facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN.

NEW BOOKS AND PUBLICATIONS.

GREAT INDUSTRIES OF GREAT BRITAIN. Vol. 1. Illustrated. London and New York: Cassell, Petter & Galpin. $3.

A handsome volume, devoted mainly to the popular description of the industries based on cotton, hemp, flax, jute, wool, and worsted, iron and steel, and shipbuilding, with well written descriptions of the leading English establishments devoted to each. In addition the well known biographer Robert Smith tells the life story of several eminent English manufacturers; Mr. Fox Bourne discusses the conditions and prospects of foreign rivalry with English mining and manufacturing industries; Dr. Gordon Hogg, late Senior President of the Royal Medical Society of Edinburgh, has three papers in relation to health and disease in industrial occupations; and Mr. James Henderson, assistant inspector of factories, discusses the factory system and other phases of industrial legislation. Though prepared especially for English readers this work will be found instructive as well as entertaining to all interested in great industries everywhere.

THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC for 1879.

This excellent little annual is now before us, brimful of valuable information for the photographer and all who are interested in the progress of this most useful art. All the new photo processes and improved formulæ brought to light during the past year are here given together with hundreds of recipes, hints, diagrams of new instruments, scientific information concerning light-colors, illumination, and many other appropriate subjects. Edited by J. T. Taylor. New York. E. & H. T. Anthony, Broadway, New York.

Notes & Queries

(1) R. J. F. writes: 1. I have some carbons and porous cups of an old Leclanche battery. What shall I do to prepare them for use in a bichromate battery? A. Soak them a day or so in warm water. 2. In the SCIENTIFIC AMERICAN SUPPLEMENT of February 8, No. 162, on page 2577, there is described an electric light under this head, "No. 29, A Simple Electric Light." Please give me the size of the carbon used. A. One sixteenth inch diameter, three quarters inch long. 3. How shall I reduce the size of a piece of carbon if it is too large? A. File it or grind it. 4. It was also stated under that head that the person used 3 or 4 cells of a bichromate battery. How many cells of a Watson battery would be needed to do the work? A. 12 probably.

(2) J. H. P. writes: I am building a steam yacht after plans taken from your paper, and I wish to ask of what quality of iron should the boiler be made to stand the Government inspection. A. The rule of the United States Inspectors is as follows: "Every iron or steel plate intended for the construction of boilers to be used on steam vessels, shall be stamped by the manufacturers in the following manner, namely: At the diagonal corners, at a distance of about four inches from the edges, and also at or near the center of the plate, with the name of the manufacturer, the place where manufactured, and the number of pounds tensile strain it will bear to the sectional square inch."

(3) R. G. asks: 1. Can you give me the best method of setting buggy axles? A. You should consult some good treatise on the subject, as any instructions that we could give you in our limited space would be of little service. 2. Give a good mixture for welding plowshares. A. Mix the powdered borax with 8 or 10 per cent of finely powdered quartz sand or flints, or what is better, dry powdered water glass—silicate of soda—and a little powdered charcoal, lampblack, or argol.

(4) C. W. L. writes: 1. I have a small engine, and wish to use a cast iron or rather an iron casting 8½ inches diameter by 9 inches height, three sixteenths of an inch thick. How much pressure would you risk to the square inch? A. If, as we suppose, you refer to a boiler, we would not be inclined to take any risk with one of that kind. 2. Describe a small pump to feed above with. A. You do not send sufficient data. 3. If I use a small round dish of iron lined with asbestos, and saturate it with kerosene, is there any danger of explosion while burning? A. With ordinary care, no. 4. Do all the small yachts and propellers used by private individuals for pleasure, etc. (the same as one would use his horse and buggy, not kept for hire or used as a money making concern), have to be inspected by the United States Inspectors, carry a full complement of life preservers, buckets, etc., and have their men licensed? A. Yes.

(5) S. writes: 1. The area of a pipe is 0·010 foot, what is the diameter of same in inches? A. 1·354 inch. 2. Give formula for reducing the area of circles in feet to the diameter in inches. A. Divide the area by 0·7854, and multiply the square root of the quotient by 12.

(6) J. R. L. writes: We want to put up a steam engine on the table land, 40 feet from the brow of the hill. The spring from which we must get water to supply the boiler is about 40 feet below, at an angle of 45 degrees. What is the best method and machinery to raise the water that height and distance? A. If you have enough water, you can use a hydraulic ram. But if this is impracticable, use a steam pump, or place a force pump at the foot of the hill and drive it with a wire rope.

(7) W. H. F. asks: What is the horse power of an engine with 9 inches cylinder, 14 inches stroke, 100 lbs. mean pressure, making 350 revolutions per minute? Working by a rule given in the AMERICAN of January 4, I find it to be 157 horse power. Am I right? A. Your answer is correct.

(8) C. R. G. asks: What is the best material for covering a 2½ inch steam pipe and a 1½ inch return pipe, each about 100 feet long, passing through a cold cellar to a radiator in the room above? Would there be any saving of steam in having them covered? A. You will effect a saving by covering both pipes. There are numerous coverings in the market that answer well. We refer you to our advertising columns.

(9) I. W. S. asks who was the inventor of the Monitor. A. The question is in dispute, but the credit is usually given to a Mr. Timby.

(10) "Engine" asks: Can I acquire a knowledge of mechanical engineering by home study, and what books and time are required to accomplish it? A. We think it is very doubtful whether you can become proficient without some practical experience in the shops and elsewhere.

(11) E. L. W. asks: What is the best thing to put on a steam boiler to make it look well and prevent rusting? A. A black varnish made from petroleum.

(12) "Reader" asks whether the car wheels made of *papier mache* have a metallic tire? A. Yes.

(13) J. W. asks: What is the average weight of English locomotives, also the heaviest used there? A. They are made as heavy as 70 tons or more. Average weight, between 40 and 50 tons.

(14) J. H. asks: What is the pressure of lake water to the square inch at a depth of 25, 50, 100 feet, etc. A. The pressure is about 0·433 lb. per square inch for each foot of depth. 2. How many cubic feet of air must an iron box or chest, weighing 3 tons or 60,000 lbs., and closed on all sides, contain, in order to keep one sixth of its bulk floating above water and five sixths submerged below water? A. The data are insufficient. The box will float as specified, when it has such dimensions that five sixths of its volume will displace an amount of water equal to the total weight of the box. 3. Where may I obtain an account of the various kinds of diving armor and appliances used in submarine work? A. You will find accounts of some of the appliances in any good encyclopedia, but you can probably obtain full particulars by addressing manufacturers.

(15) G. C. E. writes: I use a 2½ inch stream of water for condensing purposes, but as I take it from a brook, in the summer months I do not get the condensing power necessary on account of the temperature. How can I reduce the temperature to about 35° or 40° in the summer? Would running it through pipes in an ice house reduce it to the required temperature? If so about what length of pipe? Iron or wood pipes? A. Use iron pipes. You do not send sufficient data to enable us to give the amount of pipe, but it would probably be sufficient if it encircled the ice house once or twice. Unless you have abundance of ice, however, we do not think this plan is advisable.

(16) M. R. asks: 1. What thickness of granite should be used in a bank vault to make it fire-proof? The building is a two story brick, situated on a corner. A. From 18 to 24 inches. 2. Is there any other stone that furnishes more fireproof protection than granite? If so, what is it? A. We think not.

(17) A. C. G. asks how India rubber hand stamps are manufactured. A. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 83.

(18) S. B. G. asks: 1. How is it determined whether snakes can hear? A. By observation. 2. If they can hear, do they heed? A. Yes. 3. It is said that the birds of the northern climate go south in the fall; if they do, are there not more birds in the south in the winter than in the summer? A. Yes. 4. Which is proper, eighteen hundred and seventy-nine, or eighteen hundred seventy-nine? A. Both.

(19) H. J. B. asks: What kind of black paint is on the ordinary tin thermometers, and how is it put on? A. Asphaltum, one half pound; melt, then add hot balsam of copaiba, 1 pound; thin with turpentine oil, apply with a soft brush, and bake for some time in a japanner's oven. Repeat the operation several times if necessary, and finally rub with a soft cloth and a trace of oil.

(20) B. F. M. asks for a formula for preparing a good mucilage for pasting papers. Can you recommend anything better than gum arabic mucilage for pasting manifests and way bills into scrap books made of manila paper? A. Rice or starch paste is better. The following is well recommended: 4 parts (by weight) of fine glue are allowed to soften in 15 parts of cold water, and then moderately heated until the solution be comes quite clear; 65 parts of boiling water are now added, with constant stirring. In another vessel 30 parts of starch paste are stirred up with 20 parts of cold water, so that a thin, milky fluid is obtained without lumps. Into this the boiling glue solution is gradually stirred, and the whole kept at a boiling temperature for a short time. After cooling, a few drops of carbolic acid are added to the paste. This paste is exceedingly adhesive, and may be used for leather as well as for paper and cardboard. It should be preserved in corked bottles to prevent evaporation, and in this way will keep good for years.

(21) E. R. T. writes: I use an Argand burner, and though the wick fits apparently tight, when I suddenly turn it up or down, while burning, a blue blaze appears in the bowl of the lamp, though no explosion has ever occurred. This happens when the lamp is half full. I never allow it to get any lower. By moving the lamp backward and forward quickly, the oil extinguishes the blaze, though I consider this a dangerous experiment. Sometimes the blaze will shoot out the top of the chimney, and at the same time go down the wick into the bowl of the lamp, on turning it down quickly. A. From your statements it would appear that the oil used is not safe. Place the bulb of a good thermometer in a small cup nearly filled with a sample of the oil, and suspended in a large vessel containing water. Gradually heat the water, apply a lighted taper to the oil, and note on the thermometer at what degree the oil flashes (*i. e.*, the temperature of the oil at the moment it begins to give off inflammable vapors). Good oil under these conditions should not flash below 120° Fah.

(22) N. O. M. asks: 1. Which of the various "Stubs" or "Stubbs" firms is the standard one, as there seem to be at least two or three concerns of that name? I would like to know the "original." A.—P. S. Stubs, we believe. 2. Also, what will remove paint or varnish stains from ground glass doors? A. Warm concentrated alcoholic solution of caustic potash will quickly soften paint or varnish so that it may be readily removed by washing with warm water. Remove as much of the paint as possible with the knife blade before applying the alkali. The latter must not, of course, be allowed to come in contact with the woodwork or hands.

(23) A. M. D. asks: 1. For an easy and cheap way of tracing patterns for scroll or net work, without using a pencil. A. Place carbon paper between the pattern and the wood, and trace the design with a stylus. 2. Also to prevent the fret saws from breaking easily when working in the machine. A. Use a good machine, good saws, and exercise care.

(24) F. W. I. asks: Does a rapidly moving train cause a greater strain on a bridge than one moving slow. If so, why? A. Yes, because the motion of a train produces a series of blows on the rails.

(25) A. N. M. writes: I am preparing to construct a dynamo-electric machine according to the drawings in No. 161, SCIENTIFIC AMERICAN SUPPLEMENT. Will you answer the following questions, namely: 1. Should the brass caps at the ends of the armature play just within the electro-magnets, or just without? A. Just without. 2. What amount of each of the Nos. 14, 16, and 18 wire will be needed? A. 2 or 3 feet of No. 14, about 5 lbs. of No. 16, and ½ lb. of No. 18. 3. Should the vulcanite for the commutator be hard, or soft and yielding? A. It should be hard. 4. Can the electro-magnets be wound with separate wires and the wires united with a joint, or should they be wound with the same wire without a break? A. You can wind the two parts of the magnet separately, and unite them after they are fixed to the base. 5. Again, what is the force of the word "excess" as used in chemistry and medicine? I consider that it means a little more than enough of an acid to neutralize an alkali, or the reverse. Am I correct? A. Yes. 6. What is the meaning of gtt. of ss. and A in medicine or chemistry? A. Gtt. or gtt., gutta or guttæ, drop or drops; ss., semis, half; Ā or ā, Ana (Greek ἀνά), of each the same quantity. The expressions are not used in chemistry, but in medicine.

(26) W. N. C. asks what there is (other than sal soda) that can be held in solution with water,

which will prevent small threaded articles of bright iron or steel wire from rusting or turning in color, by immersing therein, when the finished surface of said articles are broken. A. Try water glass or borax.

(27) N. Q. P. asks: How many ways are there for propelling water vessels? What is meant by screw steamer? A. Screw propellers, immersed paddle wheels, partly or wholly under water, water jets, paddles, oars, and their equivalents, have been used. A screw steamer is one that is fitted with a screw propeller.

(28) G. N. F. asks: 1. Can I make a permanent earth battery to supply a current of electricity for an electric light equal to that of two kerosene lamps? A. An earth battery is not suited to the electric light. 2. Will you give me the name of some good works on physics? A. Ganot's Physics is a good elementary work. 3. Are there any books published, containing lectures on various subjects, such as would do to read at a lyceum? A. You may obtain such books as you require from any of the dealers who advertise in our columns.

(29) A. B. P. writes: I am making a shocking machine: 1. Can I use iron wire in making induction coil? A. Not to advantage. 2. What size wire must I use for making the little magnet for breaking the current? A. The same as you use for your primary, probably No. 18 would answer. 3. Is it necessary for the U to be hollow? A. No. 4. Must the current be broken between the battery and the induction coil? A. Yes. 5. Will 3 or 4 quart jars, of zinc and copper and sulphuric acid, be strong enough? A. Yes. 6. Can I use charcoal and zinc for making a battery? Would it be better than copper and zinc? A. Copper and zinc are the best.

(30) M. V.—For ink receipts see Scientific American Supplement, No. 157.

(31) J. H. S.—You will find an explanation of the wagon wheel problem, on p. 394, of vol. 39, Scientific American.

(32) J. J. asks for a formula for silver solder. A. Fine—Silver, 66·6; copper, 23·4; zinc, 10. Common—Silver, 66·6; copper, 30; zinc, 3·4. See soldering in Scientific American Supplement, No. 20.

(33) E. F. K. writes: I intend to erect works which need a chimney 55 or 60 feet high, the draught of which must be quite strong. A brick chimney costs much more than an iron one. Will the draught of the brick chimney be the strongest? A. Yes, but there will not be a great difference. 2. How long will the iron chimney last, the heat but no fire reaching it? A. A number of years, if properly painted and cared for.

(34) D. J. C. writes: 1. In a little volume entitled "Familiar Science" I notice the following question and answers: "Q. Why does the sun, in shining upon a fire, make it dull, and often put it out? A. Because the air (being rarefied by the sunshine) flows more slowly to the fire; and 2d, even that which reaches the fire affords less nourishment; and 3d, sunshine also produces some chemical effect upon the air and fuel detrimental to combustion." What is your opinion of the above? A. We do not think sunlight ever put out a fire. Its superior brightness will undoubtedly make the fire look dull. The difference in the heat of a fire with and without sunlight must be infinitesimal, if anything.

(35) J. R. asks: 1. Do iron shipbuilders use cast iron rivets to rivet the outside plates on vessels? A. No, the best wrought iron is used. 2. What is the correct focal distance for the lens of a camera, the distance from the lens to the back being fourteen inches? A. 14 inches.

(36) G. L. G. writes: 1. I have my house and another (¼ mile distant) connected with the Bell telephone, which works without a battery. Is there any kind of arrangement that will increase the sound? A. If the telephones are well made and properly adjusted, we know of no way to increase the sound. 2. I have made a microphone according to directions, Fig. 5, Scientific American, No. 20, vol. 39, but cannot make it work. A. If carefully made according to description it should work.

(37) J. R. D. asks: What power would be required to run a vertical sawmill, say in sawing an oak log 2½ feet through, feeding ¼ inch? What speed, in strokes per minute, would be most profitable? What power is required to saw the same log with a circular saw? What would be the effect if an 18 inch circular saw were run at a rate of 10,000 revolutions per minute, not considering the liability of bursting? Would it cut? A. Running either saw so as to cut the same amount of lumber in a given time, there would probably be little difference in the power required, but as the saws are usually run, you could do good work with the vertical saw, 150 to 200 strokes a minute, with from 10 to 15 horse power, when you might require from 20 to 30 horse power for the circular saw. The circular saw would cut well at the speed stated.

(38) A. E. J. asks: What is meant by squaring the circle? A. Finding the side of a square whose area is exactly equal to that of the circle: in other words, doing what is impossible.

(39) G. C. M. writes: Please inform me of the greatest depth that a diver was ever known to go down at sea in a bell or diver's suit, also the depth that they generally like to go. A. The ordinary depth is from 30 to 40 feet, but the greatest diving feat which we have seen recorded is that of a diver named Hooper, who, in removing the cargo of the ship Cape Horn, wrecked off the coast of South America, made 7 descents to a depth of 201 feet, and at one time remained down for 42 minutes.

(40) J. N. M. writes: Suppose a loaded wagon should be weighed on scales in perfect balance, then the empty wagon weighed on same scales, would the net weight of the load be the same if the scales had been out of balance? A. No, as we understand your meaning.

(41) D. J. asks: 1. What is the average expansion per degree C. of soft brass rod or wire from 32° to 50°, from 50° to 70°, and from 70° to 100°? A. Brass expands lengthwise 0·000018782, for each degree between 0° and 100° centigrade. 2. A current from a galvanic battery traverses a wire to other apparatus 100 feet distant and return. If the wires to and from the remote apparatus be properly covered and insulated, and then united together in a single cable, will the effect of the battery on an electro-magnet be materially less than when the two wires are separated from each other? A. No.

(42) R. S. asks: 1. Will mercury put in melted zinc volatilize? A. The mercury will volatilize. 2. Would the fumes be liable to salivate a person? A. Yes. 3. How is galvanizing (so called) done? A. The metal to be galvanized is first cleaned by pickling in dilute sulphuric acid, and scouring with sand if necessary, passed through a strong slightly acid bath of zinc chloride, and from this directly into and through the bath of melted zinc, covered with sal ammoniac.

(43) J. A. F. writes: I have a thrashing engine of the following dimensions: Cylinder 7 inches in diameter, stroke 10 inches, speed 200 revolutions per minute, cutting off at four fifths stroke, using steam at 60 to 80 lbs., size of steam pipe 1¼ inch, size of exhaust pipe 1½ inch, size of blast nozzle 1 inch, slide valve, Pickering governor. Dimensions of fire box, 36 inches long, 19 inches wide, to 31 inches high, boiler 24 inches waist, with 26 2-inch flues 66 inches long, with locomotive smoke stack 7½ inches in diameter, fitted with disk and screen spark arrester. I am running a thrasher with the above engine, with 36 inch cylinder, and 51 inches separator, and some of the time am short of power. I have consulted boiler makers in regard to lengthening the fire box about 8 or 10 inches. Would the flues and smoke stack be sufficient? Could I improve it by using a smoke stack 8 or 10 feet long (present stack 3½ feet long)? How much gain in power would there be by covering the boiler with some good material? Is the engine using steam economically, and are the proportions proper to get the best results? A. The engine seems to be fairly proportioned. You might make a saving of between 5 and 10 per cent by covering the boiler. If the draught is good, there would be no material gain realized by raising the smoke stack. Instead of increasing the length of fire box, it would be better, if practicable, to change the point of cut off to half stroke, and increase the speed of the engine. You do not send sufficient data to enable us to form an opinion in regard to the economy of performance.

(44) C. C. D. asks (1) for the best method of softening iron to be used in making electro-magnets. A. A good quality of soft bar iron does not require annealing for ordinary electro-magnets. Iron may be annealed by heating it cherry red and plunging it into powdered quicklime and allowing it to remain until cool, or it may be thrown on a fire and allowed to cool as the fire dies out. 2. What is the best No. of covered wire to use in making an electro-magnet? A. It depends on the battery power to be used, and upon the purpose to which the magnet is applied. If you use it merely for experimental purposes, No. 18 will probably answer.

(45) A. E. S. asks: What is understood by soft iron core for magnets? Is it wrought or cast iron? A. It is the portion around which the helix is wound. It is usually of wrought iron, but soft gray iron castings are often used.

(46) A. H. S. asks: Does the gas of coal or coke injure steel when heated in the flame so as to prevent a fine spring temper. If so, which is better? A. For fine work a charcoal fire is better than an anthracite or coke fire.

(47) M. F. H. asks: Why do axes break more frequently in cold weather than in warm? Is there frost in the steel, or is the wood harder to cut? A. Steel is rendered more brittle by cold, and the wood, if green, is undoubtedly harder to cut when frozen.

(48) E. A. H. asks: What is a good receipt for dyeing woods black to imitate ebony? A. See Scientific American, vol. 39, p. 411 (2).

(49) Engineer asks if brass or bronze shafts will run as well in cast iron bearings as cast iron shafts will run in brass or bronze bearings; that is, will the wear and friction be the same, and will they be equally good at work—in neither case to be overloaded? A. Yes.

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

J. H. B.—It is stibnite—a sulphide of antimony, which affords nearly all the antimony of commerce. Antimony is quoted in New York at 12 cents. This ore contains nearly 70 per cent of the metal.—C. K.—No. 1. A silicious limestone. It will probably make a fair hydraulic lime. The small fragment is quartz. No. 2. Chiefly lime carbonate. No. 3. Calciferous sandstone containing much iron.—W. S. B.—Clay slate, mica schist, and iron pyrites—iron sulphide—not valuable.

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COMMUNICATIONS RECEIVED.

The Editor of the Scientific American acknowledges with much pleasure the receipt of original papers and contributions on the following subjects:

On Aerial Navigation. By F. B.
Signaling. By T. H. H.
On the Collisions at Sea. By P. O. P.
On the Significance of the Popular Interest in the Electric Light. By T. F. D.
On the New Patent Law. By L. F.
On the New Patent Law. By L. D. N.

HINTS TO CORRESPONDENTS.

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

Many of our correspondents make inquiries which cannot properly be answered in these columns. Such inquiries, if signed by initials only, are liable to be cast into the waste basket.

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

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

January 28, 1879,

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