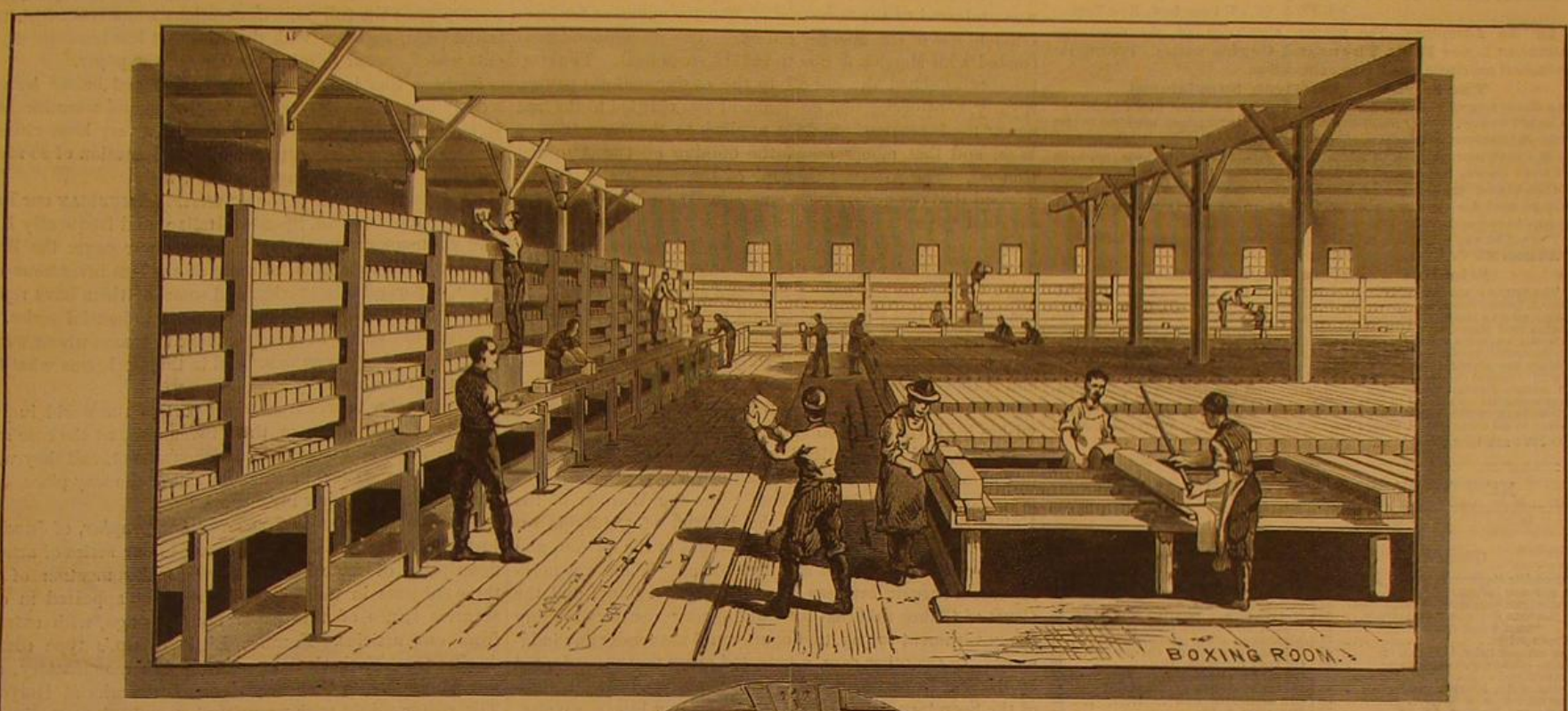
SCIENTIFIC AMERICAN

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

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

Vol. XLIII.—No. 3. [NEW SERIES.] NEW YORK, JULY 17, 1880 [$3.20 per Annum. [POSTAGE PREPAID.]



STARCH MAKING.—MANUFACTORY OF T. KINGSFORD & SON, OSWEGO N. Y.

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

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

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

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year postage included $3 20
One copy, six months, postage included 1 60

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis for every club of five subscribers at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

Remit by postal order. Address
MUNN & CO., 37 Park Row, New York.

☞ To Advertisers.—The regular circulation of the SCIENTIFIC AMERICAN is now **Fifty Thousand Copies** weekly. For 1880 the publishers anticipate a still larger circulation.

The Scientific American Supplement

Is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, postage paid, to subscribers. Single copies, 10 cents. Sold by all news dealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, postage free, on receipt of *seven dollars*. Both papers to one address or different addresses, as desired.

The safest way to remit is by draft, postal order, or registered letter. Address MUNN & CO., 37 Park Row, N. Y.

Scientific American Export Edition.

The SCIENTIFIC AMERICAN Export Edition is a large and splendid periodical, issued once a month. Each number contains about one hundred large quarto pages, profusely illustrated, embracing: (1.) Most of the plates and pages of the four preceding weekly issues of the SCIENTIFIC AMERICAN, with its splendid engravings and valuable information; (2.) Commercial, trade, and manufacturing announcements of leading houses. Terms for Export Edition, $5.00 a year, sent prepaid to any part of the world. Single copies 50 cents. ☞ Manufacturers and others who desire to secure foreign trade may have large, and handsomely displayed announcements published in this edition at a very moderate cost.

The SCIENTIFIC AMERICAN Export Edition has a large guaranteed circulation in all commercial places throughout the world. Address MUNN & CO., 37 Park Row, New York.

NEW YORK, SATURDAY, JULY 17, 1880.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 287,

For the Week ending July 17, 1880.

Price 10 cents. For sale by all newsdealers.

GOVERNMENT USE OF PATENTS.

Inventors are to be congratulated upon three recent decisions of the courts which open the way to an efficient judicial remedy for use of patents by government officers. There has been a vague idea that obtaining a patent does not protect the inventor against gratuitous use of his invention by authority of government. This view was founded upon English practice; an English patent is understood to be inoperative against the crown. But the reasons for this do not prevail in America. In this country a patent is a compact with the inventor to induce him to disclose his invention for the public benefit. In England patents are a preserved class of "monopolies"—a privilege which the sovereign is allowed to give to favored persons.

Although the right of an inventor as against government has been for some years recognized, to see how he could have a remedy has not been so easy. As long ago as 1858 a claim was preferred to the Secretary of War for payment for government use of the Sickles' cut-off. The government contracted with Merrick & Son to build a steamboat. The contractors attached the cut-off to the engine without paying royalty, considering that government was entitled to the free use of the invention. Sickles applied to the Secretary of War, and that officer asked the opinion of the Attorney General. The Attorney General of the day, Judge Black, advised that the government was equally bound with an individual to pay a royalty; and that the Secretary might pay a reasonable one *if* there were an appropriation available. This "if" gravely embarrasses the inventor's right in most cases. What he has needed has been an efficient remedy in the courts. But the courts cannot render judgment against the government for wrongs done by its officers. Nor can they enjoin the government directly from using an invention; and if they could, or could stop the use by enjoining the officers personally, this is not what the inventor wishes; he wishes his invention used and a royalty paid.

In 1863, and again in 1868, suits were argued in the Court of Claims seeking to recover royalties for government use of inventions. In the first of these cases the Warden of the United States Penitentiary in the District of Columbia set up six patented broom making machines in the prison, and employed the convicts in making brooms. There was nothing like a bargain between him and the inventor; and the Court of Claims said that for want of some contract binding the government to pay, that court could not render any judgment. In the other case, a patented army tent was adopted by the War Department and a contract was made by direction of the Secretary, with the inventor, to pay him a royalty. For reasons connected with his participation in the rebellion the payments were stopped; but on proof of the special contract he recovered judgment. Obviously these views gave no protection in all that large class of cases where executive officers were disposed to use inventions as if they were free to the government.

Three recent decisions present the subject in new aspects, and indicate the law to be that if, upon request of the inventor, an officer competent to contract for use of an invention makes use of it without payment, the Court of Claims may award compensation to the inventor upon a theory of an implied promise to pay him, while if the invention is used against the inventor's consent, or by an inferior officer or contractor, the individual thus infringing is personally liable in substantial damages, recoverable in the circuit courts. In one of the cases, Lieutenant McKeever, being the patentee of an improved cartridge box, submitted it to the War Department in the hope that it might be adopted. It was adopted. But upon the theory that government is not bound to pay royalties, none was paid to the inventor. He brought suit in the Court of Claims. That court decided that the government has not the right to use an invention, and that as the cartridge box had been submitted by the inventor to the department, the presumption must be that the government used it under an implied license and upon an obligation to pay a reasonable royalty. It could not be supposed that the inventor intended to give a gratuitous leave or that the Secretary intended a lawless infringement. A judgment for a substantial compensation founded on this theory of contract was therefore awarded.

Another suit was brought against an officer—the Postmaster of New York—who refused to enter into any contract with the inventor, believing and claiming upon English precedents that he ought not to do so. There was, therefore, no ground for a suit in the Court of Claims, but the Circuit Court held the officer personally liable for damages as an infringer. The patent in this case was for an improvement in canceling the letter stamps. It enabled the clerks to cancel the stamp on a letter by the same implement and stroke which imprinted the postmark. The device obviously diminished the time consumed in stamping letters by nearly one half; and the pecuniary saving realized in the New York office during the term covered by the suit was shown to have been $63,000. That is to say, the officer had saved, and presumably had remitted to the government at Washington, $63,000 of postal moneys, which he otherwise must have expended in paying salaries of stamping clerks. The court adjudged him personally liable for this sum to the inventor. The fact that he had paid it over to government did not protect him. The inventor was declared entitled to his damages, and the task of coaxing the money back from the Treasury was left to the Postmaster.

The third of the decisions mentioned, earlier in date than the others, applies the same principles to the simpler and easier case where certain contractors, because they were manufacturing for government, assumed to use, as they supposed government had the right to do, the complainant's invention without paying him. But the Circuit Court very promptly told them that they had no such privilege.

These decisions are subject to the ultimate approval of the Supreme Court at Washington. Should they be finally sustained they will enable an inventor to seek redress in the courts, whatever may be the way in which his invention is pirated under pretense of a use for government.

AMERICAN INDUSTRIES.—OUR ILLUSTRATED SERIES.

Not only our home subscribers, but our patrons abroad, express great satisfaction with the feature adopted by this journal, more than a year ago, of publishing illustrated articles on the prominent industries of this country. To some of our foreign contemporaries it seems to be a mystery how it is possible to gather the material and prepare for every weekly issue the full page illustrations which embellish the initial page, together with the other not less beautiful wood cuts which appear in other portions of the paper.

Nothing like it has ever been attempted before by any weekly newspaper devoted to industrial and scientific subjects, and only to a publication having a very large circulation could the expense attending the preparation of so many costly, original engravings be afforded.

From every number of the SCIENTIFIC AMERICAN our English, French, German, Spanish, Italian, and frequently Russian contemporaries, also transfer to their pages the illustrations and descriptions of some of our best inventions and more important discoveries, and some of them have reproduced the full page cuts of some of our industrial series.

This will explain to many perplexed persons whose works or machines have been described in these columns what has been to them a mystery.

They receive letters from every part of the world inquiring about their wares or their inventions, as the case may be, often in a language they understand not, and they wonder how the writer, in such an out-of-the-way place, ever heard of them or their inventions.

The London *Printing Times and Lithographer*, of June 15, just received at this office, referring to our series of articles descriptive of American industries, makes mention of the three subjects in their special line which appeared in consecutive issues of this paper not long ago, with extracts from our articles. Farmer, Little & Co.'s type casting works; Geo. Mather's Sons printing ink manufactory, and the Albion Paper Company's extensive works at Holyoke. The editor might with propriety have added to the list the printing press manufactory of Cottrell & Babcock, which appeared in the issue next preceding the three industries to which the writer refers, and this would have rendered more nearly complete the range of subjects to which our contemporary is allied.

A QUARANTINE FLEET FOR THE MISSISSIPPI.

The terrible visitation experienced in 1878, by yellow fever, by the cities along the lower Mississippi, indicated clearly to the United States Medical Department the great need of a more perfect system of quarantine regulation, inspection, and disinfection. Also, the want of swift, properly appointed craft to relieve passing vessels of sick persons and to convey such to the quarantine stations along the river. To meet the peculiar requirements of the case a fleet of four steamers has been designed by Dr. J. F. Turner, Secretary of the National Board of Health, and these have just been completed at Pittsburg, leaving that city, June 23, for duty on the Mississippi between Cairo and New Orleans. The fleet comprises the hospital and supply steamer H. H. Benner, and the steel launches Sentinel, Lookout, and Picket. The Benner is a stern wheel iron hull steamer of the Western high-pressure type, 112 feet long, 18 feet beam, 4 feet hold. On the main or boiler deck she carries an iron disinfecting tank for the reception and steaming of bedding, etc., supposed to contain the germs of fever. This tank is 6 x 8 feet, of boiler iron. The upper deck is fitted up with bath room, physician's quarters, and medicine chests. The main cabin is a clear, well ventilated space 14 x 50 feet, fitted with thirty iron cots for the reception of the sick. The launches are of handsome model and are 36 feet long by 7 feet beam, and 3½ hold. Engine vertical, driving propeller of 32 inch diameter and 6 feet pitch, making 250 revolutions per minute with steam at 120 lb. Each launch carries a small cannon for calling passing and suspected steamers to a prompt halt. Their swiftness will enable them to hurry the unfortunate sick to the nearest quarantine station, and a physician will be on board each launch. The Benner will be in charge of Dr. F. W. Reilly, of Chicago, and the crew will be selected from men who have run the dread gauntlet of "Yellow Jack." The cost of this laudable enterprise to the government will be about $35,000. The quarantine stations already provided for are located at Cairo, Vicksburg, Memphis, and New Orleans, and also at the mouth of the Red River.

INCREASE IN THE RUBBER MANUFACTURE.

It is interesting to note, in connection with the extended description of the rubber manufacture we published last week, that the total imports of crude rubber and gutta percha for the United States, for the nine months to April 1, amounted to 13,444,750 lb., valued at $7,436,560, against importations for the nine months to April 1, 1879, of 11,010,677 lb., valued at $4,387,071. This shows a material advance in prices within the past year, the average rate for

the earlier period being not quite 40 cents a pound, while for the nine months ending April 1 last, it was over 55 cents a pound. This average includes the importations of all descriptions, the best rubber having been all the time a good deal higher than these figures, and now being quoted by the importers at 90 to 95 cents a pound for choice Para. The advance in prices was primarily due to a speculative combination of Spanish houses in the trade, although it is also largely attributable to the greatly increased demand for rubber in Europe as well as here, and the difficulty in obtaining the requisite labor for getting it in and curing it at all the South American producing points. In the valley of the Amazon particularly, whence the choicest rubber comes, the trouble in obtaining efficient labor for any kind of work is the most serious bar to the progress of that fertile country, the climate being a very trying one, and the natives lazy and indolent.

The wonderful variety of useful articles into which rubber is worked up makes it one of the most important of our imports of crude material, and the large place it fills in the supply of such necessities as belting, hose, and packing, either in competition with or as superseding the use of leather, gives it an importance in our industries far beyond the money value that the figures showing the importations seem to represent.

A PATENT CASE OF GENERAL INTEREST.

All the shoe manufacturers in the country have been particularly anxious to know, for about a year past, how much longer they would have to pay the royalty, averaging 1½ to 2 cents a pair, on shoes bottomed by the McKay sole sewing machine. A case bearing upon this point came before Judge Blatchford, of the United States Circuit Court for the Southern District of New York, on the 25th ult., and his decision, though not conclusive as to the whole question at issue, has an important bearing thereon.

The patents owned by the McKay Sewing Machine Association have, from 1860 to the present time, been those under which probably nine-tenths of the machine-made shoes worn in the United States were bottomed. The association made the machines and leased them to manufacturers, under a license by which the latter were obliged to pay a royalty on each pair made, which was done by placing on the shoes stamps purchased from the McKay Association. Over one thousand boot and shoe manufacturers, embracing all the large establishments in the country, are in this way licensees of the McKay Association. This license is a very carefully drawn up document, and, besides everything else therein calculated to protect the interests of the association, it has a provision by which the licensee agrees not to contest the McKay patents during their existence. No real resistance has been made in many years to the validity of the patents, and, the business of the association having been from the first conducted with marvelous energy and ability, the patents have returned clear profits to their owners of several millions of dollars. In July and August of last year two of the most important of these patents, with the extensions which had been granted thereon, ran out, and, although the machines were covered by other and less important patents, the shoe manufacturers have, since that time, been debating the question of how long they must continue to pay these royalties. The obvious answer is that so long as they use a McKay machine, and are bound by their license, they must pay. In this connection it is important to note that the McKay Association have, during the past year, been taking back many of their old machines, where the manufacturers would allow them to do so, and furnishing in their stead new and improved machines, but the latter have patents in them bearing date of 1879, and, of course, cover their use for the full term of the last patent.

To meet this difficulty, and provide a way of using only the McKay patents that had expired, Andrew H. Jackman, of Nyack, N. Y., has lately obtained a patent on a machine of his invention, which he has used since May last, sewing 3,000 pairs of soles weekly thereon, and which he was about to offer to the trade. The McKay Association immediately commenced proceedings against Jackman, and moved for a preliminary injunction on the ground that two of their patents had been violated, one on the "process" and the other on the "product," as separate from the machine, and also because the defendant had violated his license. Considerable evidence was introduced, and able arguments were made, but Judge Blatchford finally put aside all question regarding the validity of the patents, and decided to grant the injunction on the license alone, holding that it was of the substance of a contract, and until it was broken, or the defendant released from its provisions, the association had a good case against him. The license provides several ways whereby the association may terminate it, or where it would be broken and become inoperative, but it is not at all clear that there is any easy way for the manufacturer to get rid of its provisions without the consent of the association, who are likely to be as tenacious of their contract rights under its provisions as they have heretofore been determined in upholding their patent claims.

An Opportunity for Inventors and Lock Makers.

The present kind of mail lock and key having been in use for a long time, it has been deemed expedient to make a change. To this end the Postmaster-General has just issued a notice, which will be found in our advertising page, announcing that proposals will be received for furnishing five new and different kinds of locks and keys for this purpose. He does not prescribe a model, and on that point says that, as the public exposure and searching examination necessary to intelligent bidding on any prescribed model of a lock and key would tend to impair, if not entirely destroy, the further utility of all such locks and keys for the purposes of the mails, the Postmaster-General prescribes no model or sample for bidders, but relies for a selection on the mechanical skill and ingenuity which a fair competition among inventors, hereby invited, may develop in samples submitted by them.

BURNING OF OIL TANKS BY LIGHTNING.

The suggestions recently made by us in connection with the late disastrous fire at Titusville, Pa., caused by the firing of an oil tank by lightning, have called forth a variety of interesting communications from different correspondents. Our suggestion was that the light vapors from the oil, rising high above the tanks, formed a conductor and led to the firing of the gas in the tank.

One of our correspondents, whose letter we publish in another column, suggests a different theory. He thinks that the electricity enters the tank by running along the oil supply pipe, and that sparks are discharged from the end of the pipe at its termination within the roof of the tank. He further thinks that the electrical charge may fall upon the pipe at some distance from the tank and yet the gas in the tank will be ignited. Our correspondent may be right. His theory is worthy of careful consideration. The smallest spark produced in this way will do the business. We all know how minute an electrical spark will fire an explosive mixture of gas. Even the rubbing of the feet on a carpet and a touch of the finger to an open gas pipe will light the gas.

Although it might be expected that any electricity received by the underground tank pipe would be wholly dissipated before reaching the tank, still if the original electrical charge were sufficient, and if the exterior of the pipe was more or less insulated, as it might be if it passed through dry earth, or if its surface were covered with oil, it would seem that there might be a leap of a spark from the extremity of the metallic pipe, within the roof of the tank, to the side or interior casing of the tank, and mischief would result.

When the tank is made wholly of iron, and the end of the supply pipe, where it enters the tank, is attached to and forms a good contact with the iron of the tank, then no spark could be expected. But if the roof of the tank is made of wood, and the sides of iron, as is frequently the case, no actual connection existing between the iron casing and the supply pipe, then some portion of a charge of electricity, running along the pipe, might enter the tank and leap from the pipe as we have mentioned. As a measure of prudence it would be advisable for tank owners to connect their ground pipes electrically with the iron casings of the tanks. This may be readily done by means of stout copper or iron wires outside the tanks, the ends of the wires being well soldered respectively to the pipes and to the iron casing, so that if any electricity comes along the pipes it will pass, without resistance or sparking, to the iron case and so to earth.

We are greatly obliged to those correspondents who have sent us their views on this matter, and we hope to hear from others. The subject is one of such importance that it ought to be discussed and studied until a sure protection is discovered and an end put to the long series of lightning disasters that for years past have regularly occurred in the oil regions.

The fire at Titusville on June 11 was followed June 30th by the burning of another iron oil tank, at Olean, N. Y., holding 25,000 barrels, which was also set on fire by lightning. This tank belonged to the Acme Refinery.

SERIES FORTY-NINE.

Not with egotism, but with a commendable pride, do we direct the reader's special attention to the beautifully executed engravings which embellish this number of the SCIENTIFIC AMERICAN. The reader will also find profit and be interested in the somewhat lengthy description of the extensive industry carried on by the Kingsford Starch Works, whose product is not only laundry starch, as the title of the works might imply, but a dietetic commodity which is favorably known in every part of the civilized world.

The Kingsford Works, illustrated in this week's issue, comprises the *forty-ninth* of our industrial series already published; and we would here announce that we have in preparation engravings of a number of other extensive establishments, illustrating the processes of manufacturing other articles not generally known, which we are confident will be of equal interest to any of the industries which have been already illustrated and described in these columns.

London's Stock Companies—Limited.

The English people are famous for forming stock companies (limited) in conducting all sorts of enterprises. Some time ago Truefit, the celebrated London barber, converted his shaving and hair cutting establishment into a stock company, at which some of the newspapers made considerable fun, naming several lords and bankers as among the shareholders. But Truefit understands his business, and, it is said, has made a fortune out of it, and in all probability the stockholders in his company will receive larger dividends and be more secure in their investments than if they placed their means in some other more pretentious companies. Mr. Truefit's business is certainly legitimate, and a useful one, and can only be made profitable by industry; therefore we see no reason for our London contemporaries casting slurs at any of the stock owners, if they be princes or lords.

But a new joint stock company (limited) has just been registered which is nothing more nor less than an old curiosity shop. From the prospectus we learn that the company seeks to raise £2,000, and proposes to buy, sell, and exchange works of art, books, and used foreign postage stamps. No doubt the venture is a *bona fide* one, and it is satisfactory to note that the promoter takes 1,000 of the 2,000 shares. But it is somewhat of a *reductio ad absurdum*. *Capital and Labor* thinks, to turn such a business into a joint stock company. Will there be any directors? the writer inquires; What will be their remuneration, and where will they meet? Perhaps, he adds, in the shop among the old foreign stamps, the works of art, and the books and mummies! The capital of the company is certainly not extravagant, but probably sufficient to conduct the canceled postage department, if it does not go far towards purchasing "old masters."

Basal Plane Quartz Crystals.

Until within a very few years crystals of quartz with the basal plane have been accounted excessively rare. So recently as the year 1877, Professor Egleston, of Columbia School of Mines, remarked, in a lecture before the Academy, on some rare quartz crystals, that five years before "only three crystals of quartz with the basal plane were known to the scientific world: one owned by the British Museum; one by the Imperial Museum at Vienna; the other in St. Petersburg, and these came from Brazil. They were considered priceless treasures, and the very *ultima Thule* of rarity in the mineral kingdom."

In a communication dated Morgantown, N. C., May 20, Mr. W. E. Hidden, mineralogist, informs us that in a locality in the South Mountains of Burke county, North Carolina, quartz crystals with the basal plane are comparatively abundant. Mr. John T. Humphreys, who discovered the locality, has more than a dozen of them, and Mr. Hidden himself has seven. In these specimens the apex of the pyramid of the crystal is cut off at an exact right angle to the sides of the crystal, as shown in the annexed cut.

THE BOSS PUZZLE ABROAD.

The "fifteen puzzle" epidemic, which prevailed so alarmingly here last year, has extended to England and the Continent, and our foreign exchanges come to us laden with solutions of the problem. Scientists even have taken the subject up, and communicate to their favorite papers the formula which expresses the mathematical possibilities of it, and editors write columns on the subject for their respective papers. It was a good while reaching the other side of the ocean, but, like the phylloxera, is doing its devastating work.

The American Science Association.

The twenty-ninth meeting of the American Association for the Advancement of Science will begin August 25, in the Massachusetts Institute of Technology, Boston. An exceptionally large gathering of prominent scientific workers is anticipated. One of the morning sessions will be held at Cambridge, and the rest of the day will be devoted to an inspection of the various departments and museums of Harvard University and the Observatory.

DISASTROUS STEAMBOAT ACCIDENT.

On the afternoon of June 28 the fine passenger steamer Seawanhaka, carrying 350 or 400 passengers, while going at full speed up the narrow and dangerous pass known as Hell Gate, between New York and Brooklyn, was discovered to be on fire. The flames spread with amazing rapidity. Captain Smith with remarkable bravery kept his place at the wheel, was surrounded with fire and badly burned, but nevertheless directed and grounded the boat on a safe point ashore, free from rocks. But during the brief period that elapsed before the boat touched, many of the terrified passengers were compelled by the flames to leap into the water About sixty lives were lost.

The cause of this accident is not yet known; but so far as we can gather from the newspaper reports we are inclined to think it was due to the bursting of one of the boiler flues.

It would seem from the reports that the boat was carrying about all the steam allowed by her certificate, that a slight explosion was heard, that steam first appeared in the upper cabin, then fire, and that flames blew out of the furnace door. These circumstances indicate a probability that by the bursting of a flue the gases of the furnace fire were driven out against the woodwork of the vessel and instantly set her in a blaze. The steamer carried two boilers, set in the hold. Whether our theory of the cause of the fire is correct cannot be determined till the boilers are raised.

This dreadful disaster forms but another evidence of the inadequacy of the present means for safety on steamboats. We hope that our inventors will exercise their ingenuity in discovering new appliances by which such accidents will be rendered impossible. A light fireproof material, to take the place of the dry woodwork now used for cabins, is especially needed.

AMERICAN INDUSTRIES.—No. 49.

THE STARCH MANUFACTURE.

About forty years ago Mr. Thomas Kingsford, whose son is at present the head of the firm of T. Kingsford & Son, of Oswego, N. Y., invented a process for the economical manufacture of a superior article of starch from Indian corn, and from his success then and improvements subsequently introduced have grown up an industry of great magnitude. In other countries starch had been manufactured from very early dates, but principally from potatoes, beans, the sago palm, Iceland moss, peas, and wheat, and the manufacture was carried on in a comparatively expensive way, giving a generally imperfect product. The principle involved in the manufacture is perhaps best explained by a simple illustration. If a little wheat flour be made into a paste in the hand, and then held under a small stream of running water, kneading continually, there will be left a tough substance of dirty white color, principally gluten, and the milky fluid which has passed off, when allowed to settle, deposits a white powder, which is principally starch, with more or less impurities. The perfect process of manufacturing corn starch is that which economically takes from the kernel all of the starch, and thoroughly frees it from the oil, gum, and glutinous products contained in the whole grain; this requires many washings, in some of which chemical solutions are employed, and most careful mechanical manipulation, with the aid of elaborate machinery, besides a great deal of experience in the workmen.

In our first page illustrations of to-day, and also on this page, we represent some of the most important of the processes and details connected with the manufacture of pure and silver gloss starch for the laundry, and prepared corn (or corn starch) for culinary use, as carried on at Oswego, N. Y., by the Oswego Starch Factory, the largest establishment of its kind in the world. Here, on the Oswego River, near where it empties into Lake Ontario, in close proximity to the great corn producing area of the West, and with the lowest possible cost for carriage over the waters of the great lakes and their tributaries, Messrs. Thomas Kingsford & Son, in 1848, commenced the manufacture and erected a factory. The buildings at present cover five acres of ground, and give twelve acres of floor room, while the ground actually occupied for factory purposes amounts to seventeen acres. Here the corn comes direct from its place of first shipment to the immense storage bins of the establishment—"the deepest corn bins in the world"—extending to the full height of the five story buildings, and with a capacity to hold two hundred thousand bushels at a time. Of course these buildings are very strongly put up and heavily braced to carry such an immense weight, capacious elevators being employed to discharge the grain from the vessels and afterward remove it as it is to be used in the works.

The grain first passes through immense fan mills, to remove chaff and dirt, or any substances which might afterward injure the machinery. Thence it is passed to enormous vats, where it is soaked, so as to render its constituents more easily separated, that the starch may be extracted. After a sufficient time here the grinding process follows; and for this purpose twenty-four pairs of burr stones and six pairs of heavy iron rollers are used; these mills work day and night, and, operating on wet grain, change it into pulp rather than into flour, the object being to crush and thoroughly disintegrate the particles. This pulp then passes through a great number of screens and drum sieves, which do the first part of the work of separating the starch from the hull, the refuse being used as a food for cattle.

The milky fluid which results from the washing is conducted into immense cisterns or vats, of which there are in all the factories 689, having an aggregate capacity of 3,150,000 gallons. The liquid, however, has to receive several washings, during which various solvents and filtered water are used for the removal of all impurities, and the separation of the pure starch from all the other constituents of the grain. For this purpose the establishment has forty-eight pumps, capable of raising 850,000 gallons of water per hour, and there are 6¼ miles of gutters in use for the various distributions of the contents of the vats, besides four miles of water pipes varying in size from 2 to 24 inches in diameter. The purification of the starch, however, depends more upon the practical experience of the workmen or manager than upon any rules which can be given, the thorough washing and careful separation requiring a practiced eye and the best of judgment. After this is done the starch water, as it may be called, is allowed to run into moulds, where, when it has entirely settled, the deposit will have made a long, box-like cake, which may be broken into the required squares, each weighing about seven pounds after drying, the quantity desired for each package.

THE SEPARATING ROOM.

The illustration at the top of the first page shows one of the immense rooms where the latter part of the work is being carried on. The middle of the room is filled with long tables, where the starch has been tipped out of the moulds, and a workman may be seen standing over one of the bars of starch and marking it with a sight indentation at each place where the bar is to be broken, when another workman following places a knife under this point and deftly breaks the bar, the practice of the workman and the consistency of the starch being such that it is seldom there will be a variation of an ounce in the weight of the squares broken off. Others may also be seen passing these squares of starch to the side of the room, where they are placed on an endless belt to be taken up and placed in the ovens above. Here they are kept at a low heat until dried, when a thin yellow crust is found on the surface, representing what has been left of gum or husk after the previous purifications. This is scraped off by hand with large knives, when the cakes are wrapped in blue paper and again placed in ovens until dry crystallization takes place, so that, on opening the paper, the starch will split into columnar masses, in which form it is generally sold.

The other illustrations on the first page require but little explanation further than that given by their titles. The office, as shown in the center, is a large, high room, beautifully fitted up, which would do credit to many a banking institution; on the right is seen a representation of one of the mills for grinding the corn, and on the left the furnace and boiler room. The establishment has the advantage of an excellent water power from the Oswego River, for utilizing which fourteen turbine wheels, of an aggregate of 1,200 horse power, are employed, but besides this they run ten steam engines of 845 horse power, and have thirteen large steam boilers, 33¼ miles of steam pipes being in use for drying purposes and warming the works. The making of paper boxes and cases and the wood box making are the subject of separate sketches. In the latter department 5,000,000 feet of lumber are used yearly; two nailing machines are kept at work here, but, so minutely is every detail economized, the sides and ends are dovetailed, as making not only a better box, but contributing an important saving in the way of nails. In the making of paper boxes and cases 600,000 lb. of paper are required annually. This work is principally done by hand, but some machines crease the sheets where folds are to be made, and others cut the paper and press it into the required shape when the form of package calls for such work.

In the packing room may be seen a little machine, under which empty packages are held to be filled from a spout. This is the way the pulverized corn starch, or prepared corn for culinary use, is packed. The little machine is so arranged that it will let out just enough for a package, and then the stream stops until the touching of a little spring shows that the operator has placed another empty package in place to be filled. The number of packages put up by a girl in one day will average from 1,400 to 1,500, and the whole operation is so conducted that no dust escapes. This pulverized corn starch, as it is known here, is hardly known by that name in many foreign ports, to which it is shipped in large quantities, and where it is called only prepared corn. It is exported to every part of the world, and has obtained a high reputation for its dietetic excellences.

The large view on this page, entitled the "Separating room," shows a prominent department in this industry, and one in which the ingenuity of the Messrs. Kingsford has been attended with most important results. It represents the

operation to which the pulp is subjected first after the grinding and crushing by the rollers. In the immense circular vats here shown a shaft revolves to which is attached arms of particular shape and form, which has been a matter of much experiment, to churn up and separate the different constituents of the grain, an operation which is now conducted far more expeditiously and efficiently than was formerly the case. A smaller view on the same page shows the interior of a nicely furnished hall which the establishment furnishes for the use of its employes for holding meetings, etc., and which is christened "Firemen's Hall," as being the headquarters of a volunteer organization of that kind among the men employed. In the papering and drying room, also shown here, the work is all done by men, although a large force of women and girls find employment in the establishment; and it is perhaps as well to remark here that the firm exercise the utmost care in the selection of their employes, not only as to their personal character, but insisting on the most thorough neatness and cleanliness in every department.

The main buildings of this immense establishment are all of stone, brick, and iron, some portions being seven stories high, making a total frontage of 800 feet by 200 feet deep. Besides these there are other large buildings, such as the box factory, storehouses, machine shops, etc. The works are now making at the rate of 21,500,000 lb. of starch and prepared corn annually, or about 35 tons per day, giving employment to upwards of 950 operatives. The Kingsfords have been continuously engaged in the manufacture of starch for about half a century. The Oswego Starch Factory was incorporated in 1848. Dr. S. Willard, of Auburn, N. Y., was elected President of the Company at its first organization, and has held that office continuously to the present time. A. G. Beardsley, Esq., of Auburn, N. Y., is the Secretary and Treasurer of the company. T. Kingsford & Son is the style under which the manufacturing business is carried on at Oswego, and E. C. Chapin, of 146 Duane street, New York, who is also one of the Board of Trustees, is the general agent.

IMPROVED STREET LAMP.

We give an engraving of an improved street lamp recently patented by Mr. John Stewart, of Chicago, Ill. The invention relates entirely to the frame of the lamp, which is made of cast, malleable, and sheet metal. In external appearance it is much like the ordinary lamp, but it is better calculated to resist the wind and other forces which frequently destroy the common lamp.

The socket fitting the lamppost and the base plate of the lamp frame are made in one casting, and the sides of the base plate are provided with flaring flanges having at the corners sockets for receiving the malleable iron corner pieces which are fastened by riveting, as shown in Fig. 2, which represents a portion of one of the corners in section.

STEWART'S STREET LAMP.

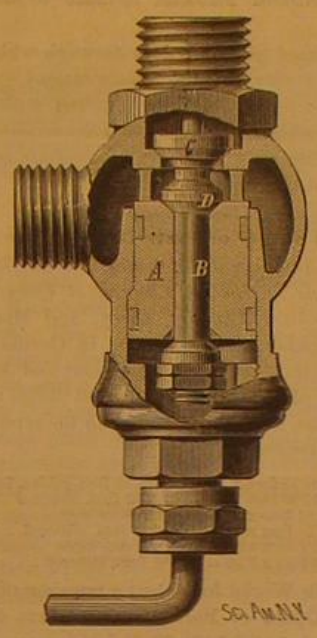
These corner pieces are angled to receive the glass, and are beaded at the outside corner to give them strength and rigidity. Small thin tongues project from the angle, and are bent over the edges of the glasses to retain them, as shown in Fig. 3. The upper ends of the corner pieces are soldered to a sheet metal frame, which supports the upper glasses and the chimney. The door frame, of tin, is hinged to the upper frame of the lamp so as to swing vertically, and is provided with a small bolt at the bottom, which is easy of access, and will hold the door locked by its own gravity. The hinges are made entirely of brass, and cannot therefore corrode, so as to interfere with the opening or closing of the door.

The inventor says that the lamp sets perfectly solid on the post, and is entirely free from the warping and twisting so common to the ordinary lamp and so destructive to the glass. We understand that there are now about one thousand of these lamps in use in Chicago giving excellent satisfaction.

For further information address Mr. John Stewart, Department of Public Works, Chicago, Ill.

AUTOMATIC SAFETY CYLINDER COCK.

The improved safety valve and cylinder cock shown in the annexed engraving is the invention of Mr. Thomas J.



PARADINE'S CYLINDER COCK.

Paradine, of Erie, Pa. It is capable of letting the water of condensation out of a steam cylinder without waste of steam, and is a perfect safeguard against injury to the cylinder by an accumulation of water.

The safety valve and exit cock are arranged in a casing connected directly with the cylinder and communicating with the steam chest by a small pipe entering the lower end.

The safety valve, A, has two seats in the casing, one above, the other below the lateral discharge opening of the casing, and it is pressed upward by steam acting on its lower end, the difference in the area of the two ends being sufficient to secure this result. The valve, A, is bored longitudinally to receive a spindle, B, carrying at its upper end two valves, C D, which are seated in the valve, A, above and below a chamber in the upper end of the valve. The lower end of the spindle, B, is also provided with a valve which has its seat on the lower end of the valve, A. The upper valve, C, is somewhat larger in area than the other valves attached to the spindle, and controls the escape of water from the cylinder.

Under ordinary conditions the pressure of steam on the lower end of the valve, A, will hold it to its seat, but when an extraordinary pressure is brought to bear upon it, as, for instance, when there is more water in the cylinder than the clearance will contain and the piston is just completing its stroke, the valve will be forced from its seat, and the water will escape through the lateral opening in the casing. In working regularly, when the steam is acting on the piston, it also presses the valve, C, to its seat so that neither steam nor water can escape, but when the steam exhausts the pressure on the valve, C, is less than that on the lower end of the spindle, B, consequently the spindle is forced upward and the valve, C, is opened, allowing the water to escape. When steam is shut off from the engine, the valve, A, will drop of its own gravity and allow all of the water in the cylinder to drain out.

Two circumferential grooves formed in the valve, A, are filled with wicking or other packing to prevent grit from working into and around the valve.

The working of this valve is entirely automatic, and it is claimed by the inventor that it is less expensive and more durable than ordinary cylinder cocks. The inventor informs us that he has had this valve at work on a pair of large engines day and night for fifteen months without once failing or showing signs of wear.

Further information may be obtained by addressing the inventor as above.

Whaling on the Pacific Coast.

According to the present practice of whalers the blubber is chopped off at sea and the rest of the carcass is left to sink or float as it may until it decays or is devoured by sharks and birds. A less wasteful system has been adopted by a company at San Francisco, which has organized a whaling and fertilizer industry, to be carried on at that point and along the coast.

The first vessel for whale hunting has just been finished. It is a screw steamer, 65 feet long and 16 feet wide, completely decked over, and very strongly built. It is fitted with two compound engines, and will carry coal for a run of thirty days, to enable the search for whales to be prosecuted along the Alaska shore if necessary. The whales are to be killed by the whaling rocket or bomb lance. They are then to be towed to the reduction works on shore, where the carcass will be treated by an improved process, which utilizes every part. In this process the whale is cut up, without separating blubber or flesh, and digested by steam at high pressure in large iron tanks. The process requires about eight hours, when the oil is drawn off and the residue of flesh and bones is taken out, dried, and ground together to produce a fertilizer. Three digesters have been set up, each large enough to hold a ten foot section of a whale, and three "tries" can be made in a day.

ENGINEERING INVENTIONS.

Mr. Robert E. Greenwell, of Osage Mission, Kan., has patented improvements in railway joints of that form in which a set of bolts project through the fish plates and have ends slotted lengthwise to receive a key which is driven in in a plane parallel with the bolt.

A machine for deepening river channels has recently been patented by Mr. Thomas B. Taylor, of Mount Meigs, Ala. This machine is so constructed as to deflect the current of a river downward, and thus cause the current to deepen the channel of the river.

A device for insuring a more perfect combustion than is usual in the fire boxes of steam boilers, evaporators, etc., has been patented by Mr. John Mailer, of San Francisco, Cal. The invention is an improvement upon the device for which Letters Patent No. 219,283 were granted to the same inventor, September 2, 1879.

Mr. Frank Laufkotter, of Collinsville, Ill., has patented an improved safety stop for elevators, buildings, mine shafts, and other purposes, so constructed as to stop the elevator cage and hold it securely should the hoisting rope break.

Ice without Freezing.

A new skating surface, called "crystal ice," has been invented by Dr. Calantarients, of Scarborough, England. Considering that after all ice is merely a crystalline substance, and that there is no lack of substances that are crystalline at ordinary temperatures, Dr. Calantarients experimented with a variety of salts, and after a time succeeded in making a mixture consisting mainly of carbonate and sulphate of soda, which, when laid as a floor by his plan, can be skated on with ordinary ice skates; the resistance of the surface is just equal to that of ice, it looks like ice, and indeed when it has been skated on, and got "cut up" a little, the deception is quite astonishing; a small experimental floor has been laid in the skating rink at Prince's, and has proved so successful that no doubt a large floor will be laid there or at some other convenient place in the autumn. This floor will obviously have great advantages, both over artificial ice floors, which are very expensive indeed, and over floors for roller skating. The surface can at any time be made smooth again by steaming with an apparatus for the purpose, and the floor itself, when once laid, will last for many years. The mixture of salts used contains about 60 per cent of water of crystallization, so that after all the floor consists chiefly of solidified water.

A NOVEL WHEELBARROW.

The engraving represents an improvement in the class of wheelbarrows whose body is pivoted to adapt it to dump its contents by tilting or turning on its pivots. The improvement consists in the extension of the front end of the frame beyond the wheel and body of the wheelbarrow, so that when the frame is suitably inclined its front end will rest on the ground, and together with the wheel, constitute a firm support for the pivoted body while being tilted.

KINCANNON'S IMPROVED WHEELBARROW.

This invention was recently patented by Messrs. J. and F. L. Kincannon, of Verona, Miss.

REPAIRING SPIRAL SPRINGS.

BY E. N. MAXWELL.

I find the impression is common among mechanics that it is not possible to mend a broken spiral spring It might be well, therefore, to place the readers of the SCIENTIFIC AMERICAN in possession of my method, which is inexpensive, very simple, and thorough.

Take a piece of flat metal, of, say about one sixteenth inch in thickness, and cut it in the shape of a parallelogram, the length being one eighth inch greater than the diameter of the broken spring, the width equal to four of its coils; bore two holes on each side *exactly* the diameter of the spring apart, and sufficiently large to admit the spring wire; make, with a round file, a slight groove just opposite each hole, as shown in the smaller view in the engraving. Screw the broken ends of the spring into these holes from opposite sides, and the job will be complete, and at a trifling cost of material, time, and labor.

It will be seen at a glance that two springs of different diameters can be coupled together by the same process. Also, that a piece of similar metal with two holes upon one side and one hole on the other side will make a superior end piece for securing spiral springs.

The angles of the piece of metal used for mending, should equal those formed by the coils and side of the spring.

MENDING BROKEN SPIRAL SPRINGS

Copper-plating on Zinc.

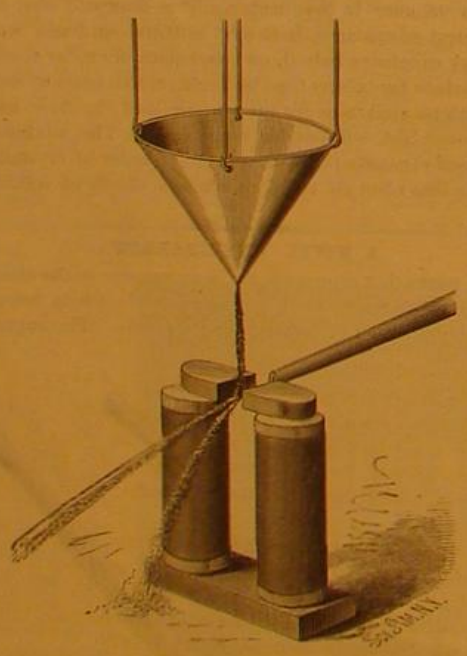
The use of cyanide baths for plating on zinc has the double disadvantage of being poisonous and expensive. Hess has overcome the objections by rendering the cyanide bath unnecessary. This he accomplishes by the use of an organic salt of copper, for instance a tartrate. Dissolve 126 grammes sulphate of copper (blue vitriol) in 2 liters water; also 227 grammes tartrate of potash and 286 grammes crystallized carbonate of soda in 2 liters of water. On mixing the two solutions a light bluish-green precipitate of tartrate of copper is formed. It is thrown on a linen filter, and afterwards dissolved in half a liter of caustic soda solution of 16° B., when it is ready for use.

The coating obtained from this solution is very pliable, smooth, and coherent, with a fine surface, and acquires any desired thickness if left long enough in the bath.

Other metals can also be employed for plating in the form of tartrates. Instead of tartrates, phosphates, oxalates, citrates, acetates, and borates of metals can be used, so that it seems possible to entirely dispense with the use of cyanide baths.

NEW ORE SEPARATOR.

In one of our recent issues we described a device invented by Mr. Edison for separating magnetic sands from the non-magnetic particles of ore by altering the trajectory of the



EDISON'S ORE SEPARATOR.

falling magnetic substance by means of an electro-magnet. We now give an engraving of another magnetic ore separator recently invented by Mr. Edison, which operates on an entirely different principle, and effects a still further concentration of the ore by the separation of the metallic from the non metallic part by diamagnetism.

The auriferous sands are placed in the hopper and allowed to fall between the poles of a powerful electro-magnet, and a blast of air is directed at right angles against the falling stream of sand just as the latter passes between the poles of the magnet. The non metallic substances are readily blown away, while the metallic portions are retarded by diamagnetism, so that the blast of air has less effect on them than it has on the non-metallic substances. The consequence of this operation is that the sands are divided into two heaps, one containing a large percentage of metal, the other containing a very small percentage, or none at all.

A Georgia Meteor.

About midnight, June 30, an exceptionally brilliant meteor was seen from Macon, Ga. The light is described as like an electric light, but whiter and vastly more powerful. The course of the meteor was from the zenith straight toward the horizon, which it would have reached at a point between north and northeast. At the zenith it appeared as large as a barrel and intensely white At 45° elevation the light changed to a brilliant red, paled into saffron, and then into all shades of green. As it began to change its hue it emitted particles or balls of fire that followed or lingered in its wake. Surrounding it, also, in this stage, was a dense vapor of smoke that reflected all the colors through which the ball had gone. At 30° elevation the light went out. Three minutes after a heavy report was heard, mixed with a metallic ring not heard in thunder or in ordinary explosions. The meteor was visible about five seconds. It is to be hoped that specimens of this body may yet be found.

The Largest Sheets of Plate Glass in the World.

The "*Société Anonyme des Manufactures de Glaces et Produits Chimiques de St. Gobain, Chauny, et Cirey,*" owns the works of St. Gobain, Chauny, Cirey, and Montlucon, in France, and Mannheim and Stolberg, in Germany There are two other factories besides at Jeumont and Aniche.

The following plain white and silvered plates were exhibited by these firms, says Mr. C. Colné, in his report on glass, at the Paris Exhibition:

	Pounds.
St. Gobain; 1 plate 21·15 feet x 13·48 = 285 10 feet, white, 7-16 in...	1,573
St. Gobain; 1 plate 17·90 feet x 9·94 = 117·92 feet, silvered	770
Jeumont; 1 plate 17·81 feet x 11·51 = 205 feet, white.....	1,100
Jeumont; 1 plate 17·21 feet x 10·82 = 182·12 feet, silvered.....	770
Aniche; 1 plate 15·76 feet x 10·43 = 164·38 feet, white	660
Aniche; 1 plate 14·76 feet x 9·05 = 132·58 feet, silvered	550

The St. Gobain Works furnished a number of mirrors to the new Grand Opera of Paris; among others one 21·29 x 9·67 feet; others from 45·12 to 52·48 feet long.

St. Gobain also exhibited 3-16 inch thick plate glass for windows, weighing only 22 to 26 pounds per square meter; thick polished slabs, such as were used in the aquarium, 7·56 feet long by 2·60 feet wide, 9-16, 11-16, 14-16 inch thick; a series of silvered reflectors, deck lights, bull's eyes, plates of a rough cast glass, smooth on one side and corrugated on the other, used for roof covering, weighing about 27 pounds per square meter, from 1 to 2·8 inch thick. The designs on the surface consist of fine parallel corrugations or small and large corrugated and plain lozenges. The large lozenges are used as a substitute for painted or stained glass in churches for economical reasons. The small lozenges are used for partitions, doors, panels, windows, covered yards, hothouses, roofs, etc.

They also make glass tiles, pressed in imitation of the clay article. These tiles are used for roofing, and are moulded in such a shape that they can be laid alongside of one another, making tight-fitting joints without any cement or mortar; it takes 13 tiles to cover a square meter; each tile weighs about 5½ pounds.

Glass flooring made of flags or slabs of rough cast glass are also manufactured in large quantity by these works; they consist of pieces 6 x 1⅜ inches thick, 11 inches long, and weigh 165 pounds per square meter; the upper surface is generally moulded in diamonds. Pavements of glass are also exhibited; these are made in the same style as the slabs, with the upper surface moulded in diamonds, but are much thicker, and are intended for pavements for carriage ways. They are made of cubes of about 6 x 6½ inches, and weigh each 19·80 pounds; they are sold by weight. Rough slabs are also made of 6·56 x 2·65 feet, varying in thickness from 9-16 inch to 1½ inches; weight from 213 to 492 pounds.

This company also exhibits all the different rough cast glasses used in the manufacture of lighthouse apparatus, such as rings, parts of rings, and rough lenses. As a specimen of the thickness that can be given to cast glass, there was shown a disk 4·03 feet in diameter by 8½ inches thick, weighing more than 1,320 pounds. This disk is an exact duplicate of the one offered to the French Observatory to make a mirror for their large telescope

Testing Alcoholic Liquors.

The following hints in regard to alcoholic liquors are given by Dubrunfaut in a French journal: Commercial alcohol and alcoholic drinks differ from each other partially by a characteristic flavor, partially by different chemical properties. A characteristic distinction is the amount of acid in the different liquors. All pure alcohols contain only 1 per cent of acid, while freshly distilled cognac shows 3 per cent, and this increases considerably when kept long in barrels. In ten or twelve years the same cognac will have 8 or 9 per cent of acid, while the original percentage of alcohol is reduced from 64½ to 50 per cent. The quantity of alcohol is decreased both by evaporation and the formation of acid. All other alcoholic liquors show the same changes, and in addition also contain copper. The presence of this metal is easily proved by ferrocyanide of potassium or sulphydric acid. If there is only a trace of copper the dry residue is burned and the ash tested. As a rule, industrial alcohol also contains copper. The percentage of acid varies enough to furnish a test for the addition of commercial alcohol to rum, brandy, etc., as an adulteration, or to strengthen it. The copper, however, furnishes no reliable clew.

A Steamer Runs Down a Lock Gate.

An unexpected source of danger in canal navigation has been demonstrated at Montreal. On June 30 the steamer Bohemian, carrying fifty passengers and an assorted cargo, entered canal lock No. 2 from the Lachine Canal Basin at half speed. For some cause, as yet unexplained, a full head of steam was put on and the steamer was hurled against the gate which separated the lock from a mass of water thirteen feet higher, a mile in length, and several hundred feet in width. The gates were smashed, and the flood which poured out carried everything before it. The Bohemian was driven back and sank almost instantly. The water drove furiously on, submerging wharfs, sinking many small vessels, ingulfing numbers of laborers, and carrying terror and ruin in every direction. It is said that the deluge of water set the huge ocean steamships in the harbor of Montreal dancing like so many cockle shells.

The outrush of water from basin No. 2 left the vessels in it on the bottom, many of them with broken backs. Others were severely strained aud their cargoes much damaged. Several weeks will be required to repair the mischief; meantime navigation will be impeded and several important mills stopped.

Progress in Rifle Shooting.

The victory of the American rifle team at Dollymount, June 27, with a score of 1,292 against 1,280 for their Irish competitors, six shooting on each side, shows that the limit of progress in rifle making and in rifle shooting has not yet been reached. This may be safely inferred from the fact that the best previous shooting in any match has been exceeded in this, and yet there is a considerable margin between its record and absolute perfection. The precision already arrived at, however, is such that but one of the 540 shots fired at Dollymount would have missed a man, the ranges being 800, 900, and 1,000 yards.

IMPROVED CARTRIDGE.

Cartridges as commonly made consist of four pieces—the tube, the head rimmed disk, an inner disk fitting in the tube, and a screw connecting the disks together and clamping the tube. This construction necessitates the use of a re-enforcing strip at the base of the shell, and the head disks lack strength. Our engraving represents a new method of constructing cartridge shells or cases, recently patented by Mr. Julien Saget, of New Orleans, La.

Fig. 1

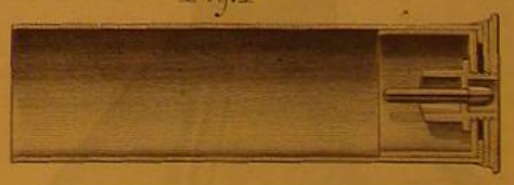


Fig. 2

SAGET'S CARTRIDGE.

The tube, which is of paper, has one end flanged internally to receive the thimble or cup, A, which is threaded to receive the hollow screw or anvil holder, B. A flanged plate, D, is fitted over the end of the cartridge, and the plate, D, and thimble, A, are drawn tightly together by the anvil holder, B. The shank of the anvil, C, is now inserted in the holder, B, and a circular steel plate, E, is screwed on the anvil holder, completing the cartridge shell, as shown in Fig. 1. The shell is charged in the usual way, and a cap is placed on the anvil, C, and pressed home.

Should the paper tubes be injured by the explosion or otherwise, it is readily replaced by a new one, thus saving the more expensive parts of the cartridge.

The steel plate added to the portion of the cartridge which receives the blow of the hammer, renders the cartridge more durable than those of ordinary construction.

Further particulars may be obtained by addressing the inventor as above.

ELECTRO-THERMIC TELEPHONE.

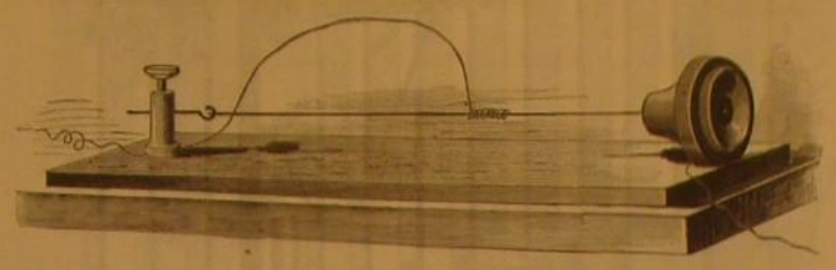
To the Editor of the Scientific American:

Some of the recent European scientific papers contain an abstract of a paper read by Mr. W. H. Preece before the Royal Society, in which he describes a telephone receiver, whose action is due to the linear expansion of a thin wire under tension when placed in a microphonic circuit. According to his own statement the instrument is inefficient, as it fails to articulate distinctly, and requires a very strong current, which would soon destroy any microphone or telephone transmitter.

This experiment is exceedingly interesting and is undoubtedly new to Mr. Preece, but, as many of my friends can testify, I tried the same experiment long since, and as it seemed to give promise of being a good telephone receiver, I followed the idea with great avidity, until I found, after a great deal of experiment with wires of different metals and of different lengths and thicknesses, that only tones with their modulations could be produced; articulation being almost entirely wanting.

Among the metals tried were iron, steel, copper, aluminum, magnesium, and platinum. The only alloys tried were brass and German silver. I also tried very thin pencils of carbon.

The apparatus by means of which these experiments were carried on was so similar to that of Mr. Preece that I send a sketch of it herewith. The head of an ordinary telephone case, containing a thin iron diaphragm, 2¼ inches in diameter, was secured to one end of a board about three feet in length. Near the opposite end was placed a post supporting a hook, to which was attached one end of the wire to be subjected to electro-thermic influence, the other end of the wire being attached to the center of the diaphragm.



ELECTRO-THERMIC TELEPHONE.

The diaphragm and the post were placed in a microphonic circuit, and a long copper wire attached to the base of the post was wound several times around the expansion wire, so that it could be moved along to expose more or less of the expansion wire to the action of the current, thus virtually altering the length of the wire.

Currents of various strengths were employed during the course of the experiments; but with all the modifications of the apparatus, or of the current applied to it, I was utterly unable to get anything like the distinct and perfect articulation secured by either the Bell or Edison receiver when used in connection with a good transmitter. However, I soon found a practical application of the electro-thermic principle, in a telegraphic relay, and adapted mechanism to the expansion wire which would faithfully render the impulses of a line in a local circuit, notwithstanding the variable expansion of the wire under different strengths of current.

Although the electro-thermic telephone receiver was practically a failure, I do not regret the course of experiment, as it has resulted in the development of an invention of practical utility, but widely different from that which was originally sought for.

GEORGE M. HOPKINS.

New York, June 28, 1880.

American Wood Engraving.

In a review of the volume of proof impressions of wood cuts from *Scribner's Monthly* and *St. Nicholas*, Mr. Philip Gilbert Hamerton, the distinguished English art critic, says that "modern wood engraving, imitating the qualities of many different kinds of art, has never been carried so far in Europe as it is now in America. A more versatile process it would be impossible to imagine. The only objection that strikes us is the painful sense of the toil involved when we know how the work is done; but this toil may be pleasurable to the engravers themselves when they have reached such a high degree of skill."

Apple Jelly.

Much inquiry has been made of late years for the best way to utilize the surplus crops of apples in abundant years. As the promise is strong for a heavy crop in 1880, it will be well for owners to prepare for the best modes of marketing. In addition to selecting and shipping fine specimens, drying, and converting into vinegar will be largely employed. Another mode, less known, and less extensively adopted, is manufacturing the fresh juice into jelly.

One of the most successful manufacturers of apple jelly, and who succeeds in making uniformly an excellent product, is Isaac Mekeel, of Poplar Ridge, Cayuga county, N. Y. By several years' experience he has brought the process to great perfection. The first, and a most essential requisite, is to use good apples—such as would be regarded as excellent table sorts. They must be fully ripe. If not quite ripe, they must be allowed to remain in heaps after gathering. Autumn table sorts are first employed, and as the manufacture continues, winter varieties ripened in a warm place come into use.

The next essential requisite is a cool temperature. The juice being separated with a grater cider mill, will ferment too soon if the weather is warm. The thermometer should never range higher than 60° in the middle of the day; 40° or thereabouts is preferred. The work is commonly commenced about the middle of October, and is continued till the first of December. If a warm day occurs, the manufacture is omitted till the weather is cooler. The slightest fermentation of the juice spoils the character of the jelly. In cold weather the whole process may extend through three or four hours, from the grinding of the apples to the completion of the jelly; but if the temperature is as high as 60°, the time must be less than an hour.

Cook's copper evaporator is used for boiling down the juice. Iron will not answer. The evaporator is thoroughly washed daily. The juice is reduced to about 30° or 32° of the saccharometer, and three quarters of an hour to one hour is required for the process. A barrel of juice will make fifty pounds of jelly. A gallon will weigh about eleven pounds—or nearly five gallons are made from a barrel of juice. The evaporator is twelve feet long, the process is continuous, and one barrel or more is reduced per hour. The jelly is poured into the moulds while hot and liquid.

Mr. Mekeel manufactures more largely in abundant years. In 1878 he made twelve tons of jelly. One bushel of apples will make five or six pounds. Not over twenty or twenty-five bushels of apples are ground or worked at a time, as it is all essential to evaporate before there is any fermentation. The fruit should be well assorted, so as to have all of equal ripeness. The cost of manufacturing is about a cent and a half per pound, including fuel. The price of the best apples is of course greater than the labor. The wholesale price of the jelly is eight cents per pound, and large quantities are shipped to purchasers. The jelly will keep any length of time; it has been found good and fresh after the lapse of four years.

It is probable that the process of manufacture might be continued into winter, in a large basement, any desired degree of coolness being secured by ventilation.—*Country Gentleman.*

NEW TELEPHONE EXPERIMENTS.

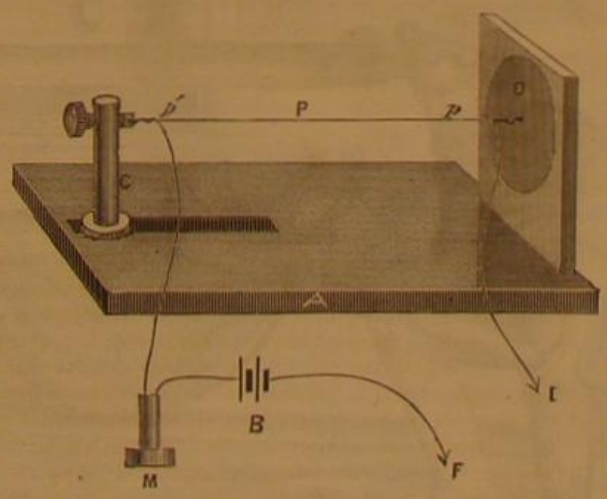
At a recent meeting of the Royal Society a paper was read "On some Thermal Effects of Electric currents," by William Henry Preece, General Post Office:

I have been engaged for some time past in experimenting on the thermal effects of electric currents, but the final results of those experiments are not sufficiently ripe at present to justify my bringing them before the Royal Society. I have, however, obtained one result which I believe to be sufficiently novel to justify a short preliminary note.

The most striking facts elicited by these experiments are:

1. The extreme rapidity with which thin wires acquire and lose their increased temperature.

2. The excessive sensibility to linear expansion which fine wires of high resistance evince.



THERMAL TELEPHONE.

Now as the rate of heating, and therefore of expansion and contraction, varies very nearly directly as the increment or decrement of the currents when these variations are very small, it occurred to me that if a long wire of small diameter and high resistance were attached to a sounding board or to the center of a disk (such as one of those used for telephones and phonographs) and it formed part of a circuit conveying telephonic currents, sonorous vibrations ought to be reproduced.

The sketch shows the arrangement of the apparatus used for the experiment.

A was a stout base of mahogany, on which a brass support, C, was attached so that it could slide and be fixed at any distance from D.

D was at first a disk of thin paper, and then of thin iron.

P was the wire experimented upon whose loose ends were connected to terminals on the wooden base, so as to be inserted in the circuit containing a microphone transmitter, M, and a battery, B, of six bichromate of potash cells in another room out of hearing.

A platinum wire of 0·003 inch diameter and six inches long from *p* to *p* was first used, and the sonorous effects were most marked and encouraging when the microphone transmitter, M, was spoken into. The articulation, though muffled, was clear, and words could easily be heard.

1. Experiments were first made to determine the length which gave the loudest sound and the clearest articulation, and, after repeated trials with every variation of length from one inch to six feet, it was found that a wire six inches long gave the maximum effect.

2. Experiments were then made to determine the diameter of the wire that gave the best effect, and after repeated trials with every gauge drawn from 0·0005 inch to 0·005 inch, it was found that wire of the diameter 0·001 inch gave the best effect.

3. Experiments were then tried with wires six inches in length and 0·001 inch diameter of different materials, namely, gold, iron, aluminum, silver, copper, palladium, and platinum, and they came out in the following order of merit:

Platinum, very clear; aluminum, very variable; palladium, clear; iron, clear; copper, faint; silver, faint; gold, very poor.

4. The effect of mechanical strain was tried. It was found not to vary the effect. When once the requisite tension, which varied with each metal, was obtained, further tightening up did not vary the clearness or loudness of articulation. Gold would scarcely bear the tension required to reproduce sonorous vibrations, hence its low position.

5. Very thin carbon pencil, 0·0625 inch diameter, was tried under compression and under tension, but no effect whatever was experienced unless a bad joint was made, when at once a faint microphonic effect was apparent.

6. No sibilant sounds whatever could be reproduced.

7. That the effect was due to heating and cooling was shown by the fact that it was possible to increase the current to such a strength as to render the temperature of the wire sensible to the touch, and then to make its elongation and contraction by low sounds evident to the eye.

It therefore appears from these experiments that wires conveying those currents of electricity which are required for telephonic purposes expand and contract as they are heated and cooled, and as the variations in the strength of the current are small compared with the strength of the current itself, the expansion and contraction vary in the same ratio as the condensation and rarefaction of the air particles conveying the sonorous vibrations which produced these vibrations.

The mechanical changes, or molecular vibrations in the wire, due directly or indirectly to telephonic currents, which result in the reproduction of sound, bear a close analogy to the mechanical changes due to the direct transmission of sound, but with this important difference, that while the vibrations due to sound are progressive along the wire, and their velocity is low and easily measured, those due to thermal effects are practically instantaneous, and therefore affect simultaneously the whole length of the wire.

Note.—De la Rive, in 1843 (*vide* "Electricity," vol. i, p. 304), observed that an iron wire emitted sounds when rapid discontinuous currents were passed through it; but he attributed the effect to magnetism, for he failed to obtain the same effect in non-magnetic wires like platinum or silver.

Graham Bell found, in 1874, that a simple helix without an iron core emitted sounds, and (in 1876) that very distinct sounds proceed from straight pieces of iron, steel, retort carbon, and plumbago, when conveying currents.

Professor Hughes showed that his microphone was reversible, that is, that it could receive as well as transmit sonorous vibrations.

Mr. Weisendanger (*Telegraphic Journal*, October 1, 1878) reproduced sounds on a microphonic receiver which he called a thermophone, and attributed the effect to its true cause, namely, the expansion of bodies under the influence of heat, which, in fact, is the explanation of all microphone receivers.

Ader reproduced speech by the vibrations of a wire conveying currents of electricity, but he found that only magnetic metals were effective, and therefore, like De la Rive, he attributed the result to magnetic agencies (*vide* Count du Moncel, *Telegraphic Journal*, March 1, 1879).

These and many other sonorous effects of currents on wires may be really due to such heat effects as I have described.

The Hudson River Tunnel.

The bill "to provide for excavating and tunneling and bridging for transportation purposes within the villages and cities of this State," passed by the New York Legislature, has been signed by Governor Cornell. The completion of the Hudson River Tunnel is now authorized, and becomes purely a question of scientific and financial engineering.

Honors to Electricians.

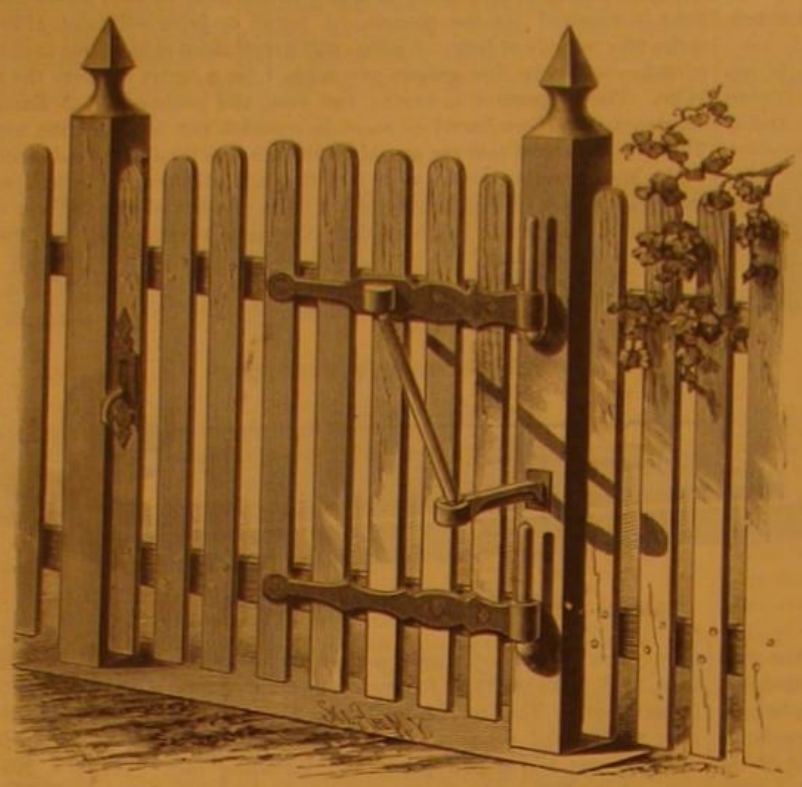
A committee appointed in 1876 and presided over by M. Dumas, have reported to the French Chamber of Deputies in favor of granting the first Volta prize of 50,000 francs to Prof. Graham Bell, of telephone fame, and the second prize of 20,000 francs to M. Gramme, the well known inventor of the dynamo-electric machine bearing his name. The first one to receive this distinction was Ruhmkorff.

NOVEL GATE CLOSER.

The engraving shows a simple and effective device for closing gates automatically without the application of springs or weights. The gate rises bodily as it opens, and is closed by its own gravity. It is hung upon hinges having long pintles, and is supported by an inclined rod, having a bearing at its upper end in a socket attached to the gate, and at the lower end in a socket attached to the post eccentrically to the pintles of the hinges. Opening the gate causes it to rise bodily by throwing the inclined rod into a more nearly vertical position, when the gate is released its own weight closes it.

The socket which receives the upper end of the inclined rod is rigidly attached to the hinge strap, making a strong and durable bearing.

A patent for this device was recently issued to Messrs. John Köhnmann and Samuel R. Latta, of Dyersburg, Tenn., who may be addressed for further information.



KOHNMANN'S GATE CLOSER.

Philadelphia's Textile Industries.

Mr. Lorin Blodgett, who has in charge the census of the textile industries of Philadelphia, finds 460 power mills or groups of mills in the city, and about 200 hosiery and carpet manufactures, not using steam power. In a recent statement concerning this branch of industry Mr. Blodgett said:

"It is well known that Philadelphia is the greatest manufacturing center of the world, but it is not so generally known that the textile manufacturers contribute more than any other class to this marked distinction of our city. The census now being taken will show that the value of the products for the present year of the various manufactories of our city will reach the grand total of $600,000,000. To this the textile manufacturers will contribute: In woolens and cottons of the general table, $48,500,000; in carpets, $23,000,000; in hosiery and knit goods, $23,000,000; in worsted yarns, $12,500,000; in silks and mixed goods, $7,000,000—an aggregate of $115,000,000—over one sixth of the whole, an amount of which they may justly feel proud, not only on account of the position which it aids in giving to our city, but also because of the means of subsistence which it affords to so many of its people. The outlying districts, of which Philadelphia is the business center, will add $38,000,000 to this, making for Philadelphia and vicinity $153,000,000."

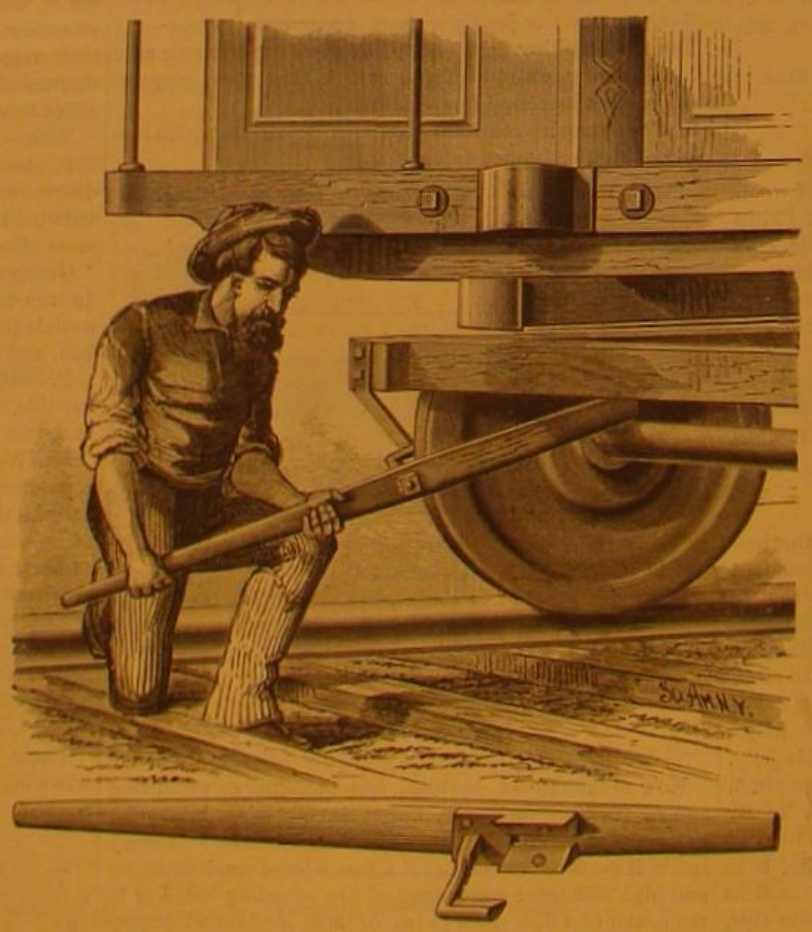
NEW CAR MOVER.

The device shown in the annexed engraving is applied to one of the wheels of a car when it is desired to move it for a short distance. It consists of a wooden lever having on one side two triangular steel bars whose edges are capable of biting into the side of the car wheel. A stout bolt bent at a right angle projects from the side of the lever near the triangular steel bars, and is threaded so that it may be adjusted to wheels of different thicknesses.

When in use one end of the lever is placed against the car axle as a fulcrum, and the edge of the wheel is clamped between the triangular steel bars and the hooked end of the bolt.

By pulling or pushing on the long arm of the lever the car wheel is turned and the car moved. When pushing, the lever is placed over the axle; when pulling, it is placed under the axle.

This device was recently patented by Mr. O. B. Blakeslee, of Rankin, Ill., and is manufactured by J. T. Mug & Co., Lafayette, Ind., who may be addressed for further information.



BLAKESLEE'S CAR MOVER.

Lake Ontario Shad.

The attempt to stock Lake Ontario with land-locked shad turns out less favorably than seemed probable a short time ago. The *Times*, of Watertown, N. Y., says that on the 19th of June the Edith Sewal, on her trip to South Bay, passed through compact masses of dead or dying fish, extending in windrows ten feet wide and miles in length, while scattered fish in countless numbers covered the waters between the rows.

The fishermen, who say that each fish has a mossy spot upon it, of a yellow cast, with a red look about the edges, have had hard work to get rid of the multitudes of dead fish, whose stench polluted the air.

MISCELLANEOUS INVENTIONS.

Mr. William V. Henry, of Sacramento, Cal., has patented an improved pumping apparatus. The object of this invention is to furnish simple and durable apparatus, especially adapted for raising large quantities of water for irrigating purposes and for draining mines. The invention consists in pump barrels suspended from a walking beam and reciprocating upon a valved piston head that is held upon a fixed rod. The barrels are fitted with check valves, and the whole apparatus constitutes a balanced force pump that may be fitted in open or bored wells and driven by horse, wind, or steam power.

Mr. Granger W. Smith, of Chili, N. Y., has invented an improvement in paper-cutting machines. The invention relates to a machine for trimming the edges of magazines, pamphlets, or books, and for cutting paper into sheets of different sizes, and for other similar purposes; and it consists in a novel arrangement of an adjustable table for holding the book or paper to be trimmed or cut, a frame for supporting said table, and an adjustable bar for clamping the book or paper, and a knife used for the trimming or cutting process.

An improved starch press has been patented by Mr. Richard Johnson, of Madison, Ind. This invention relates to means for extracting water from starch, which has heretofore been accomplished by means of ovens and other devices involving the necessity for the employment of heat.

An improvement in harrows has been patented by Mr William L. Waddy, of Peytona, Ky. The object of this invention is to enable a harrow to be reversed and slid on runners.

Mr. Silas Courtright, of Hooker's Station, O., has patented an improved tug attachment which is designed to render the tug elastic to a certain extent, and thus relieve the horses from undue strain.

Mr. John Tuggle, of New Middleton, Tenn., has invented an improved currying knife. The improvement consists in a novel construction and mode of attachment of the blade and stock of a currying knife, whereby provision is made for adjusting the blade to suit the different kinds of work.

A novel and convenient device for supporting window shades and curtains has been patented by Mr. George Baldwin, of South Manchester, Conn. The invention consists in a combination of brackets, shade rollers, curtain cornice, and curtain rod.

A button so made that the face and shank can be readily separated and again united, has been patented by Mr. Henry H. Schmitt, of South Brooklyn, N. Y. The invention, although simple, cannot be described without engravings.

Mr. William P. Owen, of Mount Pleasant, Tenn., has patented an improved folding extensible fire screen, which is composed of hinged or both hinged and sliding sections.

Mr. John L. Paxson, of New Hope, Pa., has patented an improved register adapted especially to the tallying of lumber, but applicable also to indicating the speed of machinery, or for adding a column of figures, or for measuring distances, etc.

Mr. Joseph B. Eaton, of Shamokin, Pa., has patented an improved machine for making lozenges which is simple, convenient, and effective in operation. It consists in arranging narrow belts between the cutters so as to allow the lozenges to pass through, while they hold the scrap down and feed it forward.

Mr. August Hoen, of Baltimore, Md., has patented an improved process of lithocaustic engraving, consisting in drawing parallel crossed lines on the etching ground covering the lithographic stone, for the purpose of giving a roughened surface of even texture to the stone, then applying an acid for the purpose of deepening and broadening the lines and producing pyramidal points, then covering the lines with a solution of gum arabic in water, then rubbing down or otherwise reducing the points to produce the uneven surface required for the lights and shades of the engraving.

An improvement in dividers for striking circles with chalk or pencil points has been patented by Mr. Charles F. A. Reimann, of Pine Bluff, Ark. The object of the invention is to strike two or more concentric circles at one sweep of the instrument. It consists of dividers with the pencil foot adapted to receive two points, and in providing the dividers with an adjustable arm adapted to receive several points and hold them on a level with the feet of the dividers.

An adjustable smoke stack especially designed for steam fire engines, whereby the draught from the boiler can be increased or diminished at will, has been patented by Mr. Asa W La France, of Elmira, N. Y. It consists of a section of a flanged and longitudinally-ribbed pipe, smaller than the outer section of the smoke stack set within said stack and vertically adjustable therein, whereby the exit of the smoke stack may be diminished or increased at pleasure.

Mr. William Klemm, of Pittsburg, Pa., has patented an improved curtain cord tightener, consisting of a cam pivoted in a clamp that slides on the vertically-placed rack, so that the tension of the cord that is passed around the outer end of the cam forces the inner end of the cam against the face of the rack and holds the cam and clamp immovable.

Mr. William Keane, of Stratford, Ontario, Canada, has patented an improved tow cleaning machine. Heretofore the tow has been cleaned by hand by tow pickers and beaters, operations involving considerable expense and waste of tow, besides not being effective. For a proper understanding of the nature and objects of this invention, it should be understood that the tow is the refuse from flax scutching machines, which are made in various forms, but generally using revolving cutters, which remove the rough fibrous shives and other refuse while the flax is held by the scutcher. The tow is then partially cleaned from the shives and refuse by separate operation. In this machine the beaters of the scutching machine are used for cleaning the tow after it is removed from the flax, and deliver the cleaned tow separately from the shives and other refuse, thus accomplishing the complete operation without extra machines.

Mr William E. Huse, of Brookfield, Mass., has patented an improved cattle stanchion. The object of this invention is to furnish attachments for cattle stanchions so constructed that cattle may be released from their stanchions and from the stable in a moment and without entering the barn.

THE TEREBELLA AND HERMELLA.

While wandering along any of our sandy coasts, we frequently come across some moderately large tubes projecting from the sand, and rather conspicuous in the little puddles left by the receding tide. Round their mouth is usually a set of forked filaments which, like the tube itself, are composed of fragments of sand agglutinated together. The substance of this tube is very soft, but very tough, and will endure a tolerably hard pull without breaking. If the inhabitant of these tubes be sought, it will not be found without much labor, for the terebella retreats to the further extremity at the least indication of danger; and as the tube is a foot or more in length, and is always conducted under stones or among rocks, it is not easily dislodged.

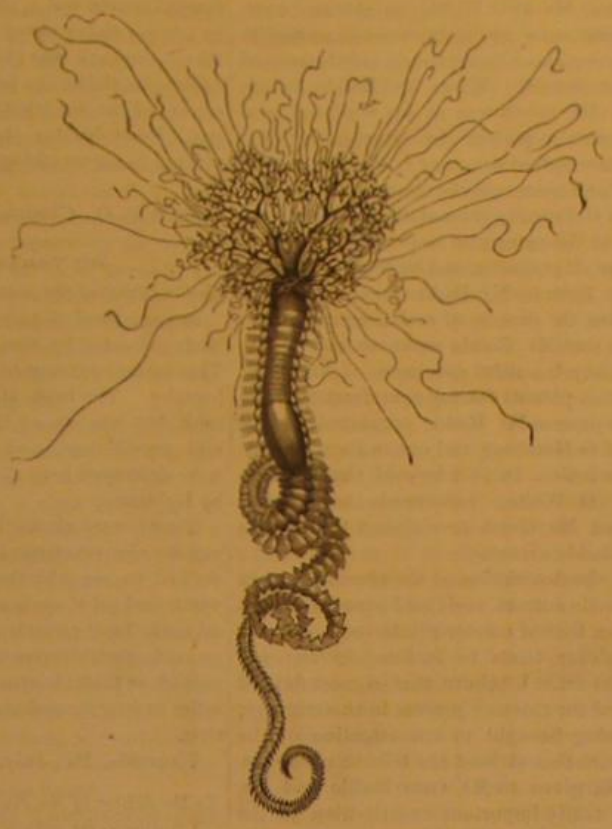
As in the case of the sabella, this annelid performs its architectural labors by means of its tentacles, which are most wonderfully constructed, so as to be capable of extension or retraction, and at the same time can seize or throw away a particle of sand at any part of the tentacle. The method of working is very well given by Mr. T. Rymer Jones in "Wood's Natural History:"

"If a specimen be dislodged from its tube, it swims by violent contortions in the water, after the manner of various marine annelids; the tentaculæ and the branchiæ are compressed and contracted about the head, like a brush; and as the animal is very soon exhausted by such unnatural exertions, it soon sinks to the bottom. Should a quantity of sand be now scattered from above, the tentaculæ, speedily relaxing, extend themselves in all directions to gather it up, sweeping the vessel quite clean, so that in a very short time not a particle is left behind that is within their reach, the whole having been collected to be employed in the construction of a new artificial dwelling, adapted to shelter the naked body of the architect.

"We will suppose a tube to have been partially constructed into the side of the aquarium wherein a specimen is about to take up its permanent abode. During the earlier part of the day the animal is found lurking in its interior, with only the extremities of the tentaculæ protruding beyond the orifice, and it will so remain until towards noon. But scarcely has the sun passed the meridian than the creature begins to become restless; and towards four or five it will be seen to have risen upwards, the tentaculæ extending with the approach of evening, until after sunset, when they are in full activity. They are now spread out from the orifice of the tube like so many slender cords; each seizes on one or more grains of sand, and drags its burden to the summit of the tube, there to be employed according to the service required. Should any of the tentaculæ slip their hold, the same organs are again employed to search eagerly for the lost particle of sand, which is again seized and dragged toward its destination.

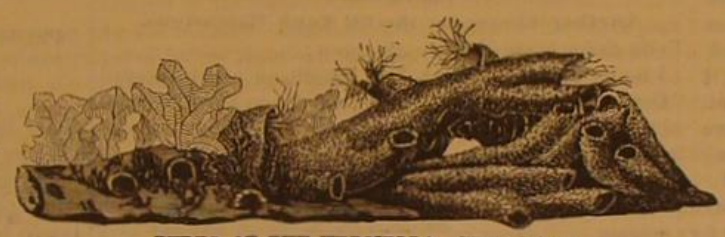
"Such operations are protracted during several hours, though so gradually as to be apparently of little effect. Nevertheless, on resuming inspection next morning, a surprising elongation of the tube will be discovered; or, perhaps instead of a simple accession to its walls, the orifice will be surrounded by forking threads of sandy particles agglutinated together."

There are many species of terebella, and even on our own coasts we may be gratified with several beautiful forms of these interesting annelids. They have, to a considerable extent, the power of reproducing lost portions of the body; and it has been found that even the whole mass of plumy tentacles can be removed without much injury to the terebella, which retreats to its tube, and after a while reproduces the whole of the missing organs.



TEREBELLA EMMALINA.—[Natural size.]

HERMELLA.—[Magnified.]



TUBES OF THE HERMELLA.—[Natural size.]

FISH PARASITES.

BY A. W. ROBERTS.

The leeches which commonly swim free in the water, and only occasionally attach themselves to the bodies of vertebrate animals to drink themselves full, have their nearest relations in those which attach themselves to the exterior of fishes and crustaceans. While, however, the free swimming leeches have ringed bodies, the parasitic leeches of fish and crabs have soft and smooth bodies, especially in the *Malacobdellæ*. In other words, there are leeches which occasionally prey upon warm-blooded animals, and are hardly to be called parasites. Others are to be found only on the skin of cold-blooded vertebrates, and, finally, those of thoroughly parasitic character, which adhere to crabs and soft-skinned animals. The accompanying illustration represents the skate sucker, *Pontobdella muricata* (natural size). From the fact that it is more frequently found adhering to the different members of the skate or ray family of fishes, it is most commonly known as the skate sucker. This genus of marine leeches can be generally distinguished by the numerous tubercles on the rings of the body, which produce a very curious effect. The prevailing color of the skate sucker is a greenish gray.

SKATE SUCKER.—*Pontobdella muricata.*—[Natural size.]

These marine leeches are provided with a large and powerful sucking disk, by which they can maintain themselves in a horizontal or perpendicular position; but their most common position, when at rest and attached to inanimate objects, is a spiral, the head being in the center.

On my return to the aquarium, one of the large fresh water tanks which had been neglected for several months had become so infested with a small variety of parasitical leech that it was with difficulty the glass front could be kept clear of them. Even the extreme tops of the aquatic plants growing in the tank swarmed with thousands of them constantly extending themselves in their endeavors to catch on (they not being free swimmers) to the tails and fins of the lake dogfish, or the large specimen of fresh-water eels contained in the tank. The eels instinctively avoided resting on the floor of the tank or coming in contact with the plants or rock work sides of the tank, but remained suspended night and day in the open clear mid-water. Still, with all the precautions taken by the eels, many of them became fringed with hundreds of the leeches. I have seen the eels repeatedly loop themselves so as to bring the head and tail together, in which position they would strip off the leeches with their teeth; and in so doing they often bit or tore off small pieces of their flesh and fins, so that in course of time (when the wounds did not heal rapidly) they became badly covered with fungus. What with the leeches and the fungus the eels had become floating skeletons. To save the few remaining, I placed them in the "hospital tank" for treatment. The course of treatment was to rapidly pass them through a bath of warm and very salt water (a nearly saturated solution). This salt bath I never knew to fail in destroying leeches and fungus, if the fish so treated were not too far gone.

The bottom of the "hospital tank" contained a heavy flooring of Coney Island sand, in which the eels embedded themselves as if only too glad to take a rest after their long suspension. At night they were fed to repletion on raw beef. Under this treatment they soon became "solid" and happy.

The tank out of which the eels were taken was then cleared of all the fish remaining, after which a half barrel of quicklime was cast into it, and in one hour's time the lime had done its work, everything living was burnt up, the tank was then drawn off, scrubbed, and washed out, and a heavy bottom of fine sand introduced.

One of the most beautiful tanks I ever had, and of which I was very proud, contained some twenty-five weakfish, thirty kingfish, twenty striped bass, two pilotfish, and several bluefish. They were all in perfect health, high color, and feeding well. In one night all the kingfish died; the next day the weakfish departed, then the pilots, and the blues.

I had nothing in the way of an explanation, as I had never in all my long experience known of fish dying in this unaccountable manner. I examined the dead fish carefully; both externally and internally they appeared to be in perfect health; their gills seemed to be unusually healthy for fish kept so long in confinement.

Next to this tank was a tank of plump and healthy blackfish, who were fed as blackfish were never fed before; and these, too, died in the same unaccountable manner a short time after the other fish.

Next to the blackfish was a tank containing over one hundred spotted codlings, and who were so fat that they seldom swam for more than five

minutes at a time without resting half an hour to take breath

A day or two after the death of the weakfish, kingfish, and blackfish, the codlings began to go. Every few minutes through the day my assistant was scooping out dead fish Still I could not detect the cause, but I came to the conclu sion that when blackfish and codlings (the toughest of all aquarium fish) die the reason ought to be discovered

All of these fish, from their first illness, had been fed on the very choicest of marine diet—soft crabs, shrimp, hard and soft clams, and even oysters and scallops. The codlings would churn the surface of the water when fed on soft crab, so keen were their appetites, and yet a minute after they would retire to the bottom of the tank, straighten out, and die I watched the codlings with painful anxiety, for I began to fear that an epidemic was spreading through the entire range of tanks, and that in a few days all the fish would be lost. I had noticed that when a codling began to die it lost its rich colors and took on a sickly brownish white color, and that its death ended in a quivering and spasmodic action, after which it would straighten out and become rigid. These are the exact symptoms of smothering Yet how could these fish die of suffocation when I was pouring oxygen into the water so rapidly that the water was of a milky color, and everything was silvery with globules of air?

Again I determined to make another examination, this time under a microscope, and placing a minute portion of a gill of one of the dead codlings under the glass, I was astonished to find it literally packed solid with very minute marine leeches, every one of which was gorged with blood taken from the gills of the fish. Here was the secret; these thousands of minute parasites had so packed the delicate breathing apparatus of the fish that they had died for want of oxygen, in other words, had smothered.

Evidently these parasites were fast spreading from tank to tank; the only way to stop this was to lock up the water in the affected tanks, and thus stop the spreading of the parasites through the entire circuit of tanks and into the storage reservoirs. The few codlings that still remained alive were treated the same as the eels, and with like good results. The locked up water was filtered through a large filter, consisting of blankets, sponge, animal charcoal, and fine sand, after which it was allowed to pass into the reservoirs. I afterwards discovered that these parasites had been introduced into the tank through the medium of twenty five small Eastern lobsters that, in all probability, through long confinement in "cars" and smack wells, had become in fested with parasites. All these lobsters died shortly after being introduced in the tank.

Correspondence.

The New Color Printing Process.—Honor to whom Honor is Due.

To the Editor of the Scientific American:

In your issue of June 29, you repeat in an article with the title of "A New Process of Simultaneous Color Printing," certain statements which in a similar form have fallen under my eye at least a dozen times in various journals within the last six months.

So long as these statements were confined to the regular daily or weekly journals, and were referred to as items for the casual reader, I left the misstatements they embodied unnoticed, although always in the possession of facts to correct them. But now as I observe their appearance in your well informed technical journal—a journal which I am happy to say is considered an authority in all technical matters by its readers—I beg to be permitted to say what I know about the very valuable and ingenious invention referred to.

The process of polychrome printing for producing com plicated color effects in one single impression—the printing from a kind of mosaic plate or ground—was the idea of many an inventive mind during the last century. Senefelder, the genial inventor of lithography, was, so far as I am aware, the first to conceive the idea of reproducing oil paintings, etc., by mechanical means, and in the course of his various experiments he also invented a process which he called mo saic printing.

In the collection of lithographic incunabula at Munich there is still to be seen "an original mosaic plate, consisting of minute sticks of color, very carefully put together, with finished and unfinished impressions taken from it." (See Ferchl, *Geschichte der Errichtung*, etc., München, 1862.)

As Senefelder died in 1835, his priority is established be yond dispute. Experiments in this direction were followed by a Berlin artist, Liepman, who, in the first half of this century, produced reproductions of oil paintings, especially portraits, by this process, which were of wonderful accuracy. It seems, however, that he was only partially successful—that he was unable to perfect the process so as to make it practically useful, and carried it only to the experimental stage; for after his first successful reproductions, of which several were regularly published, we hear no more of it. Liepman also published a book describing his invention and entitled "Der Oelgemalde Druck," Berlin, L. Sachse & Co., 1842.

Similar attempts were also made in the United States. A firm in Maiden lane or in John street, New York, whose name I cannot now remember, published some maps printed from mosaic blocks, a number of years ago; but the next person prominently identified with this invention was one Julius Greth, also a German, who began experimenting with the process about the year 1870

He succeeded in interesting successively various wealthy enthusiasts in the enterprise, leaving one for another how ever as fast as their enthusiasm cooled His last financial assistant in this way was Mr Otto Radde, an able and ener getic Hamburg merchant, who not only invested money in the enterprise, but who became himself thoroughly interested in the principles of the process. When Mr Radde found, as he did shortly, that Mr. Greth was at his wits' end, and that he was wholly unable to perfect the practical applica tions of the process, they parted company Mr Radde then struck out for himself and continued the experiment, assisted by Mr C R. Linde, a technically trained architect and en gineer. By bringing to the enterprise trained skill and en ergy that has overcome all obstacles, and by the employment of a not inconsiderable fortune, Mr Radde succeeded, about the year 1876, in making the process of real practical value It was about this time that Mr Radde wrote to me on the subject and sent me many beautiful specimens of his work, and offered his American patents for my consideration

After perfecting his process Mr Radde organized a color printing establishment in Hamburg and one in Paris, the latter on a very extensive scale. In 1879 he sold the latter establishment to Mr. W. G. White. I observe in the technical papers in Germany that Mr. Greth now claims that he has greatly improved on Radde's results.

I will only add that the description of the process given in your article is in the main correct, and that I have no interest in the matter other than that of a color printer who takes a lively interest in whatever tends to further develop our beautiful and important art. I believe that a great field of usefulness can be found for this new process in this country, and now that it is being brought to the attention of the American public I desire that at least the tribute of honor able mention should be given to Mr. Otto Radde and Mr C. R. Linde for their really important contribution to the practical worth of the invention.

LOUIS PRANG.

Boston, June 25, 1880.

Another Theory for the Oil Tank Explosions.

To the Editor of the Scientific American:

I notice in your paper of July 3, 1880, an article headed "Cannonading Oil Tanks," under which you advance a certain theory as to the probable cause of the frequent oil fires from lightning.

It is unquestionable that at all times a certain amount of gas or vapor escapes from such a body of oil, but that such a column, or "vapor rod," as you term it, should act as a conductor of electricity, we think is quite incorrect.

We give you our opinion, not as a scientist, but from a practical point, or, rather, from that which observation has led us to believe.

Perhaps all of your readers may not be familiar with the facts, therefore it will require a little preliminary explanation

Connected with each of these large *iron tanks* are a great number of *iron* pipes, leading oil from great distances and from different points into the tanks, the pipes ending abruptly within the tanks, which are closely covered, except at these openings or hatches in the upper parts of the tanks, where the pipes are admitted.

Now to illustrate, suppose a powerful current of elec tricity conducted by a rod of iron to a point where the rod terminates in the air—what is the result? A stream or sparks of fire are produced from the end of the conductor.

Just so in the case of oil tanks; at some point along these pipe lines the lightning has come in contact with some one of them. That which might be expected is just what does occur: the pipe line, acting as a conductor, leads it directly to and inside of the tank, where, reaching the end of the iron line, sparks are produced, and, of course, from the nature of the gas contained in the tank above the oil, an explosion and terrible fire is at once produced.

You say, "Ordinary buildings, when properly provided with rods, are comparatively safe, etc., and that structures of iron, simply resting on the ground without rods, are al ways exempt from electrical damages. Such structures al ways present a continuous body of conducting material for the free passage of electricity to arth. Why is it, then, that iron oil tanks form such conspicuous exceptions to our common experience with lightning? Rods put on other structures save them; but rods have been put on oil tanks, masts with rods have surrounded the tanks, but the tanks were exploded by lightning all the same."

Now this, together with other things I will mention, just helps to support our theory.

In the first place, we doubt whether any one can show an instance where lightning struck a tank direct. If such an instance should occur, what would be the result? Just as you have stated above, the iron covering would furnish a perfect conductor to the earth.

Why did not all those rods on and around the tanks pro tect them? Because the lightning did not come at those points (if it did, it would, of course, be conducted into the earth), but it came from other points, by the iron-pipe lines, directly into the tank where the explosive matter was located.

To further prove this theory, I will give an example that came under my own observation. Lightning struck a large oak tree, possibly fifty rods distant from an oil well, at which was a wooden tank capable of holding about 150 barrels; from another well, possibly forty rods distant, an iron pipe led the oil to this tank also Immediately after the tree was struck this tank was on fire. Fortunately but little oil was in the tank, and before the fire had consumed the gas sufficient to reach the oil (as there was but little chance for air), wet blankets were placed over the hatch, and the fire smothered out No signs or marks of lightning could be traced, either about the derrick or on the building with which the tank was closely housed, or on the closely fitting cover containing the hatch. It seemed positive that the line conveyed the electricity into the tank, thereby igniting the gas. Possibly this theory is not correct and I would be pleased to see anything further upon this subject.

F. G. SACKET,

Knox P O, Clarion Co, Pa, July, 1880.

Oil Tanks Struck by Lightning.

To the Editor of the Scientific American:

In your issue of July 3 you say that 'lightning is peculiarly attracted by iron oil tanks, causing disastrous fires." This seems contrary to our experience as well as our philosophy The tank struck here June 11 was not an iron tank, but was one of the old fashioned tanks with wooden and gravel tops, and iron sides only. Many iron tanks were destroyed here at that time, but they were not ignited by lightning.

Your theory about the ascending column of vapor attract ing the electric current has no doubters in these parts, but we fail to see why the lightning would not leave the oil vapor and oil if such a splendid conductor as a 20,000 barrel oil tank, built entirely of boiler iron and sunk well into the ground, was interposed, especially if the iron tank was connected, as tanks in this country are, with pipe lines many miles in length, making the best kind of a ground connection. B.

Titusville, Pa, July, 1880.

To the Editor of the Scientific American:

I notice your article about lightning being attracted by the iron oil tanks. The remedy for this has been found long since. The use of the iron top instead of wood. There has never been a tank of oil with iron top burned by lightning.

D. B. MASON.

Pittsburg, Pa., July, 1880.

The Oil Tank Question.

To the Editor of the Scientific American:

I have read your remarks referring to our late oil fire here, and giving a reason or explanation of the cause of it. I think you are out of the way in your statement, for the vapors from petroleum are oftentimes heavier than the atmosphere and rather seek the ground. Practical refiners always fear this most in and about a refinery, as these vapors hugging the ground are frequently drawn toward their furnace fires and lead to fearful explosions. Then the tops of these iron tanks are generally if not always tight, it being as necessary to keep *out* rain as to keep *in* the oil and vapor. In this particular instance the lightning struck this tank at 7 o'clock in the morning, before the sun could have generated any vapor to speak of, and these tanks are often struck in winter time, when the atmosphere is not warm enough to cause the vapors to be generated. Then, too, why is it that iron tanks with iron tops are not struck by lightning, while those of wood tops (covered with turf) are. I am anxious to get at the cause, and have written this solely to bring out more thought on the subject. C. M. C.

Titusville, Pa., July, 1880.

The Relative Cost of Motive Power.

Mr. Bissinger, M.E., at Carlsruhe, Germany, gives the following results as obtained in his examinations of the several motors in regard to the relative cost per horse power for each hour. It will be observed that the examination pertained principally to small motors.

The relative cost per effective horse power per hour is as follows:

100	horse power	steam engine	7·6
2	"	"	44·3
2	"	Lehmann's caloric engine	26·5
2	"	Hock's motor	40·0
2	"	Otto gas engine	26·4
2	"	Otto Lang gas engine	26·4
2	"	Schmidt's hydraulic motor, supplied with water from the city water works	95·00
2	"	obtained by horses and a gin	45·00
2	"	obtained by manual labor	200·00

Otto's gas motor and Lehmann's caloric engine are the cheapest of the small motors, but are, nevertheless, four times as expensive as the 100 horse power steam engine.

A New Photo Emulsion.

Dr. Vogel writes to the *Photographic News:* "I have a new emulsion with remarkable qualities. It combines the advantage of gelatine emulsion (high sensitiveness) with the advantages of collodion emulsion. It appears to keep any length of time, and, best of all, it may be poured like collodion upon the glass, drying as quickly as the latter. The plates are developed, intensified, fixed, and washed exactly like collodion plates, and dry like these. Moreover, the film may be exposed in the camera seven minutes after preparation and before drying. You will be glad to hear that several of our Berlin photographers—Prumm, Schaarwachter, and Reichard—have tried the emulsion, and reported upon its success to the Society for the Advancement of Photography. You may smile over all these wonderful things, but they are so convincing to me that I am seriously thinking of making the emulsion on a large scale."

THE STRUCTURE OF MATTER.

Read before the New York Academy of Sciences by Prof. C. F. Kroch, of the Stevens Institute of Technology.

[*Continued from page* 25.]

LEIBNITZ.

Leibnitz (1646–1716), one of the inventors of the calculus, maintained that extension is not a fundamental, but a derived idea. It can be explained by the assumption of some thing of which it is the property, of some thing that is itself simple, without parts, and consequently without extension, shape, or divisibility. He imagined the universe to be made of such simple, ultimate things, and gave them the name of monads. Although a monad has no parts, it may nevertheless be the exponent of numerous perceptible relations, just as a point in space may be viewed as the vertex of numerous angles. Great numbers of these monads are continually acting upon our senses with infinite rapidity, and producing in our minds confused images of the external world. We perceive what we call the properties of matter only because we are incapable of analyzing the impressions made upon us by these immaterial monads.

A monad can be produced by creation only, and can be destroyed by annihilation only. This follows from the assumption that it has no parts. Nothing can be added to it nor taken from it. Being a created thing, it must be subject to continual change, and the cause of this change must lie within it. In consequence of this changeability there must exist an infinite variety of monads. They appear to us to occupy space, because they have certain positions with regard to one another, certain geometric relations, and because many of them act upon our senses at once. Motion is the sum of infinitely small impulses exerted by them; yet they in no wise act upon one another, but each monad moves independently by virtue of the force that is in it, and enters into various relations with other monads in obedience to a predestined harmony which is the law of its being.

To account for the phenomena of life Liebnitz goes so far as to endow his monads with greater or less degrees of consciousness, of perception and volition; but in these speculations we need not follow him.

KANT.

Kant (1724–1804), the originator of the nebular hypothesis, fixed upon mobility in space as the essential property of matter. Our senses can be affected by motion alone. Extension is explained in this system by supposing that a body fills space by reason of the resistance it offers to all motion tending to displace it. This resistance is itself motion in a direction contrary to that of the invading body. It may be called a repulsive force, and must be inherent in all its parts. If every particle of matter is endowed with repulsive force, we have an explanation of expansion, elasticity, and impenetrability. Infinite divisibility also follows from this conception, because the mobility of every particle makes it separable from every other particle. The divisibility of matter must, therefore, be commensurate with the mathematical divisibility of space.

To account for the occupation of definite space by a body we must also endow its particles with an attractive force, which counteracts repulsion and prevents the particles from flying off into space.

It will be perceived that we are now entering a region of thought more familiar to the modern chemist and physicist.

BOSCOVITCH.

The idea that the particles of matter are endowed with both attraction and repulsion constitutes the basis of the atomic theory of Boscovitch (1759), which has formed the working theory of scientific men until quite recently.

When bodies are said to touch each other they are by no means in mathematical contact, but separated by an insuperable repulsive force, so that a distance of $\frac{1}{2^{8}0^{8}0}$ to $\frac{1}{3^{0}0^{0}0}$ of an inch intervenes. Within this interval, according to Boscovitch, there are several alternations of attraction and repulsion. In other words, if two atoms, separated by $\frac{1}{2^{8}0^{8}0}$ of an inch, are brought a little nearer together they will attract each other; if still nearer, they will repel, and so on, with this limitation, that no force however great can bring them into mathematical contact. At distances greater than $\frac{1}{2^{8}0^{8}0}$ of an inch atoms attract each other according to the law of gravitation. It is evident that at smaller distances there will be intermediate positions of stable and unstable equilibrium, and that atoms moved from these positions in any direction will oscillate to and fro by virtue of their inertia, until they either return to their old position or arrive at a new one, where there is again a balance of attractions. It is thus that the phenomena of cohesion and elasticity are explained.

Boscovitch interprets the three states of matter as follows: In a gas, the repulsive force prevails between the particles, so that it would expand indefinitely if no external force interfered. In a liquid, the particles are maintained at a definite distance by mutual attraction and repulsion; and each particle is free to rotate in any plane. In a solid, the distances between the particles are also determined by both forces; but the particles are polarized or obliged to rotate in certain definite planes. If any particle is swung out of its natural plane, it will return to it again after performing a certain number of oscillations.

In this and all the other atomic systems the fundamental assumptions are:

That matter does not continuously fill space.

That its particles are separated by distances which are great in comparison to the size of the particles.

That they act upon each other at a distance, and not by contact.

That the particles are extremely hard, and both indivisible and unalterable by any means, physical or chemical.

That the particles are impenetrable and possess inertia.

That the chemical and physical properties and behavior of bodies depend upon the collocation and motions of its atoms; and consequently,

That our senses deceive us when they convey to our minds the impression that bodies are continuous, and when they appear to reveal to us any other changes than changes of place.

Those who endeavor to make the atomic system account for the *existence* of the physical universe, and reject creation, are obliged to make certain additional assumptions, which will be examined elsewhere.

FARADAY.

Faraday, in his speculations touching electric conduction and the nature of matter (*Phil. Mag.*, 1844), reasons as follows: Of the two constituents of matter involved in the atomic hypothesis (atoms and spaces), space is the only continuous one. Consider, then, he says, the case of shellac, a non-conductor, space in it must be an insulator, whatever the atoms may be; for if it were a conductor, the shellac could not insulate. But now take the case of platinum, which must also be composed of atoms and spaces. Since platinum is a conductor, space, being its only continuous constituent, must be a conductor. Space, which is everywhere uniform, is therefore both a conductor and a non-conductor. "Any ground of reasoning which tends to such conclusions as this must be false." He then adds, Why should we assume the existence of matter independent of force at all? and he modified the system of Boscovitch by substituting the term "center of force" for atom. According to this view matter, in the ordinary acceptation of the term, disappears entirely, to make room for the emanations of force which fill the universe, and the atom is replaced by points at which lines of force converge.

THE LATEST VIEWS.

Since by the labors of Joule, Clausius, Krönig, Maxwell, and others, the science of thermodynamics has been created, the hypothesis of atoms and molecules has been greatly developed by the mathematical study of their motions, so that we are no longer obliged to define them after the vague manner of former theories; but we possess tolerably definite information relative to their size, weight, distances apart, velocity, and energy. I shall have to content myself this evening with giving a single example of this new knowledge, postponing the evidence. Thus we know with tolerable certainty of the hydrogen molecule:

1. That its weight is $\frac{46}{10^{24}}$ gramme.

2. That its volume is subject to great variation in its compounds. In its elemental state its volume is taken as the unit of comparison, and corresponds to a diameter of $\frac{5{\cdot}8}{10^{10}}$ meter (5·8 tenth-meters).

3. The distance between two neighboring molecules of hydrogen is $\frac{96{\cdot}5}{10^{10}}$ meter (96·5 tenth-meters).

4. The velocity of vibration 0° C., 1,859 meters per second.

5. The number of collisions between hydrogen molecules per second is 17,750 millions.

6. Nobert can draw 4,000 lines in the breadth of a millimeter. The interval between two such lines can be seen with a good microscope. I have calculated that a cube with an edge of $\frac{1}{10^{0}0^{0}}$ mm. would contain about 17 million molecules of hydrogen.

The theory that matter is continuous has been revived to a certain extent. In studying elastic bodies Prof. Stokes has availed himself of the idea that the smallest portions into which we can divide them are sensibly homogeneous. The theory of fluxions and modern mathematics then become applicable, provided we do not carry the divisibility too far. The smallest particles considered must be sensibly similar. Sir Wm. Thomson illustrates this by the statement that contiguous cubes of water $\frac{1}{10^{0}0^{0}}$ cm. in breadth are sensibly similar, but cubes of $\frac{1}{10^{0}0^{0}0^{0}0^{0}}$ cm. must be very sensibly different. Take two lengths of masonry, he says, each of 20,000 cm.; one may contain 1,000 bricks, and the other 999 bricks and two half bricks. They would then be sensibly similar. If, however, you take two lengths of 40 cm., one might contain 2 whole bricks and the other 1 whole and 2 halves. They would be sensibly dissimilar.

In Boscovitch's theory there is no contact of atoms, and all action is therefore action at a distance. Of this it is impossible, at least for me, to form a clear and philosophical conception. Clerk-Maxwell in his electrodynamics drops this assumption entirely, together with that of *hard* atoms. He imagines the ether filling space to contain a system of cells with elastic walls and cylindrical cavities, in which elastic balls can rotate and be flattened out by centrifugal force. In the cells there must be other balls of invariable volume as friction rollers. These would rotate freely, but their centers of gravity, in insulating media, would merely be displaced by elastic yielding of the cell wall; in conducting media every displacement would be attended with resistance similar to friction in a viscous liquid. Motion is transferred in these balls by surface adhesion only. Their displacement produces dielectric polarization in the medium, and their onward motion an electric current. The rotation of the elastic balls corresponds to the magnetizing of the medium, the axis of rotation being the direction of the magnetic force. While Helmholtz designates such a conception as too artificial, he admits that Maxwell has developed from it a complete and mathematically very elegant theory of all electrical phenomena. An entirely novel and suggestive view of the construction of matter was originated by Sir William Thomson.

Vortex Atoms.—Helmholtz had shown that if any portion of a perfectly homogeneous fluid, incompressible, continuous (not made up of molecules), and devoid of internal friction, is caused to rotate, it will form a vortex ring of invariable volume. The matter partaking of this rotation is thereby differentiated from all the rest, and will remain so for ever. Nothing short of a creative art can start or stop such rotation. If two such rings are linked together, they can never be separated, and if a single one is knotted on itself, it can never be untied.

The formation and properties of such rings may be studied experimentally, bearing in mind that we have only imperfect fluids to deal with. Prof. Wm. B. Rogers, in the *American Journal of Science*, 1858, p. 246, described various methods of producing them. Prof. J. Trowbridge, in the *Philosophical Magazine*, 1877, says. "All liquid drops falling from such a height that the surface of the liquid in which they are about to diffuse themselves is not too much disturbed to enable the drop to be acted on symmetrically by the forces at the free surface, will form rings, if too great differences of density do not exist." To render them visible the drop may be colored. "That a drop of pure water will descend through the same liquid in a vortex ring can be shown experimentally by covering the free surface of the water with a fine light powder." (I would suggest lycopodium.) "Particles of the powder will be carried down by the drop and will be seen to rotate in a ring shape far below the surface."

Prof. Tait rendered visible the formation of vortex rings in air by means of a cloud of finely divided sal ammoniac. He used a common wooden box of a capacity of about two cubic feet. In one end there was a circular hole about six to eight inches in diameter, while the other end had a towel stretched over it. By sprinkling ammonia over the bottom and then generating in it hydrochloric acid from common salt and sulphuric acid, he obtained a copious evolution of sal ammoniac vapor, which rendered the rings visible. They were produced by sudden blows upon the stretched towel. Two such rings impinging upon each other behave like rings of solid India-rubber. As such a ring approaches one's face its inner particles are seen to rotate forward, and its outer ones backward, while the air in the center moves forward faster than the ring itself and strikes the face first.

These rings suggested to Sir Wm. Thomson the idea that the universe is continuously filled with a perfect fluid, and that whatever produces upon us the impression of matter is portions of this fluid in vortex rotation. In other words his atoms are vortices, and it proposed to explain all the properties of matter by the laws governing vortex motion.

While the atoms with which we have dealt heretofore are in reality patch-work, altered and amplified to suit each new discovery in chemistry and physics, the vortex atom is not capable of such adjustment. As Maxwell puts it: "His primitive fluid has no other properties than inertia, invariable density, and perfect mobility, and the method by which the motion of this fluid is to be traced is pure mathematical analysis. The difficulties of this method are enormous, but the glory of surmounting them would be unique."

Rankine, in a paper on "Molecular Vortices," before the Royal Society of Edinburgh, 1849–50, illustrated knotted vortex atoms by means of diagrams and wire models. "Their endless variety," says Sir Wm. Thomson, "is infinitely more than sufficient to explain the varieties and allotropies of known simple bodies and their mutual affinities."

Helmholtz, Tait, Maxwell, Rankine, Stokes, and other celebrated men have all contributed to this theory.

CONCLUSION.

Having now passed in review the leading theories of the structure of matter up to the present day, I shall conclude my paper by a brief statement of the manner in which it is my purpose to continue my studies.

I shall, in the next place, examine the idea of an atom and the question whether the material universe can logically be constructed according to the requirements of the atomic system. Then will be presented the evidence metaphysical and experimental of the existence of molecules. This will include the beautiful experiments of Crookes. Another chapter will be devoted to the facts ascertained about molecules, such as their weight, relative and absolute; size, relative and absolute, shape, velocity of motion, length of path, number of collisions per second, etc. I may mention in this connection that I have no less than seven different lines of argument based on experimental data, all of which concur in assigning to molecules a diameter not far from the $\frac{1}{10^{0}0^{0}0^{0}0^{0}}$ of an inch.

Finally, I shall endeavor to show how such a knowledge of atoms enables us to explain the behavior of gases under pressure, the spectra of gases, liquids, and solids; heat resulting from chemical action, quantivalence, and other phenomena.

A LARGE HORSE.—One of the largest horses ever seen in this city arrived from Ohio June 22. His registered height is 20 hands and 1 inch, or 81 inches; his weight is said to be 2,450 lb. The animal was bred from native draught stock, is of a dark bay color, well proportioned, and in excellent health. It is said that a horse measuring 21 hands 2 inches was shown in this city many years ago; and more recently one which measured 19 hands 1 inch.

Wages and Earnings in Pennsylvania.

Mr. Miles Humphreys, chief of the Pennsylvania Bureau of Industrial Statistics, has issued a report embodying the information gathered by him last year by circulars addressed to employers in various parts of the State. Mr. Humphreys is careful to mention the fact that in many cases the returns received show only the weekly wages paid, and that, in tabulating them on a basis of fifty-two weeks, the aggregate earnings must be considerably over-estimated. When the necessary deductions are made for lost time the total must be materially reduced. Many circulars were issued to ascertain earnings from the wages worker's standpoint, but not a sufficient number of intelligible replies were received to furnish the information desired. The failure is attributed to the fact that workingmen as a rule do not keep accurate yearly accounts of earnings and expenditures.

The summary of employers' reports is given in the following table.

SHOWING THE AVERAGE WEEKLY WAGES OF EMPLOYES, THE AVERAGE WEEKS EMPLOYED DURING THE YEAR, WITH THE TOTAL EARNINGS FOR THE YEAR 1879:

Occupation.	Average. Weekly wages.	Weeks Worked.	Earnings for the Year.
Miners, coal (anthracite)	$9.28	43	$399.04
Miners, coal (bituminous)	8.51	40	340.40
Blast furnace employes	9.04	48	433.92
Puddlers (iron)	15.14	38	575.37
Heaters (iron)	17.98	40	719.50
Rollers (iron)	23.52	37	870.24
Roll turners (iron)	40.97	44	1,802.68
Roughers (iron)	17.94	44	789.36
Catchers (iron)	9.50	45	427.50
Refiners (iron)	16.97	46	780.62
Forgemen (iron)	15.56	39	606.84
Hammermen (iron)	17.50	40	700.00
Roll hands (iron not specified)	22.66	47	1,065.02
Helpers (iron)	11.00	34	374.00
Shearer, sheet (iron)	18.90	43	812.70
Straightener (iron)	10.00	52	520.00
Hammer driver	12.00	43	516.00
Steel melters	30.48	39	1,188.72
Steel converter	16.50	22	363.00
Steel helper	15.00	38½	502.50
Nailers	19.27	36	693.72
Tack maker	32.70	26	850.20
Nail cutter	12.00	25	300.00
Spike maker	9.00	48	432.00
Nail packer	8.40	52	436.80
Rivet maker	20.00	36	720.00
Wire drawer	15.00	52	780.00
Pipe threader	9.00	50	450.00
Moulders (iron)	11.26	43	484.18
Blacksmiths	10.33	48	495.84
Bricklayer	12.87	43	553.41
Carpenters	10.61	48	509.28
Cabinet makers	7.80	46	358.80
Carriage makers	8.62	48	413.76
Engineers	15.10	48	724.80
Glass workers	18.39	45	827.55
Machinists	10.84	47	509.48
Painters	9.86	42	414.12
Plasterers	7.71	44	339.24
Printers	8.66	50	433.00
Sawyers	15.78	35	552.30
Shoemakers	8.08	45	363.60
Stonecutters	9.33	41	382.53
Stonemasons	9.02	33	297.66
Tailors	8.00	46	368.00
Hatters	6.00	52	312.00
Tanners	7.53	50	376.50
Tinsmiths	11.12	51	567.12
Gasfitters	10.50	36	378.00
Track foremen (railroad)	10.00	53	530.00
Brakemen (railroad)	11.94	49	585.06
Flagmen (railroad)	7.30	51	372.30
Firemen	7.74	50	387.00
Teamsters	8.50	46	391.00
Slater	6.00	39	234.00
Quarrymen	6.25	46	287.50
Laborers	7.08	42	297.36
Butcher	10.00	36	360.00
Calker	9.00	31	279.00
Coopers	6.75	45	303.75
Brass finisher	6 24	48	299.52
Iron ore miner	9.00	48	432.00
Lead furnace helper	7.00	41	287.00
Carpet weavers	6.50	51	331.50
Loom fixer	11.71	52	608.92
Beamer	10.00	50	500.00
Dyer	10.00	52	520.00

The Projected Florida Ship Canal.

The survey of the route of the proposed ship canal across the peninsula of Florida has been completed under the direction of General Q. A. Gillmore, who reports in favor of the work. The principal direct benefits expected are the saving of about five hundred miles in the passage from our Atlantic ports to Gulf ports, and the avoidance of the dangerous passage through the Florida Straits.

The eastern terminus of the canal is fixed at Camp Pinckney, at the head of ship navigation, and twenty-nine miles above the town of St. Mary's. From here it will run southwesterly to and through the Okefinokee Swamp, crossing the Suwanee River, near Blount's Ferry, in Columbia County, and thence to Ellaville, in Madison County. At first it was contemplated making St. Mark's the western terminus of the canal, but General Gillmore failed to approve this selection, owing to the increased distance involved. The St. Mary's River is ascended by means of seven lift locks, each of fifteen feet lift to the summit level, one hundred and eight feet above tide. No guard lock is required, as the lift of the first lock exceeds any rise or flood in the river. The summit level enters the Okefinokee Swamp, through which it extends twenty-two miles, eleven and a half miles above Camp Pinckney. Fourteen miles beyond the Suwanee River is reached, near Blount's Ferry, the waters of which will be raised by means of a dam to the height of the summit level and taken into the canal. Crossing the river in the lake so formed the canal continues eighteen miles beyond to the end of the summit level, which has a length of sixty two miles. From this point the line descends by two locks, each of ten feet lift, crosses the Alapaha, and, turning again to the south, crosses the Withlacoochee River, near Ellaville, and thence runs through the center of San Pedro Bay, descending from it by five locks of fifteen feet and one of ten feet lift directly to the level of the Gulf.

A channel will have to be dug from the mouth of the canal to the deep water of the Gulf, seven or eight miles from the shore. The protecting jetties will form a harbor of safety for shipping.

The length of the canal route is about one hundred and sixty-nine statute miles, or one hundred and forty-seven nautical miles, divided as follows:

From the bar to mouth of St. Mary's River	5·5
Navigation of St. Mary's River to Camp Pinckney	34·0
Canal	122·0
To deep water in Gulf	7·5
Total	169·0

The plan contemplates a cross section of canal eighty feet wide at the bottom and twenty-five feet deep. The water surface will be one hundred and eight feet in width. The canal is widened, however, to one hundred and fifty-five feet at the bottom and two hundred and fifty-five at the top for one thousand feet above and below each pair of locks to permit the approach of vessels, and there are passing places one thousand six hundred feet by thirty feet every six miles.

The locks are five hundred feet in useful length (from the end of the gate chamber to face of breast wall), sixty-five feet wide at the gates, with twenty-five feet of water on the sills. They are arranged in pairs, side by side, to prevent the interruption of traffic during repairs, and the walls are carried to five feet above the water line. The lifts are ten and fifteen feet. The locks have about the same dimensions as those advised for the Panama route, except in the matter of lift.

The estimated cost of the canal is $50,000,000. The drainage area available for the summit level is one thousand two hundred square miles, with an average annual rainfall exceeding four and a half feet.

The Nicaragua Canal Concession.

The interoceanic canal concession granted by Nicaragua to the American Provisional Society has been ratified by the Nicaragua Senate and published as a law by the Republic. It secures to the society the exclusive privilege of constructing a ship canal across the territory of Nicaragua.

The canal is to be of sufficient dimensions to accommodate steamers of the largest class used between Europe and America, and the locks are to be not less than 500 feet long and 28 feet deep. The concession is for 99 years from the date of the opening of the canal for general traffic, and at the expiration of that period the Nicaraguan Government is to take possession of the canal in perpetuity, with the right reserved to the company to lease it for another 99 years. During the period of the concession the company is to have the privilege of constructing a railway along the whole or any part of the canal; also, such telegraph lines as it deems necessary for the construction and working of the canal, and these lines shall transmit public messages free of charge. The Government of Nicaragua will declare the terminal ports, and the canal itself throughout its length to be neutral, and that the transit in case of war between other powers and Nicaragua shall be uninterrupted. In general, the canal shall be open to free navigation of all vessels, provided they pay the dues and observe the regulations of the company. Troops of foreign nations and vessels of war will be allowed to pass through the canal under regulations of existing treaties. Vessels of war belonging to other nations engaged in hostilities with Nicaragua or any other republic of Central America will be rigorously excluded.

This concession, with all its advantages and privileges, will appertain to a construction company, and is transferable only to the company which is to be organized by the Provisional Society, and in no case can it be transferred to a foreign government or power. It is to be organized in the usual manner of such enterprises, with its principal office in New York or elsewhere, as it may deem most convenient. Its designation will be "The Nicaraguan Ship-canal Company."

The Increasing Use of Steel Castings.

The rapid substitution of steel castings for expensive forgings, and for iron castings where great strength is required, has compelled the doubling of the capacity of the works of the Chester Steel Castings Company during the past year; and now the company announce a still further extension of their establishment. Their chief success, as well as the heaviest part of their business, is in the production of heavy gear wheels, pinions, roll spindles, couplings, coupling boxes, etc., for rolling mills and sugar mills. In heavy plate mills their steel castings outlast many times the iron castings formerly used. It is claimed also that nearly all the locomotive builders and makers of large steam engines are now using the Chester castings, and that the fifteen thousand crank shafts and several thousand cross-heads on locomotives of their make show a better record for durability and smoothness of wear than any equal number of forged pieces for the same uses.

The Manufacture of Coal Tar Dyes.

The extent to which the manufacture of coal tar colors is now carried is shown by the following statistics of labor and production at one of the principal coal tar color works in Germany. There are employed over 1,000 workmen, in addition to 40 overlookers and branch managers, 25 chemists, 1 engineer, and 30 clerks and accountants. The yearly consumption of coal amounts to 17,000,000 kilos; anthracen, 825,000 kilos; naphtha and benzol, 950,000; chromate of potash, 280,000; caustic soda, 1,245,000; sulphuric acid, 2,250,000; muriatic acid, 4,050,000; nitric acid, 825,000; alcohol, 91,500; and sundry chemicals, 3,560,000.

Photographic Prizes.

The following is the list of prizes which the Photographic Society of Vienna offer for competition in the course of the present sessional year:

VOIGHTLANDER MEDALS.

(Open to members of the society only.)

1. A gold medal, value 140 ducats, for a method of increasing the sensitiveness of wet plates.

2. A gold medal, value 140 ducats, for the most reliable and sensitive dry process.

3. A gold medal, value 50 ducats, for researches into the gelatine emulsion process.

4. Medals in gold, value from 40 to 100 ducats, in silver, and in bronze, for scientific treatises, discoveries, and improvements, which have been published in the official journal of the society—the *Photographische Correspondenz*.

5. Medals in silver and bronze for the achievement of valuable results in the practice of photography.

SOCIETY MEDALS.

(Open to members or non-members.)

1. A gold medal, value 140 ducats, for the production of plates in relief for printing copies of drawings in half tint.

2. A gold medal, value 140 ducats, for monograph on pyroxyline and collodion.

3. A gold medal, value 140 ducats, for an improvement of the collotype process which will render unnecessary the constant wetting of the plate between the pulls.

4. A gold medal, value 50 ducats, for a rigorous investigation of the conditions of sensitiveness of asphalt.

Further particulars of the competition are contained in a detached programme, which, together with the prospectus and rules of the society, will be forwarded post paid on application to Dr. E. Hornig, 9, Hauptstrasse, Vienna III., to whom also should be addressed applications for admission to membership.

Curious Experiment in Magnetism.

M. Obalski describes a pretty magnetic curiosity to the Académie des Sciences. Two magnetic needles are hung vertically by fine thread, their unlike poles being opposite one another. Below them is a vessel containing water, its surface not quite touching the needles. They are hung so far apart as not to move toward one another. The level of the water is now quietly raised by letting a further quantity flow in from below. As soon as the water covers the lower ends of the needles they begin to approach one another, and when they are nearly immersed they rush together. The effect appears to be due to the fact that when the gravitation force downwards is partly counteracted by the upward hydrostatic force due to immersion, the magnetic force, being relatively greater, is able to assert itself.

Progress in Utilization of Solar Heat.

Since May, last year, M. Mouchot has been carrying on experiments near Algiers with his solar receivers. The smaller mirrors (0·80 m. diameter) have been used successfully for various operations in glass, not requiring more than 400° to 500°. Among these are the fusion and calcination of alum, preparation of benzoic acid, purification of linseed oil, concentration of sirups, sublimation of sulphur, distillation of sulphuric acid, and carbonization of wood in closed vessels. The large solar receiver (with mirror of 3·80 m.) has been improved by addition of a sufficient vapor chamber and of an interior arrangement which keeps the liquid to be vaporized constantly in contact with the whole surface of heating.

This apparatus on November 18, last year, raised 35 liters of cold water to the boiling point in 80 minutes, and an hour and a half later showed a pressure of 8 atmospheres. On December 24 M. Mouchot with it distilled directly 25 liters of wine in 85 minutes, producing four liters of brandy. Steam distillation was also successfully done. But perhaps the most interesting results are those relating to mechanical utilization of solar heat. Since March the receiver has been working a horizontal engine (without expansion or condensation) at the rate of 120 revolutions a minute, under a constant pressure of 3·5 atmospheres. The disposable work has been utilized in driving a pump which yields 6 liters a minute at 3·50 m., or 1,200 liters an hour at 1 m., and in throwing a water jet 12 m. This result, which M. Mouchot says could be easily improved, is obtained in a constant manner from 8 A.M to 4 P.M., neither strong winds nor passing clouds sensibly affecting it.

Rise of Butter and Cheese at Sea.

When the schooner Eddie Pierce, from Boston, bound to Baracoa, Cuba, was southeast of Nantucket, about 300 miles from Sandy Hook, June 18, a firkin of butter was seen to rise in the water. Others followed until three hundred and twenty-seven had come to the surface. Boxes of cheese also came up, to the number of twenty-four, and were secured, when the schooner turned back to Boston, where her owners filed a libel for salvage. The marks on the packages were illegible. There are two theories regarding the origin of the butter and cheese thus found "derelict" at sea. One is that some unknown freight vessel had been lost at that spot, and that the packages were released by its breaking up. The other theory is that the butter and cheese were lost from the compartments of the Anchoria after her collision with the Queen, near that place, June 12, and that the refrigerators in which the packages were stored had only begun to break up when the Eddie Pierce arrived upon the scene.

Business and Personal.

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

☞ The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

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

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

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

Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

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

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

(1) J. A. S. asks for the ingredients and proportions used in making picture frame makers' putty. A. Glue, 14 lb.; resin, 7 lb.; linseed oil, 2½ pints; water, 5 pints (more or less); whiting, q. s.; ½ lb. pitch is sometimes added. Melt the resin, add the oil (hot); soften the glue in cold water, then dissolve it in hot water. Add the glue to the oil and resin, beat together, and add enough warm whiting to make a stiff dough. Oil the mould with sweet oil, and mould by pressure. The dough will not keep—it soon hardens, so that it should be prepared only as required. 2. If in your power also give me the recipe for making the gold lacquer used to give silver leaf the gold color, also used by picture frame makers. A. Shellac, 2½ oz.; gum sandarac, 2 oz.; gum elimi, ½ oz.; spirits of wine, 2 quarts. Mix, and keep for two or three days; strain, add dragon's blood and turmeric to color, and thin with wine spirit.

(2) J. N. C. asks how to clean the inside of a mercurial siphon barometer tube. Having been out of use for a long time the mercury was gone and the inside of the tube has become dirty from dust and oxidation from the mercury. A. Try a small quantity of warm nitric acid. Then rinse with water, rinse with absolute alcohol, and finally with ether; warm, to expel the vapor of ether.

(3) J. L. W. asks (1) for the best known process of pickling cucumbers to keep through the winter. I want the fruit to remain firm and brittle, the pickling ingredients not to be impervious. A. Steep in strong brine for a week; then pour it off, heat it to boiling, and pour it over the cucumbers. In 24 hours drain on a cloth, pack in wide-mouth bottles, fill these with strong hot pickling vinegar, and seal at once. Various spices are added in the bottles. 2. Also, why is sand worked with cement; is it done to keep the cement from cracking, or to make it go farther, or to make it harder when dry, or dry faster? A. Sand hardens and prevents cracking, and lessens the cost of the work.

(4) G. F. W. asks how to prepare the solution and the proportionate quantities necessary to silver in different colors the glass globes such as are often used to trim Christmas trees, etc. My impression is that the globes are blown of different colored glass, and but one solution is required. A. Lead, ½ oz.; tin, ½ oz.; melt together; add immediately ½ oz. bismuth, and carefully skim off the dross. Remove the alloy from the fire, and before it cools stir in 5 oz. of mercury (with care to avoid inhaling the fumes). When the amalgam is to be used for silvering, strain it through a linen cloth and pour it into the clean dry globe through a paper funnel reaching nearly to the bottom of the globe. When the globe is turned about the amalgam will attach itself to the glass. Pour out the excess. 2. Lead, 3 oz.; tin, 2 oz.; bismuth, 5 oz. Put the alloy into the globe, expose it to a gentle heat until the compound has melted (it melts at about 197° Fah. Then by turning the globe slowly around an equal coating may be laid on, which, when cold, hardens and firmly adheres. For the different colors use suitably colored glass.

(5) D. F. H. asks: Can I with six cells of Daniell's battery sound an alarm on a bell located about ten rods distance, in a church tower? A. No, but you can with your battery let off mechanism driven by weight that will do the work.

(6) J. M. asks how to take green mould off from brownstone. A. Try a little strong hot potash solution (aqueous), rinse well after.

(7) M. B. C. writes: I have a boiler 12 feet long, 44 inches diameter, with twenty-two 4½ inch flues, the flame passing under boiler, returning front through one half of the flues, going back through the other half. What would be the horse power of such a boiler? A. About 24 horse power. 2. The flame as it leaves the boiler, passes through a damper, with 12 inches by 28 inches opening, passing down, then up stack. Is the damper of sufficient size? Would there be any gain in passing flame up through damper? Is flue in chimney a proper size, being 21 inches at base, increasing to 28 inches at top; square brick stack, height 70 feet from bottom of ash pit? A. Make your damper opening fifty per cent larger. Instead of passing the flame through one-half the tubes and returning through the other half, return through all the tubes, and do not make the second return. Your draught is now very poor; these alterations will improve it.

(8) G. B. asks: 1. How much power in pounds will it require to run a 16 foot boat, 4 feet beam, on smooth water? A. 70,000 to 90,000 foot lb. 2. Will a smaller propeller than 11 inch run it with any success? A. No. 3. How many revolutions must the screw make to the engine's once, per minute. A. The propeller should run the same speed as the engine. 4. How many revolutions must the governors make in accordance with the screw? A. You need no governor.

(9) P. L. C. asks what is the best solution in which to dip shingles to make them more durable. A. Zinc chloride, mercuric chloride (corrosive sublimate), and creosote, dissolved in water, have been used for this purpose. Water shed from roofs covered with such shingles is unfit for drinking or culinary purposes.

(10) J. E. B. asks if a boiler with sufficient capacity to generate steam to an engine of 24 inches cylinder, at 50 lb. pressure per square inch, be capable of furnishing steam to an engine with cylinder twice the area, with only 25 lb. steam, other things being the same. A. A boiler furnishing steam at 50 lb. pressure to a given cylinder, the steam would have a total pressure, including atmosphere, of 64·75 lb., and would furnish a cylinder of double capacity (not considering radiation and condensation) with steam 32,375 lb. total pressure—equal to 32 375—14·75=17 625 lb. pressure above atmosphere.

(11) J. L. writes: We are about building a school house of six rooms, two stories. The members of the school board differ as to the best method of ventilation and heating the building. Some are in favor of stoves, others are for hot air. I am in favor of getting the opinion of those who understand such things, and having every confidence in the opinions expressed in the SCIENTIFIC AMERICAN, I ask you to give us information as to the best method of ventilating and heating a school building of six rooms. A. To heat by steam, half the heating surface to be indirect coils in the basement and half long wall coils, in the rooms on the outside walls and under the windows. In the inside walls of the rooms there should be built for ventilating three flues for each room of 144 square inches cross section each. The flues for the upper rooms to start at the floor and run straight through the roof, and finished with an Emerson top, or something like it. The flues from the lower rooms to start at the floor also, and to pass direct to the roof and to have no connection with the flues for the upper story. The heating flues from the basement for the indirect coils to second floor should be in the outside walls, and run from close under the cellar ceiling to two feet above the two story floor. The registers for the first floor may be through the floor near the outside walls, and opening directly over the heating coils. It is not actually necessary to warm the outlet flues, in the inner walls, if each has a separate cowl or top. The life of a good steam apparatus is unlimited, except the boiler, which will last about twenty years. The cost would be from $750 to $1,000. Have a competent steam heating engineer make plans, and be sure he is correct as to quantity and quality; then submit the plans to the bidders, and see that the party who gets the job carries it out to the letter. If plans are to be submitted, it is best to receive them without price, on their merits only, and throw the best plan open to competition.

(12) W. C. writes: 1. I send you this day a sample of sand, and would like to know if it contains any of the precious metals. A. It probably contains a trace of gold. A fire assay would be necessary to determine this. 2. I would like to know how many pounds of steam I can safely carry on a small copper boiler, No. 18 of the wire gauge. Dimensions of the boiler are 12 inches in length and 9 inches in diameter. A. 90 lb. per square inch of joint head sufficiently strong. 3. Where is there a good school I could attend for studying civil engineering for beginners? A. "Rensselaer Polytechnic Institute," Troy, N. Y.; "Stevens Institute," Hoboken, N. J. 4. What would be the best manner of heating the above mentioned boiler—by petroleum or coal? A. Coal.

(13) A. W. P. asks: 1. What size engines will it require to drive a buggy that will carry two men over ordinary roads? A. Two engines, 3 inches cylinder by 6 inches stroke. 2. How many square feet of heating surface will be required to make steam for the engines? A. 100 to 120 feet. 3. Will a vertical tubular boiler be best? A. Yes. 4. Should I use one or two engines? A. Two. 5. Give the weight of boiler, engines, etc., as near as possible. A. Weight will depend much on the kind of boiler. 6. What power will I get from an engine, two inch and four inch stroke, with 60 lb. steam, and 300 revolutions? A. One horse power.

(14) F. H. A. writes: I have the following machinery running at the speeds given: Will you give me, through the SCIENTIFIC'S "Notes and Queries," the horse power required to drive them all at once, or a rule by which I can find out myself? No. 1, 3,600 revolutions, 3½ in. belt, lathes; No. 2, 2,000 revolutions, 4 inch belt, lathes; No. 3, 2,800 revolutions, 4 inch belt, circular saw, 12 inches diameter? A. Multiply the speed of the belt in feet per minute, by the width of the belt in inches, and divide by 600; the quotient is the horse power the belt will drive easily.

(15) E. G. McD. asks: Would you consider a lightning rod, on a frame building, which is run into a rain water cistern (say 10 feet deep in the ground), a good protection? Of course the lower end of the rod would be under water always. A. In order to make a lightning rod really safe, the bottom of the rod should have a large conducting surface connected with the earth or with water in the earth. Simply dipping the lower end of the rod for a short distance into the water is not sufficient. For example, if the rod is one inch square, and extends one foot into the water, you have a conducting surface of only 49 square inches in contact with the water. This is not enough. If it were 49 square feet of conducting surface, that would be better. One of the best of all ground connections is to have the bottom of the rod soldered to the exterior of an iron water pipe that extends a few hundred feet under ground. In this way a conducting surface of great extent is obtained, and comparative safety secured.

(16) J. L. writes: Your answer to querist how to cut glass tubes for gauges, I think I can tell you a better way. Lay the glass on a pen rack or anything so it can be revolved, and scratch it with a file, and then blow with a blow pipe a flame upon it until it is quite hot, and then blow cold, and it will snap off right where it was marked every time.

(17) D. J. writes: 1. I have an engine 3½ x13½. What size force pump would it work? A. Area of pump piston about one-third area of steam piston, if of same stroke. 2. What size should I make the air chamber? A. 8 to 12 times the capacity of pump. 3. From what depth would it suck water and about how high would it throw water? A. 20 to 24 feet suction, height depends upon the size and form of delivery nozzle. 4. What size should the feed and discharge pipes of the pump be? A. About three-fourths the area of pump piston. This thing would be of no use as a fire engine.

(18) C. E. R. asks: How much cold water pressure do I want to give a boiler to carry 75 lb. steam using same steam gauge in both cases; in other words, what proportion, or is there any rule? A. By government rule, 113 lb. Steam pressure allowed is two-thirds the cold water test pressure. 2. I am using a steam engine, 12x30, with a lead the thickness of writing paper. It will not cut off till the crank has traveled within two inches of next center. How can I change it? A. If the engine is to work at a high velocity, give one-eighth inch lead, and if you wish to cut off shorter, give the valve more lap, say one-half inch. 3. Will it give any more power by cutting off sooner? No, but you will work with more economy. 4. I am not getting power enough now; my boilers are scaled bad. What is the best way to rid of the scale and keep them clean? A. Heat the water to the boiling point before forcing it into the boiler.

(19) L. F. T. writes: In your answer, April 10, page No. 234, question 4, you did not say how I should apply the hydrofluoric acid in glass engraving. A. After waxing and cutting the design, place the plate face downward over a warm shallow leaden tray partly filled with powdered fluorspar thoroughly moistened with strong oil of vitriol (sulphuric acid) for half an hour or more.

(20) A. F. S. L. asks: What is the fastest time ever made by a locomotive engine? A. For a considerable distance, about 60 miles per hour; for short run, 75 miles to 80 miles.

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

N. C. F.—1. Clay iron stone. 2. Quartz and slate. 3. Orthoclase—feldspar. 4. Quartzose rock. 5. Quartz, hornblende and mica. 6. Mica slate. 7. Principally hornblende. 8. Sandstone with molybdenite. 9. Sandstone. 10. Graulite. 11. Oolitic limestone. 12. Limestone pebble. Nos. 4 and 5 may carry a little silver.—R. D. McC.—1 and 5. Chiefly quartz. 2 and 6. Altered feldspar and limonite. 3. Quartz and obsidian. 4. Limonite. 7. Metallic lead (button). Some of these may contain small quantities of silver; an assay would be necessary to settle this point.—S. R.—It consists chiefly of copper and iron sulphides and carbonates, probably carrying silver. If the sample is representative of the body ore, the property is likely to prove a valuable one.—N. P. P.—A variety of syenite—feldspar, hornblende, and quartz. The specimen contains a small quantity of graphite (blacklead).—E. G. A.—1. Magnetite.—2. Argillite and iron pyrites. 3. Limonite. 4. Chiefly feldspathic rock.

COMMUNICATIONS RECEIVED.

Why the needle points northerly. By E. W.

On Capillarity. By G. H. S.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

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

June 15, 1880,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

A printed copy of the specification and drawing of any patent in the annexed list, also of any patent issued since 1836, will be furnished from this office for one dollar. In ordering please state the number and date of the patent desired, and remit to Munn & Co., 37 Park Row, New York city. We also furnish copies of patents granted prior to 1836; but at increased cost, as the specifications not being printed, must be copied by hand.

Adjustable seat, desk, etc., J. S. Robinson 228,840
Alloy plating, aluminum, J. S. Howard 228,900
Alumina, bauxite, etc., purification of, W. Chadwick *et al.* 228,867
Amalgamating apparatus, P. G. L. G. Designolle 228,896
Amalgamating metals, P. G. L. G. Designolle 228,970
Ash pan and sifter, combined, S. Fink 228,749
Awning, blind, L. T. Seaver 228,784
Axle box, car, A. L. Anderson 228,720
Bag holder and truck, comb'd, H. M. Curtis *et al.* 228,733
Baking apparatus, C. Haffcke 228,755
Bale tie, E. S. Lenox 228,767
Baling press, R. P. Davis 228,876
Ball trap, M. Warne 228,939
Barrel swinging device, W. C. Rudd 228,941
Barrel washer, G. Schock (r) 9,259
Bath tub, H. Arnd 228,722
Bed bottom, spring, S. L. Stockberger 228,789
Bedstead fastening, F. S. Clarkson 228,728
Beehive, A. Barnhart 228,801
Bell, electric signal, H. Amory 228,851
Bevel, E. A. Johnson 228,903
Binder, temporary, C. Richardson 228,931
Bit brace, A. D. Goodell 228,811
Bit brace, ratchet, A. D. Goodell 228,810
Blotter, W. P. Dodson 228,808
Bolting apparatus for flour mills, L. Gathmann 228,731
Book, blank, J. C. Bonnell (r) 9,249
Books with wire staples, machine for binding, W. L. Coop 228,874
Bottles, etc., machine for washing and soaking, J. S. Clarke 228,868
Bottling or canning substances, apparatus for, P. Miles 228,828
Bracelet, Barbier & Maloubier 228,723
Bracelets, chain fabric for, W. C. Edge 228,746
Braid, etc., holder, W. P. Deane 228,880
Brick, fire, A. E. Hunt 228,901
Brick machine, R. M. Johnson 228,909
Bridle brow band, J. F. Day 228,877
Buckle, harness, Collins & Penniman 228,872
Bung bush, G. B. Cornell 228,731
Burial casket, Powers & Walker 228,836
Burglar alarm, Terry & Dyke 228,954
Cake stirrer, E. J. McClellan 228,914
Calipers and dividers, W. H. Warren 228,958
Cant hook ferrule, A. Sanford 228,943
Cap, heat producing, G. L. Witsil 228,736
Car brake, railway, C. Gentil 228,752
Car coupling, C. J. R. Ballard 228,855
Car coupling, T. Breen 228,863
Car coupling, S. B. Nickum 228,834
Car coupling, W. Tucker 228,956
Car, grain, W. S. Hanson 228,814
Car mover, G. H. Bronson 228,726
Car, stock, F. Rieber 228,933
Carpet lining, R. A. Denison 228,734
Cartridge packing case, E. G. Parkhurst 228,926
Carving fork, J. D. Frary 228,884
Chain, J. M. Dodge 228,735
Chain, drive, W. D. Ewart (r) 9,256
Clock striking mechanism, G. W. Hendrick 228,895
Clothes pounder, W. B. Wickes 228,846
Clutch for rolls, U. Haskin 228,893
Coal hod, hooded, H. Symonds 228,951
Coffee and nut roaster, W. E. Vernon (r) 9,260
Coffee pot, V. W. & L. S. Blanchard 228,862
Coffee, preparing extract of, Gue & Grant 228,889
Collar, horse, F. C. Scott 228,945
Condenser, C. B. Lee 228,909
Condiment compound, G. Holland 228,898
Corset, E. W. Bigelow 228,725
Cot, folding, Murray & Baker 228,775, 228,930
Cultivator, cotton, R. G. S. Austin 228,853
Deflagrating compound, Robinson & Dimock 228,935
Door check, L. C. Norton 228,776
Door spring, G. Bauman 228,856
Dynamometer, electro, A. E. Dolbear 228,809
Earth boring apparatus for Artesian and other wells, T. Von Ringhanz 228,780
Electrical machine, dynamo, N. S. Keith 228,903
Electro-magnetic motors, regulating, W. W. Griscom 228,888
Elevator bucket, C. D. Cowgill 228,875
Excavator, L. Adams 228,798
Exercising machine, Barker & Anderson 228,800
Farm gate, J. A. Henry 228,806
Faucet, P. Dornn 228,736
Faucet, A. E. Spencer 228,950
Faucet, self-closing, J. C. Miller 228,917
Feed water heater, E. L. Morse 228,831
Feed water heater, J. Rhule, Jr. 228,940
Fence, J. W. Hammett 228,891
Fence, portable gate, F. Villard 228,844
Filter, Willsey & Shiverick 228,794
Firearm, magazine, A. Pease 228,778
Firearm, revolving, W. H. Bell, Sr. 228,859
Firearms, B. H. Williams (r) 9,261
Fire escape, G. Lockhart 228,823
Fireworks, device for lighting, E. S. Hunt 228,760
Fishing basket, folding, F. L. Sheldon 228,948
Fishway, W. H. Rogers 228,936
Forging eyes on the ends of rods, die for, C. Lanz 228,907
Fruit drier, G. Sikes 228,787
Evaporator, J. B. Sweetland 228,959
Fruit jar lifter, E. A. Case 228,865
Gas apparatus, J. S. Wood 228,848
Gas cleaning apparatus, M. Kennedy 228,765
Gate, D. H. Wolfe 228,966
Gate hanger, W. A. Sharpe 228,785
Gate pivot, F. N. Still 228,951
Governor, steam, W. R. Michener 228,773
Grindstone tool holder, L. Young 228,849
Gun, machine, E. G. Parkhurst 228,777
Harvesting machine, H. F. Shaw 228,786
Hatchway guard, W. J. Ely 228,747
Hatchway guard, G. Parker 228,925
Hay rake, horse, G. M. & C. C. Richardson (r) 9,258
Head block, A. Rodgers 228,937
Hides, machine for ascertaining the area of, J. S. Wentworth 228,791
Hoisting and dumping apparatus, C. A. Haring 228,754
Holding tool, J. S. Finch 228,809
Horseshoe nail machine, L. W. Whipple 228,792
Hub, vehicle wheel, L. Rossiter 228,940
Hydrant and street washer, comb'd, J. H. Kennedy 228,764
Hydraulic multiplier, E. D. Meier 228,771
Jar, N. Rogers 228,938
Kneader, dough, L. Durand 228,739
Knit fabrics, machine for uniting, W. Beattie 228,802
Label holder, J. Henderson 228,757
Lamp cap, R. A. Colt 228,730
Lead and crayon holder, J. Hoffman 228,897
Leather, ornamentation of, A. J. Burkett 228,727
Letter box, T. R. Lowerre 228,911
Lifting jack, D. H. Morrison 228,830
Lime juice, preparation of, J. & T. D. Douglas 228,881
Liniment, D. Collins 228,870
Liquids, apparatus for drawing effervescent, T. Lieb 228,910
Locket, O. Johanson 228,819
Loom shuttle, J. K. Smith 228,837
Lubricator, Hardy & Dibble 228,892
Mail box, J. Sherriff (r) 9,263
Measuring tank and cock, liquid, G. W. Aldrich 228,799
Measuring tank, fluid, S. M. Cawker 228,806
Mechanical movement, W. J. Perkins 228,779
Metallurgical furnace, E. Savage 228,944
Milk cooler, C. C. Haynes 228,756
Millstone driver, J. R. Reynolds 228,838
Motion, machine for converting horizontal into rotary, G. W. Richardson 228,908
Mower, Gunnels & Shives 228,890
Mower attachment, lawn, C. G. Baldwin 228,854
Music chart, G. S. Rice 228,839
Musical instrument insulator, C. S. Weir 228,962
Noise muffler, E. D. Eames 228,744
Nut for screw bolts, A. T. Huff 228,816
Nut lock, C. R. Whitman 228,964
Ore concentrator, J. McColl 228,915
Oven, smelting, R. P. Wilson 228,793
Overshoe, rubber, T. J. Mayall 228,769
Pamphlet trimmer, J. F. Withey 228,795
Paper fringing machine, S. Garrett 228,750
Paper, manufacture of perforated and scalloped, L. H. Rogers 228,939
Paper pulp, and process and machine for producing the wood fiber, wood fiber for, P. H. Holmes 228,899
Peach stoner, W. R. Sherman 228,949
Pencil package, E. Weissenborn 228,961
Pencil sharpener, E. E. Norton 228,923
Pianoforte bass pedal, A. Wiesbauer 228,963
Pianoforte damper attachment, C. Mahling 228,912
Pianofortes, stringing, B. Dreher 228,738
Plane gauge, bench, C. Kinney 228,766
Planter, potato, Jones & Stewart 228,902
Plow, G. W. Gammill 228,885
Plow, J. Hafner 228,813
Plow, N. C. Orrick 228,835
Plow attachment, E. R. McCall 228,916
Pool ball frame, S. De Gaetano 228,879
Pottery, glazing, B. Morahan 228,773
Pottery ware, finishing tool for, B. Morahan 228,774
Preserving fruit, etc., compound for, G. A. Cutler 228,804
Printing machine sheet delivery apparatus, W. Scott 228,782
Railways, automatic switch for wire rope, J. W. C. Rhind 228,932
Razor, C. D. Moody 228,829
Razor, safety, F. & O. F. Kampfe 228,904
Reclining chair, J. Clough 228,869
Refrigerater, E. H. Hughes 228,759
Rendering fats, process and apparatus for, W. E. Andrew (r) 9,254
Rice cleaner, G. H. Stein 228,788
Rock drilling machine, J. Wood 228,797
Rolling metal, roll for, R. C. Totten 228,842
Rolling mill, S. P. M. Tasker 228,841
Roofing and paving material, C. M. Warren 228,960
Rosette, W. P. Greenwood 228,887
Rotary engine, J. H. Blake 228,861
Rotary motor, C. Krupp 228,906
Rowing machine, J. F. Walthour 228,845
Sad iron heater and receptacle, J. F. Curtice 228,732
Salve, J. Bemis 228,724
Sand band, F. M. Hurtle 228,761
Sash fastener, L. D. Cleaveland 228,729
Saw, rotary cut-off, L. W. Green 228,886
Scales, weighing, Vincent & Johnen 228,843
Screw tap, T. A. Fleming 228,882
Seeding machine, J. W. Mann 228,913
Sewage, treatment of, B. Terne 228,955
Sewer gas into buildings, device for preventing the entrance of, A. F. Pflughaupt, Jr. 228,927
Sewing machine, G. Juengst 228,820
Sewing machine belt tightening attachment, J. H. Allen 228,850
Sewing machine feeding device, J. H. Morley 228,918
Shawl strap, M. Rubin 229,942
Sheet metal pan, A. Cox (r) 9,250
Shingle cutting machine, W. Goldie (r) 9,251, 9,257
Shirt, J. F. Appell 228,771
Shoe fastening, F. & A. Schulz 228,946
Show case with revolving stand, S. H. Greenbaum 228,812
Sieves, grain riddles, etc., driving gear for, J. D. Hobbs 228,758
Sifter, ash, J. Benson 228,803
Sled for hauling fodder, W. H. Woods 228,967
Sleeve, A. J. Tower 228,790
Smelting furnace, N. Armstrong *et al.* 228,852
Smelting furnace, ore, D. W. Jansen 228,818
Soldering machine, can, W. D. Brooks 228,864
Spark arrester, K. F. W. Neuhaus 229,922
Spark arrester for car windows, G. Williams 228,847
Spinning machine flier, J. F. Foss 228,809
Square and level, combined, D. Masten 228,768
Steam boiler, G. J. Scott 228,783
Steam brake, C. Lewis 228,821
Steam trap, E. S. Newton 228,833
Stove, C. Fulton (r) 9,252
Stove, lamp, J. H. Irwin 228,762
Stove pipe, W. C. Freeman 228,883
Stoves, plated ornament for, J. Naylor, Jr. 228,921
Stuffing box, T. Walker 228,957
Swinging gate, N. H. Long 228,823
Telegraph sounders, circuit equalizer for, T. Cochran 228,871
Telephone, mechanical, W. J. Hutchins 228,817
Telephone receiver, Lockwood & Bartlett 228,825
Telephone transmitter, Lockwood & Bartlett 228,824, 228,826
Thill coupling, C. G. Hill 228,815
Thill coupling, W. Munson 228,832
Tile facing and squaring machine, C. F. Powers 228,929
Tippet and collaret, combined, I. S. Cohen 228,873
Tobacco, sweet house for curing, C. S. Phillips 228,928
Tobacco treating apparatus, P. H. Mayo 228,770
Toy, whistling, J. Chaskel (r) 9,255
Truck frame, spring, J. Roemer 228,781
Truck, piano, W. F. Beck 228,857
Trunk, W. H. Bell, Sr. 228,858
Tubes, manufacture of, J. H. Seaman 228,947
Umbrella, D. Harris 228,894
Undergarment, T. B. Farrington 228,748
Vacuum brake apparatus, F. W. Eames 228,740, 228,741
Vacuum brakes, air ejector for, F. W. Eames 228,742
Vacuum brakes, drip cock valve for, E. D. Eames 228,745
Vacuum brakes, ejector for, F. W. Eames 228,743
Vehicle baggage attachment, E. J. Osborne 228,924
Vehicle wheel, J. F. Darby 228,805
Velocipede, Langmaak & Strieff 228,908
Wagon brake, J. Riddlesberger 228,934
Wardrobe, O. C. Morse 228,919
Well drilling machine, R. M. Downie 228,737
Wire twister, D. A. Kilmer 228,905
Wood bending machine, F. Denninger 228,878
Wrench, R. Hayden 228,755
Wrench, J. A. Mell 228,827
Zinc, apparatus for treating, R. Wiester 228,965

DESIGNS.

Chain link, ornamental, D. A. Beam 11,824
Lamp bracket, F. R. Seidensticker 11,823
Overshoes, C. A. Ensign 11,821
Scarf pin, military, Case & Riker 11,820
Spoon and fork handles, G. Gill 11,822

TRADE MARKS.

Boots, L. B. Mantonya 7,941
Cigars, Muhn & Brandfass 7,942
Cigars, cigarettes, and smoking tobacco, H. Seidenberg 7,943
Hats, felt, Crofut & Knapp 7,940

English Patents Issued to Americans.

From June 4 to June 15, 1880, inclusive.

Air engines, J. A. Woodbury *et al.*, Boston, Mass.
Colored glass windows, J. A. Fargo, Newport, R. I.
Compound explosive, R. H. Dimock, New Haven, Conn.
Diving bell, C. F. Pike, Philadelphia, Pa.
Lacing hooks for boots, M. Bray, Newton, Mass.
Locomotive engines, J. B. & G. B. Smith, Dunmore, Pa.
Lubricating mechanism, C. J. A. Dick, Philadelphia, Pa.
Metallic alloys, manufacture of, C. J. A. Dick, Phila., Pa.
Paper pulp, manufacture of, C. & H. A. Chapin, Springfield, Mass.
Railway switch, J. S. Williams, Riverton, N. J.
Rivets, manufacture of, M. Bray, Newton, Mass.
Rotary steam engines, H. Thibault *et al.*, N. Y.
Sewer gas, preventing, entering buildings, A. F. Pfleighaupt, Brooklyn, N. Y.
Spring for railway carriages, A. Middleton, Phila., Pa.
Timber cutting machine, D. R. Proctor, Gloucester, Mass.
Vehicle hand propeller, A. Vick *et al.*, Mt. Carmel, Conn.
Velocipedes, N. S. C. Perkins, Norwalk, Ohio.
Vessels, construction of and propelling, A. Olsen, Ephraim, Utah.
Water closet trap, J. E. Folk, Brooklyn, N. Y.

OF THE

Scientific American

FOR 1880.

The Most Popular Scientific Paper in the World.

VOLUME XLIII. NEW SERIES.

Only $3.20 a Year, including postage. Weekly. 52 Numbers a Year.

This widely circulated and splendidly illustrated paper is published weekly. Every number contains sixteen pages of useful information, and a large number of original engravings of new inventions and discoveries, representing Engineering Works, Steam Machinery, New Inventions, Novelties in Mechanics, Manufactures, Chemistry, Electricity, Telegraphy, Photography, Architecture, Agriculture, Horticulture, Natural History, etc.

All Classes of Readers find in THE SCIENTIFIC AMERICAN a popular *resume* of the best scientific information of the day; and it is the aim of the publishers to present it in an attractive form, avoiding as much as possible abstruse terms. To every intelligent mind, this journal affords a constant supply of instructive reading. It is promotive of knowledge and progress in every community where it circulates.

Terms of Subscription.—One copy of THE SCIENTIFIC AMERICAN will be sent for *one year*—52 numbers—postage prepaid, to any subscriber in the United States or Canada, on receipt of **three dollars and twenty cents** by the publishers; six months, $1.60; three months, $1.00.

Clubs.—One extra copy of THE SCIENTIFIC AMERICAN will be supplied gratis *for every club of five subscribers* at $3.20 each; additional copies at same proportionate rate. Postage prepaid.

One copy of THE SCIENTIFIC AMERICAN and one copy of THE SCIENTIFIC AMERICAN SUPPLEMENT will be sent for one year, postage prepaid, to any subscriber in the United States or Canada, on receipt of *seven dollars* by the publishers.

The safest way to remit is by Postal Order, Draft, or Express. Money carefully placed inside of envelopes, securely sealed, and correctly addressed, seldom goes astray, but is at the sender's risk. Address all letters and make all orders, drafts, etc., payable to

MUNN & CO.,
37 Park Row, New York.

To Foreign Subscribers.—Under the facilities of the Postal Union, the SCIENTIFIC AMERICAN is now sent by post direct from New York, with regularity, to subscribers in Great Britain, India, Australia, and all other British colonies; to France, Austria, Belgium, Germany, Russia, and all other European States; Japan, Brazil, Mexico, and all States of Central and South America. Terms, when sent to foreign countries, Canada excepted, $4, gold, for SCIENTIFIC AMERICAN, 1 year; $9, gold, for both SCIENTIFIC AMERICAN and SUPPLEMENT for 1 year. This includes postage, which we pay. Remit by postal order or draft to order of Munn & Co., 37 Park Row, New York.

THE "Scientific American" is printed with CHAS. ENEU JOHNSON & CO.'S INK. Tenth and Lombard Sts., Philadelphia, and 59 Gold St. New York.