

SCIENTIFIC AMERICAN

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THE CENTENNIAL INTERNATIONAL EXHIBITION.

The progress of this country during the first century of its national life has been fully and elaborately described in our leading editorial of this week's issue; and it seems thoroughly in accordance with the spirit of our laws and institutions that we celebrate this anniversary by inviting all the world to come and see us, and to bring with them the best that they can produce, that we may compare results in friendly rivalry which may promote international commerce, and stimulate our exertions on the onward march of civilization. The first proposition of such a celebration emanated from the Franklin Institute of Philadelphia in August, 1869; but the idea was too large, and the object too national, for that excellent society to carry out. But Philadelphia, the birth-place of the nation, and the first metropolis of the country, was selected as the *locus in quo*; and the subject was at once brought before the councils of the city and before the Pennsylvania legislature at Harrisburg; and a committee of each house of the last-named body was appointed to bring the undertaking before the notice of Congress.

It is not necessary that we should in this place rehearse the history of the movement, all the events of which have been chronicled from time to time in our pages. We have now to congratulate the managers on the magnificent results of their zeal and energy, which, in times of great commercial depression, raised the large sum of \$8,500,000 for the purposes of the enterprise, conducted the vast work of organizing the exhibition, and prepared and arranged the series of buildings, unprecedented in their extent and convenience. It is especially to give the reading public a correct idea of the magnitude of this undertaking that we illustrate herewith the Centennial buildings, and also some of the more important structures erected by the different States of

the Union, and several of those devoted to the use of distinct trades and manufactures.

Our first engraving gives a birdseye view of the grounds in Fairmount Park, looking in an easterly direction; and it shows in the foreground the five large structures and the United States Government Building

constructed of wood filled in with plaster, a method which has, in skillful hands, produced some of the best and most durable edifices in Europe, which are, moreover, nearly fireproof. It is 153 feet long and 113 feet broad; and in the center is a large hall, 59 x 78 feet, containing a platform and a speaker's desk. A corridor ten feet wide runs around this hall,

and divides it from another large apartment, 28 x 59 feet, all the partitions being movable. Ten smaller rooms, for the use of committees, etc., are provided. The building is a very ornamental one, and will be much admired by our European visitors.

We resume our descriptions and illustrations on page 323 of this issue.

English vs. American Plows.

The London *Agricultural Gazette* says that the following remarks on the working of English and American plows in India were embodied in a letter recently communicated to the Agricultural Society at Calcutta: "I am very glad to reply to your inquiry," says the writer, "as to our experience of the two plows which have been on trial.

Both of them, the English and the American, were easily worked by a pair of ordinary bullocks; each turned up the soil to a depth of 6 inches, and there was no perceptible difference in the quality of the work turned out. But I imagine that no native farmer would care to own the English (iron) plow, when he could do the same work with the wooden American plow of simpler construction, and with a renewable point to the share. The points rapidly wear down in India; and the plowshare being made in one large piece, the alteration required is expensive. In the American self-sharpening, the movable top not only lasts longer but costs little to replace."

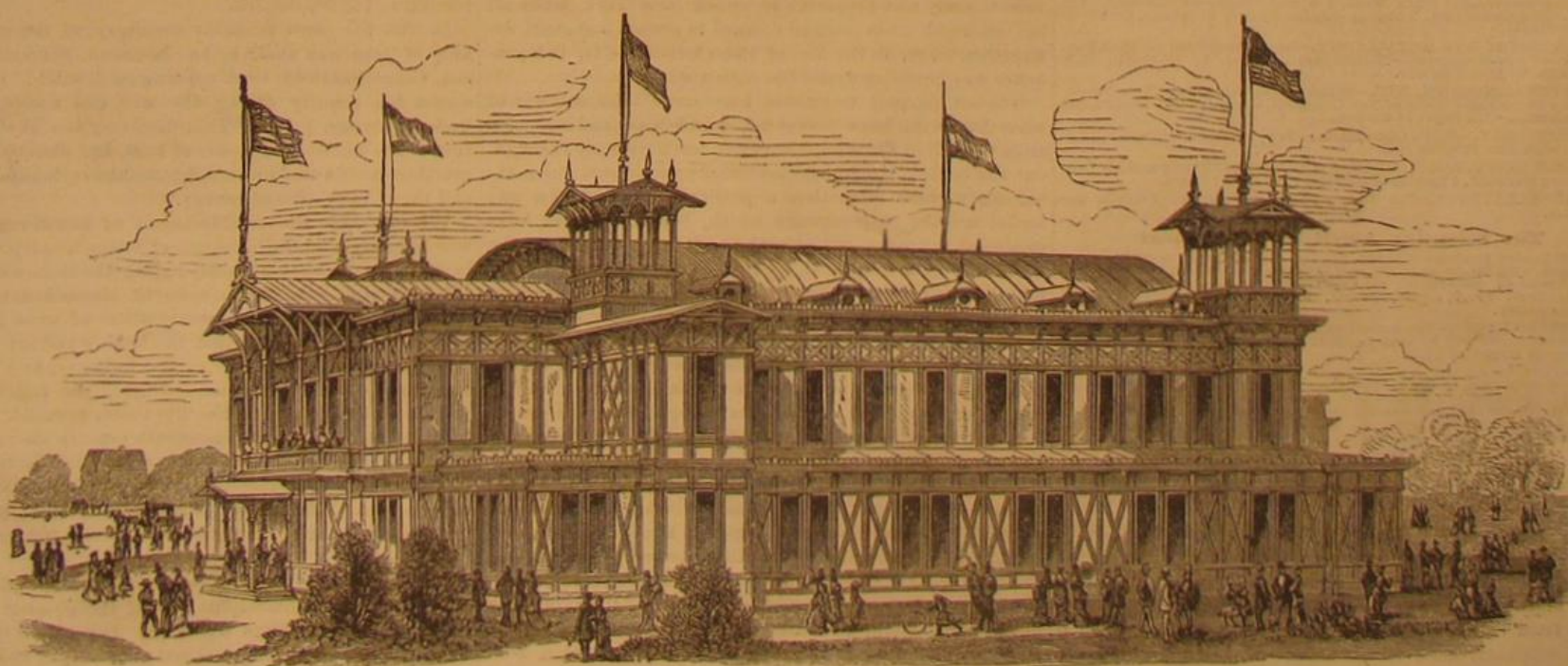
A FINE bell metal consists of 71 parts copper, 2 zinc, and 1 iron.



BIRDSEYE VIEW OF THE CENTENNIAL GROUNDS AND BUILDINGS.

On the extreme left of the picture is the Agricultural Hall, 820 x 125 feet; near it is the Horticultural Hall, 383 x 193 feet; to the southeast of this is Memorial Hall, a permanent structure, to be used for exhibiting the art collections, 365 x 210 feet; the Main Building, 1876 x 464 feet; and the Machinery Building, 1402 x 360 feet, with an annexe 208 feet x 210 feet. These buildings form almost a semicircle, the center of which is occupied by the Government Building, covering 2 acres. The five principal structures afford 50 acres of space; but some large additions are already needed to accommodate the exhibits tendered to the managers from all parts of the world.

Our second engraving represents the pavilion erected for the use of the judges and committees who are to award the prizes. It is, of course, a temporary building, and is con-



THE CENTENNIAL EXHIBITION—THE JUDGES' PAVILION.

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With 65 Illustrations.

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AMERICAN PROGRESS—I.—FROM 1776 TO 1820.

There are few darker pages in history than those which recount the condition of the thirteen colonies of North America during the months just previous to the adoption of the Declaration of Independence. A year had elapsed since arms had been taken up against the mother country; and although the colonists had resisted successfully, the very fact carried fresh terror to the doubting, for it augured invasion, not by a few battalions sent to quell a rebellious mob, but by the grand armies of England, victors in a century of wars. If not extirpation, then reduction beneath a tyranny, more grinding than that against which they had revolted, now menaced the rebels. Congress sat doubting, distrustful, divided in thought, seeing no glimmer of light in the prevailing darkness, thinking, as John Adams moved on the 10th of May, 1776, that the colonies should themselves establish separate governments, "adequate to the exigencies." But the stirring eloquence of Thomas Paine was ringing through the land, replete with the suggestion of a hope which none had dared to cherish. The war against England's blind and headlong oppression was fast becoming, through popular sentiment alone, a war against England herself; and it needed but the formal declaration of Congress to elevate the conflict from a mere rebellion to that grandest of wars, which finds its parallel in all animate nature, the struggle for national existence.

To turn from the political to the industrial condition of the colonies is but to bring to view fresh evidences to show the fragility of the foundation on which the fabric of our country was reared. Iron and steel works there were none, nor woolen nor flax manufactories: all were suppressed by England. Iron foundries had been started, and in New England hats had been made; but Parliament declared America factories "a nuisance," and crushed them ruthlessly. It allowed the production of pig iron; but the colonist was forced to have the material manufactured in England, and pay an enormous profit to the English founder. Agriculture, hunting, fishing, and cutting lumber, England could not check; hence these furnished occupations to those who were not engaged in such few trades as were carried on. Probably the most extensive factory in the country was Baron Stiegel's glass house, in Mannheim, near Lancaster, Pa. Operations were conducted in a curious manner, for the owner's ideas were of the feudal ages. He built castles and mounted cannon wherewith to salute himself on arriving and departing; and when a guest was received, the workmen were summoned from furnace and foundry to attend the new comer with music and rejoicing. The war cut off the Baron's funds from Europe, and the works were soon after discontinued.

Shipbuilding existed in New England, and brick-making in nearly all the colonies. There were but two steam engines in the territory; one built in 1772, for use in a distillery in Philadelphia; the other had been imported in 1736, for the Schuylker copper mines, at Passaic, N. J. Both were of the Newcomen type. No agricultural machines were known, except, perhaps, the grain drill, no cotton mills existed, and the green seed or staple cotton alone was cultivated. Not a printing press existed west of the Alleghenies; and there were only forty, all hand machines of the crudest type, in the colonies. Thirty-seven newspapers sufficed to spread intelligence. From Boston to New York was a week's journey by coach, sloops plied between New York and Albany; and in winter, colonists in Virginia were practically isolated from those in Massachusetts. Certainly no nation ever embarked in so gigantic a struggle worse prepared; for of the material prosperity whence the sinews of war are drawn, the colonies were destitute. Canada, refusing to join them, furnished vantage ground for the invader.

The Spaniards along the Mississippi looked with no favor on the rebellion, and the English in Florida were actively hostile. Thus on the 10th day of May, 1776, just one hundred years before the opening day of the Centennial, the few but resolute inhabitants of the thirteen colonies found themselves hemmed around with foes, bankrupt in money and in industries wherewith to gain it, menaced by an uprising among the Indians on the border wildernesses, disunited in thought and feeling among themselves; and to crown all, a British army was preparing to attack New York, while all the seaboard cities seemed doomed to certain and swift destruction. Yet, in the face of these terrible odds, Independence was proclaimed, and the nation was born.

It is our purpose to present here some brief account of what Americans have accomplished in Science and invention since the bell in Philadelphia pealed forth "liberty throughout the land." Much must necessarily be omitted; of nothing can we take more than a passing glance, so vast and varied are the achievements which, beyond all else, have combined to create a great and powerful nation in the shortest period known to history. To the same ancestry that asserted their rights as freeborn men, an ancestry gathered from the skillful workers of all countries, are due the means to ends, and the indomitable perseverance and energy which characterize the American people; and it is well to remember that in the very restrictions placed upon their efforts toward progress were found the impelling causes of the war of independence.

The industries of the country being practically ruined when the war began, the record of invention and scientific progress up to the close of the conflict is meager in the extreme. The discoveries of Franklin, the first great contributions of the New World to Science, had all been made; it was in 1752 that he demonstrated the identity of lightning with the electric spark, and drew electricity from the clouds. Early in 1775 he left England, where he had been honored and courted, and returned to bide his fortunes with

his native country; but even the engrossing labors imposed upon him as a member of the Continental Congress and a framer of the Declaration were not sufficient to distract his attention from Science; and when sent as Commissioner to Paris, he took advantage of the voyage to make observations of the Gulf Stream and to plot a chart of that great current, which still forms the basis of our maps.

One other name, that of David Rittenhouse, of Philadelphia, may be noted beside that of Franklin, whom he succeeded as President of the American Philosophical Society. Rittenhouse was a clockmaker, and carried the perfection of his art into the manufacture of orreries, which still exist, and which show the movements of the heavenly bodies for a period of 5,000 years, and their positions for each year, month, day, and hour, with marvelous accuracy. He made a successful observation of the transit of Venus in 1769, and on account of his great mathematical attainments was elected a Fellow of the British Royal Society.

After peace had been declared, the country found itself exhausted in resources and in men as well, and saddled with a debt of forty million dollars, with no system of public revenue wherewith to provide for it. Financial disaster followed, and private confidence fell in the wreck of public faith. It was no time to await the slow development of events, and the people recognized the fact. It seemed as if every one worked with a will. The whirl of the spinning wheel and creak of the loom were heard all over the land. Every family became a manufacturing society. In 1784 New Jersey alone had forty-one fulling mills for woolen fabrics, and not a woolen factory in the State. In two counties in Virginia, 315,000 yards of flaxen cloth, 45,000 yards of woolen, 30,000 yards of cotton, and 45,000 of linsey woolsey were made in one year by household labor. One family completed 1,355 pair of shoes in a year. The inventor's skill was quickly called into action.

In 1785 Oliver Evans, of Philadelphia, first applied steam machinery to the grinding of plaster and sawing of stone, and to flour mills. Then he invented the elevator or bucket chain to raise grain, the conveyor to take it from place to place, the hopper boy to spread it, the drill to carry it by rakes instead of buckets, and the kiln dryer. In 1799 he attempted to build a steam carriage, and in so doing invented and constructed the first high pressure steam engine. In 1785 John Fitch built the first steamboat, and ran it on the Delaware river. It had reciprocating paddles, and steamed at the rate of eighty miles per day. During the succeeding year James Rumsey propelled a boat on the Potomac by a stream of water driven out through the stern by a steam engine. In 1790 Jacob Perkins, of Massachusetts, invented a machine for cutting and heading nails, which produced those useful articles at the unprecedented rate of 200,000 a day. On the 31st of July, 1790, the first United States patent was issued, the patent and copyright laws being both first enacted in that year; and thereafter a marked increase in the number of inventions becomes visible.

At this period, the growing cotton industry of the country seemed to have encountered an obstacle, which bid fair to be a serious one. Hand-cleaning of cotton was slow and costly; and unless mechanical means could be devised, the new staple could never become a source of wealth. It so happened that there then came to the house of Mrs. General Greene a poor student, from Yale College, named Eli Whitney, who, in various ways, showed himself possessed of considerable mechanical skill. While some officers, her guests, where one day regretting the absence of the machine above noted, Mrs. Green laughingly suggested that Whitney should invent one. The young man overheard the words and remembered them. He had never seen cotton in his life; but making his way to Savannah, he obtained a small quantity and, shutting himself up in a room, went to work. It is said that the saw gin was suggested to him by the accidental use of a toothpick to try the tenacity of the seed. Within ten days after he began experimenting, he made a model which was capable of cleaning 50 lbs. of green seed cotton daily. Thus was completed one of the greatest inventions of modern times, and one which the inventor lived to see result in increasing the cotton production from 5,000,000 to 215,000,000 lbs.

In 1796 the great scientific discovery of the non-materi-ality of heat was made by an American, Benjamin Thompson, Count Rumford, then residing in Munich. He had deserted his country during the war, and accepted service under a foreign prince. This discovery lies at the foundation of the mechanical theory of heat, and directly led to the grandest doctrines of modern Science, the correlation of forces and the conservation of energy.

We may note the establishment of broom-making as a new industry, and the invention of broom-making machinery in 1797, by the Shakers located along the Mohawk river. In the same year Amos Whittemore, of Massachusetts, devised the first machine for the manufacture of wool and cotton cards; this device punctured the leather and set the wires. This proved of great value to the industry, and highly remunerative to the inventor. During the following year Robert McKean patented the first steam sawmill.

At the opening of the nineteenth century the signs of remarkable progress were everywhere discernible. In ten years the population had increased by nearly two millions. The exports for 1799 were \$78,665,522 against \$79,069,148 imports, and during the previous decade 306 patents had been granted.

In 1801, the oxyhydrogen blowpipe was invented by Dr. Robert Hare, of Philadelphia, one of the greatest as well as the earliest of American scientists. It occurred to him that a flame produced by the combustion of oxygen and hydrogen gases ought to be attended with a higher heat than that gun

erated by burning charcoal. But the two gases mingled in certain proportion produced a dangerous explosive mixture, and Dr. Hare was thus led to adopting the expedient of storing the gases in separate vessels, and bringing them together by tubes which met at the point of ignition.

Now followed one of the most important advances in steam navigation, although the fact was not recognized for years after. It was the practical demonstration of the efficacy of the screw propeller, by Colonel John Stevens of Hoboken, who in 1804 built a boat containing a Watt engine, a tubular boiler of his own invention, and the bladed screw. It was a pirogue some fifty feet long. The machine itself is still in existence, and was illustrated in these columns some time ago. During the same year, Oliver Evans ran an amphibious, stern paddlewheel boat on the Delaware and Schuylkill rivers. This was driven by a double action high pressure engine—the first of its kind—which rotated wheels when the craft was ashore, and operated the stern paddle when afloat. In 1806, Thomas Blanchard, of Massachusetts, invented a machine which made 500 tacks per minute, with perfectly finished heads and points. Soon after, he devised an apparatus for turning gun barrels throughout their entire length by one self-directing operation. This was the initial work which culminated, twenty two years later, in the magnificent invention of the lathe for turning irregular forms. Blanchard's inventions are now applied to many operations in making musket stocks, and comprise no less than thirteen different machines for making different portions of the weapon.

The following year, 1807, witnessed the triumphal voyage of Robert Fulton's steamer, the *Clermont*, from New York to Albany. Fulton at that time was already an inventor of repute, both in England and in the United States. He had devised a mill for sawing marble, machines for spinning flax and making ropes, an excavator for canals, and he had successfully tried, probably, the first submarine torpedo boat. It was in relation to the latter that he returned to this country from England. Here he received a congressional appropriation, and made some successful experiments in blowing up vessels; but ultimately Commodore Rodgers reported the system impracticable. Later, he obtained the exclusive right to navigate the Hudson river in his steam vessels. In 1814, Fulton built for the United States government the first steam war vessel, a heavy and unwieldy mass, capable of making about 2½ miles per hour. The war of 1812, in which she was designed to be used, terminated before her completion. Fulton died during the construction of the vessel.

During the year 1807, oil cloth for floors was invented and manufactured in Philadelphia, and John Bedford of the same city devised the first metal-bound boots and shoes. The first breech-loading military arms ever offered to troops, and likewise the first fire arm made on the interchangeable system, were invented by John H. Hall, of Massachusetts, in 1811. Some of these old weapons were captured at Fort Donelson in 1862.

In 1812, anthracite coal was for the first time successfully utilized. It appears that Colonel George Shoemaker, of Pottsville, took nine wagon loads of the "black stones" to Philadelphia, and there sold two wagon loads to Messrs. White & Hazard, wire manufacturers. White and his firemen worked faithfully for half a day, but the stones refused to burn; whereupon at noon they slammed the furnace doors shut in disgust, and went to dinner. On their return the doors were red hot and the furnace in danger of melting. Meanwhile the Colonel had sold his other seven loads to less successful experimenters, and was by them arrested as a swindler for selling them rocks for fuel.

During the war of 1812 but very few military inventions appear. Probably the most important was the columbiad, a long-chambered cannon capable of projecting shot and shell at high angles and with heavy charges. It was devised by Colonel Bomford. In 1813, Francis C. Lowell invented numerous important improvements in the power loom, notably the stop motion for winding on the beams for dressing, and the double speeder to regulate the movements of the fly frame in filling the spools. The first important American improvement in printing presses appeared in 1817, and was the Columbian press, invented by George Clymer of Philadelphia. The power was applied to the platform by a compound lever consisting of three simple levers of the second order. The first transatlantic voyage made by a steam vessel was accomplished by the *Savannah* in 1819. The vessel was of 380 tons burden, and was driven by paddles. In the year last mentioned, Jacob Perkins invented engraving on steel as a substitute for copper.

During the period from 1800 to 1820, just reviewed, the commerce of the country passed through a season of terrible stagnation, owing to the orders in council of England and Napoleon's Berlin and Milan decrees. In 1808, imports fell off to \$56,990,000 and exports to \$22,430,590. This decline continued to 1814, when an extraordinary impulse was given to trade, and imports went up to amounts excessive of the wants of the country. Subsequently, the average of imports and exports remained uniform at about \$78,000,000. From 1800 to 1810, only 1,086 patents were allowed; and from 1800 to 1,820, 1,748. The population of the country had, however, increased to 9,638,131, and with it the number and extent of manufacturing industries augmented, thus providing for the season of renewed prosperity which followed.

The rapid growth of this country in population, wealth, and culture since the year 1820 is now a just cause for pride and congratulation; and in our next two issues, we shall note the prominent incidents in this interesting and important

THE GRASSHOPPER SCOURGE OF 1876.

There is cheering news for Western farmers, conveyed in Professor C. V. Riley's recent statements, in the *Colorado Farmer*, relative to the probable numbers of the grasshoppers during the coming summer. Some one, it appears, has asserted that the soil of the region in the northwest portion of the country lying east of the Rocky Mountains is covered with prodigious numbers of grasshopper eggs; and this disagreeable announcement has gone the rounds of the press, through the length and breadth of the land. Professor Riley gives it its *quintus* in so characteristically effective a manner that we are half inclined to be grateful to the mendacious individual who set the story afloat, since it has been the means of obtaining such welcome intelligence from probably the best entomological authority in the country.

From personal observation, Professor Riley states, so far as Missouri and Kansas are concerned, the report is wholly groundless. In Minnesota, a State commission has determined that the eggs have mostly perished from excess of moisture, which dissolves the glutinous substance which normally protects and hold them together. In some parts of the high country lying east of the mountains, especially toward the north, eggs have been deposited in numbers by the swarms which left the lower and more fertile country devastated last spring; but in that region, such is the case every year, for it is the native home of the swarms which occasionally extend to the upper Mississippi valley. In Missouri, Kansas, and Nebraska, however, the number of eggs, laid by the few straggling insects that passed over those States last fall, will not equal that laid in ordinary seasons by indigenous species. In Colorado there is every hope that the protracted rains have destroyed the eggs.

Professor Riley gives it as his conclusion, in addition to the above, that, compared with other parts of the country, those States ravaged by locusts in last spring and early summer will enjoy the greater immunity during the same season of 1876, not only from locust injuries, but from the injuries of obnoxious insects, except the wood borers. In short, the people of the ravaged section have every reason to be hopeful rather than gloomy.

FIRE INSURANCE.

The address of Mr. H. A. Oakley, President of the National Board of Fire Underwriters, delivered before that body at its recent session in this city, contains many useful suggestions relative to fireproof building, which, however, here at least, appear to be "more honored in the breach than in the observance;" and the speaker's impressions of European fireproof construction may well be contrasted with the way in which late edifices are built in this city. He remarked, he says, the universal use of concrete floors, of oak, and other hard woods instead of pine as finish, the entire separation of stories from each other, the absence of wooden or lath and plastered partitions, the solid backing given to the exterior of fronts, the thickness of division walls, the absence of wooden staircases, the isolation of flues from beams or woodwork, the height of the buildings (not exceeding sixty-five feet), and the covering of the roofs with iron and slate laid on beds of plaster. To compare this excellent *resumé* of what fireproof building ought to be with the flimsy affairs built in this country is to adduce at once the reason of the gigantic conflagrations with which even the best organized of fire departments are unable to cope. A building even now in process of erection on Broadway is exteriorly a mere shell of thin iron which towers above the adjacent structures, while within it is a network of wooden beams and partitions, its present exposed skeleton showing no trace of fireproof fittings. There are many other structures of the same description in New York city.

Mr. Oakley tells us that the solid character of its buildings alone saved Paris from destruction at the hands of the communists; and he states that he witnessed the burning of entire floors in houses, involving the destruction of everything in them, without perceptible damage to the stories of the same building either above or below those burned.

The percentages of losses paid to premiums received aggregates 47-16 per cent for 1875 against 42-50 per cent for 1874. The loss rate for the first three months of the present year is largely in excess of the like period in 1875; and generally speaking, Mr. Oakley considers that the outlook for the insurance business is not good. He further says that, despite all the modern appliances for the prevention of fires, the fact still remains that there is a steady increase in their number, and from causes too often within the control of the owners or occupants of the property. We pointed out this state of affairs some time since as one of the disadvantages of the insurance system, disadvantages sufficiently great to excite the question as to whether, after all, insurance is not more injurious than beneficial to the community. The carelessness on the part of owners, of which Mr. Oakley complains, seems to us the legitimate consequence of the risk of loss being taken off their shoulders; and for the same reason, they have little interest in availing themselves of the many new and useful inventions to protect their property.

Moreover, buildings have very often been burned, and life and adjacent property been imperiled, merely to obtain insurance money; and certainly few edifices are better adapted to the practice of this crime than those of the type which we have above referred to, the almost certain destruction of which effaces all evidence of the deed. It may be added that at the present time, when real estate has greatly depreciated in value, such incendiarism might well be most prevalent; and this is in significant accordance with Mr. Oakley's further statement as to the recent steady increase in numbers of fires.

PROGRESS AT THE CENTENNIAL.

Contrary to the general expectation, the Exposition will be nearly complete on the opening day. Nine tenths of all the exhibits are in place, and there is every indication that every department will be further advanced than has been the case on the first day of any previous World's Fair. Machinery, Agricultural, and Horticultural Halls will be filled; and from the rapid manner in which the work is now progressing, it appears that the Art Department will likewise be in readiness. The condition of affairs at the present time is in marked contrast with the disorder prevalent two weeks ago; and the wonderful celerity with which the thousands of contributions have been arranged is another instance of that peculiar American characteristic which delays matters to the last moment, and then accomplishes herculean tasks in incredibly short periods of time.

The Centennial Commission has likewise indulged in tardiness in disposing of some of the more important questions before it, and in making many material alterations in existing regulations. We allude elsewhere to its action in closing the Exposition and grounds on Sunday. The temperance question has recently been discussed, the point being whether to approve of the contracts, made by the Board of Finance, licensing the sale of intoxicating liquors in the grounds. The Commission arrived at no conclusion, and indefinitely postponed the whole subject, leaving the liquor men to sell their beverages under the concessions, and the temperance advocates to carry the matter, if they so elect, to the decision of another tribunal. Some important changes in the jury arrangements, we notice, have already been made. Owing to the immense number of applications for positions on the American Committee, some 4,000 in all, the names of appointees have been kept secret, and it is only lately that any of those who, it is desired, shall serve have been notified of the fact. The total number of jurors has been increased from 200 to 250; one half of the members are foreigners, to be chosen by the foreign commissioners, and the other half Americans. Ninety-six of the latter, we learn, have been selected, fifteen of whom are from New York, and fourteen from Pennsylvania, other States having a smaller representation. The pay of the American jurors has been reduced from \$1,000 to \$500, a proceeding of questionable wisdom, in view of the fact that elaborate professional reports are to be required, in lieu of medals or other more easily settled awards. There are not many experts who can afford the time and labor, which are involved in the careful examination and criticism of entries frequently during the coming six months, in return for a sum of money hardly sufficient to meet their necessary expenses. It would have been better to have abolished free passes, and increased the revenue in that way, than to have reduced the jurors' pay to such a small amount.

The Centennial Bank has been opened, and doubtless will prove a great convenience to exhibitors and visitors. Krupp's 1,600 pounder cannon has been removed from the steamer and set up in the grounds. A magnificent series of industrial art productions has recently arrived from Italy; and a boat load of young alligators, from Florida, are disporting themselves in one of the ponds.

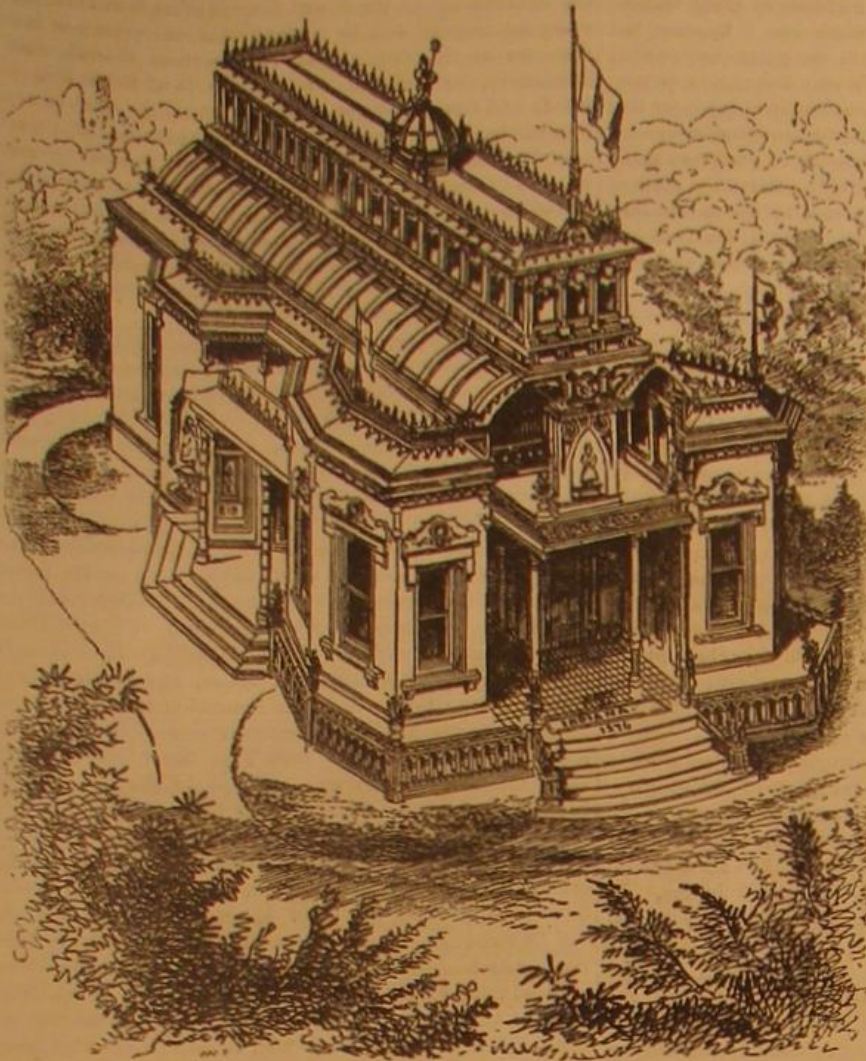
The President of the Commission has issued the final address, or rather invitation, to the public. He says:

"The sanitary condition of Philadelphia is good; rational amusements have been provided; arrangements for protection from fire, thieves, etc., are as nearly perfect as it is possible in a great city. Within the Exhibition every precaution has been taken for the safety, comfort, happiness, and pleasure of the public. The buildings of the Exhibition are in order. The Exhibition will promptly open on May 10, and is an assured fact. All preparations have been made on a gigantic scale. Philadelphia and her citizens have spent millions in preparation for the reception and care of guests. There is no disposition to nor evidence of extortion. Increased business at usual rates is considered sufficient compensation for the vast amount of capital and labor expended. Living is as cheap as, if not cheaper than, in any large city in America. The accommodations are unsurpassed. All grades of society can be accommodated. Railroad and transportation facilities are unequalled."

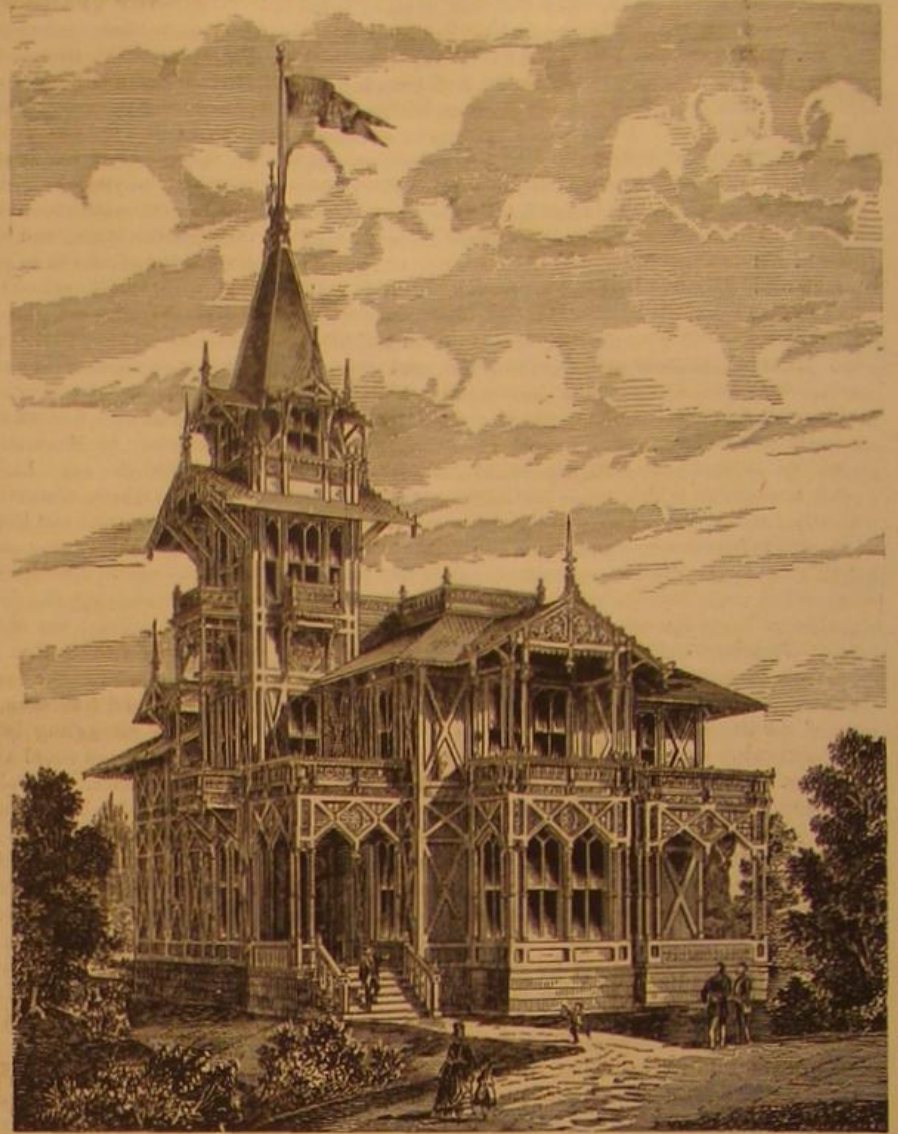
There is no doubt, it now appears, of Philadelphia being able to entertain, at reasonable prices, 150,000 and possibly 200,000 persons. The hotels will charge from \$5 to \$1.50 per day, boarding houses \$1 to \$2.50, and the Centennial Agency will provide breakfast, lodging, and supper for \$2.50. By steam and horse cars, 20,000 persons per hour can reach the Exposition from any part of Philadelphia. One minute after the arrival of trains on all main lines, passengers can be within the Centennial Buildings. There is a good prospect of still further reductions to railway fares being made, in order that every one may visit the Exposition at a comparatively small expenditure.

By the time our next number is issued, the opening ceremonies will have taken place, and the long-looked-for Centennial will be fairly under way. We shall give full descriptions of the proceedings; and when the various departments are in a condition to admit of proper examination of their contents, we shall make our readers acquainted with whatever seems to us novel and interesting.

A SOLUTION of iodide of potassium is slowly decomposed by the action of light; but when some cane sugar is added, it turns yellow, owing to the liberation of iodine. If starch is present, a blue color is produced. If a sheet of starched paper is soaked in a solution of iodide of potassium and sugar in the dark, and then exposed under a photographic negative to light, a blue positive print is obtained, which is fixed by washing in water.



THE INDIANA STATE BUILDING.



THE MICHIGAN STATE BUILDING.

THE CENTENNIAL EXHIBITION.—THE STATE BUILDINGS.

As mentioned in the general description of the buildings, on the first page of this issue, many of the States have erected separate buildings for the convenience of their delegates and exhibitors. Some of these structures are highly ornamental, and they differ so widely in general design that altogether they contribute largely to the picturesque appearance of the grounds. The Indiana Building is intended by its architect to represent the characteristics of Indiana homes and productions. It is constructed of

a combination of wood and other building materials, a frame of wood being the support of the building and roof, to which an outer wall of brick, stone, terra cotta, iron, and coal can be attached. There are three entrances by four broad steps to the front and side porches, and an open-roofed balcony extends from each side entrance to the front entrance. The assembly hall is designed to be a grand auditorium for miscellaneous gatherings. It is in the form of an irregular cross, 55 feet at its longest angle, and has about 1,400 feet of floor. From the level of the ceilings of the side rooms, it is

spanned by a truss-arched roof at a height of 24 feet above the center of the hall. It is lighted by the rotunda above, and an ornamental fountain plays in the center below. On the walls are 200 tablets, of which number 92 will be used by the counties of the State for the general statistics of each county, and the remainder will be given to individuals or firms. There will also be committee rooms, a ladies' parlor, invalids' room, post office, telegraph office, baggage room, and gentlemen's parlor; and the building will be a place where any citizen of the State can be at home, to entertain friends and



THE OHIO STATE BUILDING.

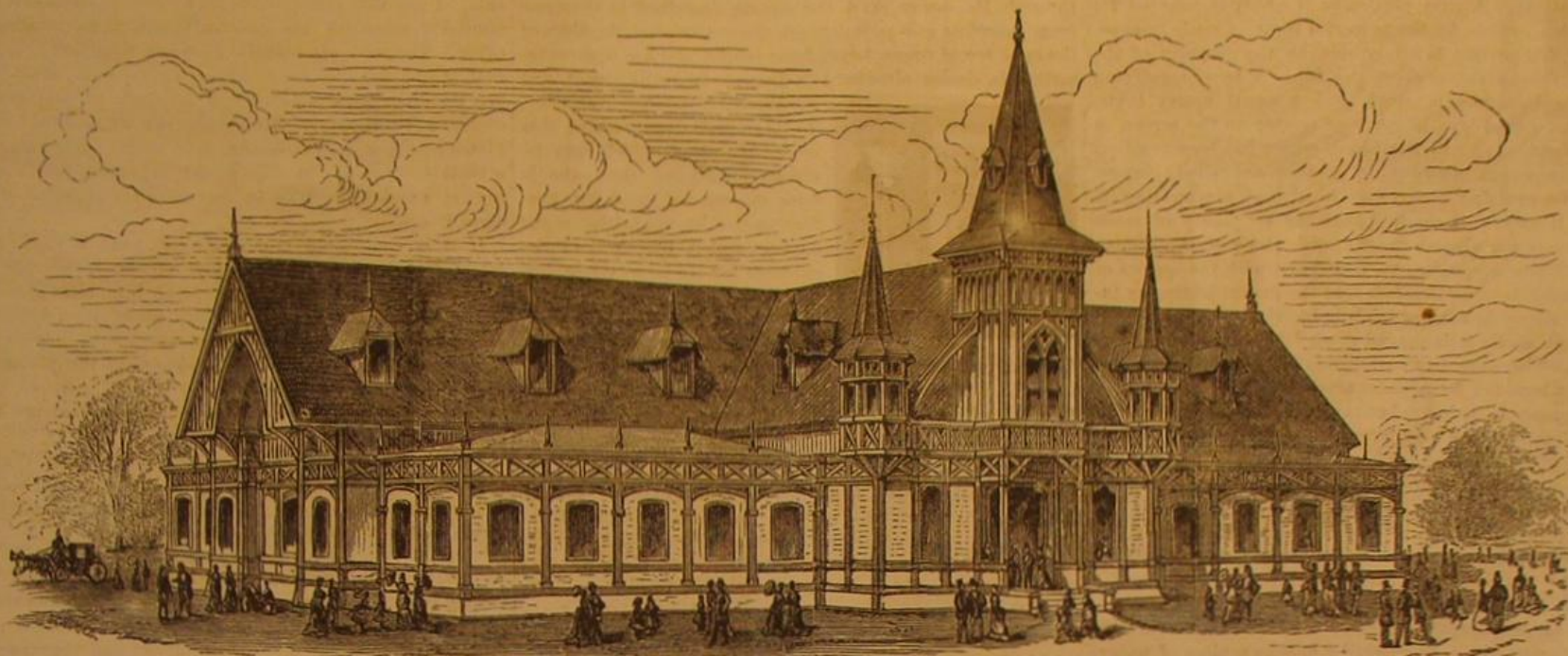
dispatch business. The whole will be surmounted by a handsome truss roof, from the top of whose arches a lighted open rotunda of glass and wood rises, crested with metallic ornaments and statues. The entire cost of the building will not exceed \$10,000.

Our next engraving shows the Michigan Building, which stands about 1,000 feet north of and facing the Main Building. The narrow gage passenger railway which runs around the entire Centennial grounds passes in front of the Michigan building. The site is elevated, and commands a fine view of the surrounding grounds. The building is of the Swiss style of architecture. Its outline is very graceful, and the exterior is elaborate and ornamental. The ground

Hopkin, entitled "Off Sleeping Bear Point, Lake Michigan," will occupy a prominent position in one of the rooms.

Our next illustration shows the Ohio State Building, which is an admirable specimen of villa architecture. In addition to the usual purposes for which these buildings have been erected, the Ohio Building is to contain a very interesting archaeological display. No State in the Union is more fertile of relics of bygone ages and races; and the Archaeological Association of the State has done much to preserve these evidences and to foster a taste for this interesting study. The exhibits will comprise all articles fabricated by the Mound Builders or Indians, whether in stone, flint, bone, shell, or copper, such as hammers, mauls, axes, wedges,

villon, erected by the exertions and under the supervision of the Women's Centennial Committee; and it is intended to be a place for the exhibition of all articles made or invented by women, and is expected to be, in fact, an epitome of the whole Exposition. It is located on Belmont Avenue, near the horticultural grounds; it covers an area of 30,000 square feet, and is formed by two naves intersecting each other, each 64 feet wide by 192 feet long. At the end of these there is a porch, 8 x 32 feet. The corners, formed by the two naves, are filled out by four pavilions, each 48 feet square. The whole structure is in modern wood architecture, roofed over by segmental trusses. The centre of the edifice is raised 25 feet higher than the rest of the building, and is



THE PENNSYLVANIA STATE BUILDING.

plan shows an area of about 50 x 65 feet in size. The foundation is of stone, with exterior facing above ground of Lake Superior sandstone. This building is constructed entirely from Michigan material and of Michigan workmanship. It is designed to show the resources of the State in respect to building material. The brown stone foundation is from Marquette; the slate of the roof is from Huron Bay. The entire interior finish is of native woods, marble, and alabaster, and is highly polished. The floors are laid with hard wood of various kinds and colors, and in fancy patterns. The doors are of solid walnut, elaborately carved; the main staircase is a marvel of beauty and skill. The wainscoting in all the rooms is paneled in beautiful designs of various woods or other material. That in the reception room is of highly polished alabaster from the quarries at Grand Rapids; that in the Governor's office, as well as the mantel in the same room, is of marble. The furniture is of the very finest character, made of Michigan material and of Michigan workmanship, and contributed by manufacturers in different parts of the State. The walls will be ornamented with pictures by Michigan artists. The large painting by Robert

tubes, perforated balls, rollers, beads, ornaments, arrow points, spear heads, pestles, and every ancient thing that is clearly artificial. The proper arrangement and care of this Department has been entrusted to Professor M. C. Read, of Hudson, Ohio.

Our next subject is the building erected by the wealthy State of Pennsylvania. It is located on Belmont Avenue, near the United States Government Building. The State appropriated \$15,000 for its erection, and it is to be the headquarters of the Pennsylvania State Commission. It is a Gothic building, built of wood, and is 98 x 55 feet. It is surrounded by a tasteful piazza, six feet wide, and is ornamented with a central tower, flanked on each side by two smaller octagonal towers. The height to the eaves is 22 feet, to the peak of the roof 39 feet, and to the top of the central tower 65 feet. The main hall is 30 x 50 feet, on the right of which are two rooms 20 x 20 feet each, intended for ladies' and gentlemen's parlors, beautifully fitted up, and having dressing rooms and other conveniences attached. On the left are two committee rooms, 20 x 27 feet.

Our last illustration in this series shows the Women's Pa

surmounted by an observatory, with a cupola on the top of the same, making the entire height of the building 90 feet. The interior of the building presents a very attractive appearance, but four columns obstructing the view, the main support of the roof being furnished by trusses resting on the outside walls. The panels are beautifully decorated with allegorical groups representing Faith, Hope, Charity, Art, Labor, Instruction, Religion, and the Family, from designs by Camille Pitou, an artist who has done much towards the embellishment of the buildings on the Centennial grounds.

For illustrations and descriptions of some of the buildings erected for the separate industries, see pages 326 and 327 of this issue.

The Solvay Soda Process.

The ammonia-soda process of Solvay has been so greatly improved that the German soda ash manufacturers fear they will no longer be able to compete with him. Solvay is now on the point of erecting a factory, says a German contemporary, large enough to supply the demand of all the consumers on the Rhine.



A Microscopical Exhibition.

Mr. D. S. Holman, the Actuary of the Franklin Institute, recently gave a very interesting microscopical exhibition in Philadelphia. The method he adopted of giving every person in the audience a good view of the image was a novel one. An assistant carried a white screen some 18 inches square to different parts of the room, and all in its immediate vicinity had thus an opportunity to examine the details of the object. Mr. Holman has invented a number of very ingenious appliances for exhibitions of this kind. Perhaps the most noteworthy is a slide by which a small animal, like a salamander, may be kept alive in water, and quiet enough to show the circulation of its blood. The fish is laid in the groove of the glass slide, through which a current of water is kept flowing. A thin portion of the body is selected for examination, which, by the powerful light, is made transparent, and this portion is firmly held by the pressure of the very thin sheet of glass above the fish. A lens magnifying about 800 diameters is used, and a small artery invisible to the naked eye is made to appear on the screen as large as the finger; and the blood, which has been resolved into its component globules, or, as they are called, corpuscles, is seen coursing along, each heart beat accelerating its motion. It may be remarked that the frequency of these beats corresponds almost exactly with those of the human subject. These corpuscles vary in shape with the species of animal, and it is upon this fact that the expert testimony introduced latterly in murder trials is based.

In the salamander it is shaped much like a boy's torpedo or a pegtop. There are two varieties in all blood, the red and white, of which the former are much the more numerous; the red appears to be inert, but the white has apparently an individual motion, and may be said to be endowed with a certain kind of intelligence. These corpuscles are suspended in a transparent fluid which, of course, the microscope does not analyze.

At a private exhibition at the Institute, Mr. Holman, by a lens of his table microscope magnifying 1,200 diameters, showed the circulation of the sap in the leaves of plants. What does 1,200 diameters mean? Simply that the surface appears 1,440,000 times as large as it really is. To furnish a basis for comparison, he pricked a hole in a piece of paper with a fine cambric needle point, and found, when put in the field of the microscope, that the hole was nearly four times as large as the field. A small portion of a leaf of the *anacharis alismastrum*, a water plant, was then shown under the lens, and the cellular structure of the leaf was seen. The cells appear like bricks laid in a wall, about forty appearing in the field, each overlapping its neighbor, and of about the same proportions as a brick.

Within each cell were little globules, which kept up a ceaseless movement round about the edges of their prison, like little mice chasing each other around a room. In all the cells the movement was in the same direction and at the same speed. That infinitesimal point could be studied with interest and profit for hours.

That motion is an attribute of all matter is very nicely shown by Mr. Holman in a slide which illustrates what microscopists term the dance of the atoms. Gamboge is pulverized and thrown into water, which is slightly colored by it. With a lens magnifying 2,000 diameters, the particles are seen in a rapid, cycloidal motion, which never ceases and is perfectly uniform, resembling very much a swarm of midges in the warm days of October.

Progress of Torpedo Improvements.

An experimental trial of a new torpedo boat, embodying the most recent improvements of the Lay system, was recently tried near the Navy Yard, Washington, D. C. The boat, of cigar shape, 16 feet long, 19 inches in diameter, is made of iron. It is propelled by liquid carbonic acid, carried in a reservoir within the shell, the liquid being allowed to expand into gas, which operates an engine and propeller. The boat is steered and the speed and direction of the engine governed by electricity, the circuit being opened and closed by means of a cable, which is wound or unwound, as desired, from a reel carried in the boat; the boat's direction and motions being governed by electric keys, located at the station or on the vessel whence the torpedo boat is sent out. The boat carries an explosive magazine which is discharged by electricity.

Mr. Lay's invention is calculated to revolutionize the entire system of naval warfare, particularly that branch pertaining to harbor defenses and protection of fortifications, as well as open combat between floating navies. So fast as shipbuilders have been able to construct the thickest metallic defenses for naval vessels, so fast have manufacturers of guns been able to invent projectiles that will pierce them. The submerged torpedo is impregnable to attack. With its explosion it carries far wider destruction than the most terrific storm of shot and shell, and the loss of life inevitable upon a close naval conflict is entirely avoided. The advantages of the movable torpedo over fixed mines and the spar torpedo are so apparent that it is not necessary to enumerate them. The torpedo boat is calculated to be used in a most efficient manner for offensive warfare. It can be used as a towing boat to effect an entrance to the harbor of an enemy or approach his fortifications, even if they are protected with fixed mines or torpedoes in the channel. To the Lay torpedo boat may be attached a line of floating explosive mines, connected with the operator's station, as is the torpedo itself, by electric cable. The torpedo boat may be despatched with these floating mines in tow to open the channel. The mines can be detached from the boat at any given point and sunk in position by an arrangement peculiar to their construction, still retaining their electric cable connection with the opera-

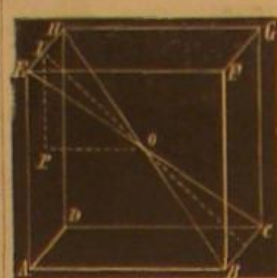
tor's station. They may be fixed at will. Mr. Lay has invented a submarine torpedo battery for harbor and coast defence. It is similar to the ship floating torpedo.

Correspondence.

The Largest Cube in a Ball.

To the Editor of the Scientific American:

There is an error in the reply of L. S. W. to J. C. W., No. 58, page 267, in regard to the largest cube which can be cut out from a ball; this error has been pointed out by others of your correspondents. L. S. W.'s assertion is strangely wide of the mark, as the great circle of a sphere passes always through its center, and the square inscribed in the same must therefore also pass through the center; but the sides of the cube are of course beyond the center, and are squares inscribed in circles situated at a distance from the center, and consequently much smaller.



The annexed figure makes this clear: the globe which may be circumscribed on the cube is here represented, and its surface passes through the eight angles; and it has none of the surfaces for its large circle, but the larger circle will have for its diameter the diagonal, EC , passing from one angle to the diagonally opposite one, through the center, O , of the sphere and cube. This diagonal is considerably longer than the diagonal of one of the sides of the cube.

To find the relation between the globe and inscribed cube, we draw the perpendiculars, PO and IP , and the line, OT . Then we have $PO = PI$, and $EI = \frac{1}{2} EH =$ half the side of the cube, which we will call s . Further: $IO^2 = OP^2 + PI^2 = s^2 + s^2 = 2s^2$. Further: $HO^2 = IO^2 + s^2 = 2s^2 + s^2 = 3s^2$; but HO is the radius of the ball, and so, if we call this r , we have $r^2 = 3s^2$, and $s^2 = \frac{1}{3} r^2$, or $s = r\sqrt{\frac{1}{3}}$. If we call the whole side of the square x , and the diameter d , we have, for the same reason, $x = d\sqrt{\frac{1}{3}}$; so that, if the diameter is 12 inches, we have $x = 12\sqrt{\frac{1}{3}} = 6.94$ inches, and the volume of the cube $576\sqrt{\frac{1}{3}} = 332.95$, considerably less than that found by L. S. W. in applying his erroneous proposition.

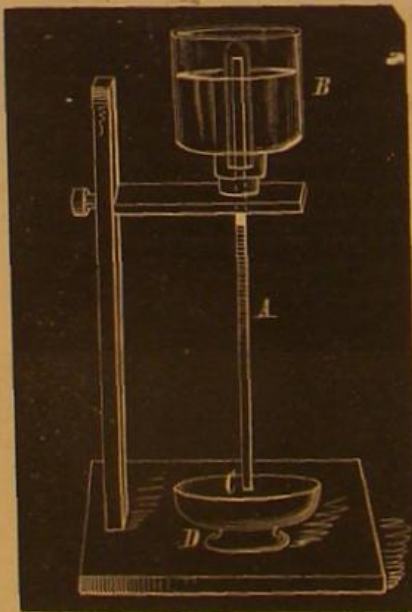
New York city.

P. H. VANDER WEYDE.

Liquids under Atmospheric Pressure.

To the Editor of the Scientific American:

The accompanying engraving shows a very simple and cheaply constructed apparatus for illustrating the flow of liquids under atmospheric pressure, which might be called an interrupted siphon. It consists of a long glass tube, A , passing through a cork fitted in the neck of an open-mouthed bell glass, or a bottle with the bottom cut off, B , and a large test tube. Any stand will do as a support. B is filled with



water to the upper opening of A . The opening, C , is closed with the index finger of the left hand, and the test tube, previously let down over the tube, A , is gently raised. The elasticity of the air confined in A is diminished, and the normal pressure upon the surface of the water, in B , forces the water up in the test tube and into A . So soon as the column of water in A is greater than the depth of water in B , the finger may be removed from C , and the vessel, B , is emptied. Of course, if C is already under the surface of the water previously placed in D , it is not necessary to apply the finger to C . By holding the test tube quite high, a small quantity of air may be kept in the top of the test tube, and thus the difference of atmospheric pressure is very prettily shown.

Baltimore City College, Md.

C.

Corn Sugar.

The Davenport (Iowa) Gazette claims for that city the first manufactory of pure glucose in this country. The demand for the article by confectioners alone, in the United States, is immense. The sources of supply heretofore have been France and Germany, where glucose is made from potatoes. Here it is the product of corn wholly. It is as pleasing to the taste as honey. The production of grape sugar and glucose opens a new department for Iowa corn. The capacity of the works at Davenport is 500 bushels per day. This branch of manufacture bids fair to become of immense importance to the State and country.

Preserving Wet Plates.

At a recent meeting of the Belgian Photographic Society, a paper was read by M. Watrigant, who was of opinion that none of the dry plate processes in vogue at the present day were capable of giving pictures equal to those from wet plates. M. Watrigant proposed a method for maintaining the moist film in a wet condition for many hours, so that it would be possible, for tourists and others occupied in photography, to employ wet plates without having the trouble of carrying about with them a lot of solutions necessary under ordinary circumstances.

M. Watrigant's plan is to take the plate as it comes from the dipping bath, and to put round its margin an india rubber ring, in such a way that the rubber laps over on each side. Upon this sensitized plate he now places a second one, similarly prepared, the two collodion films towards each other. The two are tightly fastened together in any way that might suggest itself, by string or some other means, and then one is in possession of a couple of prepared films sealed hermetically. No injury can arise from the two plates pressing against one another, as the rubber ring forms a suitable buffer. M. Watrigant says that plates may be kept in a moist condition in this state for a period of forty-eight hours.

If it is considered undesirable to have a dark tent in which to separate the films before exposure, then M. Watrigant suggests that only the sensitive film should be sealed in like manner against an ordinary glass plate, and then an exposure may be made in the camera without inconvenience, due regard being paid to the thickness of the plates in the dark slide. The result in this case is not, however, so good as that secured when two prepared films are fastened together.

The landscape photographer, by adopting the Watrigant method, may spare himself the trouble of carrying collodion, silver bath, developer, and other solutions, and this is the object which the author desired to obtain.

Zuccato's Papyrograph.

This is a useful invention for the speedy reproduction of circulars, price lists, diagrams, maps, examination papers, music, etc., upon any description of dry and unprepared paper. The writing or drawing to be multiplied must be executed with a steel pen, by means of special ink, upon a sheet of prepared waterproof paper. The ink passes through the fibers of the paper without injuring them, and attacks or corrodes the waterproofing beneath. The corroded parts are then removed by placing the waterproof paper upon a piece of thoroughly wet calico. The moisture from this dissolves the corroded lines, ascends through them to the surface of the paper, and, loosening the ink, enables it to be entirely removed by blotting paper. The result is a porous paper stencil, held together by its fibers, which presents in facsimile the delineations that have been made upon it with the ink. The stencil is then lightly painted upon the written side with papyrographic color. It is next placed upon a pad of velvet, painted side downwards, and, upon being pressed, color is forced through the lines of the matrix and brought in contact with the paper employed for printing, upon which is formed a perfect facsimile of the writing. A like result is attained, without repeating any of the before-mentioned operations, as often as a new sheet of paper is laid upon the stencil and submitted to light pressure by means of a copying press. A proof impression can be taken in a few minutes, and afterwards quickly multiplied. It is said that 500 copies can be produced from one sheet of the specially prepared paper at an infinitesimal cost.

Photo Plates under the Microscope.

M. Jules Girard, who has published several valuable works upon the application of photography to the microscope, has just communicated to the Academy of Sciences the results of his interesting researches upon the transformation of collodion in photographic operations. A microscopic examination of collodion permits one to discover the texture of the film, and to follow the reactions which take place in the production of the luminous impression. When of good quality, the collodion plate is translucent and colorless in the event in the collodion being perfectly dissolved; but its composition, age, and the actions which constitute sensitizing change its texture. The photo-micrographs which M. Girard presents to the Academy, representing enlargements to 50 diameters, demonstrated several phenomena. Old collodion which gives very fine images, but the rapidity of which leaves much to be desired, is shown to contain liquid bubbles holding unchanged ether. If the collodion contains alcohol, it has the appearance of a cellular tissue; and if there is much water in the collodion, the fibers of cotton become apparent in the form of flocculent matter. Collodion which is too thick gives intensity, but is not rapid; it has the appearance of an undulated cellulose-vascular tissue. The irregularity of the film militates against the clearness of the image. Two indications or proofs are at hand of the time during which the action of sensitizing in the nitrate of silver bath is still incomplete, and of the moment when the operation has terminated. In the first case, the greasy marks, which are an indication of the sensitizing being still incomplete, are full of streaks and groups of crystals, some in the form of needles and some amorphous. It seems as if the crystals of iodide of silver, which were in course of formation, have been arrested in the midst of their development.

In the second case, when the operation of sensitizing is complete, the texture of the film is homogeneous and compact. It is covered with a uniform network, rendered more evident by those portions which are free from crystals.

The greater part of the photographic action necessary to obtain an image is due to the successive transformation of the crystallographic system, the reaction of the iodide of silver being the most perceptible of all. The result is that an examination of the plate at different stages of the operation under a microscope of moderate power permits the operator to judge of the success or otherwise of the process he is employing.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

SECOND SERIES—Number III.

PATTERN MAKING.

In using a jack plane, we commence each stroke by exerting a pressure mostly on the fore part of the plane, commencing at the end and towards the edge of the board, and taking off a shaving as long as the arms can conveniently reach. If the board is longer than can be reached without moving, we pass across the board, planing it all across at one standing; then we step sufficiently forward, and carry the planing forward, repeating this until the jack planing is completed. To try the level of the board, the edge or corner of the plane may be employed; and if the plane is moved back and forth on the corner or edge, it will indent and so point out the high places.

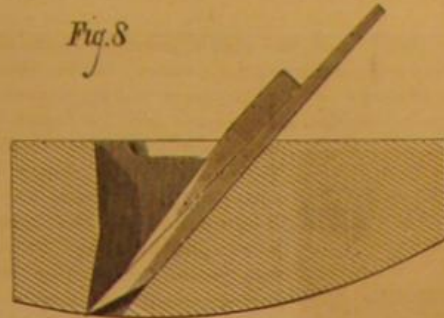
The fore plane (or truing plane, as it is sometimes called) is made large, so as to cover more surface, and therefore to cut more truly. It is ground and set in the same manner as the jack plane, with the exception that the corners of the iron or blade, for about one eighth inch only, should be ground to a very little below the level of the rest of the cutting edge, the latter being made perfectly straight (or as near so as practically attainable) and square with the edge of the iron. If the end edge of the cover is made square with the side edge, and the iron is ground with the cover on, the latter will form a guide whereby to grind the iron edge true and square; but in such case the cover should be set back so that there will be no danger of the grindstone touching it. The oilstoning should be performed in the manner described for the jack plane, bearing in mind that the object to be aimed at is to be able to take as broad and fine a shaving as possible without the corners of the plane iron digging into the work. The plane iron should be so set that its cutting edge can only just be seen projecting evenly through the stock. In using the fore or truing plane, it is usual, on the back stroke, to twist the body of the plane so that it will slide along the board on its edge, there being no contact between the cutting edge of the plane iron and the face of the board, which is done to preserve the cutting edge of the plane iron from abrasion by the wood: as it is obvious that such abrasion would be much more destructive to the edge than the cutting duty performed during the front stroke would be, because the strain during the latter tends mainly to compress the metal, but, during the former, the whole action tends to abrade the cutting edge. The face of the fore plane must be kept perfectly flat on the underside, which should be square with the sides of the plane. If the under side be hollow, the plane iron edge will have to protrude further through the plane face to compensate for the hollowness of the latter; and in that case it will be impossible to take fine shavings off thin stuff, because the blade or iron will protrude too much, and as a consequence there will be an unnecessary amount of labor incurred in setting and resetting the plane iron. The reason that the under surface should be square, that is to say, at a right angle to the sides of the body of the plane, is because the plane is sometimes used on its side on a shooting board.

When the under surface of the plane is worn out of true, let the iron be wedged in the plane mouth, but let the cutting edge of the iron be well below the surface of the plane stock. Then, with another fore plane, freshly sharpened and set very fine, true up the surface, and be sure the surface does not wind, which may be ascertained by the application of a pair of winding strips, the manner of applying which will be explained hereafter. If the mouth of a fore plane wears too wide, as it is apt in time to do, short little shavings, tightly curled up, will fall half in and half out of the mouth, and prevent the iron from cutting, and will cause it to leave scores in the work, entailing a great loss of time, in removing them at every few strokes. The smoothing plane is used for smoothing rather than truing work, and is made shorter than the truing plane so as to be handier in using. It is sometimes impracticable to make a surface as smooth as desirable with a truing plane, because of the direction of the grain of the wood. Thus, in Fig. 7, let E represent a piece of stuff requiring to be planed on the upper sur-

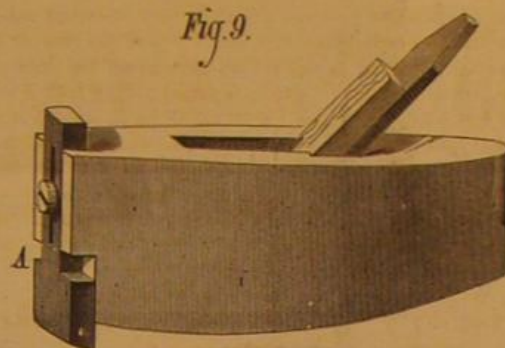
face, and let us plane it, cutting in the direction of the arrow, D; it is evident that the edge of the plane iron, when cutting the surface from B to A, will strike against the edge or end of the grain of the wood, tending to rough it up; whereas, while passing from A to C, the tendency of the pressure of the iron edge would be to smooth the grain of the wood downwards, the difference between the two tendencies being sufficient to make it necessary in many cases to use a smoothing plane cutting in both directions, as shown in Fig. 7, first from A to B, cutting in the direction of the arrow, F,

and then from A to C, cutting in the direction of the arrow, G. Thus the cutting will be at all times performed in the direction tending to smooth down and not rough up the grain of the wood. That this method of planing is necessary is demonstrated in planing across the end grain of wood, for which purpose the smoothing plane is almost indispensable, and in which operation it is necessary to use it, on small surfaces, with a side as well as with a forward sweep, thus producing a curved motion, the most desirable direction of which is determined by the direction of the grain of the wood.

Fig. 8 represents an ordinary compass plane, which is a necessary and very useful tool for planing the surfaces of

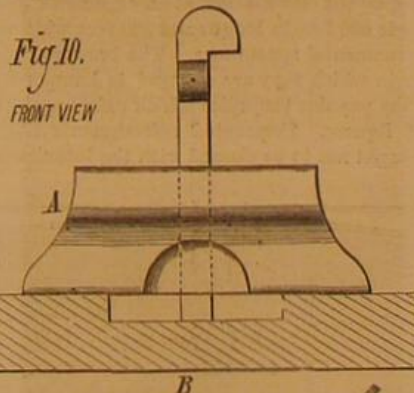


hollow sweeps. This tool is sometimes made adjustable by means of a piece dovetailed in the front end of the plane, as shown in Fig. 9, at A; which, by being lowered, alters the sweep and finally converts it from a convex to a concave. There is now, however, in the market a compass plane, the body of which is made of malleable iron with a sole made of

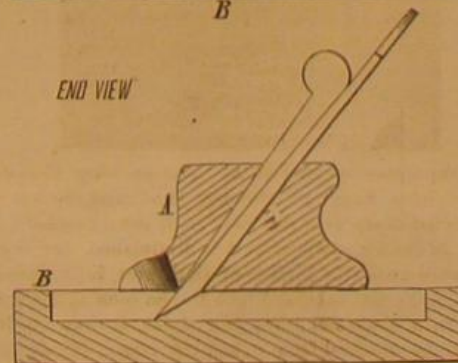


a blade of spring steel, which, by the operation of two screws, can be set to any curvature, either concave or convex, within the capacity of the instrument.

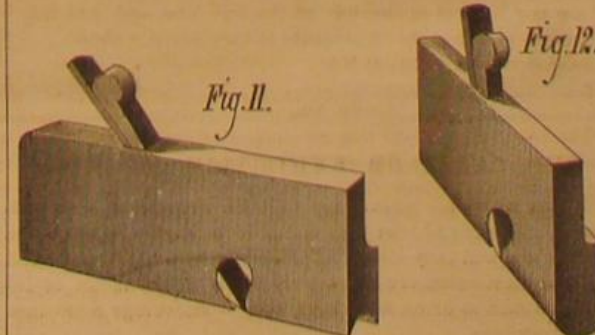
Another very useful species of plane is the router, shown in Fig. 10, which represents one of these planes in operation, A being the router, and B the work. The use of this tool is to plane out recesses (exactly to any given depth) such as are required to receive rapping plates. The wood in the plane stock is cut away just over the edge of the iron, to give clearance for the shavings, and so that the cutter may be seen at work.



END VIEW



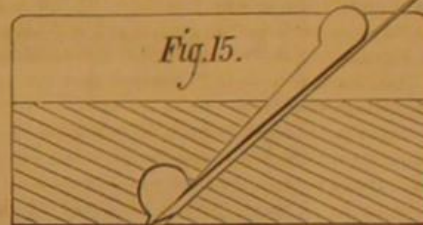
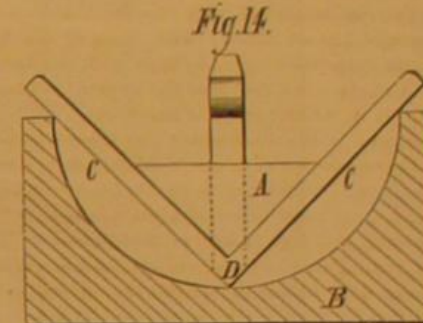
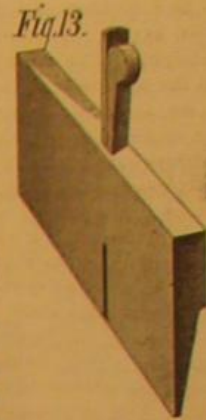
Rabbit planes are narrow planes having the sole or side of a conformation to suit the work. Fig. 11 represents a rab-



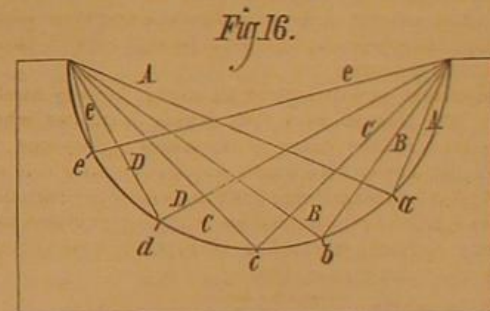
bet plane to suit a round edge, Fig. 12 a similar plane for a groove, and Fig. 13 a side rabbit plane. The latter is, how-

ever, very seldom used, but is especially useful in planing hard wood cogs fitted to iron wheels, or the teeth of wheel patterns or other similar work. For ordinary use, it is sufficient to have two, a $\frac{1}{2}$ and a $1\frac{1}{2}$ inch, as represented in Figs. 11 and 12, and two or three having a flat sole for flat bottom grooves. Small thumb rabbit planes, having an iron stock, with the blade near the front end, are now supplied, and are very useful for cutting out half checks that are not cut right across the stuff.

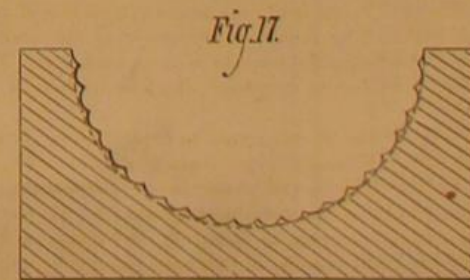
Fig. 14 is an end, and Fig. 15 a side, view of a core box plane, suitable for planing semicircular grooves out of the solid. The principle of its construction and use is that the angle in a semicircle is a right angle. Suppose, for example, that Fig. 16 represents a piece of wood having a semicircular groove in it, and we mark off on the groove the points, a, b, c, d, e, and strike from each of these a line direct to each corner



of the groove. We shall thus find that the two lines struck will be at a right angle to each other, the two lines, A A, meeting at the point, a, being at a right angle. The two side faces, C C, of the plane in Fig. 14 are made to stand at a right angle to each other; and while the plane is in position (as shown in Fig. 14) to bear against the corners of the core box, a semicircle (the apex of the plane, D, in Fig. 14)



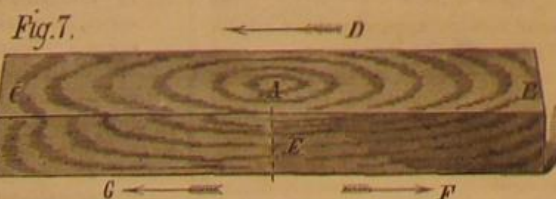
must be in the semicircle, and will only cut away the wood in the form of the circle, no matter in what position the plane stands, so long as its sides touch the corners of the semicircle. This being the case, the first operation in using this plane is to cut out the required semicircle to the necessary width, which may be done with a rabbit plane. The core box plane may thus be employed to cut out the semicircle, commencing at each of the corners and planing on each side down to the center of the depth of the semicircle. As this plane is intended to finish the work, it is desirable to cut



away as much of the stuff as possible before employing it, the work appearing as shown in Fig. 17. These planes have one disadvantage. They are apt to abrade the corners of the work; hence great care should be exercised in their use, and care must also be taken that the extreme point of the plane iron stands just at the apex of the angle of the body of the plane; for if it be in advance or not up to it, the work will not be semicircular.

Trademark Decision.

In a recent application for trademark registration for the use of the words "Star Oil," the Commissioner of Patents refused registration, because a prior registration had been obtained, by other parties, for the use of the figure of a star in connection with the word oil, thus: "Oil." The Commissioner held that, in cases where parties used a brand containing the figure of an object, the mere substitution, by a new applicant, of the name word of that figure, would not entitle such applicant to registration.



face, and let us plane it, cutting in the direction of the arrow, D; it is evident that the edge of the plane iron, when cutting the surface from B to A, will strike against the edge or end of the grain of the wood, tending to rough it up; whereas, while passing from A to C, the tendency of the pressure of the iron edge would be to smooth the grain of the wood downwards, the difference between the two tendencies being sufficient to make it necessary in many cases to use a smoothing plane cutting in both directions, as shown in Fig. 7, first from A to B, cutting in the direction of the arrow, F,

THE CENTENNIAL BUILDINGS--THE INDUSTRIAL PAVILIONS.

In this division of the numerous structures (some 150 feet in all), the Photographic Hall claims our first attention. It covers a space of 238 feet long x 107 wide, its length laying east to west. The interior is fitted up with screens for the exhibition of photographs; these are 28 in number, and 4 of them are 19 feet long, and 24 are 24 feet long each. Both sides of the screens are valuable as exhibiting space; and allowing 10 feet square to each exhibitor, 1513 exhibitors can be accommodated on the screens alone. The halls of the building will accommodate 532 exhibitors, giving them also 10 feet square each, with some T-shaped screens in addition, giving 720 square feet, a total of 19,080 square feet being thus appropriated.

The screens stand 16 feet apart, and in some cases floor space can be gained for exhibits between them; and floor space will be had for the same use all along the middle avenue between the ends of the screens. The T-shaped termination of the screens towards the middle avenue is available for pictures, and will be about 2½ feet wide. These ends of the screens, being covered with pictures, will greatly improve the effect in viewing the middle avenue along its entire length, as in sharp perspective it has the appearance nearly of a continuous wall of pictures. The main purpose of it, however, is to stiffen and strengthen the screens.

It will be seen from this that there will be an exhibition of photography here such as the world never saw, if there is more enterprise shown in filling the space allotted than there is in subscribing for the stock to build it. In this matter we must do our best, or our friends will beat us. Dr. Vogel says that there will be a very elegant and interesting collection sent from Germany. It left Berlin in February last, we believe. Dr. Horning, editor of the *Photo. Archiv.*, in Vienna, writes that a fine collection is coming from his city. He says: "I hope to be able, according to the invitation of our American co-workers, to excite an animated participation of our photographers, and I shall be glad if I can succeed, to enable me to show you my esteem for the extraordinary exertions you have made in the interest of our art."

M. Adolph Braun, the renowned carbon, art printer and publisher, has applied for 265 square feet of space, and promises to make a famous exhibit. Many French, English, and other foreign exhibitors will join in the display.

The Carriage Builders' Pavilion, next illustrated, will afford a most interesting show. The exhibits will consist entirely of pleasure carriages; and the light-running vehicles for which this country is famous will sustain our reputation in this branch of industry. The position of the building is north of the Main Building and west of the Art Gallery, on the main avenue leading from the Art Gallery to Machinery Hall, Government and other buildings. It is also near Belmont Avenue, the principal drive through the grounds.

The building is 346 feet long, 231 feet wide, in shape a parallelogram. The material used in its construction is

wood, sheathed with corrugated iron. The building is one story high, with hipped roof, having five skylights running the full length of the building. From the floor to the top of roof is 36 feet; to main plate, 24 feet. Four principal entrances allow of the easy ingress or egress to and from the building. Besides the skylight, the building has large windows, 14 feet in height on the side. Offices are placed at each entrance of the building, affording accommodation to the many visitors. The south half of the building is allotted for the carriage trade; the other half to palace cars and stoves.

The amount of square feet allotted to foreign countries is as follows: Great Britain, 4,500; Germany, 210; Italy, 224; Canada, 2,700. There will be about 75 exhibitors of car-

The structure occupies a conspicuous position near the miniature lake, on a line between the United States Government Building and Machinery Hall.

The plan of exhibition is an alphabetical arrangement of the partial files of each newspaper or periodical in such a manner as will make them instantly accessible: the space devoted to each bearing a label with the name of the publication printed thereon, and further designated by a number, by means of which a stranger, upon reference to his catalogue, will be able at once to approach the section of the building where the particular journal which he desires to examine or refer to may be found. The cases containing these files will form alcoves similar to those in public libraries for the arrangement of books; and these alcoves form long tiers, one on each side of the building throughout its entire length, a portion of the space between being reserved for the accommodation of attendants, leaving a passage way for the public 18 feet in width, extending from one end of the structure to the other. The second story, approached by four flights of stairs, is devoted to reading rooms for the accommodation more especially of newspaper men, and will be supplied with conveniences for correspondents. Mr. George P. Rowell, of New York, has assumed the management of the enterprise, and with him will rest the responsibility



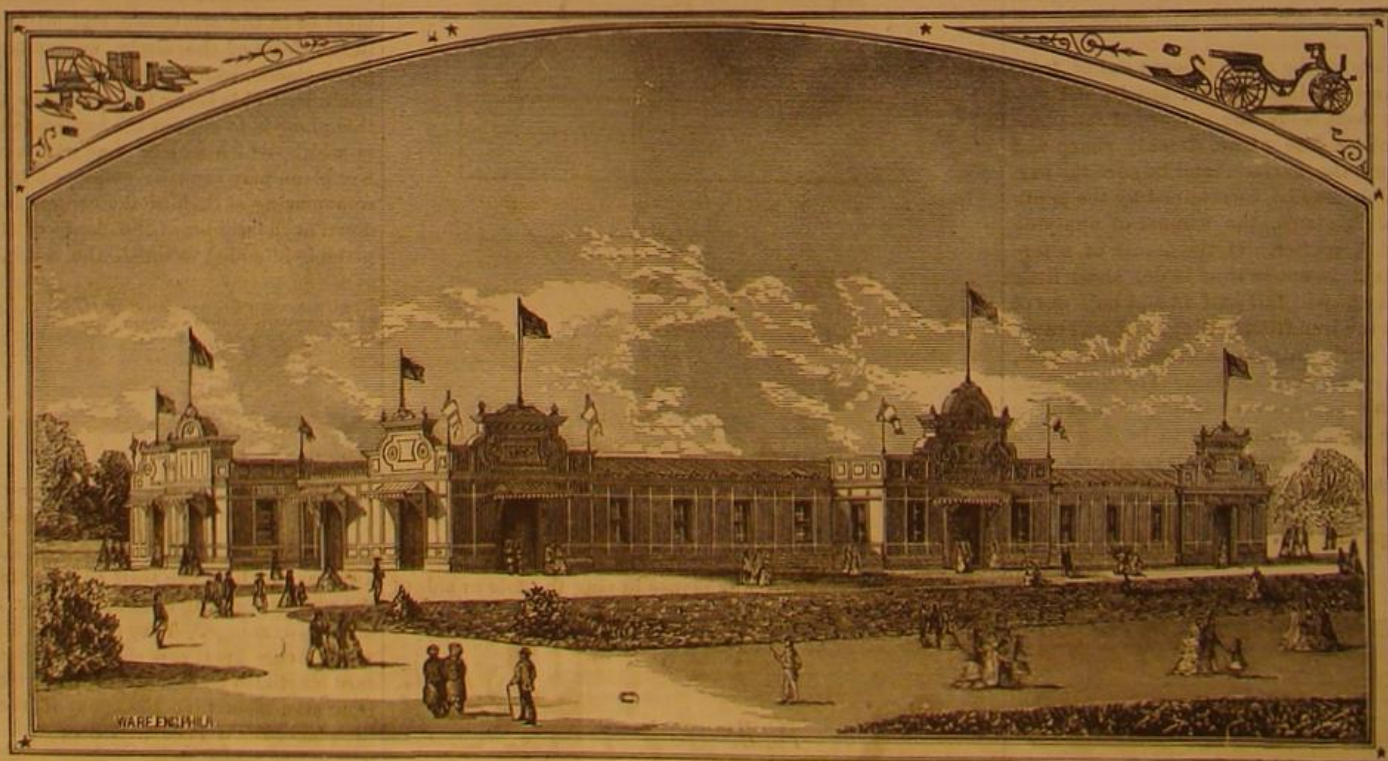
THE PHOTOGRAPHIC HALL.

riages from France who will probably exhibit in the United States.

Our next engraving shows the building erected by the United States Brewers' Association, in which is made a grand display of all the materials and processes employed in the brewing of beer, which will be exhibited in full operation. For this purpose the large and elegant building represented is erected by the Association, at an expense of \$70,000. The building is 300 feet in length and 100 feet wide, and presents a very ornamental appearance. The brewers claim that the industry in which they are engaged is hampered and imperiled by the popular prejudice which exists against the use of distilled liquors. Fermented refreshments like beer, they allege, ought not to be classed with the intoxicating distilled

of making it what it should be.

Our last engraving represents the building erected by subscriptions from members of the shoe and leather trades, for the accommodation of the industries in which they are especially interested. There is probably no branch of industry in which labor-saving machinery has been carried to greater perfection than in the boot and shoe trade, and this part alone will constitute one of the principal features of the exhibition. Here will be seen machinery for the performance of almost every conceivable operation in the trade, from mills for grinding the bark with which the skins are tanned, with currying, hairing, graining, splitting, pebbling, polishing, buffing, and coloring leather, up to the intricate and ingenious machines employed in the cutting, sewing, pegging, forming, and finishing all varieties of boots and shoes; and their name is legion. There will be machines which make pegs, and secure the soles upon the boots and shoes, by means of them, in one operation; and others which make kinds of screws of brass wire, and insert them in the shoe or boot for the same purpose. This building is 256 feet long by 160 feet wide; the roof is supported by columns 16 feet apart, the central section being a curve 80 feet wide, of the Howe truss pattern, over which is a louvre ventilator 26 feet wide, running the length of the building, 60 feet above the



THE CARRIAGE EXHIBITION BUILDING.

liquors which are productive of such widespread wretchedness. The use of beer they claim to be highly beneficial to mankind, and they intend to prove this by a national exhibit of the most extensive character. Their object is not to induce a man to drink more beer, but to encourage more men to drink beer.

Next on our list of illustrations is the newspaper building, which will contain nothing but an exhibition of newspapers.

The pavilions are 20 and 30 feet high. The ground floor of the building is divided as follows: An aisle 15 feet wide and 300 feet long runs through the center, and on either side is one 10 feet wide, parallel with the center aisles. Across the center of the building is a passage way 10 feet wide, at one end of which is a doorway leading to Machinery Hall on the north. The east and west sections of the ground floor have aisles 14 feet wide. There are eight main exhi-

bition spaces for exhibits (bounded by the aisles) 20 feet in width and 117 feet in length, and four exhibition spaces of 20 feet in width by 114 in length.

These illustrations and descriptions show clearly the various styles which have been chosen for the buildings, the selection being governed by circumstances. Altogether, a lavish provision of space has been made, and there will be no just reason for complaint of want of room. We are glad to know that the exhibits which have arrived and are arriving from all parts of the world will justify the managers in providing such extensive and costly accommodation; and we anticipate an exposition which shall redound to the credit of the United States.

Sunday at the Centennial.

It has at last, after much discussion, been decided that the Exposition shall remain closed on Sundays, the Centennial commission voting in the ratio of three to one against adopting the minority report to the contrary. All the buildings and grounds will be closed to the public on the Sabbath.

We think the decision of the commission is the one which will please the majority of our people best. The strong argument against closing lay, first, in the fact that Sunday is the only opportunity afforded to working men to visit the Exposition by daylight; and second, that many citizens and foreign visitors do not observe the Christian sabbath, and hence should not be debarred entrance on a day which, to them, is no different from any other in the week. While there is considerable reason in these views, they manifestly should not prevail when the Exposition is regarded in the light of a national undertaking. The workmen who would be benefited are only those who reside within short distances of the Centennial, a very small majority compared with the entire working class. In this country, moreover, we live under the rule of the majority, and the sabbath of that majority is the Christian sabbath, a day which our ancestors of one hundred years ago venerated and reverently observed.

Moreover, foreigners will come here to study us and our institutions as they are, and one of those institutions is certainly the sabbath as a day devoted to rest and religious

duties. Hence, the question after all reduces itself to whether a small minority of one class of the population, plus a still smaller proportionate minority of the entire religious community, are to be accommodated in opposition to a pub-

scores of instances of like deceptions being practised which probably have come under his notice; so that at the present time, antiques in Naples, coins in Rome, pipes and pottery in the East, and the thousand bits of *bric-a-brac* that travelers delight in gathering are either the handiwork of the present inhabitants of the historic localities, or, far more likely, have their origin in Birmingham, England, that world's supply shop for all heterogeneous articles, from big Japanese idols down to pins.

We did cherish the idea that the relic-manufacturing industry had not traversed the Atlantic; and although we might secretly laugh at the friend who proudly exhibits Waterloo bullets and Roman *oboli*, we were fain to accept as genuine flint lock muskets which have been through the Revolution, or the moth-eaten old uniform kept in the garret since the days of 1812, and now brought out for exhibition in this Centennial season. But this era of confidence has passed. We now point the finger of scorn at the musket, and express doubts as to whether the uniform is not one on which army officials have been testing the much-vexed moth patent. We might have continued in our innocence, despite the fact that General Washington's headquarters have sprung up over the land like mushrooms, necessitating the supposition that the hero must have been endowed with ubiquity, or else have spent his existence in traveling from one to the other; but when we regard the number of his favorite and



THE BREWERS' BUILDING.



THE NEWSPAPER BUILDING.

lic sentiment which overwhelmingly prevails.

There are various other considerations, notably the enforcement of extra work among the employees on the

other; but when we regard the number of his favorite and



THE SHOE AND LEATHER BUILDING.

grounds, and the interference with the quiet enjoyment of the day of rest by those residing in Philadelphia and its suburbs, which need not here be reviewed. As we said in the beginning, the decision will be acceptable to the greatest number of our people.

Centennial Relics.

Every year, it is said, the battlefield of Waterloo is carefully planted with battered bullets, odds and ends of accoutrements, and other rubbish, which in the following year are dug up and sold to credulous tourists, as relics of the conflict, by the enterprising natives. Not long ago the German government was ruthlessly victimized by some ingenious Arabs who manufactured and sold as real some spurious specimens of rare and ancient pottery. Almost any one, indeed, who has traveled through Europe can add

only chairs, at least one of which is now deemed indispensable to every well regulated furniture store, and the quantities of abnormally written documents attributed to the Father of his Country which photography reproduces in uncounted and genuine originals, our credulity gives way, and we warn our readers against Centennial relics. During the past winter, we have seen certainly thirty quilted petticoats which fair wearers assured us belonged to Martha Washington, and this is in only one city. How many such garments Philadelphia possesses, we cannot divine. All along Broadway, conscienceless small boys are vending musty, yellow, and ragged newspapers; and not a single anniversary of any revolutionary battle can occur but that copies of the particular ancient paper containing the account of the conflict are sold in New York, in editions so large that the long since dead publishers would have deemed their fortunes secure had their original publications achieved one half the circulation. Lafayette buttons are appearing by the gross; and as for Franklin's canes, their name is legion. There is a strong and growing desire for these things, which bids fair to establish a new and patriotic industry devoted to their manufacture.

THE DI CESNOLA COLLECTION.

LECTURE DELIVERED AT THE STEVENS INSTITUTE OF TECHNOLOGY, BY WM. HENRY GOODYEAR, ESQ., OF NEW YORK.

"Westward the star of empire takes its course" has always been a fundamental truth with regard to the progress of civilization; and although at the present day the troops of the Czar steadily pursue their march eastward, all our modern nations owe their being and development to a steady movement in the opposite direction. Our ancestors lived in the mountains of Hindostan and called themselves the Aryans; and when they started out upon their migrations westward and settled in Europe, they became in time Greeks, Romans, Germans, Celts, Slavonians: all of whom belong to the same great family, to which the name of Indo-European or Indo-Germanic has been given. We know the fact of their kinship by the similarity of their languages as revealed by comparative philology. Take a single example: Mother in Sanscrit is *mātr*, in Persian *māder*, in Greek *μήτηρ* in Latin *mater*, in Celtic *mathair*, in Slavic *matka*, in Swedish and Danish *moder*, in German *mutter*, in Dutch *moeder*, in Anglo-Saxon *moder*. If such then are the ties which connect us with the ancient world, the study of its civilization proceeds from higher motives than mere curiosity; it is the study of our own first beginnings.

The subject of the present lecture is the development of art, as illustrated by the Di Cesnola (pronounced *Chessnola*) collection in the Metropolitan Museum of Art at No. 128 West 14th street, New York.

General Louis Palma di Cesnola, an Italian by birth, but an American citizen, who fought in our civil war, was appointed Consul to Cyprus in 1865 by the American government. Cyprus is one of the largest islands of the Mediterranean Sea; it is situated near the Syrian coast and belongs to Turkey. Owing to its position, it is a convenient point for the representatives of the European powers to keep watch on each other's movements with regard to the Eastern question. Although the whole island contains less than one hundred and fifty thousand inhabitants, there were then as many as seventeen consuls on it, whose whole business was to bully each other and act as spies for their governments. Di Cesnola, whose government was not involved in the Eastern question, perceived the importance by reason of its lying directly in the route of ancient civilizations, and proved himself the only sensible consul on the island; for he commenced to dig.

The importance of the objects he exhumed soon attracted the attention of archaeologists; and in 1869, when the lecturer was on the island, with an agent of the Berlin museum, he witnessed the sale of everything that had been brought to light up to that time. But Di Cesnola continued his excavations after that; and in the winter of 1869 to 1870, he began work on the site of the ancient city of Golgos, discovered the Temple of Venus, and brought to light the most important collection of statuary yet found.

The way in which the city of New York came to secure so great a prize was as follows. It was first offered to Boston, and then transferred to London with a view to its acquisition by the British Museum. But Mr. Newton, the head of that institution, was unwilling to accept it under the conditions of the sale: namely, that it should retain the name of Di Cesnola, and that it should be kept intact. As there was a mortgage on the collection, Mr. Newton expected to obtain it on his own terms by delaying his decision until the day of the sale; but he was baffled in this by Di Cesnola, who grew tired of the whole business, and sold the collection to Mr. John Taylor Johnson, of New York, for \$40,000.

The two principal features of the collection are its ugliness and the confusion it is likely to leave in the mind of the spectator. This confusion will disappear when we study the position and history of Cyprus with a view to what we may expect to find there.

The island of Cyprus is only 150 miles distant from the Euphrates, that is to say, from the great Assyrian empire of Babylon and Nineveh. The nearest neighbors were the Phoenicians of Tyre, a great commercial nation, who had sailed as far as Britain, B.C. 1300. They first colonized Cyprus as far back as B.C. 1800 or 2000. Then the island passed successively under the dominion of the Egyptians, the Assyrians, the Persians, the Greeks and the Romans. As we do not know of any Phoenician art, the first to occupy our attention is the Egyptian. The characteristics of Egyptian art are evident in the temple of Ipsamboul. There we

see the sculpture as an auxiliary of architecture. The statues are not free, but attached to the walls. The artists seem also controlled by the principle that their work should adapt itself to the material of which it is made, in other words, that a stone statue should be stony. Lastly, their sculpture, like all art, reflects the spirit of the people. The great characteristic of the Egyptian people was their sentiment of eternity. All their works show its imprint, either by their colossal nature or by other attempts at conferring durability. We notice it in the pyramids, the tombs of their kings, in the embalming of mummies, and in their statuary. Here everything is of a fixed type, from which the individual artist may not vary. Hence we find, in all Egyptian statues, the same monotonous expression, the same conventional breadth of shoulder, the same head dress. A statue from Cyprus, which exhibits the above characteristics, is consequently pronounced Egyptian. Its date would therefore be between B.C. 1440 and the end of the twelfth century B.C., the period of Egyptian ascendancy in Cyprus.

We next find Cyprus as a part of the great Assyrian empire, and the sculpture of that period may be expected to exhibit Assyrian peculiarities. What these are appears in a representation of the winged bulls of Nineveh, taken from the Assyrian Court in the Crystal Palace, London. In the Assyrian empire, where mind was held in as much esteem as force, we find curious combinations of human and animal figures, made still more subservient to architecture than the Egyptian; for they are all in relief. There are no free figures. The Assyrian statues found at Cyprus are all distinguished by their helmets, their beards, and the peculiar simple drapery.

When Nebuchadnezzar destroyed Tyre, in 571 B.C., he crippled the power of the Phoenicians in Cyprus as elsewhere, and gave the Greeks a chance to gain a firm foothold on the island. With their increasing influence, the art of the Greeks began to flourish. There is a fine specimen of it which is easily recognized to be a statue of Hercules by the knotted club and the lion's skin. The head of the lion forms the head dress of the statue. The teeth and upper jaw form a kind of crown on its forehead, and the lower jaw is divided into two parts, one over each cheek. The face resembles that of the native Cypriote type of the present day, and leads us to conclude that its sculptor was a Cypriote. This statue is one of the most valuable of the collection, and would bring about ten thousand dollars.

The next period in the history of Cyprus is again one of Egyptian ascendancy; and the statues of this time, although still Assyrian, show the influence of Egyptian art. One specimen exhibits the Assyrian helmet, beard, and drapery, but also the conventional breadth of shoulder peculiar to the Egyptian statues.

After this the faces and drapery of the statues become more and more Grecian. In one figure the high priest of Venus, holding in his hand the dove sacred to the goddess and a patera or cup for libations, exhibits the peculiar zigzag character of Greek drapery. Originally they first carved their statues in wood, and then dressed them up. The angular nature which their first crude attempts had was afterwards copied in stone and became consecrated by usage. Observe the Assyrian helmet and beard and the Cypriote type of face. It is a curious and instructive fact that all these varieties of statues were found together in the same temple; for it shows us the gradual development of Greek art from Eastern art. One specimen is the most perfect example of Greek art in the collection; and it is not forty years removed from the date of the finest specimens of sculpture Greece has ever produced. The statue of the Discus Thrower shows indeed a giant step in advance; but it was very long before the development was reached. For five hundred years the Greeks were, like ourselves, too busy making money to have any art of their own. When we, in our brown stone fronts, etc., imitate some of the least desirable features of ancient art, and thus expose ourselves to criticism, we may point to the Greeks as imitators before us. The discus thrower just referred to dates not 150 years after the statue of Hercules.

After the Persian wars, when Cyrus had taken Babylon, and Cambyses conquered Egypt, the Phoenicians, who were the allies of the Persians, again flourished in Cyprus. Then the faces of the statues assume the semitic type, but otherwise preserve Greek characteristics. A figure in which the drapery is very carefully executed shows the peculiar ribbed woolen undergarment, peculiar to later Greek statues.

To prove that the statues shown were not the representatives of merely provincial but of true Greek art at different periods, the lecturer threw upon the screen a picture of statues from the Acropolis at Athens, and pointed out the same characteristics in them.

After the conquests of Alexander, Greek art rapidly declined, and we find portraits instead of ideal faces and figures. The Greeks were spread over too large a territory and formed too small a fraction of its inhabitants to maintain the ascendancy of their taste. They were diluted too much by the barbarians. The same cause operated unfavorably to the development of Roman art. There was not enough Roman blood in their vast empire to produce anything truly national.

The temple in which so many valuable objects were found was 60 feet long and 30 feet wide. It was built of mud bricks, 5 feet high and 2 feet thick, dried in the sun, and had a wooden roof. In the course of time the bricks crumbled, the roof rotted away, the space between the statues was filled up, and other debris accumulated above it.

C. F. K.

LINING metal for axle boxes: Tin 24 parts, copper 4, antimony 8. Melt together, and add 24 parts more tin.

Trombes.

A good deal of attention has of late been given by meteorologists to the whirling atmospheric movements denominated *trombes*. That these *trombes* are of electrical origin has been suspected from the very beginning of electrical science, and in last century experiments were made by way of imitating them on a small scale. Between two metallic plates, the upper of which was electrified, while the lower was connected to earth, various easily movable substances were brought. Water was raised in form of a cone; bran was lifted so as to form a pillar, than scattered in a whirl. In such experiments, however, the phenomenon can only be observed momentarily; the cone or column, if indeed produced, immediately disappears through the scattering of its component particles.

In a recent communication to the Berlin Academy, M. Holtz has described an apparatus by which this interesting phenomenon can be produced with greater certainty, and observed for any length of time. The arrangement consists of a cylindrical glass vessel about 8 inches high, 6 inches wide, and $\frac{1}{2}$ or $\frac{3}{4}$ inch thickness of side. It has a perforation in the middle of the bottom; this is filled with tinfoil, and closed on both sides (above and below) with two large plates of tinfoil. In the middle of the glass vessel hangs a hollow, flat-pressed, metallic ball, $\frac{1}{4}$ inch in thickness, and 4 inches in diameter. The suspending piece consists of two metallic tubes, one movable in the other; the upper one is connected with the conductor of an electric machine.

If now various easily movable substances, pulverulent, and not very good conductors, be introduced into the vessel—so much of them as will be sufficient to cover the inner plate of tinfoil $\frac{1}{2}$ to $\frac{3}{4}$ inch—then, as soon as the machine is put into action, and the second conductor connected to earth, the substances are thrown into violent motion between the two opposite electric surfaces. With sand, however, or similar materials, no determinate cone or column formation is distinguishable. But with substances of better conduction and coarser structure, such as bran or sawdust, there are constantly formed, through the deposition of new portions, large cones and perfect columns, from which, however, the stormy, whirling, and progressive motion is absent.

M. Holtz obtained a phenomenon much more similar to the natural *trombes* when he used a liquid instead of powder—especially turpentine or olive oil—and gave the lower electrode a pointed form by adding a column of wood, this substance being taken to avoid the passing of sparks. The vessel was filled with liquid up to $\frac{1}{4}$ inch above the point, and the interval between the metallic disk and the liquid was regulated according to the tension of the electricity.

"If we now bring the machine into action," says M. Holtz, "we observe, first, at the surface of the liquid a slight curling, and presently it tends to rise up the sides of the vessel in a peculiar vibratory motion. Very soon there is a stronger undulation, and a middle cone is formed, which gradually increases; and so long as it does not reach the metallic body, it flies off in minute dancing droplets. If, on the other hand, the cone has become a column, the liquid moves from the middle of the metallic surface to the border, and there falls down at several parts in the form of thinner columns, which, differently from the middle one, have their large bases above. Often, too, the rising stream parts into several of similar form, each of which follows its own path towards the middle part of the disk, and thence toward the edge, where, again, it branches into several descending streams. The liquid also frequently arises simultaneously at various parts, so that, sometimes, reckoning the downward streams, one may count more than twenty distinct columns; and all these columns are in constantly progressive and whirling motion."

M. Holtz calls attention to the circumstance that, in the formation in question, no difference was observable between negative and positive electricity; only the motion was more violent when the metallic disk was negatively electrified.

That the agreement between the artificial and the natural *trombe* is not absolute is, of course, evident from the circumstance that in the one case we have a closed space, with walls probably not without electric tension, as against unbounded space in Nature; and the formation occurs in Nature between movable surfaces, whereas in the experiment it is between fixed surfaces.

New York Academy of Sciences.

At a meeting of the New York Academy of Sciences, recently held at 64 Madison avenue, a section of biology was organized. This section will meet on the first Monday evening of each month, and to it will be referred all papers on zoology, botany, entomology, ethnology, anthropology, and kindred subjects. Professor E. H. Day, of the New York Normal College, was elected chairman of this section, and Dr. Heinemann secretary. It is proposed to form field parties and make frequent excursions to the suburbs, as soon as the season permits of botanizing and fly catching. As the meetings of the Academy are public, those of our readers who are interested in plants and insects will do well to attend, bringing with them any curiosities they may chance to find.

Improved Zinc White.

According to a recent report of the Austrian Chemical Society, M. Orr produces a very beautiful zinc white by the following process: Sulphuret of raw barium is washed, and the liquid obtained is mixed with equal quantities of chloride and sulphate of zinc. The precipitate is collected, pressed, and dried. It is then heated on a hearth, and, while hot, is thrown in cold water. This last treatment produces a mass of great density, and the material, after washing and grinding, is of great purity and whiteness.

A Locomotive for Working Steep Gradients.

An English engineer, Mr. Andrew Handyside, has recently patented in England and this and several other countries a locomotive engine for drawing trains up inclines. A trial was recently made with one of these engines at Bristol, England, and the result was such as to show that the invention is one of some merit.

The engine weighed 13 tons, and to it were attached two trucks weighing together 25 tons 14 cwt.; and one portion of the line on which the trial was made was on an incline of 1 in 12. The peculiarity of the system is that the engine is coupled to the train by a steel chain or wire rope, wound round a drum mounted in the framing of the engine. The axis of this drum works horizontally in bearings fixed in the main framing of the engine, and it is rotated by gearing from a separate pair of cylinders, distinct from the usual cylinders which drive the locomotive. A drum, 2 feet in width and 1 foot in diameter, will accommodate chain enough to fulfil all the requirements of the system. On each side of the engine framing, and on each side of one or more carriages or wagons of the trains, there are suspended one or more self-acting gripping struts, which, when let down on the rails by the driver or other person in charge of the train, will firmly grip the sides of the rails, and hold the engine or train stationary. On arriving at the foot of the incline, the engineer releases the hauling drum, and, without stopping the engine, runs up the gradient to the required distance. The struts are then let down on the rails; and by grasping the rails, they render the engine stationary, and the load is drawn up to the engine much after the fashion that loads are drawn up inclines at collieries. The last truck of the trial train was furnished with an automatic gripping strut, which, when the trucks commenced a retrograde movement, at once grasped the rails on each side, and held the train in its place beyond the possibility of its being moved, our informant states, even when the engine with full steam on was backed against it.

The experiments were of the most thorough description, and the invention was tested in every way. In the first place, the value of the gripping strut was shown. The powerful little engine mounted the gradient without its load, and, full steam on, ran the whole length of the siding. At a signal from Mr. Handyside, the brakes were applied, and the engine was brought to a standstill in the length of a rail and a half. The contrast between the power of this brake and the ordinary hand brake, with which the engine was also supplied, was fully shown. The wagons were then attached, and the brakes on the engine and on the brake van were applied simultaneously with equally satisfactory results. This experiment was witnessed with very considerable interest, as the brake question is just now occupying very much of the attention of railway men. With the continuous brake, it was pointed out that, 90 per cent of the wheels being braked, a train is pulled up in about 900 feet with the train going at a speed of fifty miles per hour. In this case, the train pulled up in 600 feet, and only 75 per cent of the carriages were braked. After duly testing the brake, the method of mounting steep gradients was shown. The engine put full steam on, ran to the foot of the incline, and then, letting out the steel wire rope which coupled it to the trucks, mounted the steep alone. The gripping struts were then let down; and the engine having thus been made stationary, the trucks were hauled up to it, the automatic gripping strut coming into action, and the whole train remaining stationary. The accomplishment of this test occupied a surprisingly short time. The trucks were then lowered to show the control which the driver was able to exercise over a train for lowering purposes. The company claim that, by this invention, smaller and less powerful engines may be used on heavy gradients, and that it will allow of less cost in constructing lines, inasmuch as less cutting will be required.

Detection of Adulteration in Wine by Means of Absorption Spectra.

Professor H. Vogel states that the simplest method of detecting adulteration in wine, especially in regard to the coloring matter, is by means of the spectroscope. The apparatus required is as inexpensive as the operations are simple. Professor Vogel employed for the purpose a pocket spectroscope which cost in Berlin 36 mark (about \$9.00). The instrument is first directed towards the blue sky, or to its reflection in a mirror, clamped in a horizontal position in a report holder, and the slit closed until the principal Fraunhofer lines, C, D, E, F, G, and a few intermediate lines are distinct. The liquids to be studied are put into square white bottles about 0.30 inch thick, and placed before the slit.

It is well known that many substances of similar color have produced very unlike absorption spectra, while others, which are very different chemically, have very similar absorption spectra, like chloride of iron and tincture of iodine. These facts are no objection to spectral analysis by absorption. It resembles analysis by polarization, which cannot be employed for all substances; but where it can be used, it is invaluable.

Analysis by the absorption spectra, of course, assumes various spectra to be known, and here stands a serious barrier in the way of its present extensive introduction, namely, the maps of absorption spectra, which are insufficient and incomplete. Drawings made in the ordinary manner are incorrectly reproduced by the lithographer or engraver, and rendered still more imperfect by the coloring applied. For this reason Dr. Vogel employs the graphic method as follows: Upon a horizontal line or abscissa he erects perpendiculars to represent the chief Fraunhofer lines, and represents the absorption of a given substance by a curve, the height of which increases with the intensity of the absorption.

The absorption bands of the most important coloring substances lie between C and F; those which lie beyond C require sunlight for their study, which is not always to be had, and hence they are useless. At the request of certain wine dealers Professor Vogel has investigated and published the absorption spectra of pure and colored wines. Perfectly pure specimens of the following sorts of red wine were obtained from reliable sources, namely: Assmannhauser, Burgundy, Nuits, Cote d'Or, and Bordeaux. Although they differed in age and intensity of color, they give the same spectra.

Pure concentrated wine absorbs the whole spectrum to the orange. Dilute wine destroys the dark blue almost entirely, allows the light blue to pass, but absorbs the green and yellow green, and stops at D, while red goes through unchanged. Tartaric or acetic acid darkens pure wine inconsiderably. Ammonia changes the color of wine to a dark gray green, and makes it much more opaque, so that it must be strongly diluted in order to obtain the spectrum, which is totally different. Indigo and blue are strongly absorbed; the absorption sinks towards the green and is least in the yellow and orange, but exhibits a faint band in the orange. By lamp light, the absorption of alkaline wine is scarcely perceptible.

The spectral reactions of the substances employed to color wines are quite different. Those coloring substances which are objectionable to the taste, but not injurious to health, give reactions very similar to those of red wine. The juice of bilberry, sour cherry, and elderberry, and extract of mallow blossoms absorb nearly the whole spectrum. For this reason it is preferable to add one part of tartaric acid or of ammonia to 10 parts of the juice.

Opening to Navigation of the Vicksburg Cut-off.

The city of Vicksburg, Miss., is located on high bluffs, under which the Mississippi makes its way by sharp deflections, east and west, of nearly fifty miles from its direct course. During the late war the Union commanders sought to avoid the heavy batteries of the Confederates at Vicksburg, which commanded the river, by opening a cut-off or canal across the country, back of De Soto Peninsula, opposite Vicksburg. The river at the upper or northerly end of the canal was accordingly shut off by a dam; and the work of digging the channel was then carried on extensively, with every promise of success, until, by a sudden rise of the river, the water broke through the dam and put a stop to the work.

General Grant, finding that too much time would be consumed in the endeavor to repair and finish the channel, adopted other expedients for passing the batteries, and the canal was left unfinished. It has now, however, been completed by the silent mining operations of the river itself; and the boats pass up and down through it, avoiding the *détour* to Vicksburg, and thus saving about thirty miles of navigation. Our engraving shows the general position of the new canal cut-off.

A Canal from the Hudson to the Mississippi.

Mr. W. J. Abernethy, editor of the *Minneapolis Farmers' Union*, writes to point out that the two principal rivers—the Fox and Wisconsin—together form an almost unbroken water channel from the Father of Waters to the great lakes. Rising, the one in the southern and the other in the northern part of the State, they flow towards each other until their waters almost touch, when they suddenly sweep away at right angles, and empty, one into Lake Michigan at Green Bay, and the other into the Mississippi at Prairie du Chien.

In a few weeks, the canal which is to join the two will be completed, and Wisconsin will honor the event with appropriate ceremonies.

On the Fox River a system of slack water navigation has been adopted, which is proving entirely successful. There are numerous falls on what is known as the Lower Fox, and these are overcome by dams with locks, to pass boats around them. The work is so far advanced that, if no unforeseen obstacles occur, vessels can run up its entire distance to Portage (160 miles west of Lake Michigan) this fall, and pass over into the Wisconsin. Considerable dredging, however, remains to be done on this river.

The Wisconsin river is, at the portage, three fifths the size of the Mississippi at St. Paul. It is a rapid stream, full of floating sand, which in low water seriously obstructs navigation. Sections of the river have been improved by wing dams; but in order to permanently secure a navigable channel, it will be necessary, in some sections of it, to make a canal on the bank. According to surveys made for a canal by General Warren, of the United States Engineer Corps, it can be built, says our correspondent, the entire distance from Portage to the Mississippi, 118 miles, for \$4,164,270.

SCIENTIFIC AND PRACTICAL INFORMATION.**DYNAMITE.**

Sobrero, the inventor of dynamite, in a recent communication to the Academy of Turin, designated two of the operations in the manufacture of dynamite as especially dangerous: first, the mixing of the nitroglycerin with the infusorial silica (*kieselguhr*), and second, pressing the mass into molds for cartridges. In both cases an explosion may easily be caused by friction and pressure. Nobel recommends the following process as far safer, namely, to mix the silica with water to a dough, then press it into cartridge molds and dry perfectly. These cartridges are then put into nitroglycerin, which they absorb into their pores, the absorption being

aided by exhausting the air. Sobrero made his experiments with infusoria of Italian origin which can be easily made into cartridges that will absorb as much as 75 per cent of their weight of nitroglycerin.

A FALLACIOUS TEST FOR LEAD IN TIN.

An item has been widely circulated, both here and abroad, in which it was stated that the presence of lead in tin could easily be detected by putting a drop of nitric acid on the clean surface of tin plate, heating gently to cause it to attack the metal and evaporate the excess of acid, and moistening the white spot with a five per cent solution of iodide of potassium; if lead were present, the spot would become more or less yellow from the formation of iodide of lead. Dr. A. Puerkhauer calls attention to the fact that tin, free from lead, will also yield a yellow spot when thus treated, evidently due to the liberation of iodine by the presence of free acid; for nitric acid cannot be completely expelled from tin, even when the tin is heated to its melting point. It may be easily proved that the yellow spot, formed on tin which is free from lead, is due to the liberation of iodine, by touching the spot with starch paste. The above mentioned reaction can be made reliable by touching the white spot made by nitric acid with very dilute caustic potash before applying the iodide of potassium, when a yellow coloration will not fail to indicate lead.

SUBCHLORIDE OF COPPER IN VERDIGRIS.

Wittstein has found in some samples of acetate of copper a white precipitate, insoluble both in water and acetic acid, but soluble in dilute mineral acids. Investigation showed that this peculiar body consisted chiefly of subchloride of copper formed by the chlorhydric acid, which is always present in acetic acid made by decomposing crude acetate of lime with chlorhydric acid. For this reason manufacturers of verdigris would do well to use only such acetic acid as has been made by the use of phosphoric or sulphuric acid, as these acids are not sufficiently volatile to distil over with the acetic acid.

A GREEN VARNISH FOR METALS.

A varnish for small or large metallic articles can be prepared, says the *Industrie Blätter*, in the following manner. Finely pulverized gum sandarac or mastic (the latter, however, is too expensive for some uses) is dissolved in strong potash lye until it will dissolve no more. The solution is diluted with water and precipitated with a solution of a copper salt, either sulphate or acetate. This green precipitate is washed, dried, and dissolved in oil of turpentine. This produces a fine green varnish which does not change under the effect of light, and will be especially useful for ornamental iron work.

HERACLINE.

This is the name given to a new blasting powder, invented by Dickerhoff, and which has been tried with success in the coal mines of France and Austria. It is composed of picric acid, saltpeter, nitrate of soda, sulphur, and sawdust. The gases produced by its combustion are not injurious, it is claimed, and it burns comparatively slowly, so that it only tears apart the masses blasted, but does not hurl them violently about.

DECISIONS OF THE COURTS.**United States Circuit Court—District of New Jersey.**

BOTTLE STOPPER FASTENING.—HENRY W. PUTNAM vs. HENRY W. YERRINGTON.

[In equity.—Before Nixon, J.—Decided March 28, 1876.]
Mere change of material used in the construction of devices is not invention; it is only the exercise of mechanical judgment, and hardly adds enough to the domain of knowledge to raise the person to the dignity of an inventor who first thought of making such a change.

The mere carrying forward of an original conception patented—a new and more extended application of it—involving change only of form, proportions, or degree, the substitution of equivalents doing the same thing as did the original invention, by substantially the same means, with better effects, is not such invention as will sustain a patent.

It is the invention of what is new, and not the arrival at comparative superiority, or greater excellence in that which was already known, which the law protects as exclusive property, and which it secures by patent.

A reissued patent must be for the same invention as the original, containing no new matter.

It is not meant by this that no new or different language should be employed.

New matter is such an enlargement of the original specification or claims as to include combinations or results which did not necessarily flow from the invention, as originally stated and described.

An inventor is entitled to all the uses to which his patent may be applied, and to all the beneficial results which legitimately follow the use of his instrumentalities, as shown by the statement of his invention, and the figures used to illustrate it; and such uses and results may be stated and described in an application for reissue by the inventor, without subjecting himself to the imputation of incorporating new matter.

NIXON, J.

The bill is filed in this case for the alleged infringement of reissued letters patent No. 1,606, for a new and useful improvement in bottle-stopper fastenings.

The original patent was issued to the complainant March 15, 1859, for the term of fourteen years. This being duly surrendered, he obtained the reissue on the 19th of January, 1864, for the residue of the term, which was further extended by the Commissioner of Patents for seven years, from March 15, 1871.

The defendant, in his answer, and afterward by stipulation, admits the infringement of the four claims of the said reissue, but insists that the said patent is invalid for two reasons: first, because the complainant was not the original and first inventor; and second, because the reissue is not for the same invention as that shown and described in the original patent.

I have carefully compared the complainant's patent as first obtained with his reissue. The statement of his invention and the figures used to illustrate it are the same in both cases. Not a device or instrumentality appears in the second that was not exhibited in the first. He states results in the reissue which were not stated in the original patent, and which were omitted, I presume, because he did not know until he was taught by experiment that such results would follow. But an inventor is allowed to do this in a reissue without subjecting himself to the imputation of incorporating new matter. He is entitled to all the uses to which his patent may be applied, and to all the beneficial results which legitimately follow the use of his instrumentalities.

The principal new effect which he sets forth in the reissue, and which he failed to note in his former specifications and claims, is the substance of the first claim: to wit: such a fastening of the new fastener over the cork that the pressure thereon may cause the fastener to hold more securely, as specified. No new device was needed to accomplish this result, and hence the claim falls within the objects and purposes of a reissue.

(Thomas H. Lodge and Palmer J. Rogers for complainant.
F. C. Nye and L. C. Ashley for defendant.)

United States Circuit Court—Southern District of Ohio.

THE UNION PAPER-BAG MACHINE COMPANY vs. J. H. NIXON & CO.

(Before Emmons & Swing, JJ.—Filed March 30, 1876.)

It is not a fair construction of the assignment of a patent that the assignee shall first assign the entire right for a particular territory, and set its whole value from his vendor, and, after having thus received all the benefit he was entitled to under the transfer, sell single machines to be used in the same territory during the extended term.

An assignee of a patent, by granting and transferring the exclusive right to manufacture or use an invention within such state, exhausts his whole power of disposition under and by virtue of the assignment to him; and such assignee has no right to flood the country with machines to be used after the expiration of the term of the original patent, thus defeating the interest of the patentee in the extension.

The rise to use a machine after the expiration of the term of the patent is an incident to the primal right to use it during the original term; if that falls on account of fraud, the incident falls with it.

Recent American and Foreign Patents.

NEW AGRICULTURAL INVENTIONS.

IMPROVED GANG PLOW.

Edward S. Beckelhymer and Hugh H. Canaday, Fairfield, Iowa.—This gang plow is so constructed that the draft may be applied directly to the forward ends of the plow beams, bringing the point of the draft attachment close to the points of resistance, enabling the plow to be easily raised from the ground.

IMPROVED CURD DRAINER.

Jonas Wilder, West Rupert, Vt.—This invention consists in a cheese-curd drainer, in which the sheet metal lining passes through the discharge slot in its bottom, and is secured to or formed solid with the discharge spout, and in a detachable screen, made in sections, in combination with the drainer and the discharge spout.

IMPROVED SEEDER AND CULTIVATOR TOOTH.

Rufus F. Billings, Kingston, Wis.—This tooth is so constructed that it will swing back should it strike an obstruction, will return to its place as soon as the obstruction has been passed, and will allow the seeder or cultivator to be backed without raising the teeth from the ground.

IMPROVED CALF WEANER.

Alvord M. McLeran, Onawa City, Iowa.—This is a combination of a folded plate, on bent and knobbed wire, and spikes with each other. The plate prevents the animal from getting hold of the teats with its mouth; and should it attempt to suck, the spikes will be thrust into the cow and prevent her from standing still. At the same time the device does not prevent the animal from putting its mouth to the ground and eating freely.

IMPROVED MILK-STRAINING CAN.

Albert P. Knapp, Randolph, N. Y.—The usual flat side of the strainer is made round, so that the appliance is more easily kept clean. A hoop is applied to the lower end which may be applied to pans, and which has eyes to catch on hooks on top of the pail. A breast prevents the milk from slopping over, and is contrived so as to serve as a handle to the strainer. The bottom is struck down in concave form, and the strainer is fitted in the middle portion considerably smaller than the top of the can, so that plenty of space may be had, around the stream of milk flowing into the can from the strainer, for the escape of the animal heat.

IMPROVED STALK PULLER.

George W. Butler and Timothy P. O'Connell, St. Antonio, Tex.—This is a machine designed especially for pulling cotton stalks. There is a cylinder provided with the curved and bearded V teeth, which take hold of the stalks, pull them, and carry them over. Another cylinder has rows of curved teeth, in such positions as to pass up between the teeth of the first cylinder to detach the stalks from said teeth. A slotted plate removes from the teeth any stalks that may adhere to them, to keep the said teeth always clear.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED PAVEMENT.

Joseph R. Abrams, Greenville, Ala.—This invention consists in a series of receptacles, in dimensions of about 10 inches depth, 8 inches diameter, and 1½ inches thick, made of artificial stone, terra cotta, or other analogous earthenware, capable of disintegration and wear, which said receptacles are filled with tightly rammed macadamized material, or broken stone, with a top dressing of sand and gravel. The said receptacles are placed upon a smooth road bed, and the interstices between the same are also packed with the same material and in the same way, so as to present a perfectly smooth upper surface, the receptacles operating as binders to prevent loosening of the materials.

IMPROVED HAND SUPPORT.

George R. Knapp, Vinton, Iowa.—This is a book rest, having shoulders of different sizes at both ends of the hand rest and a sliding extension rest for the arm. It furnishes thus a better support for the hand and arm, and admits of the neater and easier keeping up of account books, etc.

IMPROVED FRUIT DRYER.

William Aram, San Jose, Cal.—This invention pertains particularly to the combination and arrangement of vertical sliding partitions and registers in a case or oven, provided with suitably located openings for passage of hot and cold air, whereby the application and degree of heat are controlled at will in the several compartments of the case or oven, through which the fruit is conveyed on wheeled frames.

MACHINE FOR PACKING FRUIT AND OTHER ARTICLES.

George W. Deitzler, San Francisco, Cal.—This consists of one or more vertically reciprocating pistons, that press the articles by means of guide boxes into suitable packages, which are supported on movable and spring-acted bottoms, that are intermittently locked by sliding latch pieces actuated by lever connection with the driving shaft.

IMPROVED BUCKLE.

Warren T. Reaser, Centerville, Wis.—This buckle has its central cross bar provided with a stud, which constitutes the means for securing one end of the strap to which the buckle is applied, and also supports the free end of the tongue, which passes through the end of the strap.

IMPROVED BREASTPIN FASTENING.

Charles O. Hood, Pawtucket, R. I.—This is an improved breastpin fastening for the cheaper kinds of jewelry; and consists of a pin bent at a right angle at the end, and set into the longer end of a socket hinge, formed by bending a perforated plate around the end of the pin; the shorter socket section serving to retain the same. The elasticity of the pin is obtained by the contact with a shoulder formed between the socket sections.

IMPROVED NECKTIE FASTENER.

Michael D. Levy, New York city.—This consists of a metal hook, adapted to hook to the neck of the collar stud from above, and so arranged, relatively to the top of the bow, that it is prevented from rising by the collar turned over the bow, so that the hook cannot work off from the stud.

IMPROVED BOTTLE STOPPER.

Augustus E. Rich and Charles S. Sawyer, Fall River, Mass., assignors to themselves and James H. Crittenden, of same place.—This consists of a yoke hinged to a ring of wire fixed around the neck of the bottle, in which yoke a nut is pivoted, which has a thumb screw for screwing down on the rubber stopper after it has been pressed in.

IMPROVED PAINT.

John Fetzer, Rolla, Mo.—This is a paint consisting of fireproof clay, sulphate of lime, sulphate of barium, calcined magnesia, bleached glue, tragacanth gum, alum, linseed oil, shellac, and water. The paint thus prepared mixes well, and adheres as well as any oil paint, gives a fine polish, and admits of being marbled. It congeals at 60° Fahr., and should be put in a warm water bath to be applied.

IMPROVED GLASS-LINED REFRIGERATOR.

James H. Collingwood, Poughkeepsie, N. Y.—This consists in a refrigerator lining formed of glass plates jointed and cemented together at their edges, and secured to the bottom, sides, top, and doors of the box.

IMPROVED BARBED WIRE FENCE.

Myron W. Colwell, Dunlap, Iowa.—This is a combination, with a fence wire, of four pointed barbs, formed of two short pieces of wire twisted together between their ends, and secured to the fence wire by turning the prongs around the shoulders formed by offsets in the fence wire.

IMPROVED GAGE ATTACHMENT FOR SQUARES.

Edward Kuhns, St. Clair, Pa.—This invention consists in a device made in U form to fit upon the edge of a square, and overlap its sides, and provided with pointers and set screw to adapt it for use. The device is very useful in laying out stairs.

IMPROVED GRAND PIANOFORTE FRAME.

Charles F. Chickering, New York city.—In order to strengthen the pin block and prevent it from being drawn upward by the tension of the strings, the webs and plate are formed in one solid piece, with the longitudinal bars and the plate attached to the pin block, in combination with the belly rail and pin block.

IMPROVED MACHINE FOR CANCELLING STAMPS.

William H. Bowyer, Philadelphia, Pa., assignor to John J. Ridgway, Jr., of same place.—This is a revolving grinding roller, to which the stamps are exposed for cancellation on a spring-acted board with a rubber feed roller, corresponding in length to the grinding roller.

IMPROVED ADDING PENCIL.

Marshall M. Smith and Fletcher W. Potts, Verdi, Nev.—This invention consists of a spirally-grooved revolving cylinder in a slotted case, numbered consecutively in the coil up from the lower end, ten numbers to each coil. It carries an index by the groove, with contrivances in the lower part of the case to revolve the cylinder, by pressing a pointer into the case against a spring, as many numbers as a pointer in the pencil case is pushed back along a scale at the lower end, and carrying the index along the spiral column a corresponding number of figures. The pencil is then relieved of the pressure and the spring forces it out again, when it is ready to repeat the operation. This invention was illustrated and fully described on page 214, volume XXXIII.

IMPROVED HAT VENTILATOR.

Francis P. Flanagan, Springfield, Mass.—This inventor proposes a gauze cover for the ventilating hole, applied so as to cover and hide the eyelet used to bind the hold and keep the gauze in shape, thus making a neater construction.

NEW HOUSEHOLD ARTICLES.

IMPROVED COOKING VESSEL.

John B. Jones, Brooklyn, E. D., N. Y.—This is simply a second or false bottom for cooking vessels, secured in place by a beaded flange, which fits the sides of the main vessel. This forms an air chamber, and protects the contents of the vessels from being burned.

IMPROVED VEGETABLE CUTTER.

Martin Gillespie, East Palestine, Ohio.—The novel feature in this is the hopper, which being pivoted at its lower end in front of an opening in the case, may be used either as a horizontal or as an oblique self-feeding hopper.

IMPROVED SLOP BUCKET.

Benjamin P. Walker, Macon, Ga.—This invention relates to slop jars, which are provided with flaring top rims, to prevent the liquid poured thereinto from slopping out, and consists particularly in making on the flaring rim an upward extension that rests against the wall, and thereby prevents the latter from being splattered.

IMPROVED LAMP STOVE.

John Ward Cole, Brampton, Canada.—This consists mainly of water compartments for cooling the wick tubes arranged above the oil receptacle, and provided with air chambers between and at each side of the wick tubes, for the increased supply of air to the flames. A self-feeding water reservoir keeps up the supply of water around the wick tubes.

IMPROVED VEGETABLE CUTTER.

Friedrich Rentschler and John Keck, Ann Arbor, Mich.—This is formed of a plate having inclined transverse slots formed in it, bent in opposite directions at the opposite sides of said slots, and also of wires having loops formed in them at the ends of the plate. In using the device, it is laid upon a table, the loops supporting it in a slightly inclined position. The vegetables to be cut are then placed in the box, and the said box is pushed back and forth upon the plate, slicing the vessels quickly and evenly.

IMPROVED LAMP STOVE.

Joseph Irving, Chicago, Ill.—This consists of a removable non-conducting disk, provided with a metallic sleeve extending up around the burner, between which and the sleeve a portion of the draft passes; also on its lower surface, with a shallow cup of foraminous metal to protect the flame from sudden blasts. The disk rests on the non-conducting top of the oil chamber, to which a drum containing a hot air chamber and metallic chimney is hinged.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED DRAFT EQUALIZER.

Amos O. Rowley, Bassett, Iowa.—This is a three-horse evener, contrived so that the single horse may work on the short arms, and the two horses on the long arms, as is required for plowing and working reapers and mowers and the like.

IMPROVED CAR VENTILATION.

Charles G. Lea, Alton, Ill.—This is a monkshood blower, with a pipe extending into a water tank, and another pipe for conducting the air from the tank into the car, together with similar blowers for effecting exhaust to aid in inducing an active current of fresh air into the car.

IMPROVED DOME SUPPORT FOR CISTERNS.

Adam Snider, Pierceton, Ind.—This is a cone-arch skeleton on which to build cement or other arched covers for cisterns and the like. The said frame is constructed with a base ring and arch in sections, contrived for putting them up and taking them down conveniently, to allow of removal through the manhole of the arch after the latter is completed.

NEW TEXTILE MACHINERY.

IMPROVED WARP TENSION REGULATOR.

John F. Morley, Waterloo, Canada.—This is a contrivance of compound levers and an adjustable fulcrum, for adjusting the tension to warp of different sizes and strengths, and a novel contrivance for shifting the weights of the friction strap levers as the size of the warp roll diminishes.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED BOILER CLEANER.

John L. Lloyd, Williamston, Mich., assignor to himself and Oscar McCausey, same place.—This is a strong broom for cleaning the dirt and sediment from the bottom of steam boilers, and consists of wood bristles clamped between arc-shaped and screw-connecting pieces that are screwed to a handle.

IMPROVED SANDING MACHINE.

Jehiel Baker, Westport Point, Mass., executor of John H. Baker, deceased.—This is an apparatus for spreading sand over cranberry bogs. In using the machine, the lower edges of the hinged sides of the box are swung together and fastened, to prevent the sand from falling through while being shoveled into said box. When the box has received the desired amount of sand, a latch lever is unfastened, which allows the hinged sides of the said box to swing apart, and the sand to fall in a body upon the wire bottom, whence it is fed out, as the machine is drawn over the bog, by oscillating a frame and its toothed bars.

IMPROVED BRICK YARD PLANT.

Joseph L. Irby, Grenada, Miss., assignor to himself and J. H. Campbell, same place.—This consists of a system of rails and cars for conveying the molded bricks from the mill to the drying ground, and from the latter to the kiln, more economically than it is done by the common method, and also of a simple contrivance for covering the drying ground with movable sheds, when necessary, to protect the drying bricks in wet weather.

IMPROVED SWITCH SIGNAL.

Thomas W. Peeples, Elizabethport, N. J.—The invention consists in fitting the switch lever on a shaft in the opening of the lamp case, so that the lamp will be turned only a quarter while the shaft makes a half revolution.

IMPROVED ADJUSTABLE STAND FOR DANDY ROLLS.

Archibald McDermid, West Fitchburg, Mass.—This is an improved stand for the dandy rolls used in paper machines for making the impression or water mark on letter and bank note paper. It has an adjustable lower arm and journal bearing for carrying any size of dandy roll, and an adjustable top arm and screw clamps for supporting the cloth-holding stick or flag in the proper position to the roll.

IMPROVED SPINDLE STEP LUBRICATOR.

Henry Whorwell, Paterson, N. J.—This invention consists of a collar on the spindle in the oil cup, with projecting arms and flanges on the wall of the cup, to prevent the collar from turning with the spindle. The object of the collar is to prevent the oil from being forced around rapidly by the spindle, which causes it to overflow and waste.

IMPROVED TIRE-HEATING FURNACE.

Nathaniel Crank, Winslow, Mo.—In using this device, the fuel and tires are placed in a sectional ring box, the fuel is set on fire, and the covers of the box are closed. The box is then rotated by means of a crank and rod, which, through openings in the box, causes the fire to burn furiously, heating the tire very quickly and with a comparatively small amount of fuel. The covers are then turned back, and the tires are taken out and set.

IMPROVED SHAFT COUPLING.

Samuel Moses Guss, Reading, Pa.—This improved coupling comprises a solid hub, with a central hole for the shaft, which is enlarged for part of the circumference at each end. In this enlargement is fitted a bush, which is keyed firmly against the shaft, so as to press it very firmly against the part of the hole in which it is keyed, thus making a firm coupling. The parts of the solid hub are cast together with the key ways.

IMPROVED ELEVATOR HOISTING MACHINE.

Volney W. Mason, Providence, R. I.—The novel features in this device are a shipper bar, by which either pulley may be made to drive the machinery, or both may be allowed to run loose, a new means of enabling the brake to be automatically applied whenever the clutches are unshipped, and the arrangement of friction clutches and loose pulleys, so that the belt strain is equalized.

IMPROVED RAILROAD SIGNAL.

John W. Hawley, Warsaw, N. Y.—This invention consists of a wire connection extending from the signal box at the crossing to some distance from the same, to be operated by the locomotive depressing a spring-acted crank rod and releasing the signal.

IMPROVED POST HOLE AND WELL DIGGER.

Isaac M. Perry, Slate Out, Ind.—This is an arrangement of two semi-oval blades, bolted to opposite sides of the head. The handle is formed in sections. In using the device, it is thrust into the ground and then raised, bringing its contents with it, which are jarred or shaken out, and the tool is again thrust into the soil.

IMPROVED BRICK MACHINE.

Newton J. Wolfe, Canal Winchester, Ohio.—This is a contrivance by which the mud is pressed into shaping dies, which move forward into the brick molds when the presser goes back for another batch of mud; and when the dies go back to receive the next batch from the presser, the shapes made by the dies are left projecting into the mold, and are cut off at the surface of the molds, forming bricks. The filled molds are then removed, and empty ones put in to be filled as before, and so on. An essential advantage of the projecting of the dies into the molds consists in the delivering of the brick in the molds without disturbing the sand with which the sides are sanded.

IMPROVED MILL-FEEDING APPARATUS.

Robert B. Van Onner, Mifflintown, Pa., assignor to himself and James M. Van Onner.—This consists of a stationary tube, extending down from the hopper a suitable distance. A revolving disk in the bottom is turned by a damsel, which works up and down through it freely as the stone is raised or lowered, so as not to alter the feed. The said tube has openings through the lower part, out of which the feed is thrown by the disk, and has an outside tube on it, which is raised and lowered by a shaft to regulate the feed.

IMPROVED DEVICE FOR CONVERTING MOTION.

Charles E. Willis, New York city.—This invention relates to means for producing motion in any direction at the will of the operator. It consists of a cam in a support capable of turning on its axis, and surrounded by a reciprocating ring, to any part of which the cam is presented by the turning of the tube, so as to be worked in any direction. The motion is transmitted in some cases from the cam by an arm to which one end of a bar is attached, which is mounted so as to both vibrate and reciprocate, and which works the feed or other device by its other ends; but as this contrivance does not in all cases give the motion in straight lines, a combination of compound parallel bar mechanism is used with the cam, by which the device operated is moved in straight lines in all cases.

IMPROVED THROTTLE VALVE LEVER.

Charles W. Garland and George W. Garland, Lancaster, N. H.—This invention consists of a swinging throttle valve lever, with supplementary fulcrumed handles, that release spring dogs from double arc-shaped ratchet bars, but lock the lever securely when not taken hold of.

Business and Personal.

The Charge for Insertion under this head is One Dollar a Line for each insertion. If the Notice exceeds Four Lines, One Dollar, and a Half per Line will be charged.

Agricultural Implements and Industrial Machinery for Export and Domestic Use. R. H. Allen & Co., N. Y.

The Photo-Engraving Co. have been obliged to remove from 62 Cortlandt St. to a larger building at 67 Park Place. Their Relief Plates for Newspaper, Book, and Catalogue Illustrations are rapidly taking the place of Wood Cuts and are unsurpassed. See advertisement in another column of this paper.

Wanted—A second hand, medium-sized Daniels Planer. Fuller & Bliss, Baldwinville, N. Y.

Wanted—A Grist Mill. C. F. Rice, Brookfield, Me.

The Ransom Syphon Condenser will save you 25 per cent of fuel, or give an equal increase of power. Apply to T. Sault, Consulting Engineer, General Agent, New Haven, Conn.

Wanted—Manufacturers of lamps and lamp-burners to send address to C. C. Snyder, Lyons, Iowa.

Treatise on the Steam Engine Indicator, price \$1. Address E. Lyman, C. E., New Haven, Conn.

Wanted—The address of M's of Pencil Cases. Marshall M. Smith, Pat'ee of Adding Pencil, Greentown, Mo.

For Sale—35 in. x 16 1/2 ft. Lathes, \$400; 18 in. x 8 1/2 ft. do., \$125; 15 in. x 8 ft. do., \$100; 9 ft. Planer, \$400; 6 ft. do., \$225; 14 in. Slaters, \$300; Profiling Machine, \$300; Lincoln Miller, \$300. Shearman, 45 Cortlandt St., New York.

Wanted—An Earth Excavator suitable for leveeing, also a machine for making deep borings. T. S. Anderson, Greenville, Miss.

Centennial Burglar Alarm sent by mail on receipt of 75 cts. C. H. Fowler, Roseland, Mass.

2,000 bright, worm-out Gang Saws, 3 1/4 to 4 1/2 inches wide, for sale in lots to suit at 4c. per lb. Gilchrist & Griffith, Mount Pleasant, Iowa.

Hotchkiss Air Spring Forge Hammer, best in the market. Prices low. D. Frisbie & Co., New Haven, Ct.

Linen Hose for factories—1, 1 1/2, 2, & 2 1/2 inch. At lowest rates. Greene, Tweed & Co., 18 Park Place.

Patent Scroll and Band Saws, best and cheapest use. Cordesman, Egan & Co., Cincinnati, Ohio.

\$1,000 for any hand sawmill equal to A. B. Cobb's, 191 Water St., New York.

The Batet Magnetic Engine for running Sewing Machines, Lathes, Pumps, Organs, or any light Machinery, 1-32 to 1/2 horse power. Agents wanted. Address with stamp, 113 Chestnut st., Philadelphia, Pa.

Machinist's Tools, second hand, which must be sold in order to close up an old partnership. For pamphlet, giving full description of each tool, address Steptoe, McFarlan & Co., 214 West 2nd St., Cincinnati, Ohio.

Baxter Wrenches fit peculiar corners. Prices reduced. Greene, Tweed & Co., 18 Park Place, N. Y.

The French Files of Limet & Co. have the endorsement of many of the leading machine makers of America. Notice samples in Machinery Hall, Centennial Exposition. Homer Foot & Co., Sole Agents, 23 Platt St., New York.

Centennial Exhibitors, buy your Belting in Philadelphia, from C. W. Army, 148 North 3rd st., and save freight and trouble. Satisfaction guaranteed.

Trade Marks in England.—By a recent amendment of the English laws respecting Trade Marks, citizens of the United States may obtain protection in Great Britain as readily as in this country, and at about the same cost. All the necessary papers prepared at this Office. For further information address Mun & Co., 37 Park Row, New York City.

Gas and Water Pipe, Wrought Iron. Send for prices to Bailey, Farrell & Co., Pittsburgh, Pa.

Shingles and Heading Sawing Machine. See advertisement of Trevor & Co., Lockport, N. Y.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, New York.

Steel Castings, from one lb. to five thousand lbs. Invaluable for strength and durability. Circulars free. Pittsburgh Steel Casting Co., Pittsburgh, Pa.

For best Presses, Dies, and Fruit Can Tools, Bliss & Williams, cor. of Plymouth and Jay, Brooklyn, N. Y.

For Solid Wrought-Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, &c.

Hotchkiss & Ball, Meriden, Conn., Foundrymen and workers of sheet metal. Fine Gray Iron Castings on order. Job work solicited.

For Solid Emery Wheels and Machinery, send to the Union Stone Co., Boston, Mass., for circular.

Leather and Rubber Belting, Packing and Hose. Greene, Tweed & Co., 18 Park Place, New York.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon, 470 Grand Street, New York.

Spinning Rings of a Superior Quality.—Whitinsville Spinning Ring Co., Whitinsville, Mass.

For best Bolt Cutter, at greatly reduced prices, address H. B. Brown & Co., New Haven, Conn.

Diamond Tools.—J. Dickinson, 64 Nassau St., N. Y.

Temples and Oilcans. Draper, Hopedale, Mass.

All Fruit Can Tools, Ferracuta Wks, Bridgeport, N. Y.

Wind Mill Rights Cheap—One county in each State to give for introducing the mill. For terms, &c., address E. S. Smith, Good Hope, Ill.

Notes & Queries.

S. W. M. will find a description of the water-freezing machine on p. 82, vol. 33. For a battery for plating, see p. 26, vol. 32.—W. H. B. C. will find directions for bending timber on p. 43, vol. 30.—S. B. is informed that we have published very many descriptions of ice machines, and in every case we have given the inventor's name.—E. T. I. will find full directions for soldering of all kinds on p. 251, vol. 28.—M. C. H. will find directions for making adhesive fly paper on p. 75, vol. 31.—T. J. W. (who does not send his name) will find an explanation of his wheel difficulty on p. 208, vol. 31.—C. S. R. will find directions for molding in paper pulp on p. 170, vol. 30.—B. B. B. will have difficulty in sizing his Indian ink drawing, unless he mixed acetic acid with the ink with which it is made.

T. D. H. will find directions for making rice glue, suitable for mounting photographs, on p. 155, vol. 32.—A. G. W. will find a recipe for a cement for hard rubber on p. 203, vol. 30. For Babbitt metal, see p. 123, vol. 28.—C. H. J.'s case was one of spontaneous combustion. See p. 26, vol. 33.—T. J. will find directions for etching on steel on p. 250, vol. 27.—H. H. should fill the crack in his marble slab with the cement described on p. 344, vol. 32. For a description of lithographic stone, see p. 298, vol. 31.—L. C. will find a description of Portland cement on p. 199, vol. 31.—T. W. will find directions for brazing band saws on p. 194, vol. 31.—W. S. will find directions for painting brickwork on p. 277, vol. 26.—J. J. R. will find directions for finishing malleable iron castings on p. 138, vol. 29.—G. W. G. will find directions for tinning iron and steel on p. 362, vol. 31.—E. B.'s difficulty with the scaling off of copper from iron arises from the iron not being properly cleaned. See p. 139, vol. 31.—C. E. N. is one of some scores of correspondents who write to us to report the invention of perpetual motion machines. It is strange that people will waste their time on such nonsense.—C. G. will find that marine glue will do to fasten rubber to cloth. See p. 43, vol. 32.—G. S. W. will find a recipe for composition for picture frames on p. 223, vol. 31.—J. M. C. can exterminate ants in sugar by the directions given on p. 234, vol. 27.—P. P. W. will find a recipe for indelible ink on p. 129, vol. 28; for writing ink, see p. 92, vol. 33.—A. B. will probably find that celluloid will answer his purpose. See p. 23, vol. 33.—G. P., of Toulouse, France, will find directions for bluing iron and steel on p. 123, vol. 31.—W. B. should consult a physician.—H. T. P. will find directions for cementing leather to iron on p. 42, vol. 26.—H. T. P. will find a recipe for paint for iron chimneys on p. 34, vol. 33.—B. W. G. will find directions for preserving butter on p. 74, vol. 31.—R. D. B. will find a recipe for whitewash for outdoor use on p. 138, vol. 34.—A. M. L. will find measurements of coal per ton on p. 11, vol. 33.—M. J. G. will find a recipe for pure black ink on p. 92, vol. 33.—G. A. S. will find directions for cleaning coins, etc., on p. 217, vol. 26.—W. G. McC. will find directions for molding in plaster on p. 58, vol. 24.—F. J. B. will find a recipe for liquid shoe polish on p. 73, vol. 26.—B. M. W.'s so-called isinglass is mica, described on p. 241, vol. 34.—C. G. B. is informed that the words perpetual motion signify a self-moving machine, and no other.—R. C. J. will find that a method of molding paper, applicable to the manufacture of masks, is described on p. 170, vol. 30.—J. A. A. should address the Agricultural Department, Washington, D. C., for seeds.—W. P. C. will find a description of a silver-plating fluid on p. 299, vol. 31. For gold plating without a battery, see p. 116, vol. 32. For nickel plating, see p. 235, vol. 33.—D. A. S. will find directions for preparing peat on p. 1, vol. 29.—A. B. will find directions for making an aquarium on p. 60, vol. 31.—E. W. M. will find directions for making indelible ink on p. 129, vol. 28.—C. C. R. can clean mildew from carpets by the method described on p. 69, vol. 25. For removing stains from marble, see p. 330, vol. 32.—O. D. will find a description of a simple calculating machine on p. 214, vol. 33.—J. A. is right as to the Atlantic cable being coiled in the hold of the Great Eastern.—D. S. will find directions for making fulminating powder for percussion caps on p. 234, vol. 30.—S. P. will find a good recipe for a verde bronze on p. 283, vol. 31.—W. T. will find directions for transferring pictures to wood on p. 138, vol. 30.—G. A. K. will find that the long screwdriver mystery is explained on p. 21, vol. 19.—A. E. B. will find directions for preserving eggs on p. 219, vol. 31.—H. H. B. will find directions for browning gun barrels on p. 11, vol. 32.—C. A. C. will find instructions for distinguishing real from false diamonds on p. 251, vol. 34.—B. J. H. will find a recipe for a depilatory on p. 186, vol. 34.—C. H. M. will find directions for making rubber hand stamps on p. 156, vol. 31.—G. C. A. will find directions for constructing an anemometer on p. 249, vol. 33.—F. N. will find directions for getting tin off tin plate scrap on p. 319, vol. 31.—W. M. will find a formula for the proportions of cone pulleys on p. 180, vol. 26.—A. H. M. can silver his plate glass by the process given on p. 267, vol. 31.—W. H. A. will find a recipe for liquid blacking on p. 73, vol. 26. For bronze liquid, see p. 185, vol. 33. For marking ink, see p. 273, vol. 28.—J. W. S. will find directions for making a tar concrete sidewalk on p. 185, vol. 33.—A. J. H. will find directions for producing a black finish on brass on p. 362, vol. 25. For a black finish on German silver, p. 288, vol. 31.—A. L., S. P., H., G. W. C., H. L. M., G. C. A., J. G. B., H. D. E., E. C. L., A. W. R., J. C. M., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) W. J. C. asks: Is there any rule for finding the size of the steam ports of a land engine, in proportion to the horse power? A. Multiply the area of the cylinder by the speed of the piston in feet per minute, and divide the product by 4,000. The quotient is the area of each cylinder port in square inches.

(2) W. W. S. asks: I. Is a rod of all-galvanized iron wire cable a safe conductor of electricity? A. The house would be safer with such a rod than without it, provided the earth connections are good. 2. Are not glass insulators, which surround the rod completely, very liable to break by electricity expanding the rod? A. Insulators for lightning rods are worse than useless. Fasten the rod directly to the house by means of metal strips.

(3) F. E. A. says: In electrotyping I have made my impressions in wax, and brushed them with carburet of iron until well polished. I put the wires on the edges of the molds and placed them in a bath of sulphate of copper, attaching the mold to the zinc element of a zinc and carbon battery. There is a copper anode facing the mold, which is connected with the carbon of the battery. The deposit begins immediately and runs over all the high parts of the mold, but will not go down in the letters. I have five cells of bat-

tery. What is the matter? A. Five carbon cells give too high an electromotive force, except, perhaps, for starting. Try two cells. You will find it advantageous, also, to have a number of small wires attached to different parts of the mold, and all connected to the zinc.

(4) G. A. H. asks: Which is the best way to tell good steel? A. By trial of the best known brands.

(5) B. M. says: I. I have 2 one inch electro-magnets. Can I make an electro-motor by cutting off the current just before the vibrator reaches one magnet, and putting it on the other magnet to draw it back? A. Yes. 2. How long a stroke could I have? A. Probably not much over 1/4 inch. 3. How large and heavy a balance wheel should I have? A. The wheel might be about 3 inches in diameter. 4. How many cells of Calaud's battery would it take to run such a motor? A. Three cells, if the resistance of the coils is about equal to that of the battery.

(6) P. F. asks: Which is the best lightning rod, one that is hollow or one that is solid metal, having the same circumference? A. The solid one is to be preferred.

(7) C. C. W. says: I. I have constructed an electrical machine. It consists of a glass cylinder about 1 foot long x 5 1/2 inches in diameter. The crank, handle, and standards are of wood. For insulating the conductors, I have long-necked bottles. The rubber is of two thicknesses of very thick flannel. I get no electricity. Can you inform me what the matter is? A. Make the cushion of leather and stuff it with horse hair. Do not insulate it at all, unless you desire to accumulate a negative charge. The prime conductor, however, should be very carefully insulated. It is probable that the bottle is not good enough for the purpose. 2. How can I make an amalgam of zinc, tin, and mercury? A. Amalgam is prepared as follows: One part of zinc and one part of tin are melted together and removed from the fire, and two parts of mercury stirred in. The mass is then transferred to a wooden box containing chalk, and well shaken. Before quite cold, the amalgam is powdered in an iron mortar. Use with a little lard.

(8) D. McC. asks: Who was the first to apply steam to machinery? Was the power of steam discovered before Watt's time? A. We believe the mention of it by Hero of Alexandria, 250 B. C., is the oldest reference to it extant. This answers both questions.

(9) S. R. S. says: I have some dentist's pellet gold alloyed with about 1/4 copper. I want to work it into a ring, but it is so very brittle that it will not work at all. I have tried melting it again and again, but it does no good. How can I make it malleable? A. If in small particles, digest for several days in pure, hot nitric acid. This will extract part of the copper and render the alloy softer. You will find a recipe on p. 139, vol. 33, by means of which the gold may readily be obtained in the pure state, after which it will not be difficult to obtain alloys of any desired fineness.

(10) A. B. T. asks: Is the 120 foot rail, recently made in Pennsylvania, the longest ever rolled? A. No. Rails of 130 feet and upwards were recently made in England.

1. A friend says that there were held in London three grand universal exhibitions. Is this so? A. There were two principal ones, those of 1851 and 1862; and afterwards a series of ten annual ones, open to all nations, was commenced, but it was discontinued. 2. Was there ever a world's fair held in Russia? A. Not that we know of.

(11) B. J. E. M. asks: How can I make honey mead? A. Boil some honeycombs in water till the residual honey is dissolved, and ferment the liquor. Some persons add a little brandy.

(12) R. C. says: It is claimed by lightning rod dealers that a strip of zinc folded within a sheet of copper will establish a current of electricity, and that the two metals thus combined in the rod will greatly increase its conducting power. As public safety is involved in this, will you please give your views on the combination? A. All bosh. The rod will conduct better if a second copper strip replaces the one of zinc.

(13) J. H. F. asks: India rubber bags used for hydrogen and oxygen gases for the oxyhydrogen light deteriorate in course of time, so that, although there may be no perceptible leak, there nevertheless occurs leakage. Is there any way of preventing this? A. The Goodyear bag, made on the principle of the Macintosh cloth (stout canvas and rubber) will last, with ordinary care, a very long time without appreciable leakage. It is better, when not in use, to keep the bags constantly filled with air, in order to avoid creasing. 2. Would an interior coating be beneficial? How would paraffin answer? A. This suggestion is not practicable.

(14) J. F. asks: Can you tell me a simple method of ascertaining whether well water is pure or not? A. If by purity you mean suitable for drinking and culinary purposes, place a quantity of it in a clean bottle and add a few drops of an aqueous solution of the permanganate of potassa, just sufficient to impart a slight tinge. Allow to stand for several days. If at the end of this time there is no perceptible diminution of the color, the water may be considered safe. If, however, the color has disappeared, the contrary is the case.

(15) E. T. B. says: I have a black walnut stand that has been varnished. What preparation can I use to take the varnish off without injuring the walnut? A. Rub the surface quickly over with a strong solution of potassa in hot alcohol, and immediately afterward with dry sawdust. Finish with pumice-stone.

(16) M. P. B. asks: How can I easily give copper cooking vessels the tin lining necessary to keep them fit for their purposes? A. The vessels

intended to be tinned must be well scoured and present a perfectly clean surface. They are then heated to nearly the melting point of tin; and when ready, some molten tin is poured into them and brushed about with a piece of hemp over which some sal ammoniac in powder has been strewn.

(17) L. C. C. asks: 1. How may grease stains be removed from marble? A. Have you tried benzole? 2. How may iron rust stains be removed from marble? A. They cannot be removed without injury to the marble.

(18) H. T. P. asks: In a good article of wheat, what is the proportion of 1st and 2nd class of flour, and what of bran and middlings? A. This depends much upon the method of grinding and preparation. We believe the average to be about as follows: Fine 60, second 13, bran and loss, 27 parts in 100.

(19) W. L. D. asks: Please give me a recipe for iron tonic or wine of iron. A. The so-called wine of iron consists of a solution of the citrate of iron and quinine in a mixture of spirit of wine and water.

How can I make paste blacking? A. Blacking consists of a black coloring matter, generally bone or ivory black, and substances which acquire a gloss by friction, such as sugar and oil. The usual method is to mix the bone black with sperm oil, sugar, and molasses; a little vinegar is then well stirred in, and strong sulphuric acid gradually added. The acid, acting upon the salts of lime in the bone black, produces sulphate of lime and a soluble acid phosphate; the sulphate forms a tenacious paste with the other ingredients, which can be spread very smoothly. The oil serves to render the leather pliable. This makes a liquid blacking; paste blacking contains less vinegar. The proportions should be about as follows: Bone black 8 parts, oil 1 part, molasses 4 parts, sulphuric acid 2 parts, vinegar 2 parts.

(20) C. S. M. asks: Can I advantageously use the refuse lime from gas works for a manure to enrich a sandy soil? I was informed by a gardener that, if I put it on my grounds, it will certainly ruin my land. A. The gardener's statement is correct.

(21) J. S. T. asks: I wish to melt cast steel scraps with cast iron, copper, and brass. I can melt it, but cannot get it hot enough, when melted together, to run a piece of casting. Can I melt it in an ordinary foundry furnace? A. Melt the steel first, then the iron (cast, not wrought) and copper, and finally the zinc. We do not think that you will succeed in obtaining good castings from such an alloy, and, moreover, such a compound metal certainly have little to recommend it.

(22) W. C. R. asks: Where are the chief centers of the carbonate of soda manufacture in America? A. American manufacturers cannot compete with the English in the production of this salt, and consequently there are no manufactories of any account in this country. We cannot find any statistics of this trade.

(23) A. L. E. asks: Please give me a good recipe for removing stains from the fingers after smoking a cigarette? A. Use a little piece of pumice-stone with soap and water. This is the least objectionable method.

(24) C. P. H. asks: 1. What will clean white spots and stains from zinc? A. Try a little fine emery cloth, and finish with powdered pumice-stone. 2. What will clean frosted silver? A. Use a rag buff and putty powder.

(25) S. C. asks: Can you let me know an easy way to find the chord of an arc when the radius and degrees are given? A. Chord = $2 \times (\text{radius}) \times \sin(\text{angle})$.

(26) R. & H. say: 1. We have a double oscillating engine cylinder, 3x6 inches, which we desire to put in a steam launch. What dimensions of boiler would be suitable? A. Use a boiler 3 feet in diameter and 4 feet high. 2. Would steel be preferable to iron? A. Either will do. 3. What size of boat would she drive successfully at 6 or 8 miles per hour? A. Use a boat 25 or 30 feet long. 4. What size and number of blades of propeller would you advise? A. Use a propeller 28 or 30 inches in diameter, and of 3 1/2 feet pitch, with 3 blades.

(27) W. S. P. says: 1. I am building an engine of 2 inches bore by 3 1/2 inches stroke, with a fly wheel 12 inches diameter weighing 16 lbs., running at 300 revolutions per minute with 50 lbs. steam. What power would it develop? A. From 1/2 to 3/4 of a horse power. 2. What would be the proper size for a boiler with single flue? A. Make one 18 to 20 inches in diameter, and 3 feet high. 3. How large a boat would the above engine propel at a speed of 3 or 4 miles per hour? A. One 10 or 12 feet long. 4. Which would answer best, a screw or paddle wheels? If a screw, of what diameter and pitch should it be? A. Use a screw, 16 or 18 inches in diameter, and of 2 1/2 feet pitch.

(28) T. H. W. asks: Can a velocipede be constructed to run with one or more coil springs? The springs are to be wound up with a crank. A. It seems possible.

(29) C. W. says: I say that, by taking an ordinary rubber cane, with a loaded head, by the ferrule end, one can strike a heavier blow than if one grasped the cane in the center. My friends say that more power can be applied by grasping in the center. What is your judgment? A. You have the right idea.

(30) C. L. asks: Gas leaking through pipes has vitiated the air till our nostrils are assailed violently. Is this gas slightly or very injurious to health? A. Very.

Is Bright's disease a disease of the urinary organs? A. Bright's disease is a fatty degeneration of the kidneys; and it is so called because Dr. Bright, in 1827, first pointed out the frequent connection of anasarca and other dropsical affections with a degeneration of the structure of the kidneys.

neys, the prominent character of which is the deposition of a peculiar granular matter in the substance of the renal gland, together with the gradual atrophy of its cortical and tubular structure. I have broken the translucent glass of my kaleidoscope. How shall I replace it? A. Obtain a piece of finely ground glass, cut to the exact size of the tube, and fit it as before.

(31) I. H. R. says: 1. Some time since, you published a plan of making the baroscope of Habniet. After the baroscope is constructed, and the red fluid made to rise in the glass tube by blowing into it, must the top be sealed? A. No. It may be drawn out to a point, but the tip of this must be broken off in order that the air may press upon the surface of the liquid in the tube. A very minute hole will answer the purpose. 2. Is it necessary that the baroscope should be placed in the open air for the effect of the atmosphere? A. No.

(32) L. C. E. says: I make black ink, but it corrodes the pen. The ingredients are blue galls, sulphate of iron, acetate of copper, gum arabic, and sugar. How can I remedy this corrosion? A. It is probable that the sulphate of copper is not neutral. Try the addition, with constant agitation, of a solution of carbonate of ammonia until a precipitate just begins to form.

(33) F. R. W. asks: Can the American black walnut be stained or changed to a light color? A. Strong nitric acid changes the appearance of good black walnut to that of light mahogany. Chlorine and chlorinated lime bleach it.

(34) H. R. says: I am driving a circular saw by hand power with a 2 inch belt from a 5 foot driving wheel to a 3 inch pulley on the saw shaft. The objection to this plan is that the large wheel occupies so much room. Please give me some idea of the loss of power I shall sustain by using a countershaft and a smaller driving wheel. A. If the shafting is accurately fitted, the loss will probably not exceed 10 or 12 per cent.

(35) C. J. asks: Is there any chemical that will bleach rosin as it runs out with spirits of turpentine? A. No. It is impracticable.

(36) C. R. asks: What relative efficiency have petroleum and coal as fuel? If you have to generate steam in a boiler, and you use 1 ton good steam coal, how many lbs. crude petroleum would you require, with perfect combustion, to do the same work? A. About 1,300 lbs.

(37) C. P. S. asks: How can light colored tobacco leaf be made dark without injury to the leaf and its burning qualities? A. We know of nothing that we can recommend for this purpose.

(38) A. A. M. asks: Is there anything that can be put into preserves to keep them from can-dying? A. We do not know of any way of avoiding it with concentrated sirups.

(39) S. O. asks: Would two extra keels, one on each side, just below the water line, a little shorter than the main keel, make a canoe sail closer to the wind, and let it carry more sail? Canoe is 20 feet long by 4 feet wide, and has a keel about 7 inches deep. A. There is some difference of opinion on this subject. If any of our readers have made experiments, we would be glad to hear from them.

(40) G. E. S. says: I wish to put an upright boiler in a steam launch 35 feet long, 6 feet wide, and about 3 feet deep. It is desirable to get the weight of the boiler as low as possible, and to have it as large in diameter as would be safe. What diameter and length of tube would you recommend, to drive two 6x8 inches vertical engines? A. About 4 feet in diameter and 6 feet high.

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

B. F. W.—It is galena or sulphuret of lead.—W. P. D.—It is sulphuret of lead, or galena.—G. W. P.—It contains lead and antimony.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On a Window Stick. By H. T. G.
On the Glacial Period. By F. B.
On a Thread Telegraph. By G. Q. T.
On the Phylloxera. By A. S.
On Alexander Selkirk. By W. R.

Also inquiries and answers from the following:
F. C. R., Jr.—O. K.—G. A.—M. N.—A. B.—B. B.—G. M. R.—J. C. W.—C. E. S.—E. F. T.—W. L.—H. N.—W. C. R.—A. F. P.—H. C. N.—T. S.—R. H.—E. L. E.—J. S.—C. G. W.—G. M.—E. S.—E. T. B.—J. P. O.—W. M. R.—C. W. L.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Enquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who sells red cedar? Who sells lead pencils? Who sells German silver penholders? Who sells imitation gold pens? Who sells bread-cutting machines? Who makes a machine for ironing collars? Who is the best furnace for burning wet tan? Who sells the best steam trap? Who makes the best fire engine lanterns?" All such personal inquiries are printed, as will be observed, in the column of "Business and Person-

al," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

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(Those marked (r) are related patents.)

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

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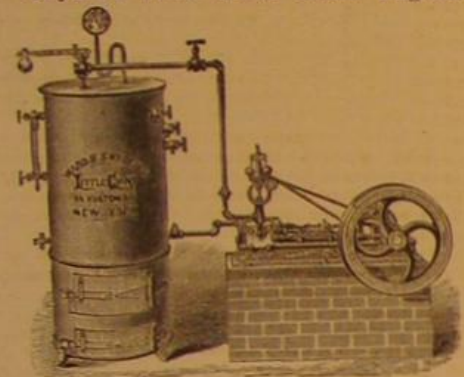
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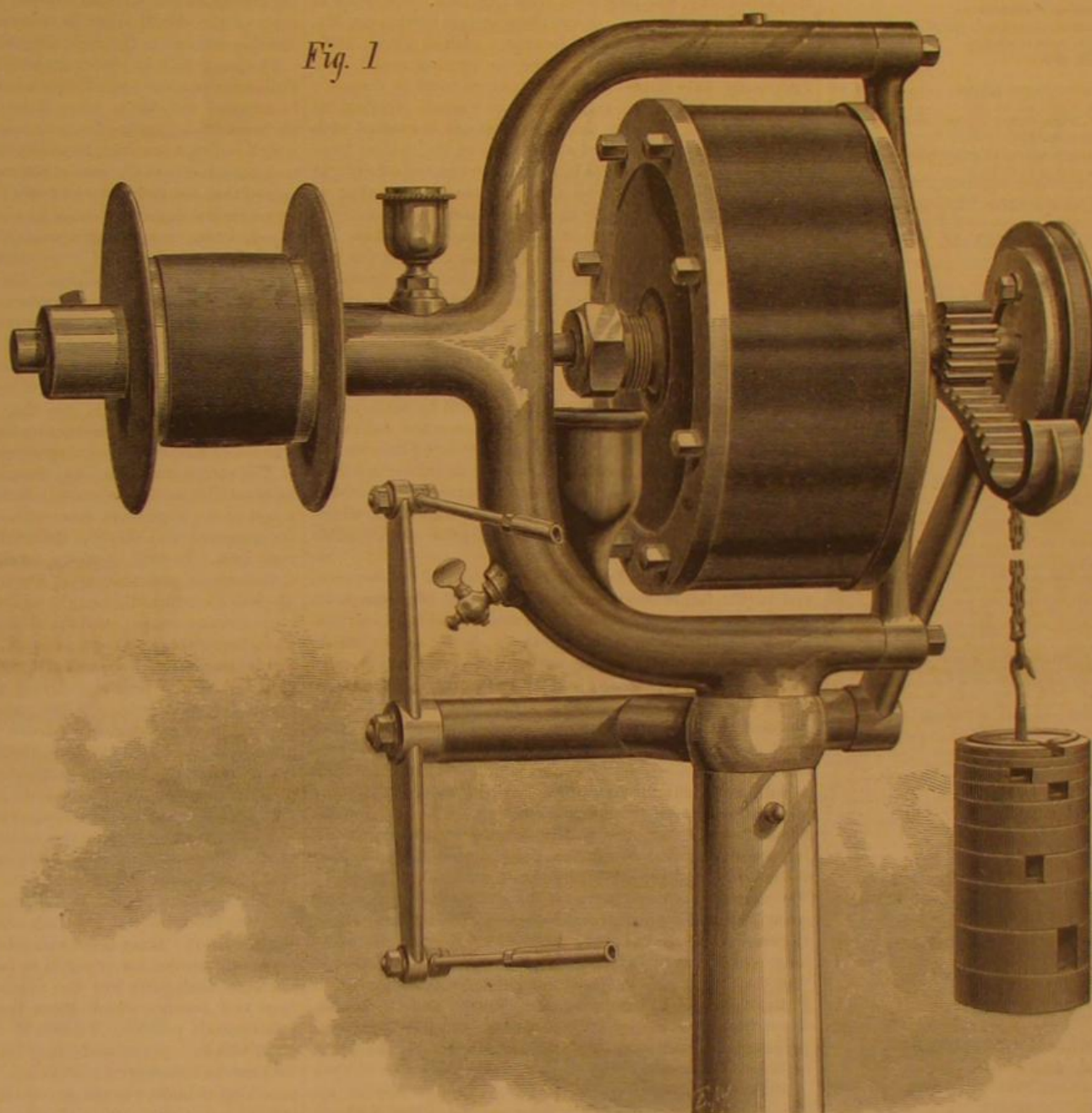
well known among engineers as the inventor of the old Huntton governor, who has given nearly thirty years' study to regulating steam engines. It is patented in this and several foreign countries, and has come largely into use. It

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Fig. 1



THE ALLEN STEAM ENGINE GOVERNOR.

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Fig. 2

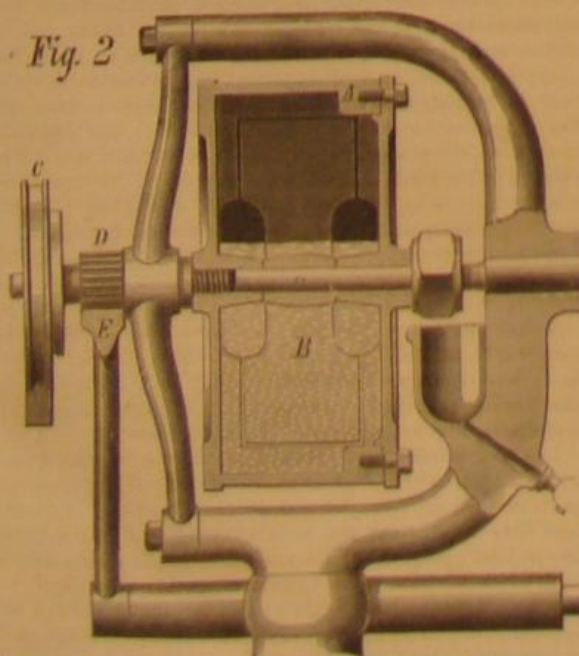


Fig. 3



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AMERICAN PROGRESS—II.—FROM 1820 TO 1840.

In no era of our country's existence does it appear that greater progress was made than during the twenty years previous to 1840. Early in 1840, Dr. Richard Hare introduced the deflagrator, a form of voltaic battery capable of giving effects of great intensity, and also another form of voltaic apparatus called the calorimotor, designed to generate, with a low intensity of electricity, an enormous volume of heat. By means of it large rods of platinum can be ignited and fused in a few seconds, and its magnetic effects are equally surprising; yet it is hardly capable of producing the faintest spark between the carbon electrodes. During the same year Henry Burden invented his first cultivator, which was the beginning of a series of splendid inventions. In 1835 he received a patent for a machine for making the wrought spike, and in 1835 for a horseshoe machine. Then followed an apparatus for making the hook-headed spikes used on railways, a self-acting machine for reducing iron into blooms after puddling, another horseshoe machine, a machine for rolling iron into bars, and finally an entirely new machine for horseshoe making, which is a marvel of mechanical skill. It is self-acting, and produces, from iron bars, horseshoes at the rate of one a second. From these several inventions, Mr. Burden amassed an immense fortune. Also in about 1820, Jordan L. Mott invented the stove for burning small coal. Previously only large lumps had been devoted to domestic purposes, and the small fragments were wasted. During his lifetime he took out more than forty patents connected with coal-burning apparatus, and also instituted the change from blast furnaces to the cupola in making stoves and other light castings. His son carries on the business of his father at the present time in this city on a most extensive scale.

In 1822 James McDonald, of New York, patented an important machine for breaking and cleaning unrolled flax and hemp. During the following year, Nicholas Longworth, of Cincinnati, made his first essay in making wine from Catawba and other native grapes, thus starting the manufacture of the famous Catawba wines. At the same time another great inventor became known in the person of Joseph Saxton. In 1823, he invented the machine for giving the epicycloidal form to the teeth of notched wheels; in 1825 he made an astronomical clock, for adjusting the compensation rod in the pendulum of which he invented the reflecting pyrometer and comparator. In 1829, he went to London and there invented the magneto-electric machine. Subsequently he devised a self-registering tide gage, a deep sea thermometer, a dividing engine, and an hydraulic printing press with flexible platen.

In 1824, the Franklin Institute in Philadelphia was founded, and in the fall of the year its first annual fair was held. During the same year, Zadoc Pratt established his great tannery in Prattsville, on Schoharie Creek, N. Y., for the manufacture of hemlock-tanned leather. He probably tanned more sole leather than any man in the world, and, it is said, employed a capital of over \$250,000, and continued the business till his death, without a single litigated lawsuit, or the loss of one dollar in bad debts, or having a single hide stolen. He was elected to Congress in 1836, and there proposed the introduction, through United States' consuls and national vessels, of foreign seeds and plants for distribution by the Patent Office, the publication and engraving of all important patented inventions for circulation throughout the country, and the establishment of a bureau of statistics. The year 1825 is memorable for the completion of the Erie canal, one of the greatest engineering works in the country. It connects the Hudson river with Lake Erie, is 363 miles long, and cost only about \$8,000,000 to construct. Also in 1825 the first house furnace using flues was employed in Philadelphia, by Professor W. R. Johnson; and in London Jacob Perkins exhibited steam artillery, which did good experimental execution against iron targets, before the Duke of Wellington.

The first signs of the electric telegraph now become apparent; for in 1826, Harrison Dyer erected a line on Long Island and used frictional electricity to give sparks where-with to mark chemically prepared paper. Dr. Nott, of Union College, in the same year, patented his celebrated stoves, which gave him a worldwide reputation. In 1827, John McClintic, of Pennsylvania, devised the first practical mortising and tenoning machine; and in the same year Mr. W. C. Redfield published his "Laws of Storms," wherein by long-continued observation, he showed that storms are vast whirlwinds, having both a rotary motion and a motion of translation on a curved path. Mr. Redfield's discoveries are of immense value, since they afford a knowledge of cyclones which enables navigators to avoid them. The first locomotive trip in America was made on the Carbondale and Honesdale road in Pennsylvania, in 1828. During the same year, the first American patent for a locomotive was obtained and the first straw and hay paper was made. It was in 1828 that James Bogardus invented the ring flyer for cotton spinning now in general use, and then, like Saxton and Burden, produced invention after invention with wonderful celerity. In 1829 he invented mills with eccentric grinding plates, which have never been fully superseded, in 1832 the dry gas meter, and a machine for transferring bank note plates. In 1836 he devised a marvelously ingenious engraving machine, and in 1840 machines for pressing glass tumblers. He also made important improvements in drilling machines, and in 1847 erected in New York the first cast iron building, we believe, ever constructed.

We now reach the period when the discoveries of Professor Joseph Henry, foremost of living American scientists, were made known. Previous to his investigations, the means of developing magnetism in soft iron were imperfectly understood. He was the first to prove by actual experiment that, in order to develop magnetic power at a distance, a galvanic

battery of intensity must be employed to project the current through the long conductor, and that a magnet surrounded by many turns of one long wire must be used to receive this current. He was also the first to actually magnetize a piece of iron at a distance, and he invented the first machine moved by the agency of electromagnetism. In 1829 he exhibited to the Albany Institute electromagnets of power superior to any before known; in 1831 he transmitted signals by an electromagnet through a wire more than a mile in length, and caused a bell to ring. In 1833, while Professor of Natural Philosophy at Princeton College, he explained the electromagnetic telegraph, but he never reduced the principles described to actual practice. Professor Henry also as early as 1830 demonstrated that the discharge of a Leyden jar consists of a series of oscillations backward and forward, a fact afterward by him proved true of lightning. He also made the remarkable discovery that a voltaic current induces an extra current in the conductor in which it is itself conveyed, which, however, manifests itself only on making or breaking connection with the battery. The system of conductors adapted to the demonstration are flat spirals of copper ribbon, known as Henry's coils; and by these induced currents of the ninth order have been demonstrated, and the possible number is theoretically unlimited.

The years 1830 to 1833 were prolific in electrical discovery. Following so close upon Henry's investigations as almost to be mingled with them came those of Dr. Charles G. Page. He invented ingenious electromagnetic locomotives, two of which pulled a car, weighing eleven tons and carrying fourteen passengers, at the rate of nineteen miles an hour; he observed that the molecular changes in a bar of iron produced by magnetization are attended by audible sounds; he invented a pole changer whereby a magneto-electric machine may be made a substitute for a galvanic battery in electrolytic and galvanoplastic operations. He also devised the earliest form of induction coil, and made a large number of important discoveries in connection therewith, resulting in the invention of a spark-arresting circuit breaker.

It was in the autumn of 1832 that Samuel F. B. Morse, then an artist in painting by profession, embarked at Havre to return to this country. On that voyage, while in casual conversation with a passenger on the recent discovery of the relation of electricity and magnetism, he conceived the idea of the electromagnetic and chemical recording telegraph substantially as it now exists. Before the close of the year a part of the apparatus was constructed in New York; but the telegraph was not experimentally exhibited in operation until 1835. In 1837 he filed a caveat and sought, fruitlessly, Congressional pecuniary aid. From this time, the inventor's life was a continued struggle against scanty means and adverse circumstances, until the session of Congress of 1842-3, when he obtained an appropriation, and in 1844 the experimental line between New York and Washington was completed, and the practicability of the electromagnetic telegraph demonstrated. To Professor Morse is also due the origination of submarine telegraphy, and the first submerged lines were laid by him in New York harbor in 1842. He also made the first daguerreotype apparatus and took the first sun pictures produced in America.

In 1832 Edward Evans patented the method of unhairing hides by sweating, without the use of lime. During the same year, Dr. Samuel Guthrie, of Sackett's Harbor, N. Y., discovered chloroform, although he did not understand its true constitution, and called it chloric ether. At this period also was produced the first lock stitch sewing machine, by Walter Hunt. Hunt made and sold his machines, but was an erratic genius, too versatile to be successful, and through his sheer negligence lost the opportunity of acquiring the fame and fortune which Elias Howe and other patentees subsequently realized. In 1832 M. W. Baldwin, of Philadelphia, was engaged in perfecting many of his numerous inventions in locomotive mechanism. He devised the plan of attaching cylinders to the outside of the smoke box, metallic ground joints, and other valuable improvements. His most important invention was the flexible truck locomotive, patented in 1842. Seth Boyden, of Newark, N. J., had already discovered the japan or varnish by which patent leather is produced, and had laid the foundation of the manufacture of that material, which has been successfully carried on at the latter place ever since. He also pursued experiments with a view to converting the hardest laminated iron into soft malleable iron; and these succeeding, he began making malleable iron castings, between 1831 and 1835. He subsequently invented several important improvements in steam engines, notably the cut-off instead of the throttle valve, and the connection between cut-off and governor. The first practical automatic pin machine appeared in 1833, and was the invention of Dr. John L. Howe, of Connecticut. It formed the head of the pin by dies from a coil of fine wire. In 1833, Hussey, of Maryland, made the first practical harvester. It had open fingers, with a knife reciprocating in the space. He was followed in 1834 by Cyrus H. McCormick, who invented the reaper, in which a sickle-edged sectional knife was reciprocated by mechanism from the drive wheel, and fingers gathered the grain. This was an invention of great importance; and it met with worldwide usage and secured great rewards to the inventor, who still carries on the business of manufacture on an enormous scale in Chicago.

In 1834 Professor Denison Olmsted, of New Haven, Conn., by observations of the great meteor shower of the preceding year, reached the theory that meteors are portions of a nebulous body drawn into the earth's atmosphere and inflamed by the heat generated by the resistance of the atmosphere to their motion. During the next year, Dr. J. W. Draper began his magnificent investigations of the actinic rays of the spectrum, which included experiments on the absorption of the chemical rays by solid and liquid media, the decomposition

tion of carbonic acid by light, the interference of chemical rays, the crystallization of substances by rays of light, the supposed magnetizing properties of light (which he found not to exist), and the effects of light upon vegetation. Dr. Draper was the first to photograph Fraunhofer's lines, the first to take a portrait by daguerreotype, the first to suggest the relation between the spectra of incandescent bodies and their physical or chemical composition, the first to devise charts of the spectral lines of bodies, the first to explain the mechanical cause of flow of sap in plants, and that the yellow ray and not the violet produces the reduction of carbonic acid therein, and the first to photograph the moon. No one American investigator has made more original researches, or extended them over a wider field, or contributed more largely to the general progress of Science, than Dr. Draper.

In 1836, another great invention appeared in the shape of revolving fire arms, which were patented by Colonel Samuel Colt, of Hartford, Conn. These were first used in the Florida war of 1837; but it was not until the outbreak of the Mexican war of 1847 that Colt erected the works in Hartford which have since assumed such immense proportions. Colt also invented a submarine battery of great power. In the next year (1837), A. A. Wells patented the process now in general use for forming the bodies of fur hats by depositing the material directly on a perforated cone revolving in connection with an exhausting fan. At about this time John Ericsson successfully applied the screw propeller to purposes of navigation in England, and immediately thereafter emigrated to this country, to which belongs his subsequent record, of which mention will be made further on. In 1839 the United States government despatched an exploring expedition to the antarctic regions. No other explorations of that part of the globe have since been made, and the somewhat doubtful report of an antarctic continent, brought back by the United States' vessels, has not been fully verified. During the same year Charles Goodyear made the important invention of vulcanizing india rubber. He had already discovered a method of treating the surface of native india rubber by nitric acid, which allowed a surface of rubber to be exposed on goods, hitherto impracticable owing to the adhesiveness of the material. In the course of experiments in 1839, he found that a piece of rubber, mixed with ingredients among which was sulphur, upon being accidentally brought in contact with a red hot stove, was not melted; but that in certain portions it was charred, and in other portions remained elastic, though deprived of all adhesiveness. More than sixty patents were afterwards taken out by him for improvements in treating india rubber and on articles manufactured from it. In 1839 also Erastus B. Bigelow invented his power loom for weaving ingrain carpet. This machine could easily weave from twenty-five to twenty-seven yards per day, whereas the previous hand loom production never exceeded eight yards. The invention was followed later by a power loom for Brussels and tapestry carpets, one of the most ingenious pieces of mechanism ever devised. Mr. Bigelow also invented a machine for weaving coach lace, and another for weaving counterpanes, both of which are in extensive use.

Here we may close the review of a period remarkable for the number of great inventions made during its continuance. The original types then produced have since formed the foundation of thousands of modifications and improvements, and the end of making such changes seems far from being attained. Progress therefore since 1840, though rapid, is due to development of previous ideas, more perhaps than to origination of new ones.

Our next issue will contain a continued history of the more remarkable inventions and discoveries from 1840 up to the present time.

RECLAIMING THE STEPPES.

It is a well known fact that there exists in the southeastern portion of the Russian empire an immense basin, depressed below the level of the ocean. In this basin lies the Caspian Sea, and into it also flow the great rivers Ural and Volga, which drain a large portion of central Russia. In the course of ages, the rivers have carried down soil and formed vast deposits which have encroached upon the sea, contracting its dimensions and elevating its bottom in parts, so that for large vessels it is no longer wholly navigable. As the sea diminished in size, so did the supply of watery vapor in the adjacent atmosphere become less; and moisture failing, the land near by has gradually changed into a desert, which is steadily growing. It is thousands of years, probably, since the arid wastes or steppes began to form; but their spread has continued until now an immense region is unfit for human habitation.

To reclaim this desert and restore it to its former state of fertility is the object of a gigantic engineering project, recently suggested by Mr. Spalding, an American engineer resident in Europe. The plan involves the connection of the Caspian with the Black Sea by means of a canal, which is described in detail on another page of this issue. It appears that the surface of the Caspian is forty-eight feet lower than that of the Black Sea. Mr. Spalding proposes to excavate from the Caspian a cutting, 480 feet wide, westward to such a distance that at its western end it would reach a depth of 32 feet. The surface of the earth at that point would be 16 feet below the level of the Black Sea. The remainder of the distance is to be traversed by a narrower channel, 160 feet wide and 9-6 feet deep at the Black Sea end, and 16 feet deep at its junction with the broader cutting. This gives a fall of 6-4 feet between the two extremities of the narrower channel, and the total length of both cuttings is about 166 miles. It is calculated that the water from the Black Sea would flow, along the slope above mentioned, at the rate of one 7-2 miles per hour, and that, if the channels remained at their original dimensions, it would take four hundred

years to bring the Caspian to a level with the Black Sea. As, however, the action of the rapid stream would infallibly soon deepen and increase the width of the passage, Mr. Spalding estimates that in forty years the levels of the two seas would be so nearly the same that the channel would be navigable. This new Mediterranean could be traversed by large ships from the borders of Persia to about the fiftieth parallel of north latitude, along the estuaries of the Ural and Volga, and to a much greater distance by ships of small burden.

The importance of the work, judging from the results expected, is not exceeded by that of the Suez Canal. The world is none too large for its population; and to reclaim the hundreds of square miles of arid Russian steppes would be to add territory and natural resources of inestimable value, not only to the Russian empire, but to all humanity.

FRENCH ARTISANS AT THE CENTENNIAL.

It is to be regretted that a meeting, recently held in Paris for the purpose of raising a fund to enable one hundred and twenty French artisans to visit the Centennial, should have been made the scene of wild communistic harangues by such firebrands as Louis Blanc and Victor Hugo. The circumstance tends to put the workmen, who may be sent here with the funds obtained through such arguments, in the light of representatives of a cause which is the embodiment of demagoguery, and with which American workmen, proud as they are of our republican institutions, have no sympathy. We had a sufficiency of agitation of the communistic character during the strike of 1872; and to the credit of our working men be it said that, even when partisan feeling ran highest, they turned away in contempt from the blatant inciters who prated of "blood and bayonets" and denounced the authority of law.

If the French artisans come here simply as workmen seeking to learn, they will find their fellow craftsmen ready to welcome and to instruct them. If, on the other hand, they visit us as apostles of the doctrines of Rochefort, Hugo, and Blanc, while no one will challenge their right to their opinions, any attempts on their part to inculcate them will encounter a rebuff so emphasized as to leave no doubt as to its signification.

THE OPENING OF THE CENTENNIAL.

The simple but impressive ceremonies which marked the opening of the Centennial passed off in a way that must have satisfied the most sanguine anticipations. In the hurry of preparation some things are forgotten, and others are apt not to fall in their proper places at the specified time; but on this occasion the great machine started off with wonderful precision. The day in Philadelphia dawned wet and cloudy. During the previous twenty-four hours there had been heavy rains, and many remembered with some dismay the depressing effect of the drenching showers which fell during the opening of the Vienna Exposition. Long before the appointed hour, however, the clouds broke away and the sun burst forth, and the predictions of the "probabilities" that fair weather was at hand, to the relief of all concerned, were verified. As early as nine o'clock the gates were opened; and thousands of people surged into the grounds, flocking to the front of Memorial Hall, where every inch of space commanding a view was in a few moments occupied. By the time the ceremonies began, over one hundred thousand persons had assembled, packing an area fully half a mile in length by 250 yards in width. While the people were thronging in at one portal, the orchestra of two hundred musicians and the nine hundred singers were admitted at other entrances. Later, the invited guests began to arrive; and as the dignitaries, both national and foreign, took their places, the expectant throng vented its enthusiasm in prolonged cheering. A tempestuous burst of applause greeted the Brazilian Emperor, who, with the Empress, occupied seats on the platform; and when the President, accompanied by his military escort and by his cabinet ministers, arrived, the shouts were deafening. Quiet was not restored until the ceremonies were fairly opened by the orchestra playing the famous Centennial March, written by Richard Wagner. Musical critics speak highly of the composition; but it was generally conceded that it was not adapted for outdoor performance, as it contained very many passages wholly inaudible except to the few hundred in the immediate vicinity of the performers. This being over, Bishop Simpson advanced to the front of the platform and delivered a lengthy prayer, the immense throng, though but few could hear the speaker, maintaining perfect stillness and decorum. A magnificent burst of music followed, in which a thousand voices, accompanied by organ and orchestra, sang Whittier's Centennial Hymn, in the last portion of which nearly the whole audience joined, producing a volume of sound of indescribable grandeur. Hon. John Welsh, President of the Board of Finance, then formally presented the buildings to the Centennial Commission. The cantata written for the occasion, by Sidney Lanier, was next sung. The senseless words of this production were happily compensated for by the superb musical setting given them by Mr. Dudley Buck.

These preliminaries concluded, the first important speech was made, by General Hawley, President of the Centennial Commission. After reviewing the inception of the project of an international exposition, and briefly referring to the labors of those charged with its preparation, he concluded as follows:

"It has been the fervent hope of the Commission that, during this festival year, the people from all States and sections, of all creeds and churches, all parties and classes, burying all resentments, would come up together to this birthplace of our liberties, to study the evidence of our resources; to measure the progress of a hundred years; and to examine to our profit the wonderful products of other lands;

but especially to join hands in a perfect fraternity, and to promise the God of our fathers that the new country will surpass the old in the true glories of civilization. And furthermore, that, from the association here of welcome visitors from all nations, there may result not alone great benefits to invention, manufactures, agriculture, trade, and commerce, but also stronger international friendships and more lasting peace.

"Thus reporting to you, Mr. President, under the laws of the government and the usage of similar occasions, in the name of the United States Centennial Commission, I present to your view the International Exhibition of 1876."

On the closing of this speech, President Grant began the reading of his address. It very briefly referred to the objects of the Exposition, and to the vast progress of the nation during the past century. At the words "I declare the International Exposition now open," the signal was given, and the national flag was run up on the great tower of the main building. The bells and steam whistles all over the city burst into a chorus of noises, with which were mingled the thunder of the saluting batteries. The orchestra, organ, and singers pealed forth the Hallelujah Chorus, and the procession of invited guests, headed by the President and Emperor, was then formed, and the march through the Main Building began.

During the morning, the two great engines had been started at intervals, and every bearing had been freshly oiled, so that no possible obstacle could exist to prevent their formal beginning of work at the proper time. Mr. Corliss stood by his gigantic offspring, waiting the arrival of the President. As the head of the procession reached the engines, General Grant and Emperor Dom Pedro stepped forward; and instructed by Mr. Corliss, each grasped the bright lever of a throttle valve. There was a moment's delay for the dignitaries to gather, and then, at 1.30 o'clock, Mr. Corliss waved his hand, the signal for admitting the steam to the cylinders of the gigantic machines. It was a scene to be remembered; and perhaps for the first time in the history of mankind, two of the greatest rulers in the world obeyed the order of an inventor citizen.

The Emperor, with his characteristic energy, was the quickest to move his lever, but the President was but a second behind; and as the motion was completed, the steam hissed into the great cylinders, the mighty arms of metal slowly began their movement, pulleys answered to the strain of belts, and the mechanism of the vast building started into life and activity. The Empress of Brazil meanwhile visited the Women's Pavilion, and there pulled a golden cord which set in motion the engine that drives the looms. Thus ended the ceremonial part of the opening, and the people scattered themselves over the grounds and through the buildings, while throngs visited the restaurants, and literally devoured every ounce of food which had been supplied; and by four o'clock, when President Grant and the Emperor returned to the grounds and sought to dine at the principal restaurant, they found several thousand hungry American sovereigns had been there before them, and they were obliged to go elsewhere for their dinner.

The interiors of some of the buildings, by dint of day and night work of a multitude of workmen during the past week, have been partially reduced to order; but here and there, and almost everywhere, a wilderness of packing boxes and rubbish is to be met with, and it will be some time yet before every department will be in perfect order.

It is impossible, at the present writing, to form any adequate idea as to the variety and novelty of the exhibits. The objects are there, but they are yet to be arranged and classified; and until this is done, a description of them, and a comparison with what we are used to seeing, must be deferred.

Government Provision for Mechanics at the Centennial.

We learn that a bill has been introduced in the House of Representatives, directing the President to appoint six skilled mechanics from each Congressional district, "whose duty it will be to attend the Centennial International Exposition at Philadelphia, carefully study the arts, industries, and products there exhibited, and make full report in writing of all that, in their judgment, is important and useful to the practical and scientific industries of this country." It is further provided that they shall be paid for their work "such sum as the Secretary of the Treasury shall deem a fair compensation." There are 292 Congressional districts, so that the corps of skilled mechanics will number over 1,750 persons. If they all attend the exhibition every day, a very comfortable addition will be made to its daily receipts at the expense of the government.

The constitutional authority to incur this expenditure will probably be found, says the *Evening Post*, just where the authority to establish a department of agriculture and an education bureau was found. Most persons will agree, however, that, if the enlightened people of this country do not take the trouble to learn for themselves what there is important and useful in the exhibition, they do not deserve to have a paternal government do it for them.

Publishing the English Patents.

The London Patent Office is about to adopt our Patent Office system of producing copies of drawings of patents by the photo-lithographic process, in place of the large lithographic sheets which now accompany the printed specifications of all English patents. Considerable opposition to this change was made by the London patent agents; but we believe it only arose from abhorrence of change, which is the national characteristic of the Englishman. But the British public will soon find our mode of producing copies far better than their old plan of lithography.

THE CENTENNIAL INTERNATIONAL EXHIBITION.

We resume our description of the buildings erected for the Centennial Exposition, the most important of which were illustrated in our last issue. The above engraving represents the pavilion erected by the State of New York, a building in the villa style, with a verandah all around it. It is the headquarters of the New York commissioners, and will, no doubt, like the other State buildings, be a meeting place for exhibitors and visitors, from the Empire State.

A very attractive feature of the Exposition will be the various restaurants, which will represent the culinary art of

in these columns; and there is a Turkish *café*, where the tiny cup of Arabian coffee, with a long pipe of the Persian pattern or the Turkish *nargilyeh*, through the perfumed water of which the smoke is drawn, may be enjoyed for the first time, probably, by most of the visitors.

Our next engraving represents the United States Government Building. It contains collections of objects sent by the various government departments, those from the army and navy being especially interesting. The structure is in the form of a cross, 360 by 300 feet, and the 81,600 square feet of floor space are appropriated as follows: To the war de-

manufactured articles. The display of artillery and projectiles, maps, charts, etc., as well as of documents and papers, is likely to attract much attention; and machinery in motion will be employed to illustrate the manufacture of small arms, cartridges, army clothing, etc.

Photographic science will be shown not only in the building described and illustrated in our last issue, but in one erected by a company especially organized for the purpose of taking photographs in the buildings, and for selling them in the Exposition, to which privilege it has the exclusive right. The building is admirably constructed and ar-



THE NEW YORK STATE BUILDING.

many nations. The largest of these is specially dedicated to American cookery. It is situated near the Agricultural Hall, and encloses three sides of a quadrangle, giving the visitors an opportunity of dining in the fresh air or on the shady piazzas with which the building is surrounded. A large hall and several private dining rooms are also at the disposal of guests. Messrs. Delmonico are, we believe, to have a building, and the owners of *Les Trois Frères Provençaux*, of the Palais Royal, Paris, which for sixty years has held the highest rank in Europe for the excellence of its *cuisine* and wines, are to exhibit to the visitors the gastronomic science of the city of good cooks. Mr. Edward Mercer, of Atlanta, Ga., has erected the building shown in our second illustration; it is 185 by 96 feet, and contains four large dining rooms. A band of "genuine plantation minstrels" is to divert the diners during the repast, and the bills of fare are to be thoroughly representative of the manners of the Southern States. There is also the Vienna bakery, already alluded to

partment, 11,200; navy department, 10,400; interior department, 20,600; treasury department, 3,000; post office department, 3,800; Smithsonian Institute, including fish commission, 26,600; agricultural department, 6,000.

The main stem of the building and its transept are traversed centrally by walks, which cross in the center under the rotunda or lantern, crossing the intersection. The principal area of the cross consists of three aisles, which have side lights beneath the eaves, the central aisle rising above the side aisle and having ventilators at the comb. The transept has a single aisle. Each of the departments has drawn upon its own stores for articles to exhibit, the objects having in many cases great historical interest, appertaining to the aboriginal inhabitants of the country, the settlement, the revolutionary struggle, the later wars, the peaceful arts, progress, surveys, inventions, scientific expeditions and researches, and natural resources, the latter including metals and other minerals, animal and vegetable productions, and

ranged; and the company numbers among its members photographers from all parts of the country and Canada. Mr. Edward L. Wilson, editor of the *Philadelphia Photographer*, is the treasurer, and Mr. John A. Fraser, of Toronto, is the art superintendent of the company.

The next and last building in our present series is one erected by private enterprise; it is called the World's Ticket and Inquiry Office, and is built by Messrs. Cook, Son, & Jenkins, the renowned agents for pleasure tours in all countries. It is a well built, elegant pavilion, with offices for the sale of tickets, hotel coupons, etc., and the affording of information and facilities for traveling to and from all parts of the world; but in addition to the utilitarian purposes of this firm, they provide one of the most attractive features of the Exposition in the display of their celebrated Palestine camp, illustrating their method of caring for travelers in that interesting country; besides which they illustrate a number of other most interesting facts connected with travel



"THE SOUTH" RESTAURANT



THE UNITED STATES GOVERNMENT BUILDING

and life in distant countries. Among these attractions is the boy Selim, so famous in Mr. Stanley's tour of search after the late Dr. Livingstone.

There are many attractive features in the grounds which surround the buildings. North of Machinery Hall is a pretty little lake covering about five acres of ground, with sloping banks covered with grass and shrubbery. The spacious grounds in front of Horticultural Hall are dotted with parterres of flowers and traversed by a sunken garden leading up to the portals of the Hall. The grassy expanse of flowers and turf is bordered by a fringe of fine trees; and the cool valleys of Lansdowne and Belmont, on either hand, furnish denser masses of shade to relieve the brightness of the scene. The esplanade, adjoining the main entrance to the grounds, has also been prettily ornamented with flowering shrubs; and in the center is Bartholdi's large bronze fountain, representing Light and Water, "the twin goddesses of cities." West of the Machinery Hall stands the great fountain of the Catholic Total Abstinence Society, which, next to the Centennial fountain, is much the most costly work of the kind in America. The center figure represents Moses smiting the rock, and the four subordinate ones are statues of Father Mathew, Charles Carroll, Archbishop Carroll, and Commodore Barry.

Dr. W. W. Hall.

We learn with painful regret of the sudden death of Dr. William W. Hall, the well known editor of *Hall's Journal of Health*. Dr. Hall was born in Paris, Ky., in 1810. After completing his education he entered the ministry, and while performing missionary labors found a knowledge of medicine so indispensable that he began systematically to study the healing art. Subsequently he devoted himself to that profession, practicing successfully first in Cincinnati and New Orleans, and latterly in this city.

Dr. Hall possessed an extraordinary faculty for popularizing medical knowledge. He was the first to start a popular journal devoted to the inculcation of the laws of health and correct living, in which the articles were written in so clear and plain a style as to be comprehensible by any one. The fact that the *Journal of Health*, which was issued first in 1853, soon attracted a circulation of 25,000 copies, shows the favor with which the public regarded his labors. Dr. Hall prided himself on writing his whole paper unaided; and as he was master of a concise, epigrammatic way of expressing ideas, it was rarely that a copy of the journal could be perused without some useful suggestion being fixed in the mind. Besides his editorial labors, Dr. Hall found time to prepare a number of valuable works on sanitary topics, which have added to his general reputation.

It is a remarkable fact that one so well posted in sanitary laws should have died through the violation of precepts which he persistently urged upon others. It seems that for some years past Dr. Hall has greatly overtasked himself in his literary labors, rising at 5 in the morning, and working almost continuously until 10 at night. The physical results of mental overwork are fully known, and perhaps few understood them better than Dr. Hall himself. Yet he fell dead in the street, and subsequent examination has revealed the cause of his death to be degeneration of the heart, one of the commonest results and, according to recent investigations, an almost necessary consequence of an overtaxed brain.

NEW YORK ACADEMY OF SCIENCES.

The chemical section of this society met at 64 Madison avenue, Monday evening, May 8, 1875. After the conclusion of some ordinary routine business, Professor Falke created quite a sensation by exhibiting a quantity of

MERCURY FOUND IN CANNED MEAT

He stated that, on opening a can of cooked corned beef, put up by a company in Chicago, he noticed some bright metallic globules, which proved to be metallic mercury. Beside

these, a considerable quantity of combined mercury was present in the form of albuminate of mercury. How the poison came in the meat is a mystery; but a member suggested that, inasmuch as thermometers are employed to regulate the temperature when canning, the mercury may have come from a broken thermometer. It may be interesting to note that a case of poisoning has been reported in Boston from eating canned cooked corned beef. Another member of the Academy informs us that he too suffered severely after eating 2

fession of their fathers unless adopted into a family pursuing some other vocation.

The paper mulberry, of which the paper is made, is propagated by cuttings from the roots, which are planted on the borders of rice fields, and mature in five years. In November the reeds are cut and sold to the papermakers; and the roots are left to send up new shoots. The shoots are cut in pieces two feet long, piled up and allowed to ferment, which loosens the bark so that it can be stripped off, after which they are dried in the open air, or scraped at once. The scraping removes the brown epidermis, which can be used for inferior wrapping paper. About 33 lbs. of the bark is boiled at one time for two hours in a strong lye made from wood ashes. It is then put in bags and left in a running stream until the alkali is washed out completely. It is next beaten, 2 or 3 lbs. at a time, on a wooden block with heavy sticks, for 15 or 20 minutes. This pulp is now mixed with a little rice paste, or a paste from a species of mallow. A thin pulp is obtained by stirring $\frac{1}{4}$ pound of this mass into 40 or 50 gallons of water. The web or mat on which the paper pulp is collected is made of slender strips of bamboo, only the thirty-sixth part of an inch in diameter; several hundred of these are bound together with silk threads; the rods all run lengthwise of the sheet and hence the mats can be rolled or folded up in one direction. A branch of the nobility monopolizes the manufacture of these mats. For coarse paper, reed mats are employed. The process of manufacture is essentially the same as in making handmade paper elsewhere. A woman sits in front of the tank and stirs it vigorously, then dips a mat and frame into the vat, takes up some of the pulp and shakes it so as to arrange the fibers parallel. A single dip makes a very thin tissue paper; most paper is made by dipping twice, and draining each time. After the second dipping, the mat is stood up edgewise by the side of the tank to drain, and the frame put on a second mat which also receives its first dipping.

While the second sheet is draining for the first time, the mat with the first sheet is laid face down on a pile of finished sheets with a rice straw between them. While the second sheet is draining a second time, the mat is taken off from the first sheet, so that only two mats are necessary. When 500 or 600 sheets, which form a day's work, are completed, they are pressed for some time with heavy weights, then taken up one at a time, by means of the rice straw, and placed by old men on smooth boards to dry in the sun. When dry, the sheets are stripped from the board by a sharp knife with the blade at right angles to the handle like a sickle. The finished paper weighs about one half as much as the bark employed.

Professor Munroe exhibited various kinds of fancy paper from Japan, and another member exhibited a Chinese book, said to be a translation of Professor Tyndall's work on sound, illustrated.

At the close of the regular meeting, Professor A. R. Leeds was elected chairman of the chemical section; and a committee was appointed to consider the subject of having a course of public lectures on Science, next season.

MINERALS.

Professor A. E. Foote, of Philadelphia, exhibited through Mr. Hallock some fine specimens of rare minerals, including petzite, molybdenite, embolite, amazon

stone, and titanium.

The meeting was adjourned to June 13, 1876.

A New Test.

To detect nitrobenzol in oil of bitter almonds: Take a solution of chloride of tin, and add excess of caustic soda until the precipitate dissolves, then add a few drops of the substance to be tested, and heat. If nitrobenzol is present, it will be reduced to aniline. Next, add a few drops of carbolic acid and some hypochlorite of soda (Javelle water), when the peculiar purple color is produced.



THE CENTENNIAL PHOTOGRAPHIC COMPANY'S HALL.

ozs. of this beef, but is uncertain whether mercury was the real cause of the affliction.

SEPARATION OF BISMUTH, CADMIUM, AND COPPER IN QUALITATIVE ANALYSIS

formed the title of a paper by M. W. Iles, Ph. B. The substance of this discovery has already been published in the *SCIENTIFIC AMERICAN SUPPLEMENT*. The three metals are precipitated by ferri-cyanide of potassium; the copper and cadmium are redissolved in excess of cyanide of potassium. K Cy, and tested for in separate portions of the filtrate, the former by hydrochloric acid, H Cl, the latter by ammonia sulphide.



THE WORLD'S TICKET AND INQUIRY OFFICE.

JAPANESE PAPER

Professor Henry S. Munroe, E. M., exhibited a number of specimens of Japanese paper, and described minutely the materials employed, method of manufacture, and uses of this curious material. The Japanese paper, said Professor Munroe, is all made from the inner bark of the mulberry, and is never bleached, although made as clean as possible; hence its faint yellow green or pinkish color. Paper is made in small villages where all the inhabitants are papermakers, just as other small villages consist entirely of blacksmiths, and so of other trades. The sons of papermakers follow the pro-

Correspondence.

A Pieno-Hydrometer.

To the Editor of the Scientific American:

I send a description of a new scientific instrument of my invention; it may perhaps interest the scientific public. It is for determining the specific gravity of fluids as well as of solids. Its construction is based on the combined principles of the pycnometer or specific gravity glass and the hydrometer. It is especially adapted to the determination of the gravity of fluids when only small quantities can be obtained, when they are of such a nature that they can only be kept in glass vessels, such as strong acids and the like.

A is a spherical glass vessel to which a long neck is attached, corresponding to the stem of the common hydrometer. B is a smaller closed bulb that contains shot, mercury, or other heavy object. This may be dispensed with if the bulb, A, is made of heavy glass. Around the stem or neck of the vessel, A, just above that vessel, there is blown another bulb, C, which serves as a float. The upper end of the stem is open. The instrument, instead of floating in the fluid the specific gravity of which is to be determined, is filled with a fluid to a mark, D, on the neck, and put in water. The degrees are marked on the glass by etching with hydrofluoric acid, or a paper scale may be used, as shown in Fig. 2. The paper can be inserted in the space between the two tubes, and the upper edges sealed together.

If we fill the instrument with water and let it float in water, the proportions of the instrument being such that it sinks to a , it will serve for determining the specific gravity of fluids heavier than water. If it sinks to a_{10} , then a_{10} will be 1.000 of the scale, and will serve for fluids lighter than water. In the first case, a being 1.000, if we fill the instrument with any heavier fluid and put it into water, it will sink in farther than a , say to a_1 , being 1.250. As the volume of the fluids to be weighed is always the same, it will be readily understood that a similar addition to the specific gravity (as from 1.000 to 1.250 and from 1.250 to 1.500) will require equal additions to the volume of water displaced. In other words, the distances of the marks 1.000 to 1.250 and 1.250 to 1.500 will be equal, provided the stem is cylindrical. This is the only instrument having a specific gravity scale of which the degrees are equidistant. Further, if the instrument be so made that the volume of the inner vessel be known, such as 10 cubic centimeters, it can be used to weigh off any quantity of a fluid or solid substance (which must be in pieces small enough to enter) from 10 to 20 grains, or as far as the scale goes. The instrument may thus serve as a balance for preparing solutions of standard strengths. It may be also used for determining the specific gravity of solids. The method is nearly the same as with the usual specific gravity glass or pycnometer and the chemist's balance. Thus: Given a substance not soluble in water, the specific gravity of which is x . If we put enough of it into the instrument to make it sink in water to 1.250, and fill up with water to the mark, and immerse again in water, it will sink now to, say, 1.750. Then calling the absolute weight of the water which the instrument will hold w , the absolute weight of the substance will be $w \times 1.250$. The weight of the contents of the instrument, after filling up with water, will be $w \times 1.750$, and the weight of the water added will be $w (1.750 - 1.250)$, and the weight of the water displaced by the substance $w - w (1.750 - 1.250) = w (1 - 1.750 + 1.250) = w \times 0.5$. By dividing the absolute weight of the substance by the weight of the water it displaces, $\frac{w \times 1.250}{w \times 0.5}$, we show its specific gravity, 2.500.

The results of the determinations with this instrument are not influenced by variations from the mean temperature, as the gravity of the fluid is always compared with water of the same temperature.

Your readers will doubtless find many uses to which this little instrument can be put.

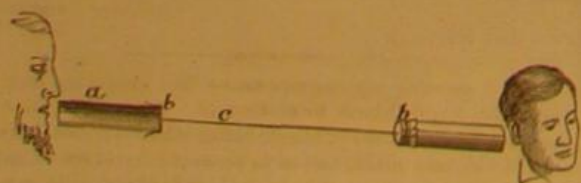
HERMANN WIEGAND.

St. Louis, Mo.

A Thread Telegraph.

To the Editor of the Scientific American:

A cheap telegraph, useful for certain purposes, can be made in this way: Take two tin cylinders about the size of a small dice box, say 3 inches long by 1½ inches diameter;



cover one end of each with parchment or bladder, forming a drumhead. Pierce the center with a pin and insert a strong thread, and make a knot to prevent its being with-

drawn. With the other end of the thread (which may be of any length, say 100 yards or more) do likewise with the other cylinder, and the telegraph is complete. By keeping the thread tightly drawn, in order that the vibration may be perfect, a person speaking or even whispering in one cylinder can be distinctly heard by another holding the other cylinder to the ear.

Would not such home-made pocket telegraphs be very useful in factories, on farms, in the army, and in many other situations too innumerable to mention? An enterprising person might realize a handsome sum by making them as scientific toys for the Centennial Exhibition. The tubes could be made of cane pole, and I would suggest that they be made to fit one within the other, so as to be easily carried. Stronger ones can be made with small cord, but would be more bulky.

GEO. QUINCY THORNDIKE.

Mentone, Alpes Maritimes, France.

(For the Scientific American.)

SETTING ENGINE GUIDE BARS.

Several of our correspondents are troubled with the difficulty of setting the guide bars upon the bed of a horizontal engine so as to ensure that the piston head has an equal amount of clearance, from the cylinder head, at each end of the stroke, and at the same time so that the guide blocks will travel to an equal amount over the recesses at each end of the guide bars. Below we give a practical method of obtaining this result.

Our first operation is to ascertain the length of the bore of the cylinder, measured from inside face to inside face of the cylinder covers, which we may do by subtracting from the whole length of the bore the depth to which the covers enter it at each end; then from the remainder we subtract the thickness of the piston head, exclusive of the bolt heads, if they project; and the last remainder will be the length of the bore of the cylinder (allowed for the stroke of the piston) plus the clearance between the cylinder covers and the piston head when it is at each end of the stroke. From the remainder so obtained, we subtract the length of the engine stroke, that is to say, twice the length of the crank from the center of the shaft to the center of the crank pin; and this last remainder will be the amount of length of the bore of the cylinder allowed for clearance, which, divided by 2, will give the amount of clearance at each end of the stroke. If, then, we add the amount of this clearance to the depth to which one cylinder cover fits into the cylinder, the sum will be the distance from the face of the piston head to the end face of the cylinder. Then we may carefully clean and oil the cylinder bore, piston rod, and piston, and then put the latter in its place in the cylinder, taking care that the distance from the face of the piston head to the end face of the cylinder end is that ascertained as above; and then the piston will be at one end of its stroke, and will allow amounts of clearance, equal at each end of the cylinder.

Our next operation is to find the exact position of the crosshead when it is at that end of the stroke which corresponds with the position of the piston; and we proceed as follows: There should be upon all guide bars a recess at each end of the working face, so that the guide blocks will, at each end of the stroke, travel over these recesses, and thus prevent the formation of shoulders on the guide bars. The distance, then, on each bar, between these recesses will be less than the length of the stroke; and we therefore subtract the distance from recess to recess, on a bar, from the length of the engine stroke, and the remainder will be the amount allowed for the guide bars to travel over the recesses, which, divided by 2, will give the allowance for overtravel at each end; and we mark such allowance upon the guide bar at the end corresponding to the end of the stroke at which the piston stands. We now place the crosshead upon the piston rod, and then put the guide blocks upon the crosshead, and adjust the guide bars upon the engine bed, so that the end of the guide block stands even with the mark above referred to, and the operation is complete.

New York city.

JOSHUA ROSE.

A Great Explosion.

A tremendous explosion of the nitroglycerin compound known as rend-rock powder recently occurred on Bergen Hill, New Jersey, directly opposite New York city. The material was to be employed for blasting in the new tunnel of the Delaware, Lackawanna, and Western Railroad Company, and was stored in a brick magazine some ten by twelve feet in area and nine feet in height. Estimates place the amount of powder that blew up at about four hundred pounds. The concussion was terrific, and the effects were felt over a radius of some ten miles. Thousands of sashes and doors in the vicinity were forced in, and even across the river in New York the glass in edifices along the water front was shattered. Houses at a distance of nearly five miles were perceptibly shaken. Fortunately the building in which the powder was stored was located in a large empty lot and on the brow of the hill; and the force of the explosion spending itself eastwardly, most of the fragments were hurled harmlessly into the marsh below. The great damage which must have ensued had the locality been thickly built up was thus avoided; and the injuries were confined to the wholesale destruction of doors, windows, and ceilings in the neighborhood.

The cause of the disaster is unknown. The accident points to the necessity, however, of the enforcement of stringent laws, preventing the storing of any of the new and powerful explosives, in large quantities, in the vicinity of any populated district, and also regulating its transportation.

Influence of Light on the Color of Flowers.

Dr. Askenasy, in the *Botanische Zeitung*, records the results of some experiments instituted by him to ascertain the influence of light on the colors of different flowers. In the main, his results agree with those obtained by Sachs; but if the different plants he employed to test the degree of influence exercised by light can be regarded as of equal value, then the degree of influence is very diverse in different plants. Scarlet and white, scarlet and yellow, and wholly yellow flowered sorts of *tulipa Gesneriana*, grown in absolute darkness, exhibited no appreciable difference in the shape or color, or intensity of color, of the flowers from those of the same varieties grown in the full light. Blue and yellow flowered varieties of *crocus vernus* developed their proper colors, but the flowers were very much drawn up, as gardeners express it. The effects of light on a dark violet blue variety of *hyacinthus orientalis* were of a double nature, with the same temperature. Those grown in the light were at least a fortnight in advance of those grown in the dark, and much more highly colored, though those grown in the dark were not absolutely colorless. To prove this, Dr. Askenasy cut off the upper portion of the spikes of several of the plants growing in the dark, and placed these portions in water, fully exposed to light, on the south side of a greenhouse. In three days the expanding flowers were of as deep a hue as the normal ones, proving also that the change of color so effected was entirely independent of previous formation of chlorophyll. The flowers of *pulmonaria officinalis* formed less color according to the stage of their development when darkened, and those in a very young state were quite white. The flowers of several other plants were affected in the same manner; hence it appears that those cases in which the colors are not influenced by light must be regarded as exceptional.—*Academy*.

Union of the Caspian and Black Seas.

The present century has witnessed several remarkable achievements in marine engineering, such as the drainage of extensive arms of the sea in Holland, the construction of the Suez Canal, and the deepening of the estuary of the Mississippi; and these not being enough, still more gigantic schemes have been projected. It has been proposed to admit the Mediterranean into two extensive tracts of the Sahara, which would give water communication to a large portion of Algeria, and make a seaport of Timbuctoo. Neither plan is likely to be put speedily into execution; but in the meantime, Mr. H. T. Spalding, of Blomfield, N. J., comes to the front with a proposal to turn the waters of the Black Sea into the Caspian, thus enlarging the latter to its pristine size, and turning the barren and almost impassable deserts, left by the subsidence of its waters, into a highway of commerce for Central Asia. This ancient sea basin is considerably depressed below the general ocean level, and has been silted up in the course of ages by the Ural, Volga, and other lesser streams which flow into it. The consequence of this contraction and shallowing of the Caspian has been, not only that the land left dry is incurably barren, but that the surrounding country has become unfruitful from want of rain, consequent on the diminished evaporation. Mr. Spalding proposes, as we have said, to restore to the Caspian its ancient body of waters, its ancient depth and area, which was nearly double its present extent, by connecting it with the Black Sea by a channel 150 miles in length, about 170 yards wide at its eastern extremity, but two thirds narrower on the western half. The projector calculates that, at the end of forty years from the beginning of the work, the level of the two seas would be so nearly uniform that the navigation of the new channel could begin. Mr. Spalding further proposes to join the Don to the Volga, and thus lay the Sea of Azof also under contribution. The mere excavation of the proposed canal does not seem very difficult; and as the Russian government appears to have directed its attention to the scheme, doubtless the opinion of competent scientific men as to its feasibility will be obtained. If it should prove successful it would be a magnificent work, and followed by political and economic results more than commensurate with the skill and outlay that would be required for its completion.—*Iron*.

New Discovery in Agriculture.

The curious discovery is announced by Professor P. B. Wilson, of Washington University, Baltimore, that minutely pulverized silica is taken up in a free state by plants from the soil, and that such silica is assimilated without chemical or other change. The experiment, of which we give a more full account in our SUPPLEMENT of this week, consisted in fertilizing a field of wheat with the infusorial earth found near Richmond, Va. This earth, it is well known, consists of the shells of microscopic marine insects, known as diatoms, which under strong magnifying powers reveal many beautiful forms that have been resolved, classified, and named. After the wheat was grown Professor Wilson treated the straw with nitric acid, subjected the remains to microscopic test, and found therein the same kinds of shells or diatoms that are present in the Richmond earth, except that the larger sized shells were absent; showing that only silica particles below a certain degree of fineness can ascend the sap pores of the plant. This discovery opens up a new line of research in agricultural investigation from which important results and much additional knowledge may accrue.

THE AMERICAN CENTENNIAL JURIES.—The list of jurors at the Centennial was announced just as this issue was going to press, and the names will appear in our next.

ENGINEERING projects are under advisement for the regularization of the river Neva at St. Petersburg, Russia.

NITROGLYCERIN.

LECTURE DELIVERED AT THE STEVENS INSTITUTE OF TECHNOLOGY, BY G. M. MOWBRAY, ESQ., OF NORTH ADAMS, MASS.

Thirty years ago the German chemist Schönbein discovered that iron behaved in a peculiar manner when immersed in a mixture of concentrated nitric and sulphuric acids. Instead of dissolving, it remained perfectly passive and unchanged. This led him to test his solution by putting some cotton in it. To his great surprise, the cotton did not dissolve either. He took it out again, squeezed it out, washed out all the acid, and put it in the drying apparatus in order to have it ready for analysis the next day. When he came back, his cotton was not there, and none of his students of whom he inquired had seen anything of it. He was convinced that somebody had been very careless, and repeated the experiment. This time, however, the Professor himself witnessed the disappearance of his cotton when the heat became sufficiently strong; and this showed him that a change had taken place in its structure. The new compound received the name of gun cotton, and the inventor took out a patent for it in 1846. Sir John Herschel spoke in the strongest terms of its great explosive power. At a meeting of the British Association, he said: "It might in the next generation arm mankind with the very wildest powers, by which they could tear up rocks, and almost call down lightning." Everybody began to make it, exhibit it at the dinner table, and discuss the question whether it was a true chemical compound or only a mechanical mixture formed by the retention of some of the acid in the pores of the cotton. The dispute was settled by Sobrero, a pupil of Pérouze and now Professor of Chemistry in the University of Turin. Walter Crum having shown that gun cotton, or pyroxylin, is a compound in which some of the hydrogen of the cotton is replaced by hyponitric acid, Sobrero made similar compounds with gum, sugar, dextrin, manna, and finally with glycerin, where it was evident that there could be no simple absorption. This was in 1848. Nothing further was heard of his invention of nitroglycerin until the Crimean war, when it was rumored that Admiral Napier was prevented from taking Cronstadt because he was afraid of torpedoes charged with the new terrible explosive by Professor Jacobs.

In 1864 the Swedish engineer Alfred Nobel obtained a patent for the application of nitroglycerin to blasting purposes. He found considerable difficulty in making it explode with certainty, and was obliged either to put gunpowder in the center of the nitroglycerin cartridge or nitroglycerin in the center of the gunpowder cartridge.

The lecturer next exhibited the properties of nitroglycerin. A slip of paper saturated with it was lighted, and burned with a light bluish flame; while another slip saturated with nitrobenzol, a similar compound, burned with a denser flame and gave off much dark smoke, showing the greater proportion of carbon in its composition. This nitrobenzol, from which artificial bitter almond flavoring is also made, is sometimes mixed with nitroglycerin in order to neutralize its explosive qualities and render it safe for transportation. It can then be exploded only by means of some powerful fulminate or by supplying it with oxygen through the addition of chlorate of potash.

A little nitroglycerin spread upon an anvil exploded with a loud report when struck with a hammer; nitroglycerin mixed with one third of nitrobenzol did not explode until chlorate of potash was added, and not then at the first trial.

The glycerin from which nitroglycerin made is so common a compound that it requires no description. It was first obtained as a residue in the manufacture of diachylon or lead plaster, obtained by boiling olive oil and litharge. It is perfectly soluble in water, and greedily absorbs moisture from the atmosphere; a tumbler nearly filled with glycerin will draw about $\frac{3}{4}$ of an inch of water from the air in a night. Nitroglycerin, on the contrary, is insoluble in water. When tasted or even touched with the hands, it produces a persistent throbbing headache; but the system soon becomes accustomed to it, and it then ceases to have any effect. Nitroglycerin is obtained by adding gradually $\frac{1}{4}$ lb. of glycerin to a mixture of 1 lb. of nitric acid and 2 lbs. of sulphuric acid. Various conditions enter into its manufacture, which cause the product to be more or less easily exploded. The result is glycerin in which one, two, or three equivalents of hydrogen are replaced by hyponitric acid.

The attention of the lecturer was first attracted to nitroglycerin in 1865, by several terrible explosions which it had caused. One occurred in New York city in Greenwich street, opposite the Wyoming Hotel. One of the guests of the hotel, on polishing his boots, had noticed a reddish vapor issuing from the box on which he rested his foot. The hotel clerk took the box outside and threw it into the gutter. An explosion instantly followed, by which every pane of glass within a hundred yards was shattered, pedestrians were thrown down, and the pavement broken up. It turned out that the box contained nitroglycerin, left by a guest as security for his board.

The next explosion was that of the steamer *European*, at Aspinwall, on the Isthmus of Panama. Forty-seven persons were killed, the vessel, the pier, and the warehouses near by were destroyed, and the damage was over a million dollars. Directly after this an explosion occurred in the express office of Wells, Fargo, & Co., corner of California and Montgomery streets, San Francisco. Eight persons lost their lives, and property to the amount of a quarter of a million dollars was destroyed.

Now here was a substance manufactured at Hamburg, Germany; carted to the wharf; loaded on board of the steamer by stevedores; reshipped at London to Panama; a

part of it forwarded across the Isthmus by railway; thence lighted to and loaded upon the steamer; bearing a twelve day's voyage to San Francisco, where it was taken to the express office; handled with the usual recklessness of expressmen, and yet it did not explode. These considerations led the lecturer to investigate the subject, after having maturely reflected on the question whether a man "who had a home ought to embark in so dangerous an enterprise," and having at one time concluded "that he had better keep a peanut stand" than have anything to do with nitroglycerin without thoroughly understanding its properties.

The following July (1867) the lecturer was sent for by the engineers of the Hoosac tunnel, who were desirous of finding some one who would take charge of the manufacture and use of nitroglycerin, and be responsible for it. He accepted the position on the condition of having absolute authority to employ and discharge all connected with the use of the explosive, and of managing the operation without interference from anybody.

A preliminary experiment with a charge of six ounces of nitroglycerin proved so powerful that those who heard the report thought his whole works had blown up. He then gave a very amusing account of his first entrance into the tunnel, carrying a pail filled with cartridges in one hand, his apparatus in the other, and the fuses on his person. All the miners were cleared out, and he proceeded to charge the holes, while the silence of the place was interrupted only by the splash of water trickling through the roof. When all the holes were filled, and the wires connecting them were ominously hanging out of the holes, resembling an exaggeration of rats' tails, a sense of anxiety and discomfort was unavoidable. Everything, however, went off satisfactorily, and the spark from the electric machine exploded all the cartridges. Until the men were drilled sufficiently to be safely entrusted with this business, the lecturer had to go in the tunnel every 8 hours, and 3 of the intervening hours were used up in preparing the charges. Five tons of nitroglycerin were thus used per month; and for the same amount of rock blasted out, only 1 life was lost through nitroglycerin, where 30 or 40 were lost through gunpowder. It is safe to say that the Hoosac tunnel would never have been completed without nitroglycerin.

The lecturer then exhibited the electrical machine, contained in a neat keg. To this he connected 15 fuses and exploded them before the audience. The machine is a frictional one, its condenser having 450 inches of surface and the rubber being 6 by 8 inches. In practice, the fuses, instead of being close together as in the experiment, are attached to cartridges placed in holes from 6 to 12 feet apart, which they fill about two thirds or two fifths. As much as 6,000 cubic yards of solid rock have been blasted out at one discharge at Lake Champlain. The drill holes are made very deep, sometimes as deep as 50 feet. They are first gaged to make sure that they will receive the cartridges. Then the exploders are attached to the nitroglycerin cartridges, and these are immediately passed into the drill holes. The holes are next plugged with a bung, perforated to allow the delicate connecting wires to pass and to keep them away from the rock, by which the insulation would otherwise be destroyed. Finally, the wires are connected with the above-mentioned electrical apparatus, which is kept in a warm, dry room, and the explosions take place the moment the apparatus is charged.

Owing to the many fatal accidents resulting from the handling of Nobel's impure, dark-colored nitroglycerin, the manufacturers were obliged to substitute a modification for it, to which they gave the name of dynamite. This dynamite consists of a mixture of nitroglycerin and a kind of silicious or infusorial earth, "known under the various names of silicious marl, tripoli, rottenstone, etc." This earth absorbs the nitroglycerin without destroying it, and the result is a mixture which is no longer liquid and which can be transported with greater safety. Dynamite is only one of a large number of similar compositions of nitroglycerin. Mixed with sponge or other vegetable fiber, nitroglycerin becomes *porifera nitroleum*; with plaster of Paris, selenitic powder; with red lead, metalline nitroleum; with gunpowder in a fine state of division, lithofracteur or rend-rock; with sawdust, dualin. Dynamite, adulterated with nitrates of soda or potash, is sold as giant powder. These additions are manifestly adulterations, because they are converted into gases, so much more slowly than nitroglycerin that the power of the latter is considerably impaired. One might as well attempt to quicken the electric current by coupling it to the velocity of a locomotive. Give four men a weight to lift which requires the united force of all of them, the exertion of force by any one, later than that of the others, wastes the force of all.

Some of these compounds develop poisonous gases when they are exploded, and cannot therefore be used in tunnels without detriment to the workmen. In the Hoosac tunnel, when they were tried, the men would not pass through after the discharge until a train had re-established ventilation, but preferred to wait for several hours to go home.

Sometimes a diluted form of nitroglycerin is advantageous, provided its price is proportionate to that of the pure article. Where the rock is hard and tough, it is easier to bore holes an inch and a half than only an inch in diameter, because the drilling machine would soon batter up the thinner drill; on the other hand, a charge of nitroglycerin, diluted so as to fill up two thirds of the depth, would be much more effective than if it were concentrated at the bottom. This, of course, does not prove that these diluted compounds are stronger than pure nitroglycerin. At Hell Gate the trinitroglycerin was found to be six times as powerful as giant powder; and, as Professor Morton says, a mixture of 47

parts of infusorial earth and 52 parts of nitroglycerin cannot be coaxed to explode, and might be recommended as a good filling for fireproof safes.

There are several methods of estimating the power of explosive substances. According to the experiments by Nobel and Abel, if the gases developed by the explosion of 2.2 lbs. of gunpowder are confined in the volume of 61 cubic inches, they will exert a pressure of 6,400 atmospheres, and the explosion will disengage 705 calories. The experiments of Messrs. Roux and Sarrau, of Paris, with nitroglycerin and gun cotton, gave 1,784 calories for the former and 1,123 for the latter. Hence, if the explosive force of gunpowder is taken as unity, that of nitroglycerin will be 2.53, and that of gun cotton 1.59.

M. Berthelot computes this force in a different manner. Taking 3,405 grains of nitroglycerin, he calculates that the elements composing it would produce an amount of heat equal to 430,500 calories, if they were transformed into water and carbonic acid; but the heat actually disengaged in making this quantity of nitroglycerin is 130,500 calories; hence the difference between the two figures, 300,000 calories, represents the total amount of heat which the 3,405 grains of nitroglycerin are still capable of developing. This makes 1,320 calories for each 15 grains.

There is one element which seems to have been ignored in these calculations, namely, the time in which an explosive is converted into gaseous matter. It takes a bullet one sixtieth of a second to reach the muzzle of a gun. A charge of gun cotton, in blasting a mine or in a rifle, explodes after the manner of gun cotton; but if fired by means of a suitable charge of fulminate of mercury, it goes off with extreme violence. Nitroglycerin soaked into blotting paper burns rapidly with a voluminous flame when lighted by flame, but detonates violently when spread on an anvil and struck with a hammer, or when fired by means of the initial explosion of a fulminate. Now, velocity of explosion is the very essence of disruptive force. This principle is lost sight of also in Mr. Nobel's method of testing explosives, which depends upon their projectile power. He puts them into a mortar and measures the distance to which they send a ball. Taking the ballistic force of nitroglycerin as 100, he finds for equal weights of other substances the following figures: Compressed gun cotton, 71; dynamite (75 per cent nitroglycerin), 72; gunpowder with 20 per cent nitroglycerin, 50; fulminate of mercury, 30; strongest rend-rock, 50.5; Curtis and Harvey's powder (exploded with a fulminate), 28.

The mistake here is that substances like nitroglycerin, which, by their velocity of explosion, produce the best effect in blasting, are ill adapted to the propulsion of projectiles. They will burst the gun or expend part of their force in crushing the ball, and hence give indications much below their true strength. The real strength of nitroglycerin is probably 8 or 10 times that of gunpowder.

The explosion of nitroglycerin is so rapid and violent that the air above it has no time to move away, but acts like a solid; hence it will act downwards when placed upon the surface of a rock.

The lecturer, in the next place, put upon the table little heaps of dynamite, rend-rock, and mica powder, the latter being his own invention. He called attention to the fact that the mica powder burned with greater rapidity, and claimed that it was a more powerful explosive than the others. All the other compounds are made with a view to absorption of nitroglycerin by some inert substance; and when they are fired, there are two explosions, one of nitroglycerin on the outside of the particles of the infusorial earth, and another of that contained in the foraminiferous interstices. Hence there two weak blows instead of one strong one. In the mica powder, however, which consists of finely divided scales of mica, not more than $\frac{1}{1000}$ to $\frac{1}{10000}$ of an inch thick, moistened with nitroglycerin, there is no absorption, and the whole mass is exploded at once.

Mr. Mowbray then protested against the popular assumption that nitroglycerin cannot be prepared with sufficient purity to remain unchanged, to be safe to use, safe to transport, and safe to store. He has sent 1,000,000 lbs. of his pure limpid trinitroglycerin all over the country in teams, which jolted over rough roads, rolled down bluffs, and broke down; in trains which were thrown off the track; and in sloops which were storm-tossed.

He concluded by hoping that railroad and transportation companies would soon put an end to the clandestine transportation of nitroglycerin under feigned names, by appointing certain days for receiving it.

C. F. K.

Hydrocarbons in Dynamite.

A Rhenish manufacturer of dynamite mixes 2 or 3 per cent of some hydrocarbon, like naphthalene, with the nitroglycerin employed. Two different sorts of dynamite are made, in which the following proportions are employed:

	1st.	2d.
Infusorial earth	23	20
Chalk	2	3
Solution of naphthalene in nitroglycerin	75	70
Barytes	—	7
	100	100

A NEW printing ink is prepared by first dissolving iron in sulphuric, hydrochloric, or acetic acid. Half the solution is oxidized by means of nitric acid, after which the two halves are mixed, and precipitation is produced by oxide of iron. The precipitate is filtered, washed, and mixed with equal parts of tannic and gallic acid, which produces a black bordering on blue. The black is washed and dried, then mixed with linseed oil; and the ink obtained is suitable for either letterpress printing or lithography.

IMPROVED MIDLINGS SEPARATOR

We illustrate herewith a new and simple midlings separator, in which descending streams of moldings are freed from impurities by the action of ascending air blasts.

In the upper part of a vertical draft box, A, are placed a number of inclined slats, B, which break and distribute the flow of midlings and the current of air. Said slats are located at the entrance of a horizontal box, C, along which the particles carried over from the vertical box are transported to the hopper, D, into which the final separation is made by a lighter current up the spout, E. The midlings are fed into box, A, from the hopper, shown above, passing upon a vibratory shoe, F, and their supply being regulated by the slides, G. The bran is discharged through the fan, H.

Below the apparatus thus described is arranged a duplicate set of mechanism in which the midlings falling from hopper, D, are again treated in the same manner by air currents set in motion by the fan, I.

The inventor informs us that he has practically tested the machine with excellent results. One has been in operation in the Oneonta Mills, Oneonta, N. Y., since September last, and has been examined and improved by prominent millers of the vicinity.

Patented March 14, 1876, through the Scientific American Patent Agency. For further particulars address the inventor, Mr. Morris N. Elwell, Oneonta, Otsego county, N. Y.

Artificial Grape Sugar.

The manufacture of glucose or artificial grape sugar from starch has become an important branch of chemical industry abroad, although in this country it is little developed, perhaps because potatoes are not so productive a crop here as there; and our starch is mostly made from corn, and hence is too expensive for profitable conversion into sugar, since any excess of corn is easily convertible into whisky.

Fr. Anthon has analyzed three specimens of grape sugar sirup, made in Bohemia, France, and Germany, respectively, with the following results:

	Bohemian.	French.	German.
Dextrose or grape sugar	48.3	30.1	50.0
Levulose or fruit sugar	6.2	5.0	—
Dextrin	25.5	48.0	—
Water	20.0	16.9	20.0

In the German sirup there was no dextrin, but 30 per cent of some substance soluble in alcohol, and not yet nearer determined.

IMPROVED STEAM RIVETER.

The annexed engraving represents a new machine for riveting together the angle bars, plates, and reverse bars that compose the frames, crossfloors, and keelsons of an iron ship. The parts are first bolted together temporarily, precisely as prepared for hand riveting, and are carried up to the machine by a large and suitably located crane. The rivets are heated in quantities, and are driven about as fast as a boy can put them in the holes prepared for their reception. The driving is done by direct steam pressure upon a large piston which moves vertically. Steam is admitted by the operator pressing the foot lever shown. When the pressure on the lever is removed, the weight on its end descends, and so causes the exhaust to open.

The machine, besides being applicable to the purposes of iron shipbuilding, is especially well adapted for the riveting together of the parts of iron railway bridges or of any work made up of angle, channel, or I beams, or of flat plates associated with them. The capacity of the apparatus, we are informed, is equal to that of ten gangs of hand riveters, and it requires the attention of but one skilled workman, three laborers, and one boy. The riveting, when done, is better than handwork, for the reason that the heavy direct pressure applied forces the heated rivet into every part of the rivet hole, filling it solidly, and this without granulating the iron, as is often the case with hand-driven rivets.

For further information address the manufacturers, Messrs. Pusey, Jones & Co., Wilmington, Del.

Peter Cooper and the Locomotive.

Anything concerning the venerable Peter Cooper and the enterprises he has been engaged in is always interesting. The following account of the first locomotive and the reasons for building it, we find, says the *Iron Age*, in one of our exchanges:

"Mr. Cooper had bought, as a speculation, the entire magnificent tract in Baltimore now owned by the Canton Company. Baltimore was then a city of 75,000 people, rich and prosperous, and had entered upon the railroad era. On July 4, 1828, the corner stone of the Baltimore and Ohio road was laid with imposing ceremonies by Charles Carroll, of Carroll-

ton. It was pushed energetically—a little too much so—for when thirteen miles had been finished it was found that, in turning the rocks to save cutting, such short curves had been introduced that the then experts declared the line utterly useless. It could not be used by steam. Five per cent had been paid in, and shares had been sold at 17, such was the zeal and confidence of the people. But the chill was immense, and everything stopped. Mr. Cooper, then 38 years of age, saw new disasters to himself in the depreciation of his tract should the road fail. He proposed to the directors to construct an engine to be available on their line. They were

"We have heard the account substantially in the same form from Mr. Cooper himself. Several years since he was engaged in the construction of a steam yacht on the East river; and upon one occasion, when visiting it, we met him and had a long conversation on the subject of his early inventions and the little locomotive mentioned. Mr. Cooper went to and from the shipyard in a chaise drawn by one horse, and invited us to return with him. On the ride home he gave us some particulars of the locomotive. The draft was obtained by means of a small fan, and was sufficiently powerful to carry shavings from the firebox through the tubes and up through the smoke stack. The boiler itself was of the vertical tubular pattern. The engine was attached to a car in the usual manner. The importance of the success of the undertaking was very great to Mr. Cooper, as he, in partnership with two others, had bought a large tract of land near the line of the road. He found himself burdened with the whole purchase, as the others were unable to furnish their share of the money; and in case of a fall in the value of the property, his loss would have been very heavy."

Useful Recipes for the Shop, the Household, and the Farm.

A new process for hardening zinc consists in pouring into the metal, while in a state of fusion, a proportion of sal ammonia varying from 34 to 7 ozs. per 22 lbs. according to the degree of hardness desired. Metal thus prepared can be worked with the file and the lathe, and may, in many cases, serve as a substitute for bronze.

A new mode of waterproofing woolen materials consists in boiling 44 ozs. white soap in 24 gallons water. Separately dissolve 54 ozs. alum in 24 gallons water. Heat these solutions to 190° Fah. and pass the fabric through the soap bath and afterwards through the alum solution. Dry in the open air.

To detect grape and cane sugar in glycerin. Mix 5 drops of glycerin with 100 to 120 drops of water, 1 drop of nitric acid, and half a grain molybdate of ammonia, and heat. If sugar is present, the mixture turns to an intensely blue color.

Celebrated Automata.

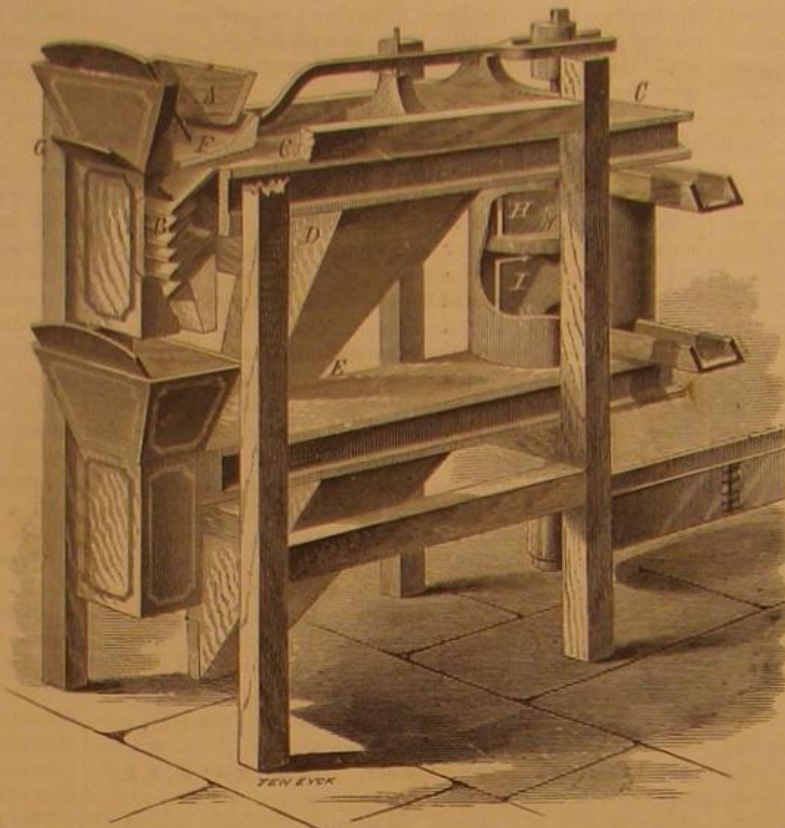
The Philadelphia *Ledger* states that a Walnut street watchmaker, of that city, has recently had in his charge for repairs the famous automaton trumpeter made by M. Maelzel, which was exhibited in Philadelphia many years ago. The first public mention of the trumpeter was in the *Journal des Modes*, for 1809, at which time it was exhibited at Vienna, and attracted much attention. About 1830 M. Maelzel came to this country, bringing with him the trumpeter and also the chess player, another remarkable piece of mechanism, but which was not an automaton in the correct sense of the word, as its actions were controlled by a skillful chess player who was concealed within the figure.

The trumpeter was first exhibited on Fifth street, below Adelphi, in a building which stood where the Messrs. Tatham's building now is. Here Mr. Maelzel had a diorama of the burning of Moscow, which was a favorite entertainment. The universally known Signor Blitz, then a young performer, also appeared, and the trumpeter was exhibited by M. Maelzel, who would wheel it out on the floor, and touch a spring on the shoulder, which started the mechanism. He would then seat himself at the piano and play the accompaniments and variations, while the automaton played army calls, marches, etc.

After remaining on Fifth street for some time, M. Maelzel took his exhibition on a traveling tour, returning to Philadelphia Maelzel afterwards went to Havana, taking Signor Blitz and his automata with him; here he was unfortunate, and becoming dispirited and his health failing, he started for home, but died on shipboard, and his effects were sold to pay his passage.

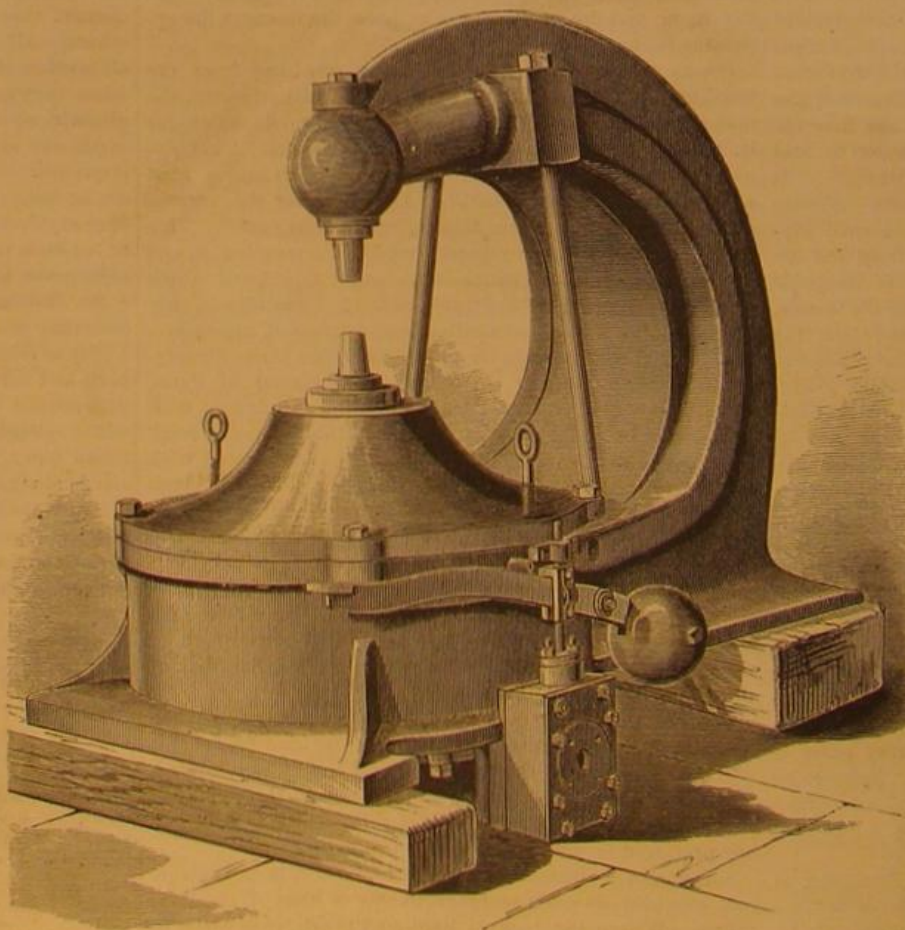
A number of gentlemen, among whom were Dr. Mitchell, Constant Guillou, and Robert Cornelius, purchased the chess player, which was placed on exhibition in the Chinese Museum, at Ninth and Sansom streets, and was lost in the fire which destroyed that building. The trumpeter was placed in the old Masonic Temple, and passed into the possession of Mr. Scherer, a music dealer on Chestnut street, and is now owned by his heirs. The machinery of the trumpeter is contained within the trunk of the figure and is worked by a steel spring which drives a barrel on which are pegs like those in a musical box. A bellows just below the neck of the figure furnishes the wind, and a valve with a steel tongue, which is lengthened or shortened by means of levers working on the pegs in the barrel, makes the different notes.

RESIN 1 part and beeswax 1 part, softened with tallow, make a good grafting wax.



ELWELL'S MIDLINGS SEPARATOR.

willing, but incredulous. He brought down from his glue factory in New York an engine with a 34 inch cylinder and 14 inch stroke, procured wheels and other appliances from the railroad company, and presently rolled out on the track the first American railway engine. The trial trip was to take place the next day. That night a thief stole all the copper and brass from the infant machine, and this caused some further delay. The trial trip was run, Mr. Cooper himself act-



PUSEY & CO'S STEAM RIVETING MACHINE.

ing as engineer; and when the little baby locomotive threatened to lose too much steam, he held down the safety valve with his own hands. The run was made with 30 passengers, 13 miles in 1 hour, and Baltimore was happy. Compare the little engine of 47 years ago with the ponderous machines of to-day! and yet they follow on the pathway the little engine opened."

IMPROVED SPOKE-SETTING MACHINE.

We illustrate herewith an improved apparatus for setting and driving spokes in a rapid and convenient manner, and in such a way that an exact inclination of all the spokes in a wheel is obtained.

A is an adjustable frame which is supported on springs, as shown, so as to be moved vertically by the bolts and crank nuts, B. The hub is placed on a central bolt, and is rigidly secured by a crank nut, C. Above the main frame is the guide or set ring, D, on which the spokes are placed while being set and driven into the hub.

After the hub is fastened in place, the adjustable frame, B, is screwed down until the center line of the hub is on a level with the circle. The hub is then dotted above the leveling straight edge, and the bolts are screwed down until the desired dish or set of the spokes is obtained. This is necessary, as all hubs are made with straight front and sloping back mortises, throwing the outer ends of the spokes forward at the same inclination. It now only remains to rest the spokes upon the guide ring, and to drive them into the hub.

The inventor claims the apparatus to be a valuable aid to the wheelwright, inasmuch as it can fill four wheels while one is being filled in the usual manner. It can easily be constructed by any good workman, and needs no skill for its manipulation. It sets all the spokes at one setting; and in driving, each spoke is tapped in turn until all are driven, thus protecting the brace between the mortises. Being adjustable, any length of hub can be filled. Finally, the machine is well suited for refilling wheels, as the set is got by the mortises and not by the end of the hub.

Patented through the Scientific American Patent Agency, March 25, 1876. For further information relative to sale of rights or machines, address the inventor, Mr. Thomas S. Morgan, New Columbia, Massac county, Ill.

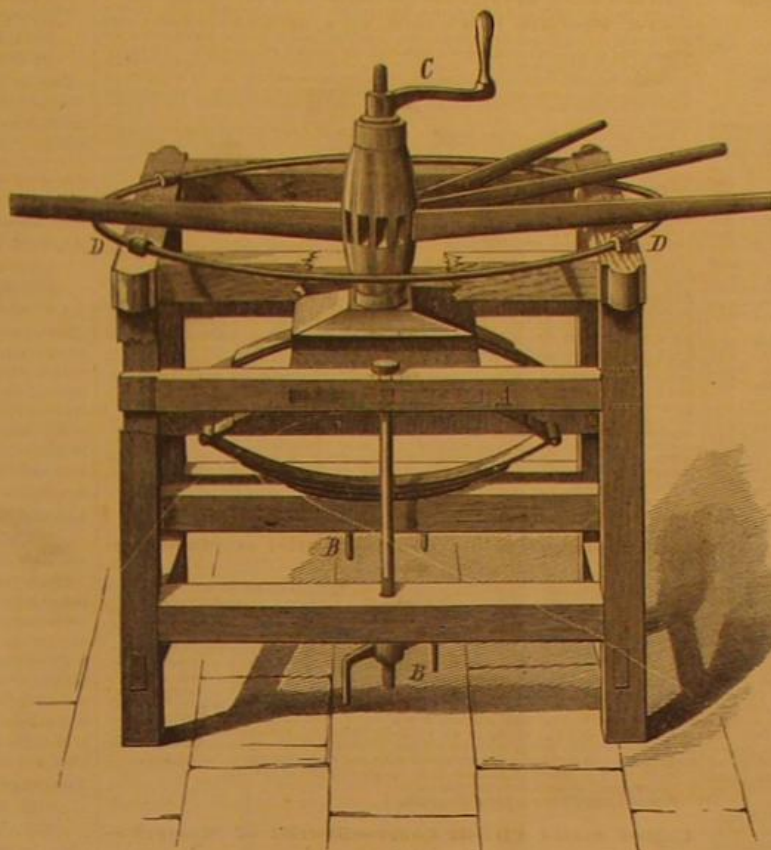
IMPROVED ROWING GEAR.

There are two cardinal objections to the present mode of propelling boats by rowing. The first is that the oarsman is obliged to travel backward and to rely upon occasional glances over his shoulder to direct his course, and the second is that his power is applied to the oar at a very decided disadvantage. The second objection is perhaps the most serious one of the two, inasmuch as it is well known that, just at the most effective part of the stroke, the end, there is where the power is weakest and worst applied. A new device has recently been patented (October 26, 1875) by Mr. William Lyman, of Middlefield, Conn., which gets rid of both of these objections in a very simple and practical manner, and, besides, secures some other advantages which will tend to commend it to oarsmen generally.

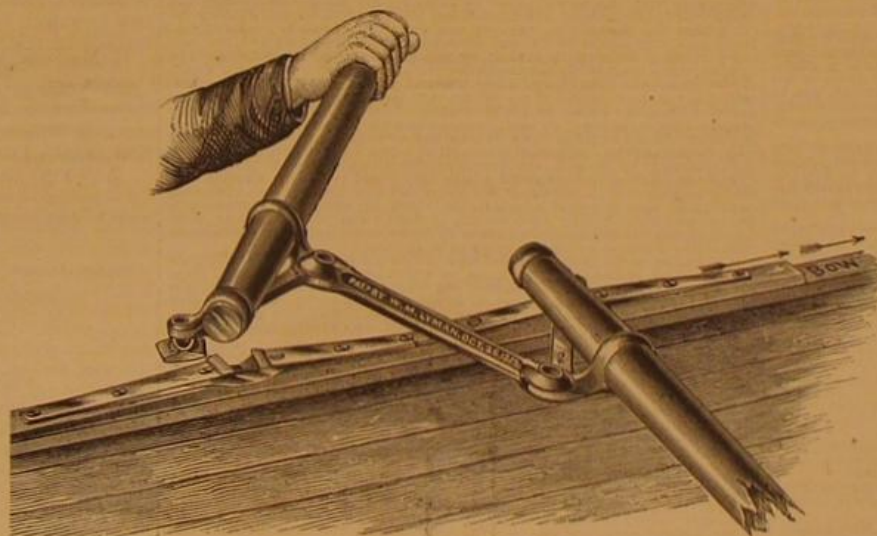
Mr. Lyman cuts his oar in two, and secures each part in a separate iron, as represented in Fig. 1. Each iron has a ball and socket joint which connects to a button, and each button slips into a slot made in the metal facing of the gunwale, and is there secured by turning a pivoted catch. Lastly, the two parts of the oar are connected by a rod hinged to each iron at 1 and 2, Fig. 1.

A moment's consideration will show that when the handle of the oar is pulled in one direction, the blade of the oar will travel, not in the opposite direction, as is usually the case, but in the same direction. Consequently, when the oarsman, seated as in Fig. 2, facing the bow, pulls in the usual way, he propels his boat bow foremost, instead of backing her, as he would do had he ordinary oars. Again, the arrangement of the lever is obviously such that the

the beginning of the stroke. The parts of oars can easily be folded together for transportation, or may be closed up along the side of the boat, without detaching them from the gunwale, when not in use. A pair of the oars thus arranged weighs about five pounds more than ordinary oars, but this additional weight, it is claimed, has the advantage that, at the beginning and end of the stroke, it helps to lower and raise the blade, owing to the peculiar position of the oar.

**MORGAN'S SPOKE-SETTING MACHINE.**

The inventor informs us that last summer he rowed some 400 miles with this gear, spending his vacation in the Adirondacks and the Thousand Islands, and ending his cruise

**LYMAN'S ROWING GEAR.—Fig. 1.**

by a row down the Connecticut river. The oars will be found on exhibition at the Centennial.

For further information, etc., address the inventor as above. The patents for foreign countries are for sale.

Underground Telegraphy in New York City.

The Western Union Telegraph Company have begun the work of laying the telegraph wires in this city underground. Experimental sections, made of iron pipes of a capacity of 125 wires each, are being placed in position, between the Cotton Exchange, the Telegraph Company's buildings, and other points. At the same time, pneumatic tubes for the transmission of written messages by the air blast are also being located on the line of the telegraph pipes. The pneumatic tubes are made of brass.

It is greatly to be hoped that this system of underground telegraphy may be extended throughout the whole city, to the exclusion of the present unsightly poles. That the plan is fully practicable has been amply demonstrated in London and other European cities.

The Discoverer of Bromine.

SCIENCE in general, and photography in particular, has just suffered a considerable loss in the death of M. Balard, who died recently in his 74th year. The illustrious chemist, to whom we owe the discovery of bromine, succeeded Baron Thénard in the professional chair in the Faculté de Sciences, in 1844, and Darcet as member of the Academy. He replaced Pérouse in the Collège de France, in 1851. M. Balard was President of the French Photographie Society, where his zeal for the new art, his great attainments, and his charming urbanity, won the respect and affection of all

Spontaneous Combustion.

"Yesterday, about three o'clock, a disagreeable odor was observed in and about R. H. Delmage's carpenter shop; a search was immediately instituted, and smoke was discovered issuing through a small crack in the floor, but in such a thin vapory state that it was at first taken for dust; a more careful examination revealed the fact that it was really smoke. There being no other means of access, the floor was immediately torn up, when it was found that sawdust had accumulated to the depth of some five or six inches, and of course some saw filings and other debris had become mixed with the sawdust; this combination was thoroughly saturated with boiled linseed oil, which had leaked from a large can placed immediately above it; from this mass the smoke was issuing, and further examination verified the startling conjecture that beneath the surface this composition was all on fire and was actually in a charred state. The surface was entirely unbroken, and smoke oozed slowly out, something as from a coal pit. There was no means of ingress to render it possible to have been the work of an incendiary, and no possible means of the fire in any way having come from above. The only solution of the matter seems to be that it was a case of spontaneous combustion. Mr. R. H. Delmage, the owner of the shop, is a man whose veracity will not be questioned, and, besides, we have the same facts attested by several others who are among the most reliable and intelligent men in this community. Here, now, is a question for scientists. Will a combination such as the above generate fire? If so, the sooner that matter is settled the better. But for the timely discovery, great damage would certainly have been the result.—*Aston (Iowa) Tribune*, May 4.

[We would inform our cotemporary that it is very well known that a combination of oil and combustible materials, such as that above described, will produce spontaneous combustion. Many such examples have been recorded in the pages of the SCIENTIFIC AMERICAN.—EDS.]

Purification of Sulphide of Carbon.

Instead of the usual method of purification with mercury salts, S. Kern recommends the nitrate of lead, pulverized and mixed with a little metallic lead. The bisulphide is shaken with fresh quantities of the salt as long as it continues to blacken it; then it is decanted and distilled. The affinity of lead for sulphuretted hydrogen and sulphur in general leads us to believe that Mr. Kern's method will prove a good one. Strips of bright metallic copper will also soon remove the color and much of the odor from bisulphide of carbon. Unfortunately exposure to light causes both odor and color to return.

WHITE'S IMPROVED WASHTUB STAND.

Housekeepers will, we think, be pleased with the new invention herewith illustrated, which is intended as a useful convenience for the laundry. It combines a hollow stand in which clothes may be kept until the arrival of wash day, an arrangement for supporting washtubs, and an ironing board. The clothes are placed in the receptacle, A, and the inclined opposite ledges, B, serve to receive the tubs. C C are hinged sections which sustain the ironing board, D. The latter fits between two studs at one end, and has at the other two side pivots that enter into section bearings, one of which is open to permit the ready removal of the ironing board when not required for use. The hooks shown on the ends of the stand also serve to hold the sections, C, in verti-



cal position. By closing the sections, C, and placing the ironing board on the stand, a very good bench is formed. The

Fig. 2.

strength of the rower is applied to excellent mechanical advantage, enabling him to pull a stronger stroke and to keep it up much longer than would otherwise be possible. Steering is also rendered much easier, and the catching of tabs is avoided through the oarsman seeing his blade at

apparatus can be cheaply made, and, the inventor states, can be sold at large profit.

Patented through the Scientific American Patent Agency, March 21, 1876. For further information relative to sale of rights, etc., address the inventor, Mr. John J. White, 279 Church street, Norfolk, Va.

DECISIONS OF THE COURTS.

United States Circuit Court—Western District of Michigan.

PATENT PHOTO-PLATE HOLDER.—SIMON WING, ALBERT S. SOUTHWORTH, AND MARCUS ORMSBEE vs. JOSEPH H. TOMPKINS.
(In equity.—Before Wilsey, J. Heard January 25, 1876. Decision April 5, 1876.)

WITNEY, J.: Letters patent were issued to Albert S. Southworth, April 10, 1853, which were surrendered and canceled—September 25, 1860, upon amended specifications, re-issued letters were granted for a new and useful plate holder for cameras. The claim is: "A sliding plate holder, comprising a plate, or several smaller plates, arranged into the field of the lens of the camera, substantially in the manner and for the purpose specified." In describing his invention the patentee, in his specification, states that it had been customary to use a separate plate for each impression, the plate being removed from the camera and replaced by another; where several impressions of the same object were to be taken, as in multiplying copies, or for the purpose of selecting the best timed pictures, this caused considerable time and trouble, to obviate which is the object of my present invention.

Complainants are assignees of the patentee, and it is admitted if the patent is valid that defendant has infringed. The only question I have occasion to examine and decide is whether the patentee was the first and original inventor.

Incidentally the question is raised of abandonment. It is insisted that the evidence shows Southworth to have conceived and perfected his invention as early as the winter of 1847-8, if not earlier. And it is shown that in 1861 the validity of the patent was declared, Wing vs. Richardson, 2d Fisher's patent cases 333; also that there have been sixteen other decrees upholding the letters patent, not all contested cases, however.

On the other hand it is claimed that the proofs show the patented improvement of a sliding plate holder for cameras was known and practiced by photographers as early as 1841 or 1842, and that the patentee did not perfect his invention until the fall of 1854, long after the machine was in use by others: That in 1859, Mr. Justice Nelson, in Wing vs. Schoonmaker, 2d Fisher's patent cases 607, held the patent invalid. The last case was appealed to the Supreme Court of the United States, which court was equally divided, four of the judges for and four against the patent.

But one case, it is said, has since been decided: Wing vs. Dunshee, in the United States Circuit Court for the District of Massachusetts, not reported, in which the previous ruling in that circuit by Mr. Justice Clifford in the Richardson case was followed. The last reported case is that against Schoonmaker, holding the patent for a sliding plate holder invalid, and in which there was apparently important and material testimony not put into the case against Richardson, decided eight years earlier. Presumptively, this would account for the different judgments of the two eminent judges.

In considering the additional testimony in this case, I have necessarily been led to examine the evidence in previous cases, stipulated into this. Briefly, Southworth's patent, owned by complainants, rests upon the fact that one Coburn, in 1846, made for the patentee a camera box, having wings on its side, in which a sliding plate holder could be placed, but no plate holder was made or used in connection with it, or otherwise. The camera was found to be too expensive, and was discarded. Then Southworth had one Stewart make a sliding front to a camera, by which he moved the lens over the plate on which impressions were taken at any desired point; but this process in multiplying pictures on one or more plates required either the camera or sitter to be moved at each separate impression taken, and was in my judgment far from being identical in principle with the sliding plate holder, by which pictures may be multiplied on one or several plates without moving the camera, the sitter, or object.

Nothing further was accomplished by Southworth in perfecting the idea which he evidently had, of multiplying pictures by some sort of an adjustable plate holder, and which he seems to have abandoned when he discarded the Coburn camera, until 1854, sometime after his return from California. In 1849 he went to California and remained nearly two years, till January, 1851, during which time he worked in the mines and gave no attention to the art of photography. When he returned to Boston he experimented some time in reference to the stereoscope, and was in poor health, altogether occupying him till the fall of 1854. In this time he perfected and took out one or more patents for the stereoscope. In the fall of 1854 he had the varioloid, confining him to his room for more than two weeks, and then again he turned his attention to the adjustable plate holder. During that fall he perfected his invention as applied, in December, for and obtained a patent, April, 1855. Southworth states, as a reason why he did not earlier make application for the patent, that he had not perfected the mechanical parts to his satisfaction, so as to carry out his idea readily. When the California excitement came on, and he followed others to the land of gold.

After he was taken with the varioloid in the fall of 1854, he says, he shut himself up in his room, and "I applied myself to this idea of taking pictures rapidly in the center of the lens by adapting the movement in a frame which would fit any ordinary camera. The view of the progress of my invention is not substantially changed by any subsequent testimony, and in my opinion dates his invention of a movable plate holder in the fall of 1854.

This was the judgment of Mr. Justice Nelson in the case against Schoonmaker, in 1859, and in which I fully coincide.

Southworth testifies again in Wing vs. Anthony, in 1874, stipulated into this case. His cross examination he says: "I used the sliding plate holder in a camera as early as 1852." For him to swear to what he thinks he did in 1852, does not establish any fact. It is too late to change ground as to the time of his invention, unless the proofs are stronger than anything before me.

It may be worthy to notice in this connection that if Southworth perfected his invention in 1846-7 or '8, and did not apply for a patent until the spring of 1855, there would seem to be a grave question whether he had not by inches abandoned to the public what he had invented. He makes a faint showing of ill health and want of pecuniary means during some part of the interval, but he had health to visit California and there engage in digging for gold for about two years. After his return he had health enough and money enough to engage "in considering new ideas, new plans, and new inventions relating to the stereoscope and other things connected with our (his) business, studying upon and taking out patents," before he turned his attention to applying for his patent.

If it had not been said in Wing vs. Richardson that there was no abandonment, because the reasons assigned—poor health and want of pecuniary means, excused want of diligence—I should be disposed to say that the six or seven years' delay was fatal to the validity of this patent. The point is raised in this case, but I need not rest my judgment upon it.

The next consideration is whether the sliding plate holder, for multiplying pictures on one or several plates, had been known and used in cameras prior to 1854, and if so, when. I make but brief reference to testimony.

The testimony of W. A. Pratt, taken December, 1873, in the case of Wing et al. vs. Tompkins, is quite satisfactory on the point, corroborated as he is in material portions of his statements.

He says he invented the sliding plate holder at Alexandria, Va., in 1845—presents a model of it and pictures taken by that method—four on one plate, of his son, on his birthday, with the date of taking, at Richmond, Va., endorsed on the back of the plate at the time, "March 6th, 1847."

He opened a gallery at Richmond in 1846. On his sign were the words: "Virginia Daguerreotype Gallery, established 1846;" here he made many thousands of pictures for sale, by this method of the sliding plate holder. He thus made pictures of the members of the Constitutional Convention of Virginia, in 1850-1; names several members whose pictures were taken—also members of the legislature of that state in session in 1850-1. He explained his method of multiplying pictures to others; among them, one N. P. Simons, who testifies to the same fact, and that he used the method in taking impressions. The camera and plate holder used by Pratt were burned at Richmond in the great fire of 1862, hence they are not produced.

William Strickland, of the movable plate holder and process for multiplying pictures on one plate, at Philadelphia in 1852, and in that year used a camera and adjustable plate holder in multiplying pictures.

He fixes the time by a bill rendered for poplar boards used in his gallery in making a revolving platform for taking stereoscopic pictures by this method, bearing date December, 1852, made an exhibit in this case. He also produces a leaf from his Daguerreotype register, in which, under date of August 11, 1852, is an entry of pictures which were taken by this method. One of the pictures is made an exhibit. He also produces the camera and sliding plate holder used by him in taking and multiplying these and many other pictures.

I pass over other testimony of prior use of complainant's patented invention, remarking, however, that the evidence to discredit the testimony of Pratt, and to show that certain exhibited pictures could not have been taken in the center of the focus of the lens, nor by the patentee's process and plate holder, is fully met by the testimony on behalf of defendant on the same subject.

Satisfied, as I am, upon both of the topics discussed, that the patent is invalid, I have no hesitation in so ruling. My judgment is supported by that of Mr. Justice Nelson, in Wing vs. Schoonmaker, in which that learned Judge said: "The proofs are full that the idea of making the same impression on different parts of the same plate by the use of a sliding plate holder existed and was carried into practical operation by working machines as early as 1847-8, and was in use by several practical photographers, some seven or eight years before the date of the patent of Southworth, and before he had perfected his machine."

There has been no ruling in this circuit upon this patent, so far as I know. This fact, taken in connection with the different judgments in Wing vs. Richardson and Wing vs. Schoonmaker, eight years apart, and upon somewhat different facts, leaves me at liberty to follow my own judgment, and especially so in view of the additional testimony put into this case.

A decree will be entered for defendant.

United States Circuit Court—District of Massachusetts.

BOSTON ELASTIC FABRIC COMPANY vs. EAST HAMPTON RUBBER TIRE AND COMPANY.

(In equity.—Before Shepley, J.—Decided October term, 1875, to wit, April 4, 1876.)

SHEPLEY, J.: A former suit between these parties commenced for alleged infringement of letters patent granted to Liveras Hull, dated January 26, 1869, for an improvement in cutting sheets of rubber into threads, was dismissed upon the ground that the patent, as it then stood, was for a machine, and that the machine used by Hull was substantially the same machine as one of prior date known to manufacturers of rubber threads as "the bottle machine."

Since the decision in that case, the patent has been reissued to the complainants, as assignees of Liveras Hull, by release 5,908, dated June 2, 1874, as a patent for an art or process, the claim being "for the improved mode of manufacture, consisting in cutting the sheet into a series of threads by a continuous cut of one cutter," as described in the specification.

At the hearing of the former case it clearly appeared that Liveras Hull, without any knowledge of any prior machine, or of any prior use of an art or process, reissues in the mode described in his specification, had invented both the machine and the mode of manufacture. But it also appeared as clearly that there was proof of a machine of an earlier date than his invention, although it was unknown to him.

It did not quite satisfactorily appear, from the evidence in the former case, that the process or mode of manufacture described by Hull, and now, but not then, the claimant, had been practiced on the anticipated machine, although that mode of manufacture could have been practiced on that machine, or at least on one differing from it only in the enlarged size of the drum on which the sheet rubber is wound. There was no conclusive evidence in that case that Hull was not the first, as he undoubtedly was in one sense an original, inventor of his mode of manufacture. But this issue was not directly involved in that case, the patent, as it then stood, being for the machine, and not for the art or process. Evidence has now been introduced, much of it coming from witnesses who were not examined before, which seems to prove satisfactorily that a machine was constructed by one Helm during the fall of the year 1860, and completed before the 1st of January, 1861; that a sheet of rubber, many yards in length, was wound round and round upon the drum of said machine; that the machine had a single circular cutter which was pushed up to the drum through the rubber at one end of the cylinder; that the drum was then caused to rotate slowly, and the circular cutter to rotate rapidly, and at the same time to traverse slowly along the face of the drum until it reached the other end of the drum, by which operation the sheet of rubber was cut into a series of threads by a continuous cut of one cutter.

This was the same process claimed and described in complainants' patent is too clear to admit of dispute. Complainants contend that the process was only imperfectly carried out, that the thread made was imperfect, and that the use of the Helm machine was merely experimental, and the experiment was abandoned before Hull made his invention.

The law upon this subject is too well settled to require the citation of any authorities.

A patent may be defeated by showing that the thing secured by the patent had been invented, and put into actual public use, prior to the discovery of the patentee, however limited such use (other than experimental) or knowledge of the prior discovery may have been.

Seven witnesses, who are unimpeached and uncontradicted, testify to the public and practical, not merely experimental, use of the patented process, in New Brunswick on the Helm machine, prior to the time of the alleged invention by the patentee. They prove that the threads cut by that machine were good marketable threads, well cut, and publicly made and used in large quantities in the manufacture of both shirred goods and suspenders, and that the fabric made from them was a good shirred fabric and regularly sold in the market. There is some conflict in the testimony as to the subsequent history of the Helm machine, in which this cut by the patented process. That history is not material to this inquiry. We are dealing with the mode of manufacture of the thread. The evidence shows that mode of manufacture to have been practiced, not for experiment, but in the regular course of business, openly, successfully, and practically, within the knowledge of a large number of persons at a time prior to the date of the alleged invention.

Bill dismissed.
(James E. Maynard, for complainants.
George Gifford, Willard, Hyde, and Dickenson, for defendants.)

United States Circuit Court—District of Massachusetts.

HELEN MARIE McDONALD vs. S. M. BLACKMER et al.
(In equity.—Before Shepley, J.—Decided October term, 1875, to wit, April 4, 1876.)

SHEPLEY, J.: Since the disclaimer, which was filed before the date of the bill in this case, the claim of the complainant is limited to that only which was described in the specification of her patent, namely, "as a new and useful article of manufacture, a skirt protector, having a flange, and a border bound with or composed of enameled cloth or other waterproof material." I see no reason to doubt that she was the first and original inventor of this article, as distinguished from a skirt facing, which is an entirely different article, and from a skirt protector, which, being made of wigan or similar material, was substantially useless for the purpose, as compared with the complainant's invention.

Decree for injunction and account, as prayed for in the bill.
(John F. Eaton, for complainant.
Broune and Holmes, for defendants.)

United States Circuit Court—District of Massachusetts.

PATENT GAS APPARATUS.—THE GILBERT AND BARKER MANUFACTURING COMPANY vs. THE WALWORTH MANUFACTURING COMPANY.
(In equity.—Before Shepley, J.—Decided April 4, 1876.)

SHEPLEY, J.: The complainants are the owners of letters patent of the United States, dated August 3, 1869, No. 93,368, for an improved apparatus for carbureting air. The invention is described in the specifications as relating to the apparatus used for carbureting air in the manufacture of illuminating gas for dwelling houses and factories, and as consisting in the arrangement of the carbureter with the meter wheel or pump for driving the air through said carbureter to the burners, and the coil and heating pipes for evaporating the oil within the carbureter, whereby the whole apparatus is rendered perfectly safe with regard to life and property in the building lighted, the carbureter being situated in a vault or house away from the building to be lighted, while the heating apparatus and the pump or meter wheel are within the building to be lighted, and where they can be easily and quickly reached, and under perfect control of the occupant of the house. There was nothing novel in the meter wheel, or the carbureter, or the combination of a meter wheel with a carbureter, or their connection with the gas pipe, air, or heating pipes, except so far as their location and arrangement was claimed to be new, by placing the carbureter in a vault or house by itself, separate from the building to be lighted, and arranging the meter wheel and the heating coil in the building to be lighted where they could be easily reached, and under control of the occupant of the house without exposure to explosion consequent upon frequent access to the room in which the carbureter is placed, and connected by pipes passing through a wall or the ground, so as to cut off any communication of gas or flame between the room in which the carbureter is placed and the building to be lighted.

It is denied on the part of the defendants that there is any patentability in such a change of location of parts, all of which are confessedly old. Mere change of location is not patentable; but where change of location brings into existence a new combination of devices operating by reason of such new combination to produce a new and useful result, such new combination is patentable. (Woodruff, J., in Marsh et al. vs. The Dodge Stevenson Manufacturing Company, 3 Official Gazette, 398.)

I am not prepared to say that the new arrangement and location constituting a new form or mode of combination, as described in the patent, taking into consideration the new and useful result claimed for it, was not patentable. If it was novel at the time claimed as the date of plaintiff's invention. Without instituting a comparison between the patented invention and all the other prior existing forms of apparatus for carbureting air for illuminating purposes, which have been proved to have existed, I have selected the Meriden machine for the reasons that it is proved to have been constructed and operated successfully in the fall of 1864, while the invention of Gilbert & Barker is not even claimed to have been before June, 1867, and also because this apparatus appears to me to have embodied in 1864, in successful and practical and public use, every element of the first claim of the complainants' patent of August, 1869.

The Meriden apparatus was used for carbureting air for illuminating a factory. It consisted of an air pump and air receiver, a well known equivalent for the meter pump wheel, a carbureter, the equivalent of complainants' carbureter, placed in a vault built in the side of the ground and having three feet from the main building to be lighted. This was actually both a vault and a house, and therefore identical with complainants' vault or house. There was an air pipe, which connected the pump inside of the building to the carbureter in the vault, passing underground and furnishing a conduit from the air in the pump to the carbureter, being thus the equivalent of complainants' pipe A. There was a gas pipe leading from the carbureter in the vault through and underground, and furnishing a conduit for the carbureted air or gas from the carbureter to the building to be lighted. This is identical with complainants' pipe N. There was also a steam pipe with its connections, but that is not material to the inquiry involved in this case, because the defendants do not use any artificial heat, and the complainants do not make their heating coil and pipes a part of the arrangement and combination claimed in the first claim.

The Meriden apparatus contained every element of location, arrangement, and combination claimed in the first claim of complainants' patent. There are many other references to the patent and the drawings, and other comparisons between the described inventions and arrangements other than those of the Meriden apparatus which might be made confirmatory of the view I have taken; but those already stated seem so conclusive to my own apprehension that further illustration would seem to be superfluous. It follows that the bill must be dismissed.

Bill dismissed with costs.
(E. W. Stoughton and William Stanley for complainants.
Causten Browne and James S. Holmes for defendants.)

NEW BOOKS AND PUBLICATIONS.

ARCHITECTURAL IRON WORK, a Practical Book for Iron Workers, Architects, Engineers, etc. With Specifications for Iron Work, Useful Tables, and Valuable Suggestions. By William J. Fryer, Jr. Illustrated. Price \$3.50. New York city: John Wiley & Sons, 15 Astor place.

This book is the best specimen which has reached us of a new trade literature which is now springing up to answer a demand created by the extensive use of iron in architecture, not merely for the rods and girders, but as a building material. The author is evidently thoroughly acquainted with his subject, and his book is an exhaustive treatise on the science and art of building in iron. The specifications are admirably drawn, and the tables of proportions, weights, and loads for iron work of all kinds are full and complete. The book is well illustrated, and is a clear, practical treatise, adapted for workmen and owners of buildings as well as for the engineering profession. It is, moreover, free from those technical expressions which too often impair the value of such works for practical workmen.

VILLAS AND COTTAGES, OR HOMES FOR ALL: Plans, Elevations, and Views of Twelve Villas and Ten Cottages, Suited to Various Wants and Locations. Designed by William L. Woollett, Fellow of the American Institute of Architects. Price \$3.00. New York city: A. J. Bicknell & Co., 27 Warren street.

Judging from the number of books on villa architecture which reach us, there must be a lively demand for rural and suburban residences just now;

and it is gratifying to observe the increasing neatness and propriety of design which characterize them, and the gradual disappearance of the grotesque and clumsy attempts at ornamentation which disgraced the homes of the last generation. In internal convenience and sanitary arrangement, there is also a marked improvement. Mr. Woollett's designs, shown in 40 well executed plates, fully justify the above remarks, being marked by good taste and ample provision for supply of light and fresh air. The brick buildings illustrated in this book are especially commendable for the substantial and effective use of this material, which is in most respects the best ever employed in building human habitations.

CHEMISTRY, THEORETICAL, PRACTICAL, AND ANALYTICAL, as applied to the Arts and Manufactures. By Writers of Eminence. To be completed in Forty Parts, price 50 cents each. Philadelphia, Pa.: Lippincott & Co., 715 and 717 Market street. For sale by James Sheehy, 33 Barclay street, New York city.

This book, says the title page, is constructed on the basis of the late Dr. Sheridan Muspratt's "Chemistry as applied to the Arts and Manufactures," and it is to that widely circulated work that the new publication, an installment of which is now before us, owes its chief recommendation. There is, however, some new matter in it, and the modern notation is introduced. The work would be more readily adopted as an authority if the names of the "writers of eminence" were given. A work of this magnitude ought not to be published anonymously.

ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES FOR 1874. By F. V. Hayden, United States Geologist. Washington, D. C.: Government Printing Office.

Professor Hayden is engaged in a work of national importance, and is carrying it out in a thoroughly efficient manner. In his account of his labors during 1874, he describes the topography and geology of Colorado and some parts of the adjacent territories; and the botanical and palaeontological features of the country explored have not escaped observation. The work now being done by the expedition is an immense one; and a perusal of one of Professor Hayden's reports enables us to fully appreciate it. The book is well and liberally illustrated, the photographs who travel with the expedition being constantly at work as the party progresses.

LADIES' FANCY WORK: Hints and Helps to Home Taste and Recreations. By Mrs. C. S. Jones and Henry T. Williams. Price \$1.50. New York city: H. T. Williams, 46 Beekman street.

This is the third of a series of useful volumes which the above named publisher is issuing, with the design of collecting, in permanent form, an immense number of hints and suggestions relative to tasteful household ornamentation, some of which, hitherto, have appeared in family newspapers, while others have been known only to few individuals. The present book tells how to make fancy work of all kinds, including paper and wax flowers, shell, leaf, and moss ornaments, bead and worsted work, and the thousand knick-knacks of ribbon and cardboard which ladies delight to manufacture. It is copiously illustrated, handsomely bound, and the descriptive matter is plain and easily followed.

ENGINEER'S AND MECHANIC'S POCKET BOOK. By Charles H. Haswell, Civil, Marine, and Mechanical Engineer, etc. New York city: Harper & Brothers, Franklin Square.

Mr. Haswell's engineer's pocket book has been before the mechanical public now for over thirty years, so that there is little necessity for here recapitulating its contents. It is one of the best, if not the best, of handy books of reference extant; and it must be a matter of some difficulty to suggest any useful practical facts or tables which are not to be found somewhere among its 700 pages. The present edition is the thirty-second, and is fully up to the times, through fresh and careful revision of the contents. It is strongly and handsomely bound in leather, in pocket book form, and can be obtained, postpaid, by mailing \$3.00 to the author, at 6 Bowling Green, New York city.

CATALOGUE OF THE FISHES OF THE BERMUDAS. By G. Brown Goode. Washington, D. C.: Government Printing Office.

This work is one of a series intended to illustrate the natural history collections constituting the National Museum, which were entrusted to the care of the Smithsonian Institution by Act of Congress in 1846.

CENTENNIAL COLLECTION OF NATIONAL SONGS. Price 40 cents. New York city: C. H. Ditson & Co., 711 Broadway.

A collection of songs, more or less familiar, which will probably be welcome to many people in this year of celebrations.

Inventions Patented in England by Americans.

(Compiled from the Commissioners of Patents' Journal.)

From March 28 to April 24, 1876, inclusive.

AIR BRAKE, etc.—Empire Vacuum Brake Company, New York city.
AIR GUN, etc.—A. A. Pope, Boston, Mass.
AIR PISTOL.—A. C. Carey, Malden, Mass.
BATH TUB.—A. Seligsberg, New York city.
BENDING TUBE PLATES.—S. P. M. Tasker, Philadelphia, Pa.
BENDING TUBES, etc.—C. Scofield, Vineland, N. J.
BINDING SHEAVES.—S. Johnston, Brockport, N. Y.
BOOT, etc.—R. S. Manning, Trenton, N. J.
BOOT-LASTING MACHINE.—F. S. Hunt, Lynn, Mass.
BOOT-SEWING MACHINE.—C. Goodyear, Jr., New York city.
BRISTLE-DRESSING MACHINE.—E. B. Whiting, St. Albans, Vt.
CAKE MACHINERY.—G. W. Nelson, New York city.
CARTRIDGE ANVIL.—J. Saget, New Orleans, La.
CHAIR.—W. T. Doremus, New York city.
DENTAL APPARATUS.—H. C. Howells, Flushing, N. Y.
ELASTIC SEAM.—J. Bigelow, Boston, Mass.
ELECTRIC ENGRAVING MACHINE.—J. C. Guerrant, Danville, Ill.
ENGINE VALVE.—E. Purvis, New York city.
FRED WATER HEATER.—H. N. Waters et al., West Meriden, Conn.
GAS APPARATUS.—W. H. St. John, New York city.
GAS METER.—J. Morgan, New Orleans, La.
GAS STOVE, etc.—C. F. Brooker, Wolcottville, Conn.
GRAIN CONVEYER.—N. G. Stmonds, Boston, Mass.
HOOF EXPANDER.—C. H. Shepard, Elizabeth, N. J.
HORSESHOE NAIL, etc.—J. B. Willis, Keeseville, N. Y.
INJECTOR.—J. Fergus, Philadelphia, Pa.
MACHINE GUN.—F. L. Bailey, Indianapolis, Ind.
MAGNETIC MACHINE.—J. B. Fuller, New York city, et al.
MANGLING APPARATUS.—W. G. Lewis, Framingham, Mass.
MASHING GRAIN, etc.—R. d'Heureuse, New York city.
MINING MACHINE.—F. M. Lechner et al., Columbus, Ohio.
OBSERVATORY.—L. B. Sawyer, Boston, Mass.
PAPER BOXES, etc.—S. Wheeler, Albany, N. Y.
PAPER-CUTTING MACHINE, etc.—W. Scott, Chicago, Ill.
PIPE NOZZLE, etc.—M. Clemens, Worcester, Mass.
PLAYING CARDS.—I. N. Richardson, Malden, Mass.
PRESERVING FABRICS, etc.—W. Thimpany, Cleveland, Ohio.
PYROTECHNIC SIGNAL.—E. F. Linton, East New York, N. Y.
RAILWAY WHEEL.—A. Atwood, Brooklyn, New York, et al.
REFRIGERATOR, etc.—J. H. Wickes, New York city.
SAFETY CHECK, etc.—J. E. Winner, Philadelphia, Pa.
SAW FASTENER.—N. Thompson (of Brooklyn, N. Y.), London, England.
SHIP ALARM, etc.—F. X. Wagner et al., New York city.
SMOKING PIPE.—R. S. Manning, Trenton, N. J.
SPARK ARRESTER.—D. R. Proctor, Gloucester, Mass.
SPINDLE CAP.—C. Weller, Philadelphia, Pa.
SPITTOON.—J. C. Moore, Philadelphia, Pa.
TEXTILE FABRIC.—S. Barlow, Lawrence, Mass.
THERMOMETER.—G. W. Schumacher, Portland, Me.
TREATING ORES, etc.—R. McC. Fryer, New York city.
TREATING FEAT, etc.—J. N. Rowe (of Rockland, Me.), Liverpool, Eng.
TREATING WOOL, etc.—J. M. Dick, Buffalo, N. Y.
TUBE CLEANER.—C. B. Rogers, Saybrook, Conn.
UMBRELLA, etc.—G. B. Kirkham, New York city.
VENERS-CUTTING MACHINE.—H. T. Bartlett et al., New York city.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED DIE FOR MAKING WASHERS.

Jacob Greenwald, Buffalo, N. Y., assignor to himself and William L. Wallace of same place.—This is a die for cutting washers and similar articles at one operation, being intended to be used with a common drop press or punch. The invention consists in making the movable die in two sections that are screwed together, and attaching the central punch by shank and screw nut to the lower section.

IMPROVED WINDLASS WATER ELEVATOR.

Ezra M. Robards, Hutchinson, Kan.—This is an improved apparatus for raising water from wells by wind wheels or other power. It is so constructed that two buckets may be raised and lowered alternately, while the power moves continuously in the same direction.

IMPROVED RUBY PIN INSERTER FOR WATCH MAKERS.

Carl H. E. Bechert, Oroville, Cal.—This is a new form of spring nippers for inserting ruby pins in the rollers of lever watches.

IMPROVED WINDMILL.

William Ford, Great Bend, Kan.—This is a novel contrivance of the wind wheel, whereby the fans are self-adjusting to the wind, and the wheel is kept to the wind without a tail vane. It also consists of a contrivance of apparatus for automatically regulating the speed of the wheel.

IMPROVED ELECTROMAGNETIC CAR BRAKES.

Philip V. Conover, Keatchie, La.—This consists in the employment of an electric helix and a sliding piston in connection with the ordinary car brake mechanism.

IMPROVED FIREMAN'S ELEVATING LADDER.

Berthold Huber, Brooklyn, E. D., N. Y.—This is an improved extension ladder, which may be raised vertically or inclined at any desired angle. It is constructed on the lazy tongs principle, the sides being brought together and the apparatus extended, by said sides being connected to two toothed sections which are turned by hand-crank gearing.

IMPROVED MACHINE FOR MAKING CORES.

William J. Reagan, Pottstown, Pa.—This consists of a revolving stand, to which a number of core boxes of different diameters are hinged, the length of the cores being determined by adjustable pistons carrying the core-supporting vent pins.

IMPROVED SCREW-CUTTING MACHINE.

Charles W. Roberts, Cohoes, N. Y., assignor to Norman W. Frost, of same place.—The object of this invention is to improve the construction of the machine known as the C. W. Roberts pipe-cutting and threading machine and vise, so as to make it more convenient in use and more effective in operation. It embodies a number of useful and novel improvements, mainly in construction, which it is hardly possible to describe without the aid of drawings.

IMPROVED FEED MECHANISM FOR THREAD WINDING.

Ambrose Giraudat, Neuve (Norwood P. O.), N. J.—This is an ingenious machine for winding threads for making stamens for artificial flowers, and for other uses. It winds the threads regularly and at equal distances apart, or at a greater or less distance as may be desired.

IMPROVED RAILROAD RAIL CHAIR.

John L. Rahmstreck and Charles W. Rahmstreck, Rahway, N. J.—In this device a movable plate is made to fit between the rails and the inner surface of a lock flange, and is provided with toes and wedges, constructed and arranged to operate in connection with each other.

FRICTIONAL GEARING.

Moses Ray, Valley Grove, West Va.—This invention relates to the transmission of power to machinery through smooth-faced friction wheels, and consists in arranging the shaft that drives the machinery in bearings that are held forward with greater or less pressure, according to the character of the work, while it will yield to any undue strain to avoid fracture or injury to any part of the machinery.

IMPROVED METAL-CUTTING MACHINE.

Jacob Schofield and Joseph Stevens, Newton, Ia.—This machine is for shearing off pieces of iron of different thickness, and comprehends two cutting jaws, of which the lower jaw is adjustable to different heights, while the upper jaw is brought down by suitable lever power.

IMPROVED MACHINE FOR MAKING TWIST DRILLS.

Edward S. Taber, New Bedford, Mass.—This is a machine for making twist drills with increasing pitch or inclination of the grooves. It consists of a graduated cam combined with the mandrel which advances the blank along and revolves it to the cutters, which causes the advance of the mandrel to increase in speed as the work progresses, and thus increases the pitch.

IMPROVED MIDDINGS SEPARATOR.

Joseph P. Reel and Andrew J. Seyler, Cedarville, Ill.—This invention comprises a reel in which the fine middlings are first separated from the light coarse matters to be discharged, and air blast apparatus and sieves for separating the remaining middlings from the residue passing out of the tail of the reel.

IMPROVED HOSE COUPLING.

George W. Price, San Francisco, Cal.—This invention consists of a tapered ring outside of the hose, said ring screwing into one of the parts of the coupling over another tapered ring inside the hose, so as to bind the hose and thus attach it to the coupling. There is also a kind of detachable hinge joint at one side of the coupling, and sliding keys and hoods at the other side, for fastening the two parts of the coupling.

IMPROVED CUT-OFF FOR WATER CONDUCTORS.

William P. Myer, Terre Haute, Ind.—This cut-off is adapted for leaders of buildings. It is easily shifted to direct the water into one or the other of the discharge pipes, and will always indicate in what position the shifting spout may be set.

IMPROVED FRED WATER HEATER.

Samuel N. Hartwell, Wollaston Heights, Mass.—This consists mainly in the combination of a feed water heater with a grease condenser, through which the exhaust steam is passed, the steam then being drawn to the heating chamber, to which the feed water is conducted in a spray through a coiled pipe with perforated end. The air which accumulates in the heating chamber is drawn off by an air pipe leading to a flue.

IMPROVED CAR COUPLING.

Martin V. Remaly and Joseph F. Kinnard, Kittanning, Pa.—This car coupling couples readily without the stepping in of the attendant. It consists of a drawhead having a central bottom rib, with side openings or recesses for the coupling link to swing therein. The coupling link rests, by a central cross piece, on the rib, and couples with a pivoted hook of the drawhead of the adjoining car.

IMPROVED TOOTH-PICK MACHINE.

Leonard Anderson, Palmsville, O.—This invention consists of a couple of veneer cutters, one on each of the two opposite sides of the mandrel carrying the rotating block, and a splitting wheel for splitting the veneers into picks. The latter is geared with the mandrel which revolves the block in such a manner that the cutting and the splitting wheel move up to the block in the same measure that it is reduced by the cutters, thus automatically cutting the blocks into picks, without further attention, after the block is put on the mandrel.

IMPROVED STOP WATCH.

Henri A. Lugrin, New York city.—This invention consists, first, of a quarter second hand and its dial, located on the top of the watch movement instead of the face, whereby the hand can be geared with less complication of machinery than when located on the other side; second, of a minute hand located on the same side of the movement and at one side of the center post, so as not to interfere with the quarter second, in combination with a short section of a dial to be used, if necessary, for counting minutes; third, of the adjusting lever, for shifting the quarter second back to the starting point, also arranged for shifting the minute hand back at the same time.

IMPROVED MACHINERY FOR DRESSING LEATHER.

Harrison D. Chamberlin and Justus P. Luther, Berlin, Wis.—This is an improved machine for scouring leather when taken from the vat, and substitutes machine labor for the tedious process of scouring by hand by means of a machine. It is a combination of the stones and brushes applied to pivoted arms of a revolving shaft. Guide rings or weights hold the stones and brushes to their work.

IMPROVED HAIR-HEADING MACHINE.

Ella J. Crosby, Sabula, Iowa.—This is a rubber-covered base piece, in connection with an adjustable sorting piece, that swings above the base piece and heads the hair by friction therewith.

IMPROVED WINDMILL REGULATOR.

Solomon Vermilya, Plain View, Minn.—This is an improved regulator for windmills, and consists of a friction pulley operated by a fulcrum and weighted lever in connection with a governor, the pulley operating a windlass that throws the wheel in and out of the wind.

IMPROVED LIFTING JACK.

John B. Fayette and Lorenzo Meeker, Oswego, N. Y.—This improves the construction of the lifting jack, for which letters patent were granted to same inventors, July 13, 1875, so as to give it a greater range and a greater accuracy of adjustment. When a movable tube standard has been adjusted at the proper height, it is locked in place by turning an eccentric. This construction enables the jack to be accurately adjusted to any desired height.

IMPROVED EARTH AUGER.

Oscar Rust, Macon, Mo.—This improvement relates, first, to the form of cross section of the body of the auger, whereby the draft or force required to operate it is reduced; and, secondly, to the construction of the head of the auger, and parts connected therewith, whereby it is adapted to slide up and down on the boring shaft, so that it may be removed from the well or hole without raising the shaft, and whereby also certain other advantages are attained in practical operation of the auger. It is an improvement on letters patent granted on August 3, 1875, to the same inventor.

NEW TEXTILE MACHINERY.

IMPROVED FULLING MILL.

Joel M. Baldwin, Evans' Mills, N. Y.—This improvement in fulling mills consists, essentially, of a shaft running through a middle opening in the hammer heads, and working them by an eccentric in said opening. By this, space is economized, the mill can run faster, and the contrivance can be located above the floor. The improvement also consists of a construction of the box and frame in part of metal, making a more permanent mill.

IMPROVE WARP TENSION REGULATOR.

Alexander M. Pyfe, Cornwall, Canada.—This is an improvement in the class of warp tension regulators in which the roll, over which the warp passes from the warp beam, is arranged to be shifted in position, corresponding to the beat of the lathe, by means of levers connected with the latter. By the arrangement the roll will move toward the harness when the lathe swings back after beating up, and at the same time the shed opens; and when the shed closes the roll will move back again as the beat-up takes place, thus relieving the warp of undue strain by the shed, and at the same time making uniform tension.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED BARBED FENCE WIRE AND BARB FORMER.

William H. Jayne and James H. Hill, Boone, Iowa.—The first is an improved four-pointed fence barb, composed of two pieces of wire bent into the form of a U, from opposite sides of the fence wire, in such a way that the bend of each piece may be between the arms of the other. The arms are bent down upon and around the said fence wire, leaving the four points projecting in opposite directions. The same inventors have also devised and improved a fence barb former, which is an improvement on a similar device for which letters patent were granted to them January 18, 1875. The invention consists in an improved barb, four slotted disks, and the three handles, connected together and operating so as suitably bend the wire.

IMPROVED WIRE FENCE TIGHTENER.

William F. Daniels, Lime Spring, Iowa.—In using the device a bar is hooked upon the wire, and a cylinder is put in in such a way that the wire to be tightened may pass into its slot between the arms of the bar. The cylinder is then turned, winding the wire around it, until the said wire has been drawn to the desired tension, where it is held by a pawl and ratchet wheel.

IMPROVED TOY BOX.

Joseph Kayser, New York city.—This is a box for candles, collars, and other purposes, which produces, by the opening and closing of the drawer, a change of pictures on the top part of the box.

IMPROVED GLAZED PLAID PAPER.

John F. Marsh, Springfield, Mass., assignor to Springfield Glazed Paper Company, of same place.—This is a new method of manufacturing glazed plaid paper, consisting of the following steps consecutively performed, namely, coating the paper with an ordinary glazing preparation, ruling the glazed surfaces in suitable colors and designs, and finishing or glazing the coated and ruled surface by polishing or pressing the same.

IMPROVED COFFEE SHELLER.

José A. Mosquera, Caracas, Venezuela.—This is a machine for shelling coffee in a rapid manner, so that the beans are freed from the shells or pods without being crushed or broken. It consists of a grooved and notched revolving cylinder that breaks the shells in connection with suitable knives. The lower separating knife is placed nearer to the cylinder than the upper breaking knife.

IMPROVED BAYONET.

Samuel W. Hill, Pittsburgh, Pa.—This is a ramrod and bayonet combined in one device, and so constructed that it serves for both purposes equally as well as the ordinary ramrod and bayonet do for their respective purposes.

IMPROVED MIRROR.

Henry Goldberg, Herkimer, N. Y.—This is a reflecting mirror, suspended from the ceiling by means of straps attached to the sides of the frame, passing over pulleys on the ceiling and attached to a single adjusting strap. It can be conveniently manipulated by a person standing between the ordinary mirror and the suspended reflecting mirror.

IMPROVED REVOLVING SCRAPER.

Edward Huber, Marion, O.—This invention consists in inwardly curved upward extensions formed upon the rear ends of the sides of the scraper, and in an apron attached to the cross bar of the handles to overlap the back. The extensions rest upon the earth when the scraper is tipped over, to prevent the earth from being scraped up by the back. The apron prevents the earth from slipping over said back.

IMPROVED CAKE CUTTER.

James Collins, Central City, Col. Ter.—This consists of a cutter with a central sliding and spring-acting part for forming and cutting, simultaneously with the outer part, the article to be produced.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED VENTILATING CAR.

Edward C. Ibbotson, Chelsea, Mass.—Diaphragms of wire are placed beneath the portion of the roof which extends over the platform. Above the diaphragms are chambers which communicate with the interior of the car, and also with cowls on the roof. The air enters under the diaphragms and escapes by the cowls.

IMPROVED GATE.

Emerson Lyon, Stoughton, Mass.—This gate is suspended on rollers, attached to hangers from an upper cross bar. For the passage of wide or high loads the gate is pushed back, so that it and the bar are balanced upon a post, and the gate and bar are then swung around upon the pivot of the post into a position parallel with the roadway.

NEW HOUSEHOLD ARTICLES.

IMPROVED DISH CLEANER.

Robert W. Chappell and Isaac Mayfield, Spencer, Ind.—This invention consists in connecting a chamber for holding the dishes or other articles with the upper part of a pump cylinder by a pipe, and with the water tank by a spout; also, in using a gate and rack in connection with the dish chamber.

IMPROVED STEAM COOKING APPARATUS.

Stillman Wilkins and James D. Murphy, Abingdon, Ill.—This consists of a series of traps, through which pass concentric tubes. When the cooking is to be wet the bottom of the section is made flat, and the part of the tube above said bottom is close, or made without perforations. When the cooking is to be dry, the bottom of the section is concave, and the part of the tube above said bottom is perforated, so that the water of condensation may flow down through the said tube. Any desired number of sections or trays may be used, and the upper section or tray is provided with a conical cover, which brings the steam to the center.

IMPROVED STOVE PIPE THIMBLE.

Charles Inward, Riceville, Iowa.—This is an improved thimble for connecting a stove pipe with a chimney, or with a wall or ceiling through which it passes. It is formed of an inner part, provided with the collars, and an outer part, made in halves. One half is made in one piece with the inner part, and the other part is hinged at one edge to the edge of the first half, and secured at its other edge by a hand screw and lugs.

IMPROVED CLOTHES WRINGER.

Samuel F. Leach, Chelsea, Mass.—This is an improvement in the clothes wringers formed of two elastic rolls arranged to work in frictional contact and rotate in opposite directions. The object is to reduce the friction incident to the use of such wringers in consequence of the pressure of the springs. To this end a pair of spiral springs is applied at each end of the rolls, and they are connected at their upper ends with a cross bar carrying small friction rolls, which are mounted in a small frame and bear on the journal of the upper roll. The journals of the lower roll are supported on similar friction rolls.

IMPROVED STEP LADDER.

John Calvin Blauvelt, Blauveltville, N. Y.—This mainly relates to an improved construction, whereby a step ladder may be readily adjusted for use as a ladder, without it being necessary to turn it away from the wall or other object.

IMPROVED METHOD OF MAKING TEA AND COFFEE.

Jonathan Miller, Himrod's, N. Y.—This invention relates to a new method of preparing decoctions or infusions of tea, coffee, etc., and it consists in the method of filling a tight and unyielding chamber full of the ground coffee or tea, and then passing the hot water through the same, whereby the expansion of the grains consequent upon the absorption of the water produces a considerable pressure, which, in the unyielding chamber, fills up the little interstices or channels between the grains, thereby preventing the fine dust or pulverized portions of the coffee from being washed through and compelling the water to permeate the pores of the coffee grains in its passage through: the said expansion in the filled chamber acting in the nature of a press, so that the bulk of the coffee is held as in a solid mass below the supernatant water.

NEW AGRICULTURAL INVENTIONS.

IMPROVED FRUIT PICKERS' BASKET.

Orville W. Odell, Woodhull, N. Y.—This is a bucket so constructed that the picker can lower it and empty the fruit without coming down from the tree and without injuring the fruit. The novel features consist in arrangements for allowing the bottom to open and the fruit to escape.

IMPROVED CULTIVATOR.

Casper Oehlein, St. Paul, Minn.—This invention may be adapted as a furrow opener, to make furrows for the reception of the seed, and rakes may be attached to it for cultivating potatoes, by loosening the soil and tearing up weeds.

IMPROVED CHECK ROW PLANTER.

Joseph Rothchild, Shelbyville, Ky.—In this machine are embodied new and ingenious devices for dropping the seed at a greater or less distance apart, the adjustments of which are effected by a simple lever motion.

IMPROVED WHIFFLETREE ATTACHMENT FOR PLOWS.

Thomas B. Baldwin, Troy, Pa.—This consists of the roller commonly connected to the plow beam, for gauging the depth of the furrow. It also holds up the whiffletrees and the traces, and prevents the horses from stepping out of the traces.

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Temples and Oilcans. Draper, Hopedale, Mass.

All Fruit Can Tools, Ferracute W'ks, Bridgeton, N. J.

Notes & Queries

W. P. will find something on the use of petroleum in boilers on p. 164, vol. 30. As to zinc in boilers, see p. 315, vol. 34. Engineers of pleasure steamboats must be duly licensed. See p. 228, vol. 32.—C. H. B. will find a table of the values of metals on p. 169, vol. 32. We publish an Index in each volume.—C. S. R. will find directions for galvaniz-

ing cast iron on p. 346, vol. 31.—W. H. D. will find directions for making friction matches on p. 75, vol. 29.—D. J. will find a recipe for paint for outdoor work on p. 409, vol. 31. Celluloid is described on p. 23, vol. 33.—J. McG. will find a recipe for waterproof glue on p. 42, vol. 32.—H. D. E. will find directions for separating alumina from clay on p. 91, vol. 32.—J. L. W. is informed that we cannot recommend a boiler scale preventive unless we know what impurities the water contains.—M. M. H. is informed that his query as to the wagon wheel is answered on p. 263, vol. 31.—J. T. R. should consult a physician.—W. J. will find an answer to his query as to pitches of gas pipe threads on p. 378, vol. 32.—C. L. R. will find a recipe for rubber cement on p. 263, vol. 30.—W. M. will find a treatise on taxidermy on p. 159, vol. 32.—A. B. H. will find a description of the process of refining petroleum on p. 340, vol. 26.—J. R. will find directions for bronzing castings, on pp. 11, 85, vol. 33.—J. B. K. will find directions for annealing gold on p. 299, vol. 28.—D. C. W. can cement rubber to cloth with the compound described on p. 263, vol. 30.—J. J. H. should address a manufacturer of air compressors.—L. M. will find directions for straightening wire on p. 299, vol. 34.—G. W. E. will find directions for making Vienna yeast on p. 185, vol. 33.—W. N. S. will find directions for making marine glue on p. 42, vol. 32.—A. L. L. will find directions for making rubber stamps on p. 156, vol. 31.—F. R. B. should address the manufacturers of the rifle in question.—E. T. C. will find directions for fireproofing shingles on p. 280, vol. 28.—F. M. H., A. L. H., E. P. B., H. A. T., J. A. B., J. B. K., A. B. R., W. M., W. P. M., B. O., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) J. S. B. says: I have a room divided by a partition wall, over which is a space of 2 feet; and I wish to know how mirrors may be placed so that a person in one room can see a particular point in the other? A. Place a mirror over the partition in such a position that it will reflect the light coming from the desired point in one room to the observer in the other.

(2) A. McC. says: 1. There is an engine in this vicinity 18x24 inches; it runs at 90 revolutions a minute with 60 lbs. steam, and cuts off at 1/2 stroke. It is estimated to supply about 50 horse power. It takes steam from two boilers, each 4 feet in diameter by 14 feet long, each containing 56 three inch tubes. The grates are 4 1/2 x 8 1/2 feet, and are set 22 inches from boilers. The bridge wall is 6 inches from boilers, and there is a good draft. This engine requires on an average 1 1/2 tons of Illinois coal per day of 10 hours. The company are greatly dissatisfied at the amount of coal burnt, and wish to find some way to reduce it. Is the amount unreasonable? A. Under the conditions stated, the engine is not working as economically as could be desired. 2. Can you suggest any improvement in the setting of boilers? A. Before making any change it would be best to find out the cause of the excessive consumption, whether it is due to defects of the engine or inefficiency of the boiler, and this could only be determined by experiment.

(3) W. J. McG. asks: 1. When was the planet Uranus in perihelion? A. Uranus will be in perihelion in January, 1883. 2. Were Mars and Jupiter in aphelion during October, 1874? A. Yes, Jupiter on the 24th, Mars on the 25th. 3. What angle will the equator have to the ecliptic at the middle of the next Platonic year? A. A Platonic year is a period of time determined by the revolution of the equinoxes. This revolution, which is calculated by the precession of the equinoxes, is accomplished in about 25,000 of our years. Assuming that the Mosiac record of creation is correct, this world is now near the end of the first quarter of the first Platonic year, and astronomy has not informed us exactly in what position the earth will be in 30,000 years hence; but from the latest observations, the angle will be between two and three degrees less than at the present time.

(4) H. B. asks: How can I calculate at what rate of interest, compounded yearly, \$2,000 is of the present value of 120 monthly payments of \$40 each, first payment due at the end of one month? A. We believe it would be necessary to solve this by interpolation, calculating present values for different rates of interest. Some of our readers may be interested in making the solution.

(5) J. D. R. says: A brother and myself are about building a small steamboat, but differ in regard to the kind of engines. We want to use 2 engines 10 inches in diameter, to drive a main shaft at 20 to 25 revolutions per minute. My brother contends that 10x12 engines, geared so as to make 4 revolutions to one of the shaft, would be best, while I contend that 2 engines 10x8 inches, attached directly to the main shaft, would be less liable to break and use no more steam. Which would you recommend? A. We think your plan is preferable.

(6) M. C., Jr. says: I am using 2 engines (on the same shaft, working at right angles to each other) 8 1/4 inches in diameter and 30 inches stroke, making 30 revolutions per minute, with an indicated boiler pressure of 85 lbs. to the square inch. How many feet of 2 inch gas pipe (entirely surrounded by cold water) will it take to condense the exhaust steam from those engines, and leave the water so condensed at a temperature of 170° Fah.? Can I attach the end of the 2 inch pipe to my feed pump directly, in place of the air pump, and so force the water back into the boiler as fast as it is condensed? A. We do not think you can make this arrangement work very satisfactorily.

(7) S. F. H. asks: 1. What would be proper dimensions for a steam yacht about 20 feet in length? A. Make it of 5 feet beam and 2 feet draft. 2. What would be the proportions of an engine, boiler, and screw, and the pitch of screw

necessary to drive the boat at a speed of 5 to 10 miles an hour? A. Use a propeller 2 feet in diameter and of 3 feet pitch, and an engine 3 by 5 inches. Boiler should be 28 inches in diameter, 3 1/2 feet high.

(8) Y. E. says: 1. We have twin tubular boilers, the tubes of which have been in about 4 years, and are now giving out. We have had 3 new ones put in since last summer, all in the lower row. They all crack where they are expanded, just behind the front boiler head. As I think 4 or 5 years too short a time to last, I want to know if you can assign any cause for their failure. We use tannate of soda, and the tubes are not badly scaled. We use common tallow in cylinder, and heat the feed water with exhaust steam. A. It is not uncommon for tubes to give out in this time, even with careful management; and as in other cases they last much longer, the result is commonly attributed to defective material. 2. When we blow some water out of the boilers (which we do once or twice a day) and open the blow-off cock wide, there is a heavy jarring in the boilers, the check valve rattles, etc. I think this is caused by the connecting pipes between boilers and mud drum being too small. Can said jarring injure the tubes? A. The jarring you speak of certainly does no good, and we think it would be worth your while to have it stopped. 3. How was Mr. L. Cooper's boiler of 1 inch gas pipe (described in No. 13 of your current volume) built? A. Mr. Cooper will perhaps oblige this and several other correspondents by replying. 4. Are self-packing or steam-packed rings in cylinders generally considered better than common cast iron rings tightened with springs? A. There is considerable difference of opinion on this subject. 5. Will a glass water gage, placed about 6 feet from boiler and connected thereto by half inch pipe with two elbows, show the height of water correctly, or should the pipes be larger, or the gages be nearer the boiler? A. It would be better to use larger pipes.

(9) W. E. D. says: 1. I have a second hand upright iron boiler, 12 inches in diameter and 4 feet long; when new, it was tested to 130 lbs. pressure. Would it be safe to put in 12 one inch gas pipe flues, and use it for running an engine? A. We think it would answer with a single flue through the center. 2. Which way would be the best to set it, upright or horizontal? A. Set it upright. It would be well to test it before use.

(10) E. A. McC. says: 1. I have for several years used large quantities of peaty muck for bedding stock, and as an absorbent of the liquid manure and the gases from manure while fermenting. The bedding and green muck forms from a half to two thirds of my compost, which I consider very valuable after heating for several weeks and turning once or twice. I have now a pile of peat muck which was put in wet last fall, with two wheelbarrow loads of green horse manure at the bottom to start the heating. A few days since, with thermometer at 40° outside, the pile showed, at 18 inches below the surface, a temperature of 126°. Professor Kedzie, of the Michigan Agricultural College, says that this brown peat muck, so abundant in our Michigan swamps, is worthless. Is this a fact? A. Professor Kedzie's opinion is very probably correct. 2. Does heating benefit or injure it? A. It is to some extent beneficial. 3. Can sulphuric acid be used, on green peat, as a heating agent? A. No.

(11) L. H. E. asks: Having the area of an ellipse, how can we find the two diameters? A. You must assume one.

(12) C. D. P. F. says: In a country place we use water from the river, and it is not clear. We pump by steam through some 1,000 feet of pipe to a cistern about 150 feet above the river level. By the peculiar formation of the river bank, we had to place the steam pump some 20 feet above the river, and the question is what kind of filter we should use, and where it should be placed. We had a small box filled with sand placed in the cistern, and the pipe leading to the house, but it was so small it would not answer. In addition, the iron pipe stains the water; and having been affected by water taken through a galvanized pipe from the well, we are prejudiced against this form and also lead pipes. How can we clean the iron pipe to prevent the discoloration? A. As to filtering the water, see p. 267, vol. 34. We presume the iron rust shows itself in the water only when the pump is first started, and the water afterwards runs clear. If this is so, you should arrange your pipe with faucets to admit of discharging this discolored water outside of your cistern, and also to exhaust your pipe when not in use, that the water may not then stand in it.

(13) J. O. asks: 1. What is the best material to use in the division wall of a double house? I have tried a brick one, but one can easily hear in the next house. A. Where you have tried brick your wall was probably only 8 inches thick, and the floor joints meeting at the center of the wall, they left, in shrinking, open crevices through it. If you make the wall 12 inches thick, and place 4 inches of brick between the ends of the floor joists, your wall will be tight enough.

(14) J. B. T. says: We have been heating a new church, 40x60 feet, with a single hot air furnace in the basement, placed in the center, about 20 feet from the front, with one large register in middle aisle, directly over furnace. The church is only one story high, and the excavation in the cellar, where the furnace is placed, runs across the whole width of church and extends back to the furnace. There are two open windows about 2 feet square inside walls of cellar, about 4 feet from front. One of these has a trough about 1 x 2 feet, running in horizontally, about 12 feet parallel with front wall, for cold air. There is no ventilation in ceiling. Our trouble is that in very cold weather we cannot get the thermometer (placed about 4 feet above floor) higher than 58° or 60° Fah., yet with this amount of heat below, the air in the gallery that runs across front of church, about 12

feet high, is so hot as to be almost unendurable. Can you tell me what will remedy this? A. Try a ventilating register under each window, communicating indirectly with the exterior air; this will enable the heated air in the upper part of the church to expand, and drive out the cold vitiated air at the bottom.

(15) O. O. J. asks: 1. Can the stroke of a common slide valve of an engine be lengthened by the eccentric? A. Yes, by employing an eccentric having more throw. 2. Which is the most economical in fuel, to set the valve at a quarter of an inch lead, cutting off at one half stroke, or at one sixteenth lead, cutting off at three fourths stroke, engine running at 80 revolutions a minute? A. Cutting off at the half stroke would be the most economical. Your condition of lead should be just reversed, however, since, the longer the steam follows, the greater the necessity for lead. 3. Is common black oil good to put in a boiler to keep it from scaling? A. Some people recommend it, but the value of an anti-incrustator depends on the quality of the water used.

(16) A. B. C. asks: Will I lose power by belting a saw and grist mill so that the belt will run from bottom of driver toward driven pulley, and returning on top? A. It is better to run the belt the other way; but the difference, if the belt is given ample width for its duty, will not be practically appreciated unless the belt is very long, or of very common leather.

(17) J. J. asks: 1. Is it possible to caseharden cast iron? A. Yes. 2. Could car axle journals be hardened by the application of any substance while in motion, so as to become harder by friction? A. Not more than they would be by the casehardening which ordinarily takes place on a surface subject to friction under a pressure. 3. Is chilled cast iron or casehardened iron the hardest? A. There is a very little difference in favor of chilled cast iron.

(18) O. D. asks: Why are rubber gaskets injurious to boiler plate? I have several manhole plates in my boiler, and the edges of the sheet iron corrode away quite rapidly. What action, if any, does the rubber have on iron? A. Possibly the sulphur induces a chemical corrosive action.

(19) J. D. J. asks: 1. Can the lap on a slide valve be increased or diminished, so as to make it cut-off at any point desired, by setting the eccentric so as to give the valve more or less lead? A. No. 2. You say that a person who wants to run a stationary or portable engine in New York city must furnish a certificate of competency to run an engine. Where can he get the certificate? A. Inquire at the police station of the district.

(20) G. S. N. says: My engine is 2x6 inches with a fly wheel 15x24, making 200 revolutions per minute. I wish to drive a lathe whose changes of speed on cone pulley are 6, 5 1/2, 4 1/2, and 3 1/2 inches. What sized pulley must I have on drive shaft to give the lathe the proper speed? A. Use one 10 inches in diameter.

(21) P. F. says: If the packing rings in a cylinder were subjected in their travel at one point to a steam pressure of 275 lbs. to the square inch, and at another point in their travel to 75 lbs., what would be the result in one year's use on a locomotive running 100 miles a day? A. The packing used under the greatest pressure would wear the most.

(22) G. B. asks: Will glycerin have any poisonous effect on the system, if used to preserve meat, fish, etc.? A. No. Glycerin is not injurious.

(23) E. W. asks: 1. In what part of the earth's revolution around the sun is our planet at the average distance from the sun stated by astronomers? A. The distance stated by the books is a mean between the shortest and longest distance. 2. How much does the orbit vary in distances from the sun? A. The difference is about 3,000,000 miles.

(24) Sprague & Co., Glenwood, Iowa, say: In our issue of April 15, you tell H. S. Jr. that his engine, of 2 1/4 inches bore and 5 1/2 inches stroke, is rather too small to drive the engine lathe of 16 inch swing. We have an engine (our own make), of 2 3/4 inches bore and 4 inches stroke, that drives a 20 inch swing engine lathe, 6 foot iron planer, drill press, shop grindstone, and milling barrel for foundry, and about 40 feet of main line shaft all at once, with 80 lbs. steam in boiler. It makes 220 revolutions per minute, and cuts off at 3/4 of the stroke.

(25) H. P. B. says: 1. We have two boilers, one upstairs and one down. Can they be connected so that we can draw from the lower when there is not enough hot water in the upper, for a bath room? A. Yes.

1. Of what are eggshells composed? A. Mostly carbonate of lime. 2. Can they be made use of? A. They are used in medicine.

(26) H. A. J. says: We mine clay by sinking large pits, 50 feet in diameter at the surface, hoisting the clay out by means of a derrick and hoisting engine. These pits are often sunk to a depth of 50 or 60 feet, and our trouble lies in getting out the water. We are now hoisting it out with a large hoghead, having seen nothing that we thought was more easily worked. It is impossible to let a steam pump down, as the sides are slanting, and, if broken, would cave in. Can you tell me of any pump, worked by hand or steam power, that would overcome the difficulty? A. From your description we think you could put in what is known as a submerged pump, to be worked by levers wherever desired, or a steam siphon or vacuum pump.

(27) W. W. S. asks: 1. How is carbon, such as forms in gas retorts, worked into regular shape? A. By sawing. 2. Which is the most powerful electric battery? A. Grove's battery is one of the most powerful. The negative element consists of a thin strip of platinum placed in a porous cell

containing nitric acid. An amalgamated zinc casting, contained in an outer cell nearly filled with water, serves as the positive element. The water is acidulated with from 10 to 12 parts by weight of sulphuric acid.

(28) S. H. K. asks: Can the Gramme magneto-electric machine be constructed of hand power capacity, and its light practically adapted to magic lantern illumination? A. We think not, unless it might be in conjunction with one of Gas-siot's carbonic acid vacuum tubes.

(29) G. H. E. says: I have made a telegraph instrument. I put on the magnet 1,000 feet of No. 32 wire, covered with cotton, but it does not work. I am sure the wire is on right. I intend it for a relay, but when attached to a battery it does not show the least attraction. How many feet and what size of wire should I use for the instrument to be worked with a hundred miles of wire? A. You need three or four times as much wire to get good results.

(30) M. A. W. says: I have made a battery with zinc and carbon plates. I ground coke and mixed with it molasses and baked it, for the carbon, and used old scrap zinc amalgamated for the other plates. Each is fastened to a strip of pine-wood, screw cups rising above for connection. Both are suspended in a porcelain cup, containing a solution of bichromate of potash, sulphuric acid, and water. The zinc is acted upon very perceptibly; but on bringing the wires together, there is no current, nor the least sign of a spark. I have seen a battery, to all appearances the same as mine, that was a powerful one. What is the trouble with mine? A. A battery of that description gives little or no spark. If the connections are properly made, it should work a small telegraph sounder very well.

(31) F. H. M. says: 1. I have a wooden house standing about 600 feet from the sea. In rear of the house, about 15 feet away, is a large rock, and another stands about 10 feet in front. Do you advise me to put a lightning rod on my house? A. A good rod, properly attached and having a good earth connection, will certainly offer great security to the house. 2. Is any danger from lightning incurred by using the wires of a district telegraph company? A. Theoretically, yes; but we have never known harm to result from this cause.

(32) B. D. asks: Is it necessary, in order to secure the safety of a building against lightning, to have two ground connections? A. If it were possible to have one ground connection with no appreciable resistance, that would be sufficient. It is better, however, not to depend upon one ground unless you are sure that it is a good one. Earth connections, as generally made by lightning rod men, are, 9 times in 10, worse than useless.

(33) J. M. says: 1. Please inform me if, in making an induction coil, the primary and secondary coils are connected in any way, or only wound upon each other, with insulator between? A. They are not; keep them well insulated from each other. 2. Is the battery connected with the two ends of the primary, and the shock received from the two ends of the secondary? A. Yes. 3. What size of iron wire shall I use for the bunch in the core? The magnet is 6 inches long x 1 1/2 inches diameter. A. No. 18 or 20. 4. Will 6 (No. 1) cells of Leclanché's battery be enough? A. Yes, but the circuit should only be closed for a few moments at a time if the Leclanché battery is used.

(34) F. E. says: 1. I am making an induction coil and battery. The coil is 8 inches long and intended to be about 6 inches thick. Primary wire is 1 1/2 inches in diameter, and secondary 1/8 inch, the sizes you gave in answer to a former question. Primary wire is 100 feet long, and secondary 1,200 feet. Primary is covered with cotton, secondary with silk. Both are covered with thin narrow strips of cotton and silk respectively, lapping about 1/4 to 1/2 inch, kept tight with a little sealing wax here and there. The battery is a 1/2 gallon one cell Grove. Are these proportions right, and is the machine strong enough to give good shocks? The coil is 5/8 inch in diameter, and is composed of 80 iron wires. A. You will not get much spark without greatly increasing the length of the secondary, but such a coil will give severe shocks. 2. How can I make the simplest current breaker? A. A spur wheel with spring contact is one of the simplest. One side of the circuit is connected to the wheel, the other to the spring. By turning the wheel, the current is interrupted as the spring falls from one tooth to another. 3. Will a 1 inch wide piece of thin platinum foil be the correct size for the above battery? A. Yes. 4. Can I make the porous cup of plaster of Paris, very thin, so as to be quite as good as earthenware? A. Plaster cups do not answer. Use clay cups.

(35) A. S. says: Please inform me if a way has been invented to telegraph a person's own handwriting. A. Yes, several. Caselli's pantelegraph has been used for commercial business in France. By this system, pictures as well as writing can be transmitted.

(36) E. M. R. asks: 1. How can I strengthen a steel magnet that has lost its power? A. By passing each half several times in the same direction over the opposite poles of a strongly charged electromagnet. 2. Why will not a register work on a long circuit? A. Because the current is too much weakened by the resistance of the line. Register magnets are ordinarily wound for circuits of low resistance. By rewinding with small wire, and greatly increasing the number of convolutions, they can be made to work very well on long circuits.

(37) C. H. F. says: I have a new constant current 20 cell battery. Can I apply any attachment that will give an interrupted current for medical use? A. A small magnet placed in circuit, and connections so made that the latter is broken every time the magnet attracts its armature, might answer.

(38) M. L. L. says: I have observed some points in experimenting with an ordinary line relay of forty ohms on a line four miles long, having five other relays of the same resistance in circuit, which seem very peculiar; and I shall be glad if you can assist me to an explanation of them. I prepared a dark box, as used by Edison in experimenting with the "etheric" force, but instead of the common pencils I used two lumbermen's pencils, with points cut square across, which were 1/4 inch wide and 1/8 thick. I connected a wire from one of the pencils to one of the main line connecting posts of the relay, and one from the other pencil to the armature; and upon opening the key I noticed through a 3/4 inch hole in the box, a white spot of light (not a spark) the size of a silver three cent piece, which was only visible upon opening circuit; and after opening circuit two or three times the spot would disappear entirely, and it would require line adjustment of the pencil points to get the light again. I again tried the experiment with another pencil, the points of which were 1/2 inch square, and I only got the center part or strip of the spot, about 1/4 inch wide. I can get similar results by connecting the wire to the core bar of the relay instead of the line post. A. Unless the spot was due directly to the battery current, as it most likely was, you have been deceived by reflection or irradiation. Further experiment will make this evident.

(39) G. D. P. asks: What chemicals are used in automatic telegraphy to prepare the paper for receiving dispatches? A. The best solution for this purpose is the following: Water 100 parts, nitrate of ammonia 150, yellow ferrocyanide of potassium 5.

(40) C. A. says: 1. Please give a description of the Siemens and Halske galvanic cell. A. Siemens and Halske's battery is a modification of the sulphate of copper cell. It consists of a glass jar in which a copper disk is placed. Over this is a bell-shaped tube of unglazed porcelain through which vitriol is dropped as required. The jar is about half filled with paper pulp, and on this is put an annular disk of brown paper or cotton cloth. The zinc rests on the paper in a solution of zinc sulphate. 2. What are its internal resistance and electromotive force? A. The electromotive force is the same as the Daniell's cell, but the resistance is considerably higher, though not so high as to prevent the use of the element for local.

(41) A. F. B. says: What is the best form and size to make an electromagnet, not over 3 inches long, to develop the greatest attractive or lifting power with all the battery needed for the purpose? With what size of insulated wire should the cores be wound, and about how much should be put in a coil? A. Make a soft iron horseshoe magnet. Use No. 14 copper wire, 100 feet in a coil.

(42) A. B. says: 1. I wish to make a magnet with a core 2 1/2 inches long, made of soft iron. What should be the diameter of the core? A. This depends upon the battery used. 2. What size of cotton-covered copper wire should I use? A. Use 240 feet of No. 16 copper wire, and two or three cells of Daniell battery will be found effective.

(43) B. L. asks: 1. In working a foot lathe, shall I be able to use a lighter fly wheel by fixing a spring to assist the return motion? A. Yes. 2. Shall I lose any power by applying said spring? A. Yes, a little.

(44) W. L. asks: Can you give me a recipe for a soldering liquid that will mix with oil? A. We do not know of any such preparation.

(45) H. and H. ask: Can you give us a recipe for bleaching chair cane? A. Have you tried sulphurous acid or chlorinated lime? If the cane be freed from grease by a little solution of carbonate of soda, there should be no difficulty.

(46) A. W. asks: Is there any way of taking the stain out of red or stained cotton without injury to the staple? A. Send us a piece of the goods in question, plainly marked with your name and address.

(47) J. H. H. asks: Is there a liquid, solution, compound, or any substance that is adhesive to tin and insoluble in linseed oil? A. Melt together in an iron pot equal parts of pitch and gutta serena. Use while hot.

(48) J. C. R. asks: How can kerosene stains be removed from marble? A. Cover the stain with hot pipe clay and allow to cool gradually. Repeat the operation if necessary.

(49) A. S. asks: How can I keep oil paint, used on flags, soft, so that the paint will not break when perfectly dry? A. Try the following: Dissolve 2 1/2 lbs. good yellow soap in 1 1/2 gallons boiling water, and grind the solution while hot with 1 1/4 cwt. good oil paint.

(50) W. R. H. asks: 1. What is there in refined kerosene oil that causes it to cut rubber tubing? A. Kerosene oil partially dissolves rubber. 2. Can any substance be added to the oil to counteract the effect? A. There is nothing that can be added to the oil that will prevent this action.

(51) M. F. G. asks: Please give me a recipe for making black ink, with a rich gloss. A. A fine gloss may be given to any good black ink by the addition of a suitable quantity of sugar. For the preparation of inks, see numerous recipes in back numbers.

(52) E. H. asks: What is the proportion of the compound salts used for the bichromate batteries? A. In 1 gallon of water dissolve 10 ozs. bichromate of potash; to this add 1 pint of strong oil of vitriol. When cool, it is ready for use.

(53) R. M. A. asks: Can you give me a simple and effectual solvent for paint? A. Rub quickly over the surface a strong solution of potash in alcohol, and rinse immediately in water to remove traces of alkali.

(54) W. H. A. asks: What can you recommend for an oven lamp in place of gas, which we are now using in three rotary ovens, which require light inside? A. In a somewhat similar case, we have known a good variety of coal oil to give satisfaction.

(55) N. A. W. says: I have been trying to hermetically seal tin cans containing cold fruit, after exhausting the air with an air pump; but the air rushes back into the can. How can I successfully and perfectly perform the operation? A. Solder a tube made of some easily fusible alloy into a suitable opening made in the can. Then fill the vessel with the fruit, and seal every other opening except the tube; place the open end of the tube in connection with the vacuum chamber of the air pump, remove as much as possible of the air, and, by the application of a hot flame or iron, close the tube close to its junction with the can.

What is caustic ammonia? A. Spirits of ammonia (*spiritus ammoniac causticus*) is prepared by passing gaseous ammonia into rectified spirit (alcohol) which absorbs it. Caustic ammonia, liquor of ammonia, or aqua ammonia is a strong solution of the gas in water.

(56) J. D. McC. asks: Is there any chemical process by which the disagreeable smell can be taken from coal oil without destroying the virtue of the oil? A. Agitate for some time with strong oil of vitriol, wash with clean water, and finally agitate with lime water, and allow to settle.

(57) J. E. P. says: One of your correspondents was good enough to advise me to use gum tragacanth with white pigments, and to spray with caoutchouc dissolved in naphtha. I find the latter makes a dirty solution, and I have no guide as to proportions. How is this solution prepared? A. In order to facilitate the solution of the caoutchouc it is better to use a large excess of the gum. Allow solution to go on for about 12 hours; strain through a linen cloth, dilute largely with fresh naphtha, and filter through clean filter paper. If the solution is too dilute, allow it to evaporate until of the required strength, which experiment will best teach you. We do not think this preparation is a commercial article.

How are the figures of ferns and other flowers produced on fine muslin? I have heard that the spray or atomizer is used for this purpose. Can you give me the process? A. Use an atomizer containing a solution of one of the aniline colors.

(58) C. H. K. asks: I send you some samples of waterproof material which will do for covering furniture, but are not waterproof enough for outdoor work. I use glycerin in the manufacture; but when I put water on the articles it draws the glycerin out, and, when dry again, the surface cracks. Can you tell me any way of avoiding this? A. Try dipping for a moment in a clear but weak solution of caoutchouc, and allow the solvent to evaporate in the air. By this means a delicate transparent film of the india rubber will remain, adhering strongly to the cloth.

(59) A. G. N. asks: 1. Would galvanized iron rope be suitable for a lightning conductor? A. Yes. One about half an inch in diameter is preferable to smaller sizes. 2. How should the point be joined to the wire, and of what material should the point be composed? A. Points can be made of any metal; galvanized iron points answer very well, and may be fastened by soldering.

(60) W. B. C. says: My cistern water has suddenly become very hard. How can I soften it? A. Try the addition of a little lime water. This will decompose the bicarbonate of lime held in solution, and fall with it to the bottom as an insoluble powder. Allow to settle for a short time before using it. Experience will teach you the proper proportion of the lime solution to add.

(61) J. F. asks: What is resorcin, and how is it made? A. Resorcin ($C_6H_4O_2$) is a compound isomeric with pyrocatechu and hydroquinone, and homologous with orcin. It is obtained by the action of melting potash upon galbanum, a gum resin imported from Africa. To prepare it, the resin, freed by alcohol from its gummy constituents, is fused with 2 1/2 to 3 parts hydrate of potassium till the mass becomes homogeneous. Water is then added, the liquid acidulated with sulphuric acid, and filtered when cold; the filtrate shaken two or three times with ether; the ethereal solution distilled, and the residue, after being evaporated to a certain extent over the water bath, is introduced into a retort and distilled over an open fire. The first portion of the distillate is watery and contains volatile acids; but afterward an oily liquid passes over, which soon solidifies in radiating crystals. The product may be freed from adhering volatile acids by dissolving it in a small quantity of warm water, supersaturating with barryta water, and again agitating with ether. On removing the ether by distillation, there remains a sirupy liquid which soon crystallizes, and may be further purified by redistillation. Resorcin is very soluble in water, alcohol, and ether, insoluble in sulphide of carbon and in chloroform. It crystallizes only from very concentrated solutions, in tabular crystals or short thick prisms. When first prepared it is quite colorless, but acquires a faint reddish tint by keeping or by exposure to the air.

(62) P. R. asks: What will cure cancer in a child's mouth? A. We believe your trouble is *cancrium oris*. It occurs in children of debilitated habits, between the ages of two years and five. The symptoms are generally these: The child is out of health and evidently weak, and on one cheek is a hard indolent swelling. On examining the cavity of the mouth, a whitish or ash-colored eschar is seen in the center of the cheek, which gradually increases until the slough has spread over the whole of the interior of the cheek, lips, and gums. The saliva is copious, and horribly fetid. There is great constitutional disturbance; pulmonary complications are very apt to arise and the disease frequently ends fatally. The

treatment consists in the application of the nitrate of silver to the slough, in frequently syringing the mouth with solutions of chloride of zinc or chlorinated soda, and in the free administration of strong beef tea, wine, or brandy, and chloride of potassa in decoction of bark.—Tanner.

(63) H. L. S. asks: How can I find the most favorable spot for an artesian well? A. The only way in which a question of this kind can be settled with certainty is by boring. We do not know of any reliable work that teaches how this practical method can be avoided.

(64) A. E. P. asks: Is the pressure on a dam increased by the amount of flow back from the dam, or is it increased only by the perpendicular height of the water? I claim that it makes no difference as to the amount of flow or water stored, but a friend thinks it does. A. You are right, as we understand your question.

(65) F. M. J. asks: 1. If a flue in an upright tubular boiler springs a leak under water, and we plug both ends with the flue in the boiler, is there any danger of the plugs boiling out? A. Yes, unless they are secured by a bolt passing through the tube. 2. Is the pressure in the flue greater than that in the boiler? A. No.

(66) G. C. says: We have an engine 8 x 16 inches, carrying 60 lbs. pressure. How fast should we run it for economy? A. At from 140 to 150 revolutions per minute.

(67) E. L. asks: 1. How can I draw a normal to an ellipse, from a point located outside of the ellipse? A. Draw straight lines from the point to the foci of the ellipse. The line bisecting the angle, so formed at the given point, will be the normal. You will find the properties of ellipses explained in any good treatise on conic sections.

(68) G. W. M. says: 1. I have a boat, 18 feet long and of 6 feet beam, with a propeller of 14 inches diameter. Can I run the boat with an engine 3 x 3 1/2 inches, and a boiler 30 inches long and 24 wide? A. The propeller is rather too small. 2. What size of steam pipe should I have? A. Steam pipe 3/4 to 1 inch in diameter. 3. How fast can I expect to run her? A. You may realize a speed of 5 miles an hour.

(69) J. T. asks: 1. What is the difference between a high and a low pressure engine? A. One has a condenser, and the other exhausts into the air. 2. Why will a low pressure boiler, carrying 40 lbs. steam, run a boat as well as a high pressure one carrying 150 lbs. steam? A. You must be mistaken in your statement. Can you verify it?

(70) W. H. says: I wish to construct a water engine to run a screw-cutting lathe of 9 inches swing and 4 feet bed. Our hydrant water has a force of 64 lbs. per square inch. I have been informed that one could be constructed similar to a steam engine, but with enlarged ports. Is this so? A. A wheel would make a more efficient engine. There are numerous forms of water engines in the market, and it would be well for you to address their manufacturers.

(71) J. H. K. says: I have been running an engine and boiler for 7 years; the boiler is tubular, and I find that, where the steam goes direct from the steam chest into the heater, there is an incrustation on the lower part of the boiler over the furnace, of 1 1/2 to 2 inches in thickness. The boiler became cracked in two places, and commenced leaking. I then took out the boiler, examined it closely, and found that the flues of the boiler were entirely surrounded or covered with a lime sediment. Can you recommend any thing to put into the water to prevent the accumulation of any further incrustation in the boiler, and to take off the present sediment from the flues? A. We would recommend you to blow off some of the water, at least once a day, and about once a month clean the boiler, letting the water run out, twelve or twenty-four hours after the fire is hauled.

(72) J. J. R. says: I have an ordinary furnace in the basement of a 3-story house. The furnace has a sheet iron cover, which becomes hot and radiates in the cellar. Could I check the radiation by blanketing the cover with asbestos or other felting? A. Yes.

(73) J. A. says: Three plain cylinder boilers, side by side, were 30 inches in diameter and 40 feet long, with a 3 inch water connection at the bottom, and a steam drum on top, 8 feet long and 20 inches in diameter, with a connection with each boiler. There was a safety valve in center of drum, 8 inches above the top of the drum. They were filled up to the safety valve, and then the pressure was put on up to 85 lbs. on the inch. One joint leaked so that we had to make it afresh; it was under the safety valve casting; after taking off the weight, the engineer said that two or three barrels of water ran out of the valve, and the valve was the highest point of the boilers. I verified this myself. Can you explain this? A. From your description it seems probable that, while the boilers were being tested, they were stretched or distorted considerably, so as to have greater volume, and that, when the pressure was relieved by raising the safety valve, the boilers contracted and the water poured out at the highest point. We have frequently called attention to the ill effects likely to arise from the cold test, and always recommend that the boiler be filled with water and gradually heated.

(74) R. E. H. says: If a lever be placed with one end on a solid block, the other on scales, and a weight be suspended from center of lever will not the weight have more effect on the scales if I move it nearer to them, and less if I move it the other way? A. Yes.

(75) J. W. O. asks: Several of my friends say that the closer a horse (or any other animal) is to his load, the easier it is to pull, and vice versa. I cannot see why the draft increases with the distance, except by the additional weight of chain or rope, and friction on the ground, if it touches the ground. A. You have the right idea.

[OFFICIAL]

INDEX OF INVENTIONS

FOR WHICH
Letters Patent of the United States were
Granted in the Week Ending.

April 25, 1876.

AND EACH BEARING THAT DATE.

(Those marked (r) are reissued patents.)

(76) F. E. K. says: We have two new boilers that have never been tested. Their dimensions are: Length, 22 feet, diameter 44 inches, thickness of shell $\frac{1}{2}$ inch, with 20 stay rods and 20 stay bolts. They are built of C. H. No. 1 iron. There is one 4 inch safety valve for the two boilers. What is the greatest pressure at which it would be safe to run them? A. From 50 to 60 lbs.

(77) H. K. says, in reply to L. F. F., who asked which is the deepest well in the world: I believe the well at the St. Louis county insane asylum is, being 3,577 feet deep. At the depth of 3,545 feet the thermometer stood at 113° Fah.

(78) J. R. F. says, in reply to J. J., who asked how much the outside horse will gain in plowing a circular field, beginning at the center: Let d =distance between horses, r =radius of circle plowed by inside horse, and n =number of times they plow around. Then, while the inside horse is plowing around a circle with a radius r , the outside horse is plowing round a circle with a radius $r+d$, and the distances traveled by each respectively are $2\pi r$ and $2\pi(r+d)$, and the difference is $2\pi d$. The total difference, for a times around, is $n \times 2\pi d$. The inside horse in the second time around travels in the track of the outside horse the first time, and so on for each succeeding time until the last time around, when the outside horse makes a track of the radius $r+n \times d$, which the inside horse does not travel; neither does the outside horse travel in the track of the radius r , made by the inside horse in the first time around. Hence the difference in the distance traveled is $(r+n \times d)2\pi - r2\pi = n \times d \times 2\pi$, the same as above. This will be observed, is simply the difference between the distance which the inside horse travels the first time around and that which the outside horse travels the last time around.

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

H. A. W.—We do not think that you would succeed in the artificial production of the mineral, even if you had the exact composition. Send us a specimen, and we will examine it for you.—C. J. J.—Send us a sample of the tin powder used in electrolysis.—W. C. S.—They are scales of decomposed mica with oxide of iron.—Rev. J. McC.—The bolt does not appear to be well made, nor of superior iron.—L. L.—It is black oxide of manganese, containing copper.—J. M. G.—It contains siliceous, alumina, oxide of iron, and carbonate of soda, carbonate of lime, and carbonate of magnesia.—W. M. T.—It is sulphide of iron.—E. P. C.—It is iron pyrites.—W. W. J.—It is difficult to say, without making a lengthy chemical analysis, why you cannot harden your steel.—J. W. F.—It is white iron pyrites.—F. W. B.—It is a coating of oxide of zinc. It does not injure the zinc, but rather tends to protect it from further action. If you desire, you can coat the interior of the refrigerator with paraffin.—W. B.—They are well crystallized sulphate of lime or gypsum. They are sometimes found 10 times as large as those sent, and as limpid as pure water. Have you found any such?—R. D. B.—We are unable to account for the scaling. The metal appears tough, close grained, and bright as though it had been rolled cold.—J. W. F.—No. 1 is red oxide of iron, with silicate of alumina. No. 2 is siliceous with black oxide of iron.—W. T. C.—No. 1 is the sulphate of baryta. No. 2: The powdered mineral contains the carbonates of lime, magnesia, and iron, with some silicates of alumina and siliceous.—J. E. L.—We did not detect arsenic.—T. S. L. G.—We could not detect gold in specimen sent. It was mostly iron pyrites.

J. B. F. asks: What horse power does it take to run a 5 foot corn burr and sheller?—W. E. T. asks: How can bear grass be prepared for market?—E. P. W. asks: What is a cheap material for small balloons, from 1 foot to 10 feet in diameter? Could tissue paper be made to answer by covering it with balloon varnish or some other preparation?

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On a Remarkable Cloud. By J. P. N.
On Sunday at the Centennial. By J. E. F.
On the Imponderables. By W. T. Q.
On Sugar. By —

Also inquiries and answers from the following:
J. McM.—G. W. W.—L. S. W.—P. F. S.—A. B. L.—
E. J. McC.—B. B. L.—C. C. T.—C. J. B.—A. McG.—
—B. C. C.—A. L. S.—J. H. H.—B. C. W.—J. H.—
J. B.—T. G.—P. H.—J. R.—C. B.—W. J.—D. J. S.—
H. M. H.—J. M. H.—J. E. B.—H. D. W.—B. A. J.—
B. H. P.—F. B. H.—C. S. N.—U. V. W.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Inquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who makes distilling apparatus? Who makes flax-cleaning machinery? Who makes an electricity-lighted student's lamp? Who publishes engravings of low pressure beam engines? Who sells the best tin roofing plates?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

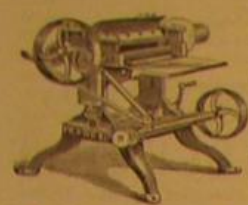
A complete copy of any patent in the annexed list including both the specifications and drawings, will be furnished from this office for one dollar. In ordering, please state the number and date of the patent desired and remit to Munn & Co., 37 Park Row, New York city

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AIR COMPRESSORS

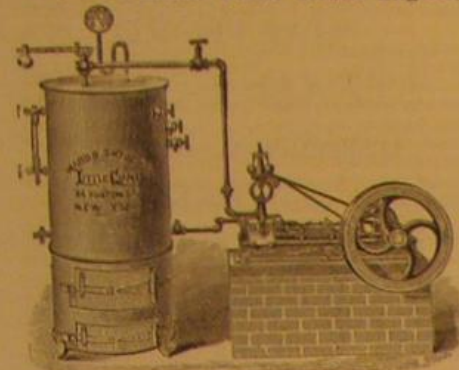
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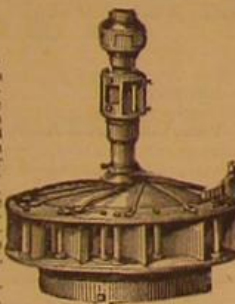
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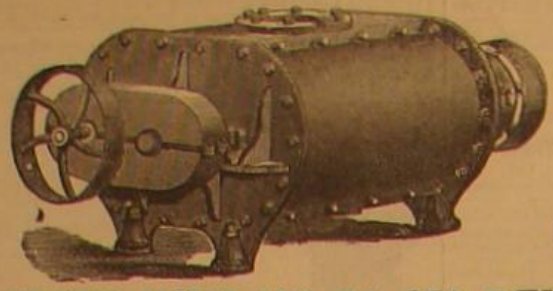
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THE CENTENNIAL EXHIBITION—THE GREAT CORLISS ENGINES.

In the annexed engraving are represented the great Corliiss engines, which furnish a part of the power to the mechanism displayed in Machinery Hall. It is expected that other engines exhibited will also be geared to shafting and thus put to useful work. There are not many points of actual novelty about the Corliiss machines, and they may fairly be classed as gigantic specimens of a well known engine, with smaller sizes of which our machinists have long been familiar. They are very lofty, perhaps too high for critical engineering taste, and at first sight remind one of the ordinary river boat beam engine, with however a solid instead of the skeleton beam. The frame is A-shaped, the beam center being at the vertex with the cylinders and main shaft located at the base angles. The various parts of the frame are in the hollow or box form, and the corners are flattened, giving an almost octagonal section. A very curious effect is gained by abolishing straight lines in the working parts and substituting curves and S pieces, an innovation the value of which engineers are somewhat disposed to question. The cylinders are 40 inches in diameter, 10 feet stroke, and are rated at 1,400 horse power. The single shaft to which they are connected carries a magnificent gear wheel, of 30 feet diameter, 24 inches face, and having 216 teeth cut with a pitch of 5.183 inches. This is probably the largest cut iron gear ever made. It weighs 86 tons, and its periphery travels at the rate of over 42 miles per hour. The crank shaft carrying this wheel is 19 inches in diameter, and is made of the best hammered iron. The bearings are 18 inches in diameter and 27 inches long. The cranks, of gun metal (iron), are polished all over except in the recesses on the back, and weigh over 5 tons each. The beams are 9 feet wide in the center, 27 feet long and weigh each about 11 tons; they are also of quite novel form. The connecting rods, now that they are in place, have the appearance of being rather light; but this comes no doubt from the massive look of the beams, which have a more ponderous appearance than is their due, on account of their unusual depth at the center. In order to have these connecting rods of as perfect material as possible, they were built up entirely of worn-out horseshoes, of which there were used in their construction no less than 10,000. They are 25 feet long. The piston rods are steel, and are 6½ inches in diameter.

The finest part of the whole machine is unfortunately out of sight, since it lies in covered ways under the floor. We allude to the gearing by which motion is imparted to the shaft. The immense gear wheel drives a pinion of 10 feet in diameter, and parallel to the axis of this is a line of shafting, diminishing from 9 to 8.7 and 6 inches. This, by means of four trions of miter bevels, transmits power to four 6 inch shafts at right angles, leading in different directions to walled pits under heavy standard frames, which carry the driven pulleys on the ends of the overhead shafting. We cannot speak too highly of the workmanship of this mechanism. It works with perfect smoothness; and so correctly are the wheels cut and the various portions fitted and arranged that no noise is apparent.

The Corliiss valves and valve gear are too well known to need description here. One of the principal modifications is a substitution of an S lever for the usual disk which op-

rates the valves. The weight of the entire machine, with its shafts, is over 700 tons.

Improvement in Freezing Mixtures.

M. Dubrene, says the *Moniteur Industriel Belge*, has devised a means of producing refrigerating mixtures which will give varying degrees of cold, as may be desired. The invention is based on the fact that, when nitrate of potash or, better, nitrate of soda is added to nitrate of ammonia (the added salts not exceeding a certain proportion), the resulting mixture produces, by its solution in water, a lowering of temperature very nearly equal to that produced by nitrate of ammonia alone. It is thus that, in making mixtures in which the nitrate of soda enters in the proportion of 1 to 40

tail dealers; for without doubt, many who visit the Exhibition from distant points in the country will take the opportunity of doing more or less shopping in New York and Philadelphia. Of course, to the extent that this shopping is done here and in Philadelphia rather than at home, will the retailers in the sections from which the visitors come suffer. It is probable, however, that more will be spent away from home than would have been if the buyers had remained at home. The immediate beneficial effects on the trade will, therefore, fall on the retailers. It is fair to assume that, in any event, the local interests of New York and Philadelphia will be largely benefited by the Exhibition, and those of New York nearly, if not fully, as much as those of Philadelphia.

Specific Gravity.

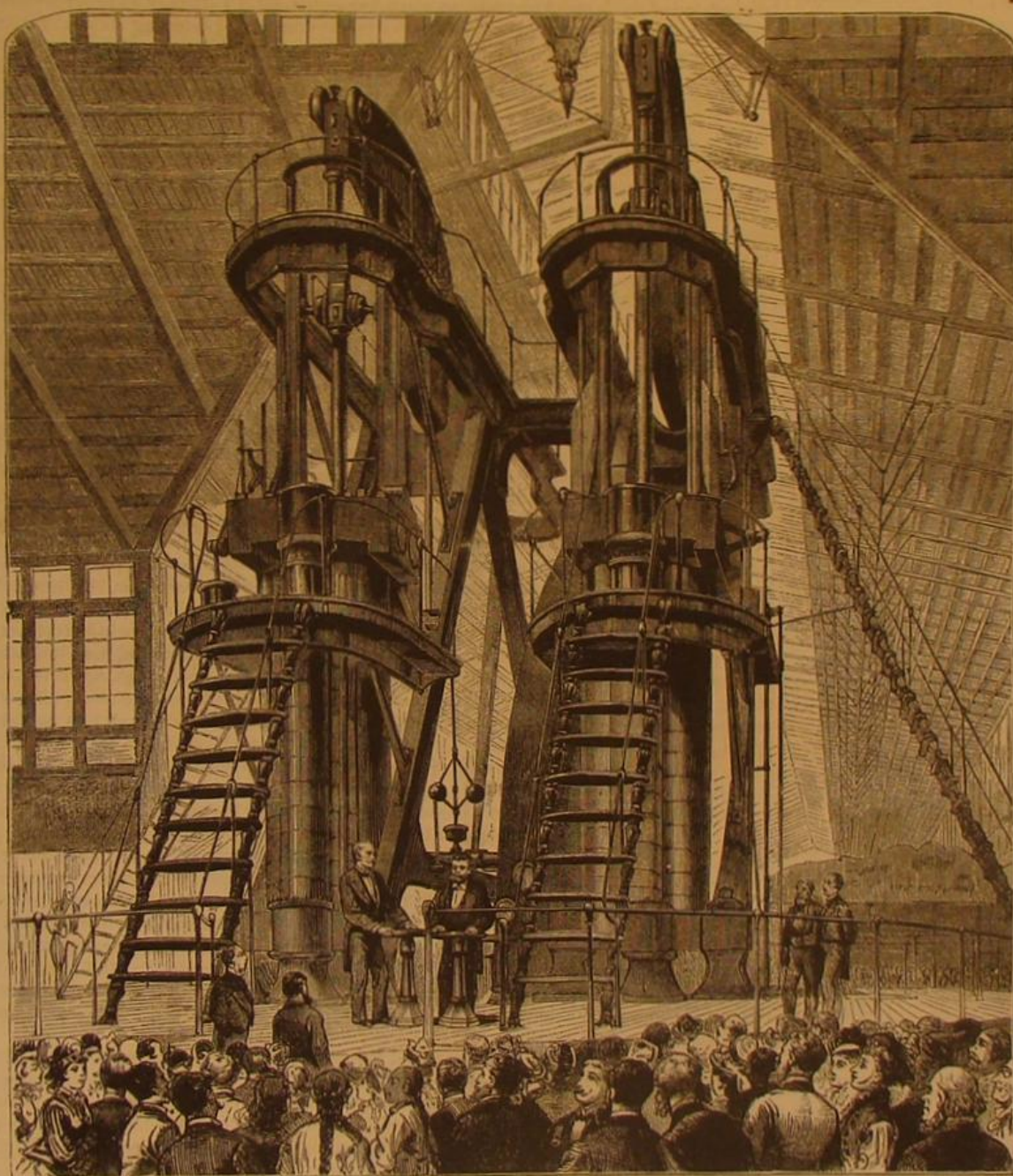
When the king asked Archimedes if he could find out whether the jewellers had, in making the crown, kept back some of the gold, and supplied its weight with some other metal, the philosopher was put to thinking and experimenting; and one day he exclaimed, with excited energy: "Eureka! Eureka!" ("I have found it! I have found it!")

What had he found? He had discovered that any solid body, put into a vessel of water, displaces its own bulk of water; and therefore, if the sides of the vessel are high enough to prevent it running over, the water will rise to a certain height. He now got one ball of gold and another of silver, each weighing exactly the same as the crown. Of course the balls were not the same size, because silver is lighter than gold, and so it takes more of it to make the same weight. He first put the gold into a basin of water, and marked on the side of the vessel the height to which the water rose. Next, taking out the gold, he put in the silver ball, which, though it weighed the same, yet, being larger, made the water rise higher; and this height he also marked. Lastly, he took out the silver ball and put in the crown. Now, if the crown had been pure gold, the water would have risen only up to the mark of the gold ball; but it rose higher, and stood between the gold and silver mark, showing that silver had been mixed with it, making it more bulky. This was the first attempt to measure the specific gravity of different substances.—*Miss Buckley.*

Progress of the Burglar's Art.

We learn from an English contemporary that, notwithstanding the many precautions taken by eminent safe makers to prevent the possibility of any forcible opening of their indispensable manufactures, the skillful and scientific burglar has lately adopted the method of destroying the works of safe locks by powerful acids, the introduction of which, it is asserted, renders both the copper and iron of the works soft and pliant in a few moments.

NEW SAFETY BANK CHECK.—One of the banks at Lyons, France, uses checks of paper dyed to a full shade of ultramarine green, upon which the name of the bank is lithographed. The amount and signature are written in with a dilute mineral preparation, producing yellowish white letters and figures on a green ground. In this country it is not uncommon to write with a solution of oxalic acid on a blue paper, which produces a similar result in a more simple way.



THE CORLISS ENGINES AT THE CENTENNIAL EXHIBITION.

parts and the nitrate of ammonia in the proportion of from 99 to 60 parts in 100, compounds are formed by which temperature may be reduced by Fahrenheit degrees varying in number between 70 and 482. A mixture of 20 parts nitrate of potash and 80 parts nitrate of ammonia reduces temperature 87° Fah.

Effect of the Centennial on Business.

The *Evening Post* thinks that one result of the Centennial will be a relaxation of the business stringency which has existed in New York and other Eastern cities. If only 5,000,000 people, exclusive of the inhabitants of Philadelphia, should visit the Exposition, and spend but \$25 each, \$125,000,000 would thus be put into circulation. As a rule, says the *Post*, it may be assumed that the great body of those outside of Philadelphia who go to the Exhibition will be of the class which is thrifty and saving; the money they spend would, to a great extent, except for the Exhibition, be retained by them. Excluding that part of this money which will be received by those who furnish the necessities of life to the visitors, this money will first go into the hands of re-

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- ELECTRICITY, LIGHT, HEAT, ETC.—Lines in Stellar Spectra.—New Theory of the Sun's Spots.—New Instrument for Illustrating Refraction.—Influence of Light and Heat on Selenium.—Microscopy at the Royal Society.—Pheip's Electrical Printing Instrument.—Improvements in Electromagnets, by Professor TROWBRIDGE.
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AMERICAN PROGRESS—III.—FROM 1840 TO THE PRESENT TIME.

We have now reached a period in which it is practically impossible to follow the progress of the country uniformly in all branches of Science and industry. It is necessary, therefore, to consider each class of invention or each branch of Science separately, and briefly to note the principal advances in each, from 1840 up to the present time. It will be sufficient to point out the fact that, during this period, over 165,000 patents have been issued as against 11,614, all told, previous to 1840, to indicate the difficulty of attempting to arrange inventions in any semblance of chronological order.

Among the most important improvements in the steam engine are the detachable adjustable or drop cut off gear, the invention of Frederick E. Sickels, and the application of the governor to determine the point of cut off made by Zachariah Allen and George H. Corliss, of Rhode Island. The beam engine is a peculiarly American type, and usually embodies the valve gear invented by R. L. and Francis B. Stevens. In 1852, Ericsson brought out a new form of the caloric engine, which machine he was the first to adapt to practical uses. Ericsson's other inventions are so numerous that a mere list would occupy more space than can here be afforded. Among the most prominent were those embodied in the United States steamer Princeton, the first screw man of war. They included a direct-acting engine of great simplicity, the sliding telescope chimney, and gun carriages and new machinery for checking recoil. He has also devised instruments for measuring distances at sea, a hydrostatic gage for measuring the volume of fluids under pressure, an alarm barometer, etc. He was the first to apply the revolving turret to war vessels; and the performances of the famous Monitor, his first essay in armored ships of that description, need no renewal here. Mr. Ericsson has of late been engaged in the construction of one of the most formidable marine torpedoes known, and also has devoted much attention to the construction of solar engines. Among the remarkable forms of recent American engines may be mentioned the Scott and Morton, in which the cylinder rotates with the fly wheel, and the Ellis bisulphide of carbon machine, in which the vapor of bisulphide of carbon is substituted for steam.

Since 1851 over three thousand patents have been granted for harvesters and their attachments. Some of the most important improvements consist in the Sylla and Adams patent, having a cutter bar hinged to a frame, which is in turn hinged to the main frame, this being the principal feature of the Buckeye harvester; the combined rake and reel of the Dorsey machine, sweeping in a general horizontal direction across the quadrantal platform; the Henderson rake, on what is known as the Wood machine, having a chain below the platform which carries the rake in a curved path; the Sieberling dropper, which is a slatted platform vibrating to discharge the gavel, and the Whiteley patents, which constitute the Champion machine of Springfield, Ohio. In threshing machines, American improvements aim at speed and lightness, and spiked cylinders are retained to beat the grain as it passes in a zigzag course between them. There are few implements which at the present time engage a greater share of the attention of inventors than cultivators and plows, which are constantly being produced in endless variety. The first application of machinery to the tying of knots was, we believe, embodied in an American mower.

In printing presses, American inventors have steadily maintained the lead. The Bullock press carries the forms upon two cylinders, requires no attendants to feed it, and delivers from 6,000 to 8,000 sheets per hour. The Campbell press is remarkable for fine points of adjustment. The Hoe web perfecting press is one of the most recent inventions of the kind. It delivers from 12,000 to 15,000 perfected sheets per hour.

Joseph Dixon, in 1854, was the first to use organic matter and bichromate of potassa upon stone to produce a photolithograph. Latterly the process of photo-engraving has been advanced to a remarkable extent. It is largely employed in preparing engravings for the SCIENTIFIC AMERICAN, and the reader will find some remarkable results of the most recent improved processes in engravings directly reproduced from lunar photographs in No. XX, current volume. Colonel J. J. Woodbury, M. D., has produced microscopic photographs of admirable clearness and magnitude. The finest photographs of the visible spectrum have been obtained by Mr. Lewis M. Rutherford, of New York city. The map 82 inches in length embraces more than 2,500 sharply defined lines. Mr. Rutherford has also achieved remarkable success in producing finely ruled "gitters" or glass plates, by means of which Dr. Henry Draper has produced a photograph of the ultra-violet rays of the diffraction spectrum, which far exceeds in distinctness any thing previously attempted in this difficult spectral region. Mr. Rutherford's finer gratings have nearly 18,000 lines to the inch, ruled by a diamond held in a machine of his own invention, which is driven by a miniature turbine wheel. Magnificent photographs of the moon have been taken by Mr. Rutherford, and he also has succeeded in making the sun reproduce its own image. To him is also to be attributed probably the highest application of photography, that of using it for uranographical measurements, and for the study of the solar and stellar spectra.

The first ice machine based on production of cold by the vaporization of volatile liquids was invented by Professor A. C. Twining, of New Haven, in 1850. He used sulphuric ether as the liquid to be vaporized.

By far the most important chemical discovery ever made by an American is that of the demonstration of the anæsthetic qualities of chloroform, by Dr. W. T. G. Morton, in 1846.

Dr. Morton's claim as original discoverer has been vigorously disputed, but it is believed that the facts are sufficient to accord him the full measure of honor deserved. It appears that Dr. Wells, one of the opponents of Dr. Morton, observed the anæsthetic effects of nitrous oxide gas in 1844, but it is well known that the practical use of that gas by dentists is of quite late date.

Just before and during the war great improvements were made in fire arms. The principal small weapons are those of Colt, Sharp, Whitney, Allen, Maynard, Remington, Spencer, and Berdan. These include rifles which, in practised hands can be loaded and fired nearly thirty times a minute. In great guns, the Parrott rifles, the essential feature of which is a wrought iron jacket shrunk around the breech, played a conspicuous part during the war. In 1845, General Rodman invented his method of casting guns around a hollow core into which is introduced a stream of cold water, while the outside is kept heated until the metal is cooled from the interior. Rear Admiral Dahlgren also invented the gun which bears his name, and which is distinguished by its exterior form. To obviate the contraction consequent upon cooling the large casting, the Dahlgren guns are made larger than required, and after cooling are annealed and turned down to the desired shape. The most efficient machine gun built on the small arm principle is that of Mr. R. J. Gatling. This fires 400 cartridges per minute, the rapidity depending on the rate of rotation of the crank whereby the mechanism is operated. The inventor of military munitions perhaps best known, both here and in Europe, is Mr. B. B. Hotchkiss. One of his most recent devices is probably the most effective weapon of war ever invented. It is a machine cannon, capable of throwing sixteen 1 lb. explosive shells per minute, to a distance of nearly three miles. Mr. Hotchkiss has also lately devised a remarkable simple and ingenious breech-loading rifle musket, beside some new forms of breech-loading field cannon. It may be added that, with a single exception, the needle gun, the main features of all the prominent military rifles originated in the United States.

While the invention of the lock stitch in sewing machines is generally claimed for Walter Hunt, as we have already stated, it is also conceded that the same device was independently invented by Elias Howe. Howe's machine, patented in 1846, used a grooved and curved eye-pointed needle carried upon the end of a vibrating arm, which, passing through the cloth, formed a loop through which a shuttle passed another thread. Following this came many improvements, such as A. B. Wilson's four motion feed and rotating looping hook, the latter of which draws down the needle thread and drops through it the spool containing the lower thread. Over 2,000 patents have been granted for modifications in sewing machines, and inventors still find ample opportunity to exercise their ingenuity in devising further improvements. We may note in this connection that Mr. E. H. Knight, one of our best mechanical authorities, states that the three mechanical contrivances upon which the most extraordinary versatility of invention has been expended are the harvester, the breech-loading fire arm, and the sewing machine; each of these has thousands of patents, and each is the growth of the last forty years. Next after these, it appears to us, our inventors most favor cultivators, churns, car couplings, bee hives, and washing machines.

We have already alluded to Morse's successful completion of a telegraph line between Washington and Baltimore in 1844. In 1848, Royal E. House, of Vermont, patented an admirable long line printing apparatus, by which messages were sent in Roman capitals in lieu of dots and dashes. The next important improvement was that of Hughes, who patented a telegraph in which the feat of printing a letter with every impulse or wave of the electric current was accomplished. Two years later G. M. Phelps, of Troy, N. Y., combined the most valuable portions of the House and Hughes patents in a combination instrument, which is considered the most perfect printing telegraph for long lines yet produced. To Mr. Cyrus W. Field is due the credit of suggesting the transatlantic cable; and through his persistent labors and energy that great undertaking was successfully accomplished.

Stearns' modification of the Gintl duplex telegraph system was the first practical solution of the problem of sending two messages at the same time on the same wire. Moses Farmer has also devised a way of sending two messages at the same time in opposite directions, by using two auxiliary batteries in combination with two principal batteries. The important researches of Thomas A. Edison have aided greatly in reducing to a practical shape the system of quadruplex telegraphy; and the phonetic system of Gray and Bell aims to increase indefinitely the number of messages which can be sent simultaneously over a single wire, by using tuning forks moved by electromagnets, for sending and receiving the signals. Only one fork at the receiving station is in unison with a particular fork at the sending station, and responds to it. The first system of fire alarm telegraph was invented in 1862, by Channing and Farmer, and shortly after was adopted in Boston.

The first practical steam fire engine was invented by Ericsson; but machines of this description were not actually employed until 1853, when, through the enterprise of Miles Greenwood, of Cincinnati, Ohio, that city was provided with them.

Borings for oil were first made by Mr. E. L. Drake, of Titusville, Pa., in 1859. He originated the practice of driving a tube through the rock instead of excavating and cribbing.

Among the most important railway inventions made by Americans may be noted the Westinghouse air brake, which uses compressed air as a means of applying the brakes,

the entire mechanism of which is under the control of the engine driver. Miller's platform is a device of great importance, since it obviates the danger of the telescoping or crushing of the cars in event of a collision. Sleeping cars were for the first time used on American railroads in 1858; and in 1864 George M. Pullman devised the palace cars which bear his name, and which are regular hotels on wheels. The first street car lines were established in the United States. A recent railway device involves the use of compressed air for shutting gates and signaling; and a remarkably ingenious combination of switch mechanism and electric signals, the invention of Superintendent J. M. Toucey, Mr. D. M. Rousseau, and others, has been applied on the underground section of the New York Central and other joining lines in New York city. Hall's system of signaling by telegraph at bridges and railroad crossings was the first introduced, and to him should be awarded the credit of its first application.

In astronomy the work of American scientists has covered a wide field. The first approximately correct theory of the motions of Neptune were wrought out by Professor Sears C. Walker, in 1847. This labor, together with its subsequent reconstruction by Professor Simon Newcomb, resulted in the magnificent discovery of the planet by purely mathematical means. Professor Newcomb has also made some splendid investigations relative to the perturbations of the moon by the planets. To Professor C. A. Young is due the discovery of the chromosphere surrounding the sun, one of the most valuable contributions to solar physics ever made.

Professor A. M. Mayer has presented strong evidence to show that the antennae of insects are their organs of hearing. He has also determined the law which connects the pitch of a sound with the duration of its residual sensation, and deduced principles applicable to the study of harmony and musical composition. Professor Mayer's investigations in acoustics are all strikingly original, and have placed him in the front rank of contemporary scientists.

To the great engineering works of the United States, we can only briefly allude. The prominent ones are the Croton aqueduct in New York, the Pacific railroad, the Hoosac tunnel, the East river and St. Louis bridges, the Hell Gate excavations, and (more important than either of the others) the operations of Captain Eads at the mouth of the Mississippi, by which that stream, besides the prevention of its overflowing its banks, is to be rendered accessible to vessels of the deepest draft, thus opening the whole Western section of the country to direct commerce.

From the struggling and destitute band of colonists in 1776, to a great and powerful nation of forty millions of free people, such has been the work wrought in the hundred years now closed. History offers no more marvelous spectacle, no loftier example of the might and grandeur perpetuated in republican institutions. Not by conquest nor by war has this glorious result been reached, but by the peaceful development of the genius and energy implanted in the people themselves. Our true standing army is one of inventors, not of soldiers; and to the former alone, under God, do we owe our national prosperity. It was the inventor who, when the first war for national life left us prostrate though victorious, gave us the means to throw off our dependence on other nations, and stand forth, not merely politically but industrially and commercially, a free and independent people; it was the inventor who taught us how to utilize the vast resources of our territory; it was the inventor who, in the hour of need, converted our workshops into gigantic magazines of war material, who equipped for us the greatest army that modern times has ever seen, and who gave us weapons wherewith to wage the terrible conflict in which, for a second time, the nation's existence was imperiled. Therefore most fitting is it that, on this great anniversary, we ask mankind to witness triumphs of genius and of industry, not those of the statesman nor of the warrior, nor the work of the pen nor of the sword, but that of the hammer and the loom, the engine and the lightning spark, the labor of men who are at once the leaders and the supporters of American progress, the American inventors.

THE PRESENT CONDITION OF THE CENTENNIAL.

There is one verdict which will be unanimously agreed upon by all who complete a review of the Centennial Buildings at the present time, and that is that the Centennial Commission has worked wonders. It is only necessary to recall the unfinished grounds and dreary expanse of empty space and packing boxes, both at Paris and Vienna, to add still further emphasis to the assertion. True, the Exposition is not complete, but enough so to excite the wonderment and admiration of every beholder now.

The erection of the main buildings and their preparation to receive their contents necessarily delayed work on the grounds; but this is being vigorously pushed forward, and an army of laborers is planting lawns and flower beds, making roads, and otherwise beautifying the surroundings. Least advanced of any part of the Exposition is Machinery Hall; and in this respect, the visitor who may have expected to enter into a vast room, filled with whirling machinery, will be disappointed. The fault, however, lies not with the Commissioners, but with our own exhibitors, for their contributions vastly outnumber those of all other nations combined. It follows that the chances of comparing American machinery with that of foreign make are to be limited; as 1080 American machines against 98 English shows a great disparity between the two greatest machine-making nations in the world. The great cotton mills of Great Britain are represented by one loom, and the best thing in that is an electric brake arrangement. There are a superb Jacquard loom weaving silk book marks, some gigantic armor plates, and the Walter printing press. These are the principal British

exhibits which catch the eye. Nothing from the Napier, or the Penns, or the Maudslays, or any of the great engine builders and founders whose celebrity is worldwide. The German display is at present a heap of rough packing boxes, some fine rifled guns, armor plates, and locomotive wheels from Krupp at Essen, and a huge pyramid of spiegeleisen. France has treated the Exposition with as much indifference as England. She has about 92 entries, and the most notable now are soap making machines and a tapestry loom. French machinists have been greatly progressive of late, and we looked with much interest, though fruitlessly, for many of the machine tools, notably those by Abbey of Paris, which our Parisian contemporaries have described. Belgium has an engine of the Corliss pattern, which is worth careful examination. Brazil shows a small stationary engine of antiquated appearance, and some fair ironwork. Sweden, another great iron-producing country, has a narrow gauge locomotive, and nothing else at present worth mentioning in this general review. Spain and Italy, Holland and Russia, have not arranged their exhibits. In the American section, the Corliss engines are in motion and are driving a few machine tools which are familiar to all our readers. Otherwise the display is not sufficiently advanced to admit even of a general idea of its future magnificent proportions.

In the Main Building, the progress has been greater, and the exhibits are already grand in variety and excellence. By all odds, the most magnificent display in the entire Exposition is the Japanese. It is the complete history of the country, told by object teaching. We know of no metal work that can compare with the bronze vases and ornaments displayed, nor were such collections of oriental pottery and lacquered work ever seen in this country before. Not only is every industry of that most industrious people represented by its choicest products, but we are shown every natural resource of the Empire. The mineralogical exhibit alone is superb. The various educational systems are explained down to the daily records of the pupils, and the collections of scientific apparatus used in the colleges are exhibited. Certainly, not merely in the intrinsic value and magnificence of her contribution, but for the admirable skill and discrimination shown in its selection, Japan outstrips every other nation yet represented. The second place must be allotted to England, whose display, as far as can be judged, is destined to be extremely interesting. Its most prominent features at present are the pottery, decorated ware, and textile fabrics. The British colonies offer exhibits notable for excellent selection and suitability for illustrating the resources of the various localities. The French exhibit also superb pottery and a magnificent show of objects of industrial art, laces, and textile fabrics. Austria, as yet incomplete, has a case of Vienna goods, which are models of exquisite taste. The beautiful display of Bohemian glass attracts the greatest share of attention among the ladies. Germany sends an exhibit which noticeably includes some exquisite porcelain and a superb display of scientific and educational books. It is blemished by the bronzes, which are inartistic, and by the many cheap chromos which already have been imported by thousands into this country. It is but just to add that the German display is not complete, and that, when it can be examined in its entirety, it will probably be found worthy of the great nation that sends it. The Egyptian exhibit is excellently arranged, and on the whole will give a fair idea of Egyptian industries. The Spanish contribution will excite considerable astonishment. It certainly is one of the finest in the building, and is notably rich in the number and variety of textile productions. It is well calculated to dispel the idea that Spain's industries have been severely paralyzed by her recent internal troubles. Norway and Sweden send displays, well advanced toward completion and admirably arranged. We note especially the life-like figures in wax, dressed in costumes of the country, and some fine specimens of silver and iron work.

Italy, as might be expected, has a larger representation in the portion of the Exposition devoted entirely to art than in the general concourse of nations. Still, in the Main Building, her exhibit bids fair to be one of great beauty. There is an exquisite collection of Genoese silver jewelry, wood carvings of superb workmanship, and a curious selection of antique and modern pottery, which, perhaps more than all else, will will excite admiration. The Netherlands, also, has some remarkable examples of Flemish and Dutch woodwork. China exhibits her famous porcelain and marvelously intricate ivory and teak carvings. The prominent feature in the Chinese exhibit is a table of *cloisonné* ware (copper enamel), of exceptional beauty and value.

The American display is admirable. In silver ware and jewelry it is unexcelled; and in no part of the Exposition is furniture exhibited which can compare with that of the New York manufacturers. The representation of pianos and organs includes specimens from all our celebrated makers, many of whom have introduced the excellent innovation of building glass inclosed rooms for their instruments, so that, when the latter are performed upon while other pianos are being played, there will not be the confused babel of discord which in so many fairs has formed an objectionable feature. The book display is elaborate, and, in general, the American section compares most favorably with the exhibits of other nations.

Of the very varied and interesting contents of the Agricultural Building, no fair estimate can yet be formed. The unroofing of the structure during a storm delayed its completion and prevented an early arrangement of exhibits. As near as can be judged from such as are already in place, this department will form one of the most complete and interesting parts of the Exposition. Horticultural Hall is beautiful, and later will, without doubt, embrace a large variety of specimens, some of them being of rare species. The forcing

houses are quite well filled; and probably after many of the foreign plants have been started therein, the display in the large edifice will be improved. It should be remembered, however, that the horticultural display includes the plants growing in the beds as well as under cover.

We are not exactly clear as to the principle which governed the selection of exhibits for the Women's Pavilion. It appears that only a portion of the female handiwork exhibited is located therein, while the rest is scattered among the entries in the other buildings. This rather detracts from the completeness of a display which is otherwise very creditable. Women are making Waltham watches in the Machinery Hall, and women have contributed handmade laces, robes, and needlework to other departments. Had all been gathered under one roof, the objects of the separate building would have been furthered, and the visitor would have obtained a better idea, of the variety and skill embodied in female labor, than he perhaps can now. Still the exhibit as it stands is good, and to the fair sex especially will doubtless prove the principal attraction.

In concluding this brief general review of the present condition of the Centennial, the highest credit must be given to the authorities for the excellent manner in which the great enterprise is governed. Where many abuses might creep in, it is surprising to note how few really exist. The restaurant charges have been extortionate, but these are now reduced. We hope for the substitution of a better catalogue for the present rather cumbersome volume, which will afford the visitor the information he needs, and not a mass of glaring and useless advertisements. We would also suggest that allowing a juggler to perform at a prominent stand directly inside and in front of one of the principal entrances, and then to peddle his wares, is not calculated to add to the dignity or value of the Exposition. These, however, are but minor and, perhaps, unavoidable blemishes.

Living at Philadelphia is rather high; and those who live within a hundred miles of the city will find it to their advantage, both economically and in point of convenience, to avail themselves of the railroad facilities in going and coming every day. The daily excursion is not fatiguing, since there is no need of the visitor walking a step inside the exhibition grounds and within the principal buildings, except in the art building (the Memorial Hall). Rolling chairs and attendants are furnished for 60 cents an hour, and the visitor, comfortably seated, is wheeled from point to point, and thus can inspect the exhibits at his leisure. For long distances, a steam railroad, which runs around the circuit of the grounds, is always available. Although, as we have stated, the Exhibition is not fully complete, the present will be preferred by many as an opportunity to make the visit. The cool weather and absence of a crowd will be found much more conducive to a pleasant examination of the immense number of beautiful objects now ready than will the same work performed during the sweltering heats of July and August.

Ivory.

The apprehension that ivory would become one of the products of the past, as we have often heard our cutlery and billiard ball manufacturers maintain, does not seem to be justified by the facts. According to the following, from the *British Mail*, Messrs. Lewis & Peat, colonial brokers, have issued a very interesting report of the modern ivory trade, which, though showing great improvement since 1842, is a mere shadow of what it must have been in the ancient times. The total quantity imported into Great Britain in 1875 was 680 tons, the largest in any year between that time and 1842, when it was only 297 tons: the lowest being 1844, but 211 tons. The fact of there being an appreciable increase in last year's imports over 1874 of 70 tons is, says the report, "of the greatest interest, because in this article especially, much more than any other known, there is no reason to apprehend any falling off in the demand." In one important article of manufacture—billiard balls—there is not any other substance which can be used as an adequate substitute. The public sales are held four times in the year. Prices last year were, on the average, much lower than the previous one, which is attributed to the general commercial stagnation. The prices of good teeth, weighing from 50 lbs. to 160 lbs., varied from \$275 to \$335 per cwt.; "scrivelloes," \$120 to \$270. Walrus teeth, sound, weighing from 1½ lbs. to 5½ lbs., were worth 60 or 62 cents per lb.; defective, 40 or 44 cents. Rhinoceros horns, of which 3½ tons were imported in 1874, realised from 34 to 72 cents. The probable value of the ivory imported last year could not be less than \$2,500,000. A larger portion came through Egypt than in the previous year, and less from Zanzibar and Bombay, from South Africa a little more, and from West Africa a little less.

The Great Strike of Miners.

There are, it is stated, something like 30,000 men out, in South Yorkshire and Derbyshire, England, besides a number of topmen, enginemen, and other employees. The main body of men are still stoutly determined to stand out against the drop of 15 per cent, and the employers are quite as firmly resolved not to make any concessions. At a few collieries, the men have turned in at a reduction of 7½ per cent on the understanding that they will make further concessions in order to bring them to the general level of the district after the strike is settled.

TO PREVENT THE CRACKING OF GLUE by heat or extreme dryness, the addition to the solution of some calcium chloride is recommended, which retains sufficient moisture to obviate this inconvenience. Thus prepared, glue can also be used upon glass and metallic surfaces.

THE SPANISH CENTENNIAL BUILDING.

Although the Spanish display at the Centennial Exhibition is not of very large extent, it is varied in character and contains many objects of exceptional beauty, especially in the art department. In the Main Building, 11,253 square feet have been allotted to Spain, which the Spanish Commission has inclosed, making an entrance through doors in the middle of the front. This inclosure is 46 feet in height, the material being wood and canvas, painted, carved, and gilded in a very rich and elaborate style. There is a grand doorway in the center, and two side portals, all handsomely decorated. The doorways are to be hung with heavy folds of silk curtains—red and yellow, the Spanish national colors.

The Spanish Commission has also constructed the octagonal building shown in the annexed engraving. The structure is well proportioned, and the slight amount of exterior ornamentation is characteristic of its nationality. This structure is separate from the one inside the main building above referred to.

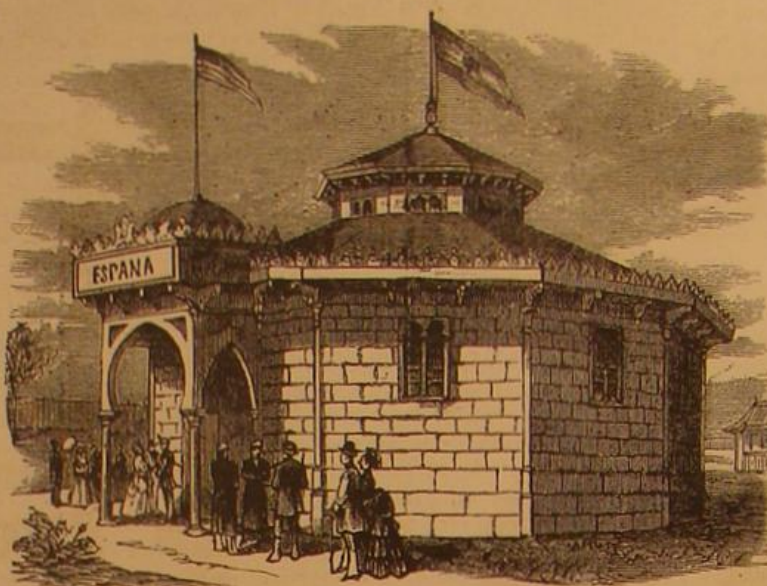
Speed of Railway Trains.

The following are the highest authentic instances of high railway speeds with which we are acquainted; Brunel, with the Courier class of locomotive, ran 13 miles in 10 minutes, equal to 78 miles an hour. Mr. Patrick Stirling, of the Great Northern, took, two years back, 16 carriages 15 miles in 12 minutes, equal to 75 miles an hour. The Great Britain, Lord of the Isles, and Iron Duke, broad gauge engines on the Great Western Railway, have each run with four or five carriages from Paddington to Didcot in 47½ minutes, equal to 66 miles an hour, or an extreme running speed of 72 miles an hour; the new Midland coupled express engines, running in the usual course, have been timed 68, 70, and 72 miles an hour. The 10 A. M. express on the Great Northern, from Leeds, we have ourselves timed, and found to be running mile after mile at the rate of a mile in 52 seconds, or at 69.2 miles an hour. The engines used are Mr. Stirling's outside cylinder bogie express engines, the load being ten carriages. —*Engineer.*

THE CENTENNIAL BUILDINGS.—THE NEW JERSEY BUILDINGS AND THE WOMEN'S PAVILION.

The State of New Jersey has erected a building at Philadelphia in the rustic gothic style, the high roof and the protected windows and porch being especially noticeable. It is an elegant and well built structure, and is likely to be carefully investigated by country visitors, whose interest in commodious, elegant, and cheap homes seems to know no abatement. The New Jersey building appears in the center of our engraving herewith, "The South" restaurant appearing on the left, and a new view of the Women's Pavilion being shown on the right

of the picture. The last named building has already been described in our columns; and we are informed that it owes its origin to the refusal on the part of the Centennial Commission to allot separate spaces within the principal buildings for exhibiting women's work. The display of work within the building, it will be acknowledged, shows well the great variety and number of industrial pursuits which are open to females, the demands of which on the hand and brain are not, as a rule, so excessive as to reduce the workers to a condition

**THE SPANISH CENTENNIAL BUILDING.**

of hard and badly recompensed toil. The large proportion of the exhibits show that there is an immense field for women's work, requiring the deftness of finger and the taste for which their sex takes the precedence of man, and affording ample remuneration for steady, capable workwomen.

The Water Gas Humbug Again.

The Chicago Times is the latest victim of the absurd water gas delusion. A "Professor" Kendall, that too confiding journal asserts, has exhibited to its representative "an apparatus which burns from one fourth to seven eighths as much water as it does any other combustible fluid," makes gas better than that produced from coke (!) at 50 cents per thousand feet, and produces sufficient fire "to do the cooking and washing for six persons for seven days for a like small sum." The Times says that "the result overwhelms the mind with its wonderful possibilities," and that "it will astonish the scientist as well as the unschooled and the undisciplined." We fear that all the astonishment regarding the subject will be at the ignorance and credulity of the Chi-

cago paper. Water is nothing but the result of burnt hydrogen, which gave out its heat at the time of its combustion. No fuel can be burnt twice, and it is as impossible to burn hydrogen in water or watery vapor as it is to burn carbon in atmospheric carbonic acid.

Fixing Pencil Lines and Colors on Drawings.

W. E. Debenham describes a method of fixing powder and other colors after they are applied.

"I immerse the drawing in or flow over it a solution of freshly prepared moist gluten in alcohol, the alcohol to be at a strength of about seventy or eighty per cent, or a solution of gelatin or metagelatin or kindred substance (the word gelatin will be used hereafter to include kindred substances), in water, with as much alcohol added as the solution will bear without precipitating the gelatin. If the solution be hot, it will bear a large addition of alcohol. It is necessary that the solution be very alcoholic, or the colors may run, as they would in an ordinary aqueous solution. The gelatin coating may be rendered insoluble by treatment with tannin or chrome alum; the chrome alum is either added to the gelatin solution itself, or applied separately, and afterwards exposed to light.

"To prepare a photograph or drawing that color may adhere, I apply either of the alcoholic solutions already mentioned, or a solution of glycerin or sugar, or a mixture of any of these; and this preparative liquid should contain fifty per cent or more of alcohol in order that it may penetrate evenly. If the work can be colored before being mounted, as in the case of a photograph to be enameled, I apply the preparation liquid to the back of the paper. The alcohol makes it penetrate to the front, and the color is taken in a very even and fine manner.

"The fixing solutions are also applicable to water color, pencil, and crayon drawings; and I prefer to employ gluten solution as an aqueous solution of gelatin, if desired, as an additional coat, or for the purpose of attaching it to the collodionized glass in enameling. The fixing solution itself may also be used for this latter purpose, and the coloring or touching is not to be disturbed. When it is required that the gluten solution should contain more gluten than the alcohol will take up, I evaporate rapidly, but not to precipitation, a portion of the solution, and mix with the remainder."

NEWSPAPER and other publishers will be supplied with electrotypes of the Centennial Buildings and most of the other engravings which appear in the SCIENTIFIC AMERICAN and SUPPLEMENT, on very cheap terms. For prices address the publishers, and indicate at the same time what engravings are desired, and the date of the issue in which they appeared.

**THE CENTENNIAL NEW JERSEY BUILDING AND THE WOMEN'S PAVILION**

MUNTZ'S TANNIN-TESTING APPARATUS.

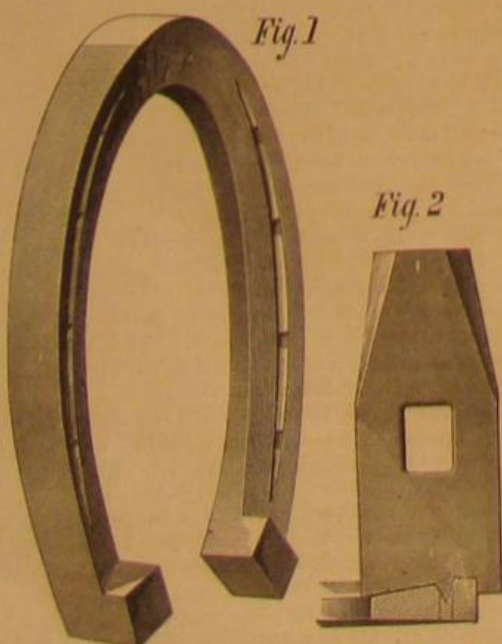
The accompanying engravings, which we extract from *The Engineer*, represent a new and simple apparatus for testing the efficiency of any tanning solution or material. The principle involved consists in forcing a solution containing tannin through a piece of hide. The density of the solution is taken before and after the operation, and a comparison of the densities enables the value of the solution to be readily determined.

Fig. 1 is a perspective view, and Fig. 2 is a section showing the internal arrangement. Having taken a small piece of raw hide, and placed it inside, on the base of the apparatus, the india rubber cover is closed down over it, and secured by the screws in the claws. The liquid to be tested is then poured in on the top of the piece of hide through the small opening, which is fitted with a screw stopper, B. This done, pressure is brought to bear by turning the perpendicular main screw, V, at the bottom of which is attached a brass disk, which gradually compresses the india rubber cover, and forces the liquid to filter through the hide. The screw must be tightened up occasionally so as to maintain the pressure. A glass is placed beneath the machine to receive the liquid, which percolates drop by drop. When sufficient has been obtained to fill a small test glass, the density is taken. To do this the glass should be filled with the first liquid kept in reserve, and the tannometer inserted. In a few minutes it will become steady, and the degree is then noted. The same process must be repeated with the filtered liquid. The difference of degrees between the two densities shows the percentage of tannin in the analyzed substance. This difference is multiplied by 40 if $2\frac{1}{2}$ per cent of stuff is put into water; by 20, if 5 per cent; by 10, if 10 per cent; and by 5, if 20 per cent. For instance, if the tannometer marks for the first liquid 28, and for the second 13, the difference, 15, or $1\frac{1}{2}$ degrees, must be multiplied by 40 if we have taken $2\frac{1}{2}$ per cent, which gives 60 per cent of tannin; by 20 if we have taken 5 per cent, which gives 30 per cent of tannin; by 10 if we have taken 10 per cent, which gives 15 per cent of tannin.

The tannometer referred to is practically a hydrometer, which is supplied with the instrument. With it were detected the valuable properties of *balsamo carpon*, which, when gathered ripe and the gum taken off free from the fiber of the pod, contains 80 per cent of tannic acid. It is this gum which weights the leather. Gall nuts are liked by the tanners, but it is now found that the property of gallic acid is to open the pores and allow the other weighting materials to enter the hide. With this small machine, tanners and chemists can test the bark from different trees, some of which are known to yield tannic acid, and are employed for the manufacture of ink and dye, but have never been used for tanning leather. The hide takes from the solution all the properties it requires when the substance is filtered.

STEPHENSON'S HORSESHOE AND SWAGE.

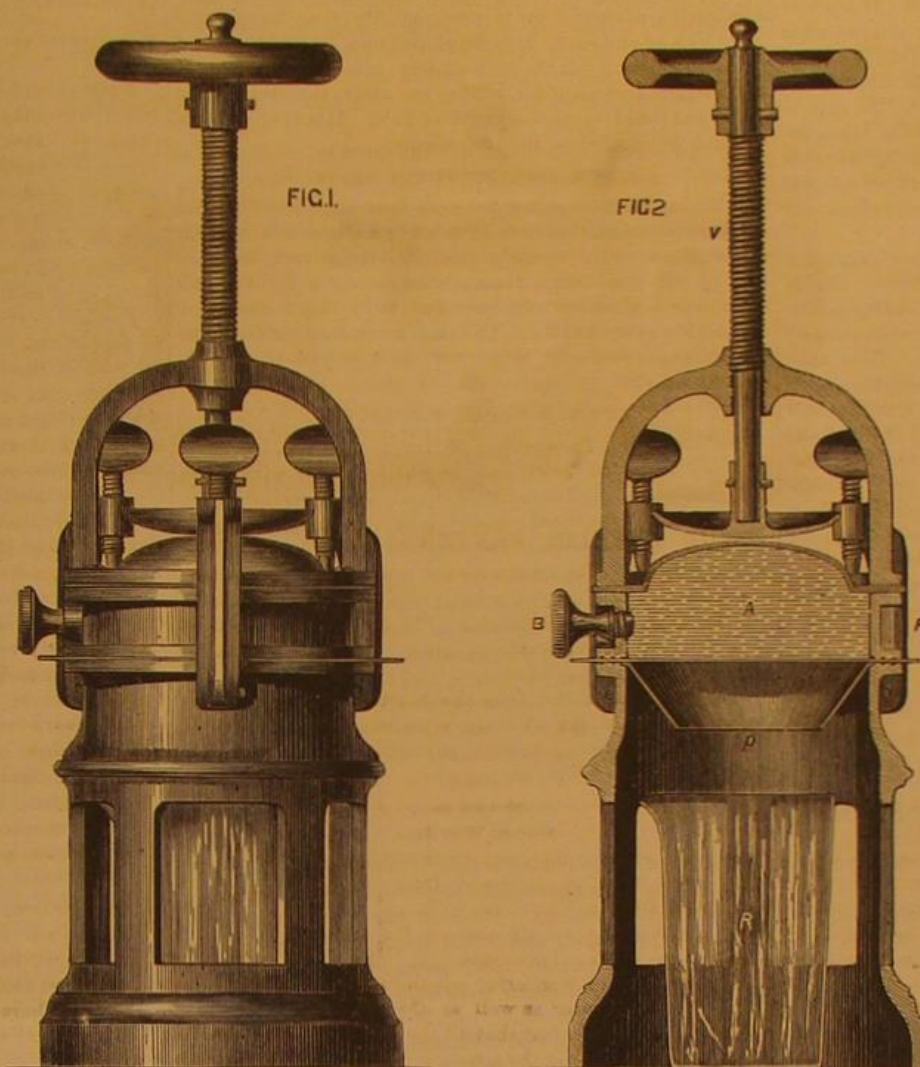
In the annexed engraving is represented a new horseshoe, so formed that the weight of the animal is thrown on its outer edge, which portion offers the principal support to the



hoof. This peculiar construction is obtained by means of a specially devised swage, the use of which will be understood from the following description

The calks of the shoe are located as usual. The holes for the nails are much further back from the edge than in the ordinary shoe. The portion between the nail holes and edges is flat. The remainder slopes inward, as shown in Fig. 1. The swage is represented in Fig. 2, and has a groove corresponding to the outer part of the shoe, which is here exhibited in section, a ridge for forming the nail hole indentation, and an inclined part corresponding to the like portion of the shoe. The swage is placed on the blank, and on moving it around the outer edge it raises the same, cuts the groove, and forms the concave all at once.

The inventor points out that there is fully three times as much iron on the outside of the nail groove as there is in the

**MUNTZ'S TANNIN-TESTING APPARATUS.**

ordinary shoe. This gives more room for opening, and enables the smith to make the shoe extend out full around the edge of the hoof. The location of the nail holes allows of the nails being driven straight through the hoof instead of in a bowing condition, and thus the clinch can be driven down more solidly.

Patented December 28, 1875. For further particulars address the inventor, Mr. Squire N. Stephenson, Richmond, Bedford county, Tenn., or William T. Frohock, 639 Arch street, Philadelphia, Pa.

COLLINS' DOUGH CUTTER.

Mr. James Collins, the inventor of the improved door check; illustrated elsewhere on this page, has also devised a new dough cutter, the patent for which is now pending through the Scientific American Patent Agency. The implement consists in an outer ring, A, which supports a central tube in which is a spring plunger. The lower end of said plunger is screw-threaded to receive either a solid disk, B, or short hollow cylinder. By means of the outer ring, A, alone, cakes or biscuits of circular form may be cut. When the hollow interior cutter is applied, the device may be employed for forming doughnuts or other articles from which a central circular piece is removed, the implement cutting the outer circumference and removing the inner piece at a single operation.



tion. The solid disk is employed to make the depression in tarts, for the reception of fruit or preserves.

Further particulars may be obtained by addressing the inventor, P. O. box 63, Central City, Colorado Territory.

To make rivets for joining leather hose, use 64 parts copper to 1 part tin

A New Method of Swimming.

A lecture on swimming was lately given at the Marylebone Baths, London, by R. H. Wallace-Dunlop, C.B. The feature of the lecture was the introduction of what was termed plate swimming.

Plate swimming is the fastening of round paddles on to the hands, in size and shape resembling plates; and by this means Mr. Dunlop maintains that great extra power is given to the swimmer. This was abundantly proved by a man swimming across the bath assisted by the plates when he had a heavy weight attached to his neck, when it would undoubtedly have been impossible to have swum without such assistance. Plates or paddles are also attached to the

feet, and, the lecturer maintained, are also of great assistance in keeping afloat. Mr. Dunlop spoke in very high terms of Captain Webb's book on swimming, and read several extracts from it—in particular, one that dwells on the importance of learning a style of swimming adapted to keep the swimmer afloat for a long period, rather than to enable him to swim very fast for a short distance, and then succumb. Captain Webb's portrait, when thrown on the sheet, was, of course, well received, and after the lecture the practical working of the plates was shown in the water. Mr. Dunlop will probably lecture again, and we would rather defer till then any detailed criticism on his invention. We feel confident, however, that the plates give increased power in the water in the way of enabling the swimmer to carry, say a rifle and ammunition, but we do not at present feel sure that they will increase speed.

Among the exhibitors in the water was Ainsworth, of the Serpentine Swimming Club, whose peculiar leg stroke was admirably adapted to exhibit the fins or feet plates, or paddles, that were used. There is one point we may mention in connection with this most interesting invention, which is that it is indispensable that ordinary swimming be first learned. We consider this, upon the whole, to be in its favor, as we should be sorry to see artificial means of floating resorted to, which would tend to check persons learning to swim in the ordinary manner.—*Land and Water.*

COLLINS' DOOR CHECK.

The annexed illustration represents a novel door check designed for holding doors in any desired position without

the use of blocks, chains, or any attachments which might injure the carpet or floor. It consists of a rubber-headed bolt, A, sliding in a casing and acted upon by a spiral spring which forces it downward. To the upper end of the bolt is pivoted a lever rod connected to a crank. When the latter is carried below its pivot, the spring is free to act and so to cause the bolt to hold the door. When it is desired to throw the device out of action, the crank is raised above the pivot, and is carried by the spring against the stop pin, B, when it holds the bolt securely in elevated position. The invention is easily applied; and in case of the spring becoming weakened by use, a new one is readily inserted.



Patented through the Scientific American Patent Agency, April 25, 1876. For further information address the inventor, Mr. James Collins, P. O. box 63, Central City, Colorado Territory.

(For the Scientific American.)

CALCULATING THE SPEED OF WHEELS, PULLEYS, ETC.

Although we are constantly solving problems as to the speed of wheels of given dimensions and the dimensions of wheels revolving at given speeds, enquiries on this subject come to us in such numbers that we cannot do better than give some plain, authoritative rules which all our mechanical readers will do well to remember:

To find the number of teeth in a gear wheel, revolving at a given speed: Multiply the speed of the driving wheel in revolutions per minute by the number of teeth it contains, and divide by the speed of the driven wheel, and the quotient is the number of teeth required. Example: If a wheel contains 50 teeth and makes 25 revolutions per minute, what number of teeth must a wheel contain to gear into the first, if it make 125 revolutions per minute? $50 \times 25 = 1250 \div 125 = 10$, the answer. For pulleys, or band wheels, the rule is the same, except that the diameter of the wheel is taken instead of the number of teeth. Example: A driving wheel is 24 inches in diameter, and makes 120 revolutions per minute; what size of pulley must be used to obtain 60 revolutions per minute? $120 \times 24 = 2880 \div 60 = 48$, the answer.

Another rule, which will answer whether we employ a single pair or two pairs of pulleys, is as follows: Divide the speed required by the speed of the driving shaft, and the quotient will be the proportion between the revolutions of the driving shaft and the revolutions required. Then take any two numbers that will, when multiplied together, give a product equal to that proportion; one of such numbers will form the relative proportion between the sizes of the first pair of pulleys, while the other number will form the relative proportion between the sizes of the other pair. Example: It is required to run a machine at 1,200 revolutions per minute, the driving shaft making 120 revolutions per minute. What sizes of pulleys should be used? $1,200 \div 120 = 10$. Then: $5 \times 2 = 10$, or $4 \times 2\frac{1}{2} = 10$; so that the proportion being 10 to 1, we may use two wheels of any sizes, provided that the one on the driving shaft is 10 times as large as the one on the machine. Or since $5 \times 2 = 10$, we may place on the driving shaft a pulley 5 feet diameter and belt it to one of 1 foot diameter, thus forming the proportion between the first pair of wheels of 5 to 1. The next pair of pulleys must be in the proportion of 2 to 1, that is to say, we may belt together a 2 feet and a 1 foot pulley, a 4 and a 2 feet, or any others so that one is twice as large as the other. Again, since $4 \times 2\frac{1}{2} = 10$, our first pair of pulleys may have the proportion of 4 to 1, and the second pair the proportion of $2\frac{1}{2}$ to 1, or vice versa, as circumstances may require.

It is obvious that, when the speed of the driving shaft is less than the speed required, the larger pulley of each pair must be used as the driving wheels. JOSHUA ROSE.

New York city.

SCIENTIFIC AND PRACTICAL INFORMATION.

PURIFICATION OF COMMERCIAL CHINOIDINE.

The following method for purifying the residue, obtained as a brown resinous mass, from the mother liquor of quinine, is given by Professor J. E. De Bry, of the Hague: Dissolve 324 parts of the resinous mass in 1,670 parts of dilute sulphuric acid (1 of acid to 33 of water), heat, add caustic soda until alkaline, then add a solution of hyposulphite of soda. Three parts of chinoidine require 1 to 6 parts of soda. The dark sirupy precipitate is allowed to settle, the liquid decanted, the precipitate washed with hot water, and this wash water added to the mother liquor. The liquid is heated, and an excess of caustic soda added, when the purified alkaloid is precipitated as a white sticky substance. It is dissolved in dilute sulphuric acid and evaporated at 212° to dryness. It is very hygroscopic.

ELECTRIC ALARM AGAINST SUFFOCATION BY ILLUMINATING GAS.

Burglar alarms have come into extended use, in this country at least, and to them have been added fire alarms, to go off when a certain temperature is reached; and it has been suggested that a suitable alarm for coal gas from leaky stoves could be added, making use of the property that carbonic oxide possesses of precipitating palladium salts. Another modification has been invented by Ansel, for detecting the escape of street gas in a room. It possesses the advantage of simplicity, and its operations depend on a physical law, not a chemical one, namely, that the lighter a gas is the more rapidly it diffuses through a porous membrane.

The apparatus consists of a pear-shaped vessel covered with a porous membrane or unglazed earthen plate. This vessel has attached to it a U-shaped tube filled with mercury. One pole of the battery dips into the mercury, the other terminates just above the surface of the mercury in the open end of the tube. If this apparatus is placed in a room where coal gas is escaping, the gas enters through the porous plate more rapidly than the air can escape; a certain pressure is produced, which causes the mercury to rise in the open leg and complete the circuit, thus giving the alarm. It is said that a comparatively small amount of gas in a room will set the apparatus in motion. A similar apparatus with the opposite arrangement of the terminating wires could be employed for detecting a large escape of carbonic acid from any source, for this gas is so heavy as to at once produce a partial vacuum in the pear-shaped vessel, and, of course, a fall of mercury in the open leg. The amount of carbonic acid requisite to vitiate an atmosphere is, however, so small that it would probably be without effect on this instrument. There may be other cases where the pressure of gases much heavier or lighter than air could be detected more quickly

by this than by the ordinary methods, as in coal mines and wells; while an advantage is that signals may be automatically conveyed to any desired distance. This seems, at least, a promising field for inventive genius and research.

PLATINUM PHOTOGRAPHIC PRINTS.

Professor Stebbing has written an article to the *Photographisches Archiv*, extolling Willis' process of printing in platinum, which takes, he says, but one fifth as long as silver printing. A sheet of starched paper is floated on a very weak silver solution, then laid on a glass plate, and over it is poured a mixture of sesqui-oxalate of iron and platino-chloride of potassium (or sodium?) and evenly distributed with a tuft of cotton wool. When dry, it is exposed under a negative until a weak picture is produced, the time being regulated by a photometer. It is developed on a warm solution of oxalate of potash; it is immediately removed, washed in weak oxalic acid until the whites are clear, then washed in water and toned on sulphocyanide of gold. It is finally drawn through hypo solution and well washed.

A NEW ADULTERANT FOR SUGAR.

It having been suspected for some time at Marseilles that sugar imported thither from Réunion Island was adulterated, examinations were recently instituted by government authority. It was found that the sugar, of a light brown color, was adulterated with sand and with slag to the value of \$2.40 in every 220 lbs. The slag ground up imitated the natural sugar perfectly, while the sand served to give increased weight.

NEW ELECTRICAL DISCOVERIES.

Professor John Trowbridge, of Harvard College, has made (1) a new induction instrument, in which the fine wire of the coil, instead of being distributed upon a single straight electromagnet, is distributed equally upon two straight electromagnets. 2. The cores of the magnets are made of bundles of fine wires. 3. The armatures are composed of thin plates of soft iron.

In his experimental instrument, the armature consisted of twenty plates of iron, each $\frac{1}{4}$ inch thick, forming an armature $1\frac{1}{4}$ inches in thickness.

Professor Trowbridge states that the use of this armature, in connection with the wire cores, increases the strength of the electric spark four hundred per cent, and also increases the length of the spark 100 per cent.

Good Words.

The first of the following notices is taken from the Austin (Texas) *Daily State Gazette*, the other from the *Comic Monthly*, published in this city. We need hardly state that both journals express their unsolicited opinions. Both reached us at about the same time, and it seems to us a notable coincidence that two periodicals so widely separated, both geographically and in character, should substantially agree in the mode of expressing their complimentary opinions of our journals. To the editors we offer our best thanks, and we reprint the notices, not only to exhibit to our readers how general is the appreciation in which the *SCIENTIFIC AMERICAN* and the *SUPPLEMENT* are held, but also as examples of encouragement well calculated to stimulate labors, even as arduous as our own.

"The *SCIENTIFIC AMERICAN* is the pride and glory of the intelligent people of this country. It has done more to foster invention, encourage science, and develop the peculiar mechanical genius of our people than all other publications combined, with the Patent Office thrown in. It is the mirror of sciences and mechanic; and everything that is novel, original, and useful finds its way into its well filled columns. Each number is a perfect storehouse of knowledge. We have lots of technical works, but few practical publications. The *SCIENTIFIC AMERICAN* is practical. It should be in every household, for it can never do harm to any, and may be the source of many future discoveries. No artisan, farmer, or student can afford to do without it, unless willing to sacrifice the surest source of reliable scientific knowledge. Impressed with the golden opportunity afforded by the Centennial, the *SCIENTIFIC AMERICAN* is issuing a supplement in addition to its regular weekly number. It is distinct from the regular issue, and has a large circulation. Those who desire to keep posted should take both. The *SCIENTIFIC AMERICAN* proper deals with the latest inventions and mechanics generally, the *SUPPLEMENT* with Centennial matters, the international exhibitions of past years, chemistry and metallurgy, technology, astronomy, natural history, medicine, hygiene, etc. It is uniform in size with the *SCIENTIFIC AMERICAN*, for convenience in binding. The *SCIENTIFIC AMERICAN* can be obtained for \$3.20 per annum including postage, or both it and the *SUPPLEMENT* for \$7. No subscriber can fail to receive back treble this value in the course of a year, even from the practical hints they contain."

The other contemporary says:

"THE BEST IN THE WORLD.—Nothing gives a better idea of the advancement our country has made in those arts and industries which make a nation great than that well known and widely circulated weekly, the *SCIENTIFIC AMERICAN*. This paper gives a record of all events transpiring from week to week in invention, discovery, and industrial and mechanical arts of every description. It gives fine illustrations of all important new or improved machinery; new discoveries and processes; able critical and descriptive articles; and, indeed, a vast fund of information, scarcely obtainable in any other form at any price. The *SCIENTIFIC AMERICAN* has for many years occupied the front rank, not only in this country but in the world. It is, indeed, invaluable to the inventor, manufacturer, scientific investigator, and

artisan, and its large circulation and high reputation attest the appreciation of the public. During this year, the *SCIENTIFIC AMERICAN* is specially valuable, as the Centennial is bringing into notice many machines and manufactures. The publishers have duly felt the responsibility resting upon the leading scientific journal of the world, and, in addition to their regular edition, are issuing a large and handsome extra edition which they call the *SCIENTIFIC AMERICAN SUPPLEMENT*. To inventors or manufacturers, whether native or foreign, who desire to reach the notion of American trade, nothing can be offered equal to the combined influence of the regular and supplementary editions of the *SCIENTIFIC AMERICAN*; and of both, Americans have just cause to feel proud."

Substitute for Wrought Iron and Steel.—The New Manganese Bronze.

A correspondent of the *London Mining Journal* says that the researches of the White Metal Company of Southwark and the extensive experiments of Colonel Younghusband, of the Royal Woolwich gun factories, have established beyond question or doubt that the new alloy may be considered to be twice as strong as brass, bronze, white, or gun metal, and that it must, therefore, inevitably supersede these compounds: while compared to wrought iron, its strength is computed to be as 1,000 to 360.

The best brass we may take as being composed of 80 parts of copper and 20 of zinc, bronze as composed of 90 parts of copper and 10 of zinc. But it is found that an addition of 1 to 2 per cent of manganese (which does not increase the price) to either of these compounds, but especially the latter, not only marvelously improves the alloy, but gives us virtually a new metal. It is harder, it is tougher, it is more elastic: so much so that, while the best wrought iron reaches its elastic limit under a strain of 10 tons, has a breaking strain of from 22 to 24 tons, and an elongation of from 10 to 15 per cent, a forged piece of manganese bronze bore a strain of 12 tons, a breaking strain of 30 tons, and an elongation of 20-7, and in some instances of even 35-5, per cent. It can be forged, rolled, and otherwise manipulated at a red heat with an ease and readiness hitherto unknown; and the hardness, toughness, and elasticity appear to be easily varied, according to the mode of treatment and the proportion of manganese added. No better instance of this vast superiority can be given than that no metal or alloy could be found except phosphor bronze—to which manganese bronze is to be preferred—to bear the strain of the engines of the new vessel, the *Shah*, on their crank bearings, and that the vessel was practically valueless until that alloy was tried, and it alone fulfilled all the requirements. There seems to be no doubt, therefore, that the new bronze will be used for all those purposes for which copper and its alloys have been hitherto employed; for who would use brass or bronze when they can get the new metal, doubly enduring, and therefore doubly as economical, for the same price? Thus, it will be required for all bearings for engines of every description, for slide valves, pistons, etc., for boiler tubes, for locomotives, for fire boxes, for hydraulic press cylinders, and all high pressure pumps. However, it is a very handsome metal, more golden-looking when polished, and retains its luster much longer, than brass.

The most remarkable suggestion which, however, has been made with regard to it is that manganese bronze should not only be used instead of copper for sheathing vessels, but that it will ultimately take the place of wrought iron and steel for plating our war ships, its power of elongation being a great desideratum. Careful calculation proves that a bronze plate two thirds of the thickness of wrought iron can be manufactured for the same price, and it gives us a stronger resisting power at a less weight, while a plate of the same thickness would be twice as invulnerable. Not only so, but a steel or other shot striking a manganese-bronze-plated ship would not split and crack and shatter the plate into a thousand pieces, to the imminent danger of those who are fighting it, but the shot would literally have to force its way, drilling a hole, through the tough and elastic bronze, and which hole could be readily and effectually plugged. The same arguments apply in every point to the manufacture of cannons and guns of every description. And as gun metal is really bronze, if these statements are true, all cannon ought at once to be made of the new metal. In fact, its uses seem perfectly illimitable. From Colonel Younghusband downwards, all agree as to the fineness and evenness of the texture and the perfect homogeneity of the metal; while it has also been observed that the contraction in diameter when elongated is perfectly symmetrical.

As this bronze, as we have seen, must contain (say) 88 per cent of copper, 10 of tin, and 2 of manganese, it is utterly impossible to overestimate the value which such a discovery implies to the mining industries of Devon and Cornwall, which have been so long depressed. A demand for this alloy (such as we may reasonably anticipate will, after a time, arise for it, both at home and abroad, from the infinity of uses to which it may be applied) will resuscitate the copper, tin, and manganese interests, the second of which is now in an almost ruinous condition from the low price of that metal.

NEWSPAPER enterprise at the Centennial Exposition is illustrated by the fact that the publishers of the *New York Times* will print an edition of their paper on the Walter press every morning, in the Exposition building. Duplicate electrotype plates will be made, and one set will be sent over to Philadelphia at 4 o'clock every morning, from New York; and from the plates so sent, the regular morning edition of the paper will be printed. It is expected that the *Times* will thus furnish the news in Philadelphia, in advance of all our other city dailies.

PRACTICAL MECHANISM.

BY JOSHUA ROSE.

SECOND SERIES—NUMBER IV.

PATTERN MAKING.

Of chisels, the principal kinds used are the paring chisel, used entirely by hand pressure, and the firmer chisel, for use with the mallet. The difference between the two is that the paring chisel is the longer. A paring chisel, worn to half its original length, will however answer for use as a firmer chisel, because, when so worn, it is sufficiently long for the duty. A chisel should not, however, be used indiscriminately as a paring and firmer chisel, for the reason that the paring chisel requires to be kept in much better order than the firmer chisel does. It is necessary to have several sizes of chisels, varying in width from an eighth of an inch to an inch and a half. A paring chisel for general use is shown in Fig. 18. Its width is about one and a half inches, and its handle should be exactly of the form shown in the engraving, the total length of handle being six inches, from A to B being one and a half inches, and the diameter at C, and from B upwards, being one and a half inches. The hollow below B is of three eighths inches radius, and the diameter at D is one inch. This shape and size gives a good purchase, especially from A to B, where the hand is most often applied, the end, E, being against the operator's shoulder. A firmer chisel having a handle of the ordinary pattern is shown in Fig. 19.

Fig. 18.



Fig. 19.



Fig. 21.

Fig. 20.



Chisels are sharpened in the same manner as plane irons; but being usually narrower, they require special attention in the grinding, as they should be held against the grindstone with an amount of pressure proportionate to their width. In describing Figs. 5 and 6, in a previous issue, we explained how a long feather edge may be given to a tool in the grinding; and these remarks apply especially to chisels. Hence, towards the finishing part of the grinding operation, the chisel should be held very lightly against the stone; the flat face of the chisel should never be ground, but should be kept straight and even, otherwise the whole value of the tool will be impaired. In setting the edge of a chisel upon an oilstone, it is necessary to exercise great care that the hands are not elevated so as to oilstone the blade at a different bevel to that at which it was ground, and not to allow the movement of the hands to be such as to round off the bevel face at and near the cutting edge, an error which, from lack of experience, is very apt to occur. The position in which the bevel of the chisel should be pressed to the oilstone should be such that the marks made by the oilstone will lie from the back of the bevel to the cutting edge, but be shown more strongly at and towards the cutting edge. The motion of the hands of the operator should not be simply back and forth, parallel with the length of the oilstone, but partly diagonal which will greatly assist in keeping the bevel level with the oilstone. Very little pressure should be applied to the chisel during the latter part of the process of oilstoning; and the flat face of the chisel should be held level with the face of the oilstone, and moved diagonally under a light pressure, sufficient only to remove the wire edge. After the setting is complete, the chisel should be lapped upon the hand to remove the fine wire edge left by the oilstone.

The next tool is the gouge, of which there are several kinds. Those having the bevel on the concave side are termed inside gouges; and when the bevel is on the convex side, they are called outside gouges. Gouges, like chisels, are also classed into firmer and paring gouges, the distinction between the two being the same as in the case of chisels. It is not necessary to possess a full set of each kind of gouges; half a set each of inside and outside will suffice, with an extra one or two for paring purposes. Fig. 20 represents a paring, and Fig. 21 a firmer, outside gouge.

The inside gouge may be ground a little keener than the chisel or plane iron, and requires care in the operation, since it has generally to be ground on the corner of the grindstone,

which is rarely of the same curve as the gouge requires. In oilstoning a gouge, what is called a slip is employed. Slips are wedge-shaped pieces of oilstone, of various curves and shapes to suit the purposes for which they are applied. The gouge should be held in the left hand, and the slip in the right, the latter being supplied with clean oil. The back or convex side of the gouge must be laid level on the face of the oilstone, and the handle worked to and from the workman, who must roll it at the same time, so as to bring every part of the curve of the gouge in contact with the face of the oilstone. All the remarks upon grinding and oilstoning chisels apply with greater force to gouges, because the small amount of the surface of the gouge, in contact with either the grindstone or oilstone, renders it extremely liable to the formation of a feather edge in grinding, and a wire edge in oilstoning. In grinding outside gouges, a new feature steps in; for if the gouge be kept at the same inclination throughout the grinding, as in the case of all the tools heretofore mentioned, the center of the gouge will be keener than the corners, to avoid which the gouge is given a rolling motion to bring every part against the action of the grindstone, while at the same time lowering the back hand as the corners of the gouge approach the stone. This, if evenly performed, gives an equal keenness to all parts of the cutting edge. The same rising and falling motion of the back hand is necessary in oilstoning the convex side of the gouge. The concave side is to be rubbed with an oilstone slip, taking care to let the slip be flat in the trough of the gouge and not elevated at the near end; for if once a habit of beveling, however slightly, the flat faces of tools is contracted, it tends to increase, so that the tools finally lose their characteristics and are in fact ruined so far as their application to good work is concerned. Hollow gouges are dispensed with by the use of rabbet planes, shown in Fig. 11.

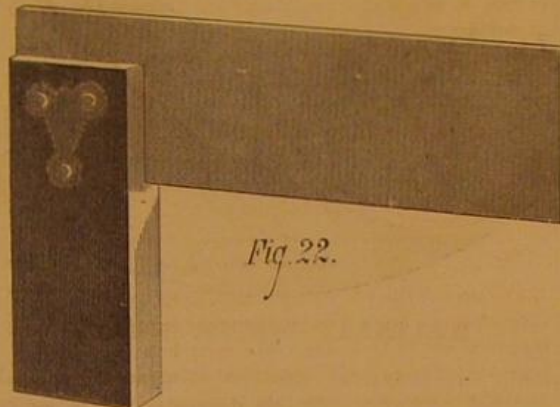


Fig. 22.

Several sizes of the squares are necessary to the pattern maker, because his work necessitates in many cases that the blade be short in order to admit of its application to the work. Fig. 22 represents an ordinary try square; the blade should be of sawblade, and the back of hard wood, the inside and outside edges of the back being covered with sheet metal to prevent undue wear. In addition to this, however, a bevel square is required; and it is best to have one with a sliding blade, so that the length it projects from the square back, on either side, may be adjusted to suit the work. Such a bevel square is illustrated in Fig. 23.

Fig. 23.

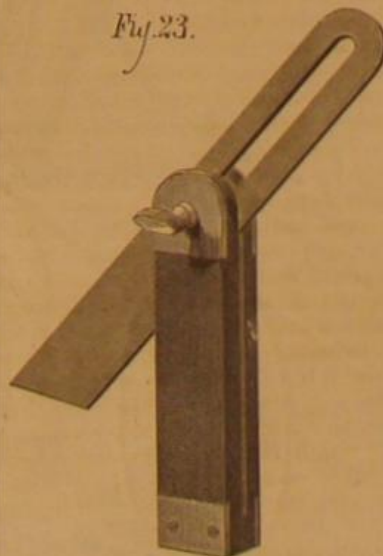


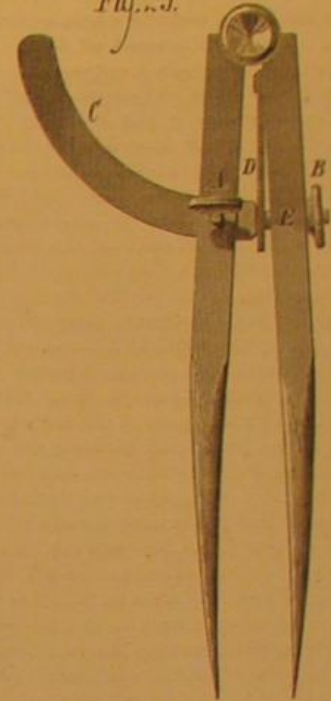
Fig. 24.



Of compasses there are two kinds, one being plain and having no means of permanent adjustment, as shown in Fig. 24. This is used for casual measurements or marking. The other has an attachment by which it may be permanently set, as shown in Fig. 25, in which A represents a thumb screw employed to set one leg firmly against the radius piece, C, and B being an adjusting screw for finally adjusting the compass points after the thumb screw, A, is fastened, the spring, D, operating to keep the leg, E, firmly against the face of the screw, B; so that, when the adjustment of the compass points is once properly made, the compasses may be laid upon the bench and used from time to time without danger of the adjustment being altered by handling or by a slight blow

An excellent attachment for compass points has lately come into use; it is for the purpose of fastening to the marking leg a pencil, to avoid scratching the surface of the work with the compass point. This device and its mode of application are shown in Fig. 26, in which A represents a thin tube with feet on it, provided with the split, B. C is a

Fig. 25.



clamp provided with a thumbscrew, E. D represents one of the compass legs. F is a piece of lead pencil which passes through the tube, A. The attachment is slipped on the compass leg, and the screw is tightened up, clamping that leg to the feet, G G, and clamping at the same time the pencil in

Fig. 26.

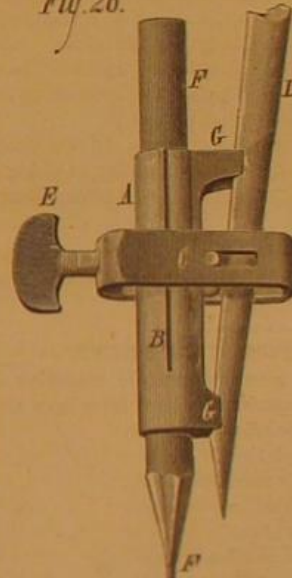
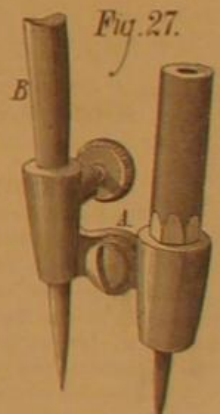


Fig. 27.



the tube. Another of these attachments, in which the pencil point is adjustable in a direction other than that in which the compass point stands, is shown in Fig. 27, the pencil tube being swiveled at A, and B representing the compass leg.

The points of compasses should be forged out when they get thick from wearing short, and they should be tempered to a blue color. For marking small holes, compasses are too cumbersome for fine work, and spring dividers are preferable. A recent improvement in these tools consists in making the spring helical, as shown in Fig. 28, instead of making it broad, flat, and thin, as formerly.

Fig. 28.



Iron Sheets Thinner than Paper.

We have heard of iron as thin as paper, but have just had a packet of specimen iron sheets brought to our office, not half as thick as the sheet this is printed on. This sheet is 0.004 inch in thickness; the iron sheets we have received are 0.0015 inch thick, or only three eighths of the thickness of the paper. At the same time the iron sheets are so tough as to be torn with difficulty, and so flexible as to bend with almost the facility of ordinary printing paper. These wonderful specimens of iron were made from the rough pig up to the rolled sheets by our neighbors, the Pearson and Knowles Coal and Iron Company, whose skillful manager, Mr. Hooper, has discovered a means of rolling these infinitesimally thin sheets in numbers without their sticking together.—*Warrington (England) Guardian*.

IMPROVED WATER WHEEL.

The novel features in the improved water wheel illustrated herewith is found in the buckets, which are provided with inner arms to strike studs as soon as the buckets enter the chutes. One bucket is thus opened to the full striking force of the water just as the preceding one enters the exhaust, so that the dead pressure of the water becomes, it is claimed, entirely utilized.

Fig. 1 is a side elevation, and Fig. 2 a plan view. At A are the buckets pivoted to the wheel, as shown, so as to swing out and meet the pressure of water passing through the channels, B, to the exhausts, C, and so as to close in for passing the cut-off partitions, D. Said partitions prevent back action of the water. At E is shown one of the studs, so located that the bucket arms come in contact with it, and the buckets are thus opened. The closing of the buckets is effected by the curved part of partitions, D.

The water enters on the sides of the casing through the gates, of which there may be three or more, and is so conducted that it strikes the wheel in a tangential direction. At the same time the current opens one of the buckets, which then shuts up the whole opening to the exhaust, so that the full force of the water is spent on the bucket.

While the apparatus is in operation, four buckets are employed to each gate. The first bucket is opened to receive the water; the second bucket carries the water to the opening in the lower part of the casing, where it is gradually discharged as the bucket moves on, thereby avoiding the jerk on the wheel which might otherwise occur. The third bucket moves right over the opening in the lower part of the casing, allowing the full discharge of the water; and the fourth bucket strikes the partition which extends on one side of each gate toward and close to the wheel, and becomes closely shut.

The advantages claimed are that the apparatus works with any head of water, also under back water. It can be adjusted to any required power by the partial or entire opening of the gate. It employs the whole periphery of the wheel for the utilization of the power; and it gives the advantage of the full pressure of the solid column of water without the necessity of accelerated motion and consequent augmented use of water.

Patented through the Scientific American Patent Agency, March 14, 1876. For further information address the inventor, Mr. Henry Waltner, Hamilton, Ohio.

IMPROVED COTTON STALK PULLER.

We illustrate herewith a new and simple invention for pulling cotton stalks in preparing the land for a new crop. The construction is such as to afford a powerful leverage upon jaws which tightly grasp the stalks, so that the work is accomplished almost as fast as the operator can wheel the implement from plant to plant.

The machine consists of a wooden frame made in parallelogram shape and mounted on wheels, the axle being located near one end. It is supported and strengthened by suitable braces, and the rear crossbar serves as a handle. Two jaws, the ends of which project in front of the forward crossbar, are pivoted to each other and to the axle. The shank of one jaw is bent at right angles and secured to one of the side bars. To the other shank is pivoted a rod which passes through a slot in the side bar and connects with a hand lever, as shown. This lever is moved by the operator to open the jaws so as to cause them to grasp the stalk; then, by bearing down on the rear end of the frame, the plant is pulled from the ground, the axle serving as a fulcrum for the leverage. The device is labor-saving, and to the planter will doubtless prove an efficient and useful implement.

Patent now pending through the Scientific American Patent Agency. For further information address the inventor, Mr. Robert D. Brown, Austin, Texas.

Flower Pots.

We learn from the *Hamburger Gartenzeitung* that the fabrication of flower pots from a mixture of cowdung and earth is now extensively practised in Germany, 16,000 being used last year in one establishment. For forcing they are highly recommended, though they will not bear plunging in a hot bed; and they are admirably adapted for nursery work, for plants raised in pots and afterwards turned out, in this case pot and all. Even standing dry, the roots of plants will penetrate the sides of the pot, and extract some nourishment from them. They are made by machinery, and one man can make from 700 to 900, or even 1,000, in ten working hours. There are machines for two sizes, 2 inches by 2 (price \$2), and 2½ inches broad by 2½ high (price \$2.50.)

The Blue Color of the Sky and Sea.

The blue color of the sky and of the sea is satisfactorily proven to be due to the presence of exceedingly small particles of matter, that float in the air or water.

A beautiful illustration of the multitude and minuteness is given by Rev. Wm. H. Dallinger, as follows:

"Let clean gum mastic be dissolved in alcohol, and drop it into water; the mastic is precipitated, and milkiness is pro-

Fig 1

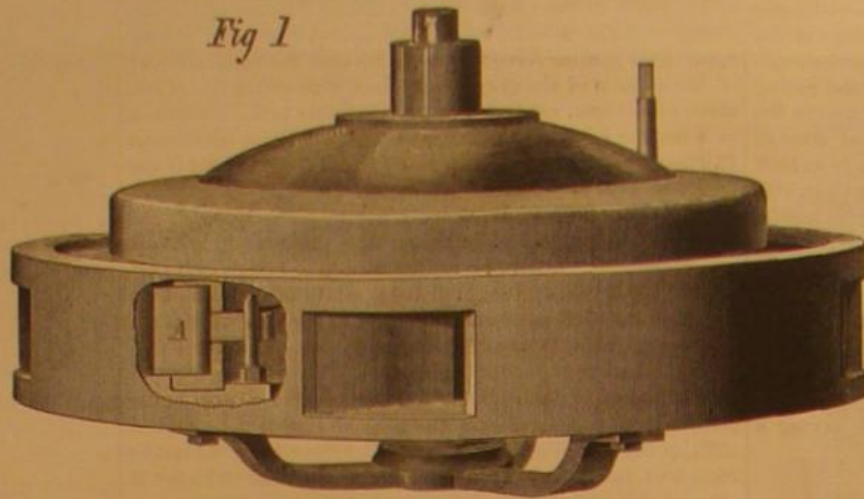
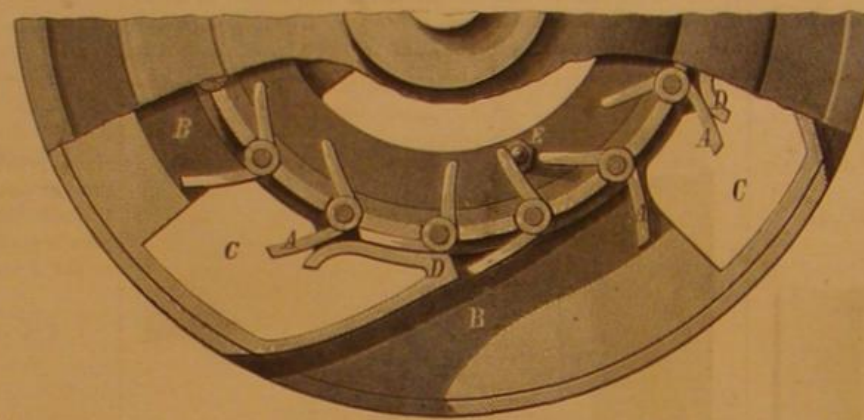


Fig. 2

**WALTNER'S WATER WHEEL.**

duced. Gradually dilute the alcoholic solution, and a point is reached where the milkiness disappears, and by reflected light the liquid is of a bright cerulean hue. 'It is in point of fact the color of the sky, and is due to a similar cause—namely, the scattering of light by particles small in comparison to the size of the waves of light.'

"Examine this liquid with the highest microscopical power, and it appears as optically clear as distilled water. The mastic particles are almost infinite in number, and must crowd the entire field of the microscope; but they are as absolutely

**BROWN'S COTTON STALK PULLER.**

ultra-microscopic as though they had no existence. I have tested this with an exquisite $\frac{1}{16}$ of Powell and Lealand's, employed with a new and delicate mode of illumination for high powers, and worked up to 15,000 diameters; but not the ghostliest semblance of such particles was seen. But at right angles to the luminous beam passing among these particles in the fluid, 'they discharge perfectly polarized light.' 'The optical deportment of the floating matter of the air proves it to be composed, in part, of particles of this excessively minute character,' and among the finest of these particles Professor Tyndall finds the source of bacterial life."

Breathing through the Nose.

There are various reasons for considering the nose the natural outlet of the lungs, and hence various advantages are to be derived from breathing through the nose.

1st. If we breathe through the nose we will be enabled often to detect the presence of noxious odors in the air we breathe, and so be warned in time to prevent disease.

2d. The internal nose is studded with hairs, which in some degree at least prevent the ingress of noxious matters in the air we breathe. Dust is strained out; and it is confidently asserted, by persons who have tested the matter, that miasmas are prevented from entering the blood if one breathes only through the nose. Some persons have lived in malarious districts, slept on the banks of malarious rivers, etc., for years, and yet have escaped all the forms of fever which usually followed a residence in the country, who have ascribed their exemption solely to the settled habit of breathing only through the nose.

3d. By breathing through the nose, little, if any, air passes into the lungs until it has come in contact with the membranes of the nose, which are supposed to possess some power of neutralizing malarious and contagious poisons.

4th. By drawing our breath only through the nose, the air is warmed by contact with the membranes before it reaches the lungs, and so inflammations and congestions of those organs are avoided.

Per contra, the habit, so common, of breathing through the mouth has many disadvantages. In this way a great volume of air is quickly taken in, loaded with dust, malarious or contagious impurities, etc., of which we are utterly unconscious, until the blood has been poisoned, and serious, perhaps fatal, disease has been inaugurated. The cold air, being taken in in great volume and with great rapidity, chills the lungs, whereas, if breathed through the nose, it would be warmed before reaching the lungs.

The habit of breathing through the mouth is caused largely by weakness of the respiratory muscles, and one excellent method of strengthening those muscles is to breathe through the nose. It is certainly as wise a plan as sucking air through a silver tube, so often recommended. Then breathe through the nose, as Nature indicates, if you would have good health.

Japanese Iron.

A foreign technical serial gives the following account of Japanese ironworks: The blast furnaces of Japan are small and of very simple construction, although built on the same principle as those of Europe. The walls are built of fireproof clay, mixed with a few stones. The blast furnaces are round, and have an opening at the side, closed by a band of clay; opposite are two other openings, through which comes a strong current of air, driven into the furnace by Chinese bellows worked by men. Before pouring the ore into the furnace, they mix it with coal, and subject it to a previous calcination, so as to get rid of its carbonic acid and sulphur. The Japanese do not understand puddling as practised in the West; but the principle of their procedure is exactly the same. The fused iron, mixed with a little sand and pieces of iron, is again fused with charcoal in a second furnace, where it is left to cool for several days, until the whole mass has the appearance of fluid. The Japanese method of making steel is quite different from that practised in Europe. They mix a certain quantity of iron in pigs and iron in bars, cover the mixture with borax, and melt the whole for a week in a small fireproof crucible. The borax serves to dissolve the impurities in the dross. When the metal is separated from the dross, which floats on the surface, and cooled, it is hammered hard, and alternately plunged into water and oil, after which it is cemented and tempered. The mode of cementing is as follows: The steel, on coming from beneath the hammer, is covered with a mixture of clay, cinders, marl, and charcoal powder. When this plaster is dry, the whole is subject to a red heat, and the steel is cooled very slowly in warm water, which is allowed to become tepid. Steel thus obtained is not very supple, but extremely hard, because it is not properly tempered or freed from its impurities. It would not do for making watch springs, but it is used by the Japanese for swords and sabers, which are tempered as many as eleven times, and knives, which are tempered four times.

To whiten lace, iron it slightly, and sew it up in a linen bag; let the bag remain for 24 hours in pure olive oil. Then boil the bag in soap and water for 15 minutes, rinse in warm water, and then dip into water containing a slight proportion of starch. Take the lace from the bag and stretch it out to dry.

A FISH THAT FISHES.

Dame Nature never indulged in a more curious freak than when she produced a fish which gains its livelihood by fishing for his fellow fishes. The fact is all the more wonderful since no other animal save man adopts the bait as a mode of capture for finny prey. The otter and seal pursue fish and take them in fair chase, the sea hawk seizes them bodily and lifts them aloft quivering in its talons, and neither brute nor bird uses a lure of any description to attract the victim within reach. The chironectiform, however, whose

commission has been conducted, and the future operations of that body. He states, in order to show the extent of operations, that the number of eggs of the California salmon alone, collected during the season of 1875 at the United States establishment on the Upper Sacramento River, amounted to about 11,000,000, making a bulk of 80 bushels, and weighing, with their packing, nearly 10 tons. The work of propagation has been successfully carried on in the Potomac river, in which, from 6,000,000 to 10,000,000 lbs. of shad and herring are now taken during the spring months alone.

ground be too hard for such a maneuver, it will shoot boldly from the bottom, leap over the upper edge of the net, and so escape into the water beyond. The fish has also the peculiarity of living to a great age, and it is said that carp exist in French ponds over a century old. It is tenacious of life, even when food fails and when removed from the water, and if carefully packed in wet moss so as to allow a free circulation of air, it will survive for weeks. Professor Baird anticipates no difficulty in domesticating this valuable fish in American waters, since it can be multiplied at very little ex-



THE CHIRONECTIFORM OR ANGLING FISH.

somewhat ungainly aspect is represented in our engraving, taken from the *Australian Sketcher*, sets a trap with which Nature has provided him, in the shape of an extraordinary apparatus located on the top of his head. The appendage is a flattened, bony member, covered with granulated skin, and working on a universal motion joint, and having a thick muscular base. At the free end of the bony shaft is a semi-spherical gland, resembling much in form the seed vessel of the gum tree (eucalyptus), covered in its front aspect with a brilliant nacreous integument, and having an aperture connected with its interior. From this gland rise several soft branched appendages with white shining vermiform filaments at the tip of each branch. The chironectiform is found in the vicinity of New Zealand. A neighboring European genus—the lophius, or angler—which also has an attracting apparatus, but much less complicated, is stated to crouch close to the ground, and, by the action of its fins, to stir up the sand or mud. Hidden in the obscurity thus produced, it elevates its appendages, moving them in various directions by way of attraction or as a bait. The small fishes which may approach, either to examine or seize them, immediately become the prey of the fish. We must grant that the habits of the present fish may be somewhat similar, but that superior attractive power is given it by having the nacreous lining to the gland at the base of the filaments, which shines under water like a mirror. The fish is delineated in a dark nook at the bottom of the sea, enticing a wary victim to closer acquaintance with its formidable armature of teeth. The possible victim represented is the *platystethus abbreviatus* (a new species) of Hector, whose type was dredged by H. B. M. S. Challenger off Cape Farewell, N. Z., from the great depth of 400 fathoms; numbers of the same species, however, are cast on the beaches of the west coast after heavy gales. Attention is drawn to the spinous armature of the body of our angler, which must prevent all but very hungry monsters dining off it in its turn. The specimen is represented one half the natural length.

THE WORK OF THE UNITED STATES FISH COMMISSION.

Professor Spencer F. Baird, United States Commissioner of Fish and Fisheries, in a letter to Congress in behalf of a small appropriation for fish propagation, gives some interesting facts regarding the scale on which the work of his

There is no reason, says Professor Baird, why any stream in the United States, having direct communication with the Gulf of Mexico or either ocean, may not be made to abound to an equal degree with these and other fishes.

A portion of this year's appropriation is to be devoted to the introduction of the European carp, a species eminently calculated for the warmer waters of the country, especially the mill ponds and sluggish rivers and ditches of the south. This fish, an engraving of which is given herewith, often reaches a weight of six or seven and sometimes as high as eight pounds. Its length varies from six inches to two and a half feet. The upper portion of the body is a golden olive brown, and the abdomen is a whitish yellow. Its flesh is excellent eating; and as game, the fish is but little inferior to the trout. It inhabits the fresh water lakes and streams of central and southern Europe, whence it has been spread by

pense even in restricted ponds. The work of the Fish Commission includes not merely the stocking of streams with new fish, but the replacing in water courses fish which once existed there but now have become extinct. At one time all the rivers on the Atlantic coast abounded in shad, and furnished an enormous aggregate of food, not only sufficient for several months' supply to the inhabitants, but allowing a surplus for shipment, either fresh or salted. Now, however, this condition has become a matter of tradition in regard to nearly every stream south of the Potomac, and nothing but the method of artificial propagation will restore the stock. When we bear in mind that the eggs of a single pair of shad, artificially treated, can be made to produce more young fish than those of two hundred pairs of natural spawners, the importance of the measures to be adopted by the Commission will be readily appreciated. During the years 1874 and 1875, Professor Baird states, the distribution of eggs and spawn was as follows: Shad 18,689,550; Penobscot salmon, 2,294,565; California salmon, 5,153,740; total 26,137,855. To this is to be added the hatching and distribution, during the spring and winter of 1875-76, of California salmon, Penobscot salmon, land-locked salmon, and lake white fish, not yet completed, but amounting to at least 14,000,000 fish, thus making a total of 40,000,000 supplied by the United States Fish Commission in three years. This, at the assumed ratio of 1 to 200, would represent the proceeds of 8,000,000,000 eggs laid in the natural way and subject to all the especial perils of natural spawning.



THE CARP

man over the northern portion. It prefers quiet waters with soft and muddy bottoms, and spawns in May or June according to locality. The food consists of larvae of aquatic insects, worms, and soft plants, though the fish will eat almost any vegetable food in artificial ponds.

The carp is probably the most cunning of all fishes, although it can be easily tamed. It seems to learn the danger of hooks and baits, after a few of its fellows have been captured. Even the net, which is so effective with most fish, is often useless against the ready wiles of the carp, which will sometimes bury itself in the mud as the ground line approaches, so as to allow the net to pass over it; or if the

Improved Photo-Cameo Pictures.

The picture is to be printed in oval or obtuse angular shape, with toned margin, and then to be gelatinized. After that we paste sand paper on a piece of thick cardboard, a little larger than the picture to be operated upon, rough side out, and cut the oval or obtuse angle exactly by the copying mask out of the center, place its sand paper side on the picture, and run through a roller press. The sand paper will give the toned margin a dim appearance, while the surface of the picture will remain shining. If we wish to get a finer dim margin, we have only to put on the sand paper a second time in another position, and press again. Instead of sand paper, paper lace, or woven stuffs may also be used, but the former, in most cases, produces the best effect.

NOTES ON CHEMISTRY.

READ BEFORE THE NEW YORK ACADEMY OF SCIENCES, APRIL 10, 1876, BY
PROFESSOR ALBERT R. LEEDS

ON UNUSUAL OCCURRENCES OF PHOSPHORIC ACID

1. In commercial soda ash: in notable quantity. As this is used as a flux, the occurrence of phosphoric acid might, in certain cases, produce unlooked-for results. Its presence would, moreover, as a general rule, be detrimental.

2. In fluorite: shown to be present in American fluors, more especially those from Southern Illinois. According to Berzelius, the spar from Derbyshire contains 0.5 per cent of phosphoric acid. No analyses of American fluorites appear to have been recorded. When they are performed, the determination of the percentage of phosphoric acid should form not the least important feature of the analysis, and should be made with extreme care.

3. In cryolite: the mineral analysed came from Evigtok, Greenland, and every care was taken to select out pure material, free from the minerals usually occurring in connection with the cryolite.

4. In artificial fluor spar, patented under the name Stevens flux: It is made by heating cryolite with lime, and washing out the fluoride of calcium thus formed. A quantitative determination gave 0.00934 per cent of phosphorus, corresponding to 0.0214 per cent phosphoric acid.

5. In the so-called chemically pure sulphuric acid: in the course of the preceding analysis it was necessary to use a large amount of sulphuric acid in order to get the minerals into solution. Although it seemed an almost absurd precaution to look for phosphoric acid in the sulphuric acid, yet it was done, with the result of finding some actually present. The acid analysed was that which has been used at the Institute for several years with great satisfaction. That portion of the acid used in the preceding analysis contained 0.0006 per cent of phosphoric acid.

On other probable occurrences of phosphoric acid: It is worthy of note that cryolite is one of a class of minerals, similar in their constitution and in their rock associations. Thus cryolite, $3 \text{ Na F} + \text{Al}_2 \text{ F}_6$, occurs at Evigtok in gneiss, chiolite, $3 \text{ Na F} + 2 \text{ Al}_2 \text{ F}_6$, in the Ilmen Mountains in granite, associated with topaz, fluorite, and cryolite. Examination, more critical than that to which they have been subjected, would probably reveal the presence of phosphoric acid in a number of similar fluorine-bearing minerals.

A converse proposition is probably true of minerals containing phosphoric acid. In quite a number of instances this is the fact, as in amblygonite, wagnerite, and apatite. The associations of these three minerals are likewise very similar. There is an interesting field of study open regarding the mineral combinations in which phosphoric acid, chlorine, and fluorine enter in combination with alkaline bases, and earths. By artificial means, the number could probably be largely increased. Finally, many silicates deserve re-examination. The minerals chondrodite, topaz, and muscovite are similar in containing fluorine and in their associated rocks, the first occurring in granular limestone, the second in gneiss or granite, the last forming a constituent portion of gneiss. It is doubtful whether these and similar silicates have ever been examined for phosphoric acid, with the aid of the refined qualitative tests of late years, perfected for this substance.

Over great areas of metamorphic rocks, the soil produced by rock decay retains an inexhaustible fertility, and every soil analysis shows the presence of a considerable percentage of phosphoric acid. In the case of the gneiss rocks of the Atlantic States, this phosphoric acid is not improbably derived in part from an undetected trace of phosphoric acid in the muscovites.

That these surmises should not appear unwarrantable, it should be borne in mind: 1. That in the great majority of cases, phosphoric acid has never been looked for. 2. That it is only of late years that chemists possessed a ready method of detecting it, and an accurate method for its quantitative estimation. 3. It might frequently be precipitated in combination with certain bases, and the fact be readily overlooked.

A RAPID METHOD OF DOUBLE WEIGHING.

In the weighing of the two portions required for the analysis in duplicate of a substance, the following device, which, if not new, is new at least to the writer, will be found materially to shorten the time required: Equal portions, as nearly as the eye can judge, say (in the case of a carbon determination in steel) about 5 grammes (75 grains), are placed in the two watch glasses of the balance. They are equilibrated by transferring from the heavier side. Each portion is then removed and equilibrium restored by weights; their sum is the weight of both portions. Of course, this is accurately true only when the balance is in perfect adjustment. If not, the following mode of double weighing will give accurate results in the same time as is required to make one double weighing in the ordinary manner. Calling the right hand watch glass R, and the left hand watch glass L, after the two portions are in equilibrium, one (say that in R) is removed, and its place supplied by weights. These are to be taken as the weight, not of the portion in L, but of the portion in R. The portion in L is now to be removed, and the weights by which it is replaced are in like manner to be regarded as the weight of the portion in L.

AVOIDANCE OF ERROR IN WEIGHING ABSORPTION TUBES.

Certain discrepancies having appeared in duplicate determinations, where absorption tubes were employed, and which were assignable to no known error in the method of conducting the analysis, they were attributed in part to the large volume of air displaced, and the variations in temperature and pressure at the successive periods at which the

weighings were effected. The absorption apparatus was therefore nearly, but not quite, counterbalanced by a second absorption apparatus of the same displaying capacity and similar glass. The latter was partly filled, and then sealed and kept in the balance case; the former was left in the balance case until the temperatures of both were equal. The amount absorbed was in this way directly measured by the small increment in weights requisite to restore equilibrium. This device has caused the anomalies to disappear, and duplicate determinations rarely differ more than two hundredths of one per cent.

A GENERAL METHOD OF SPECTROSCOPIC EXAMINATION.

A short while ago, Mr. Hes drew attention to the fact that traces of boracic acid could be detected by moistening the borates with glycerin in the application of the spectroscopic test. Mr. Brown Ayres, at the lecturer's request, has applied the same reagent to a number of insoluble and non-volatile compounds of the spectroscopic elements, and finds that a mixture of one part of hydrochloric acid and three parts of glycerin greatly enhances the delicacy and brilliancy of the spectroscopic test. The mixture is applied from a dropping bottle, similar to that used with cobaltic nitrate in blowpipe analysis, and from its adhesive properties may be used with solid particles, and the concentrated residues from evaporation.

EXAMINATION OF AN ARTIFICIAL MINERAL.

This was formed during the casting of an alloy consisting of 85 parts of copper and 15 parts of tin. During the process of casting, a portion of the alloy refused to pour, and was dumped out upon the clean brick floor of the casting room. It was found, on solidifying, that a great number of crystals had formed on the surface and in the cavities exposed to the air. The crystals are needles not exceeding $\frac{1}{4}$ inch in length and $\frac{1}{16}$ inch in thickness. Luster adamantine, and of great brilliancy. Color, white and transparent. It scratched glass, its hardness being over 6. The specific gravity at 62° Fah., by the bottle, is 6.019. It will be noted that this is lower than the specific gravity of natural cassiterite, which is from 6.4 to 7.1. It glows brilliantly in the oxidizing flame, but gives no evidence of fusion at the terminations of the crystals. It tinges the flame green. With soda, it gives a white coating of oxide of tin. Crystals not apparently affected by several hours' digestion in hydrochloric and nitric acids. In chemical constitution, it is a stannic oxide, containing a small amount of oxide of copper. A quantitative analysis was not made, owing to the small amount at disposal. The mineral is therefore an artificial variety of crystallized stannic oxide or cassiterite.

MUSICAL VIBRATIONS.

LECTURE DELIVERED AT THE STEVENS INSTITUTE OF TECHNOLOGY, BY
PROFESSOR C. F. BRACKETT, OF PRINCETON, N. J.

The lecturer began by remarking that it was "carrying coal to Newcastle" for him to lecture on musical vibrations in a place where original researches, known and respected even across the water, were made on this subject.

We come in contact with the external world by our senses, and we recognize matter by its effects upon them. All matter presents itself to us by its activities; it is moved by a power which never allows it to rest. If we attach a porous cell to one end of a glass tube and cause the other end to dip in a vessel of water, a jar of hydrogen placed over the porous vessel will gradually cause the passage of the gas it contains into the cell and tube, and will drive out the air before it, which will escape in bubbles through the water. On removing the jar, the inherent activity of the hydrogen impels it to escape again through the pores of the cell, and the water rises in the tube.

By means of a condensing pump we are enabled to force air into a receiver; on turning the stopcock, the inherent activity of the air forces it out again until equilibrium is restored. Conversely, we can withdraw the air from a receiver by means of an exhausting pump; but on opening the stopcock, the activity of the outer air forces it into the receiver until the first conditions are again established. These experiments show that air in its ordinary state, under pressure, and relieved of pressure, possesses inherent activity. In its ordinary state air is under continual pressure, owing to the weight of the atmosphere above it.

A pendulum moved to one side returns to its original position, passes beyond it, and continues to vibrate until stopped by friction and the resistance of the air. Water and alcohol placed in the same vessel in layers, taking care not to mix them, will gradually and completely intermingle by their own inherent activity.

If one end of a wooden rod is fixed in a vise and the other end is bent over, the particles on one side are compressed and those on the other extended. On releasing the end, the particles by their inherent activity recover their original position with such energy as to pass beyond it, and the rod continues to vibrate in lessening arcs until it comes to rest. Another form of elasticity was illustrated by means of a rubber tube about ten feet long, of which the Professor held one end and an assistant the other. When this tube was shaken and struck, a series of depressions and elevations were formed, which traveled the whole length of it, like waves, and at one time caused the tube to appear like a series of long links. These vibrations are due, first to the impulse given the tube, and second, to its inherent activity or elasticity. By means of a little manipulation, cords may be made to vibrate as a whole, or in two, three, or more sections: which accounts, as we shall hereafter see, for the wonderful harmony of the pianoforte.

The vibrations of a plate were next exhibited, by covering it with a layer of water and placing it in the vertical lantern.

On rubbing the glass with the wet fingers, its vibrations became apparent by the wave motions of the water projected on the screen. The vibrations of a glass tube may be shown by putting some fine powder in it and producing a sound near its mouth, when the powder will arrange itself in little plates, standing on edge and moving to and fro; at certain points, however, the powder remains at rest. These points are called nodal points, and mark the length of the waves. If we had a fork making 1,024 vibrations a second, and a glass tube vibrating in unison with it, the nodal points in the glass tube would be just one foot apart, and would show us that sound traveled about 1,025 feet a second.

Let us now examine how the air is affected by these vibrations. If we suspend a pine rod by the middle and rub the fingers coated with resin over it, it emits a shrill sound. Substituting a brass rod, clamped in the middle and having an ivory ball suspended in contact with one end, for the wooden one, and rubbing it in the same manner, the ball is violently projected from it. The explanation is that all friction acts rhythmically. When one body slides over another, the particles of one seize those of the other and drag them along until the resistance overcomes the attraction between the two; then they return to their former positions, to be again displaced, and these actions recur at regular intervals. Now suppose the rod to be replaced by a tuning fork, and the ivory ball by the particles of air in contact with the fork. These particles are first thrown off, forming a condensation of the air; then they return, forming a rarefaction, and are immediately projected again by the next beat of the fork against them. The condensed and rarefied waves are then propagated outward through the air.

The cross section of a tube contains a great number of air particles. The motion of a wave of sound through them was compared to that of a wave of water at the bottom of the ocean, seeing that we live at the bottom of the ocean of air. The existence of nodal points in a tube was explained by the fact that there are two sets of waves present, traveling in opposite directions. The first waves are reflected on reaching the bottom of the tube, and return, meeting the following waves. At certain points these waves unite, producing a greater wave, while at others they neutralize each other, one tending to pull a particle down while the other tends to lift it up at the same time, and so the particle remains at rest. It is not quite correct, however, to suppose that the particles move up and down. They really move in small circles, as has been shown by the brothers Weber of Germany, who suspended fine particles in troughs of water and studied their motions.

There must be something to convey the sound to the ear. In our experiments we have assumed that the air conveyed the sound, and it generally does. If we put a bell rung by clockwork under a receiver and exhaust the air, the sound ceases altogether; on readmitting the air, it is again plainly heard. The transmission of sound is not, however, confined to the atmosphere. This was demonstrated by a very neat experiment. A music box was wound up and put inside a thick wooden box. Then the latter was closed tightly, and covered with numerous layers of woolen cloths until the sound was completely smothered. On placing an æolian harp in communication with the music box by means of a wooden rod about six feet long, the vibrations passed along this rod and the music became distinctly audible, being reproduced by the æolian harp.

There are several ways of finding the number of vibrations made by a body in a given time. One is to take a Geissler tube, through which sparks are sent from an induction coil as often as the circuit is completed by a vibrating body. On revolving the tube, each spark will illuminate it in a different position. By counting the number of flashes and knowing the rate of revolution of the tube, we can readily find the number of vibrations of the body breaking circuit. Another way is to attach a fine point to the end of a tuning fork, whose rate of vibration is required, and draw it across a plate of smoked glass, while the fork is sounding. The point will scrape off the black and produce a sinuous line. The number of waves in this line, together with the rate of motion of the fork, will give us the rate of vibration. A third way of accomplishing the same thing is by means of the siren, an instrument consisting of a cylindrical brass box, having an aperture below for the admission of air and a number of small holes arranged in a circle in the top. Above this revolves a disk containing the same number of holes inclined in the opposite direction. The instrument is provided with an apparatus for registering the number of revolutions. When the air is forced in below, by means of an acoustic bellows, it escapes through the holes in the top and sets the disk in rotation. Each time two holes coincide the air escapes in puffs, and the result is a succession of sounds forming a note more and more acute the more rapidly the disk revolves. As we know the number of holes and have only to read off the number of revolutions on the index, the rate of vibration is easily computed.

The last topic considered was resonance. If we place two forks tuned to perfect unison, each mounted on a resonance box, several feet apart, and set the one in vibration, the other will soon take up the sound and continue it even after the first has been stopped. The particles of air struck by the first impinge upon the second with rhythmical and accumulating force until it too begins to swing.

Many other interesting points connected with this subject will have to be reserved until the next lecture, "On Harmony and Discord, with Optical Studies."

C. F. K.

To revive the color of black cloth garments, use a mixture of 2 pints vinegar, 1 oz. iron filings, 1 oz. copperas, 1 oz. ground logwood, and 3 ozs. bruised galls.

(For the Scientific American.)

GEOMETRICAL CHEMISTRY.—REMARKABLE DISCOVERY BY PROFESSOR HENRY WURTZ.

In France, our centennial year has been honored by the discovery of a new metal, to which its Gallic discoverer, De Boisbaudran, has given the name of gallium. But 1876 was destined to higher chemical honors at home, for it has witnessed here not merely the discovery of a new element, but the revelation of a new theory of chemistry, and the evolution of a new code of laws for its working. If the expectations of their author, Professor Henry Wurtz, shall be justified, a grand revolution in theoretical chemistry is at hand, in comparison with which that of Laurent and Gerhard was insignificant. One thing is certain: chemistry is still but a collection of generalizations. We have no theory of chemistry, as Dr. Crum Brown recently said, although we are struggling towards it. Here Professor Wurtz comes to the rescue, offering us a theory which promises to explain many facts heretofore imperfectly understood, to correct our so-called rational formulas, to upset our theory of types, and to open new avenues of research.

Professor Wurtz begins by demonstrating mathematically the relative diameters of molecules in solids and liquids. Hitherto molecules have always been compared in a gaseous state, but he proposes to compare them as liquids or solids, and, as far as possible, at the temperature at which ice begins to melt, or just below 32° Fah. His first remarkable discovery was that the relative volumes of various simple substances, in a solid or liquid state, whether elements or compound radicals, as found by dividing their equivalents or atomic weights, as we are wont to call them (multiplied by 1,000 to avoid fractions), by their specific gravities, were perfect cubes of whole numbers.

Now it is well known that solids, whether cubes, spheres, or polyhedra, are to each other as the cubes of their diameters: hence, thought our New Jersey chemist, the cube roots of these figures represent the diameters of our molecules.

For instance, the diamond has a specific gravity of about 3.555. The atomic weight of carbon is 12; if we divide 12,000 by 3.555 we have 3,375, which is the cube of 15; hence the molecule of carbon in the diamond has a diameter of 15.

The volume occupied by a molecule of carbon when in combination is, however, not constant, being usually 8,000, or 20³. The molecular volume of hydrogen is still less constant, but generally a perfect cube.

Oxygen alone retains a constant volume, namely, 5,184 (the cube of 17.3075) and hence Professor Wurtz takes this as his standard for all other values.

In his memoir, published in a late number of the *American Chemist*, he adduces numerous examples to prove the truth of this discovery, showing that, whatever space an element occupies in a liquid or solid, at 32° Fah., that space or volume can be represented by a perfect cube, whose root of course is the diameter of the space, be it cube or sphere. Such, in brief, is the distinguishing feature of the first part of the new discovery.

Strangely enough, this law holds good for compound radicals as well as elements, and we find NH₃ and CN following the same law, as if they were simple bodies. This one fact enables us to distinguish true radicals when in combination; and beside confirming the well known and generally received theory that ammonium and cyanogen are compound radicals, it convinces us that water, H₂O, is a real compound radical like cyanogen.* Another startling result of this law is that we find that CH₂ is also a compound radical, while ethyl, methyl, and amyl, the so-called alcohol radicals, are not radicals at all. Instead of writing alcohol as we now do,

$\begin{matrix} C_2H_5 \\ | \\ H \end{matrix}$ O, or water in which an atom of hydrogen is replaced by ethyl, we should write it H₂O, 2CH₂, or two molecules of the hydrocarbon radical CH₂ with one molecule of the water radical. One of the practical applications which can be made of this slight change is to calculate the quantity of alcohol in water (if above 24 per cent), directly from the specific gravity. Professor Wurtz says that this illustrates the fact that hydrometer tables can now be constructed for every aqueous liquid or solution with absolute accuracy.

Allotropic forms of the same element occupy different atomic volumes. This leads him to believe that there are eleven allotropic forms of phosphorus, and offers a convenient method for studying allotropism.

For the silicates, as well as in the more complicated formulae of organic chemistry, the laws of Wurtz will be of great value in establishing the true formulae. The striking changes that he proposes in the formulae of some of our old friends will make us hesitate to adopt his theories until their truth is more fully established in all their details, lest further investigations reveal new laws which can still further modify the formulae. For example, although ice has the formulae of H₂O, as at present, he would write free water in its liquid state as H₁₀O₈; the peroxide of hydrogen he writes H₁₀O₁₀, hydrochloric acid H₂Cl₂; and to common salt he is obliged to give at one time the formula Na₃Cl₂, at another NaCl₄, at another NaCl.

We have already stated that the molecular volume of oxygen ever remains constant, while those of other elements vary as they pass from one form of combination to another. Hydrogen is especial Protean; elements that are, like oxygen, more acidic or electro-negative vary the least, those that are most basic or electro-positive vary the most. The volume

assigned to a molecule of hydrogen in water is 6,408 = (18.574)³. In hydrochloric acid there are two molecules of hydrogen, one having a volume of 13,824, the other of 15,625, which are the cubes of 24 and 25 respectively. In hydrocyanic acid, he puts the hydrogen volume still higher, namely, 29³; in ammonia gas, N₂H₆, he puts three hydrogen molecules at 18³ and three at 19³. This same changeableness follows so many elements as to be quite confusing to the reader, but perhaps it is all right. It is not given to every man to see great truths so clearly as Kepler and Wurtz, and even Kopp taught this apparent inconsistency. Here, however, there is a law that seems to regulate this condensation; when one molecule combines with another, or with several others, it tends to assume the same volume, or nearly the same, as that of some molecule already present. Thus, when hydrogen combined with chlorine, whose molecular volume is 24³, it became respectively 24³ and 25³. When combined with nitrogen, which is 20³, it became 18³ and 19³, as stated above. The result of this is that we sometimes have, in a complex molecule, a regular series of consecutive cubes. It is worthy of mention in this connection that, although the molecular volumes vary, it is, with the exception of hydrogen and some heavy metals, within narrow limits; nor do the volumes of different elements differ much among themselves. *The cube root, or diameter of the molecular volume, as Wurtz calls it, is for chlorine generally 24, sometimes 28; for bromine and iodine, 28 and 24; sulphur, 24; selenium, 28 and 24; carbon, 20 and 15; nitrogen, 20; silicon, 23; hydrogen, 16 to 28; aluminum, from 19 to 23.

In 1855, H. Kopp carefully studied the subject of atomic or molecular volumes (*Ann. Chem. Pharm.*, xcvi, 1, 153, 303). For liquids and solids, he necessarily obtained, in general, the same results as Professor Wurtz, the molecular volume being the quotient obtained by dividing the atomic weight by the specific gravity. In the case of a non-condensable gas like oxygen, the molecular volume must be calculated by tedious methods from their liquid compounds. And here these two investigators differ widely; but Kopp, like Wurtz, attributes, as we said, variable volumes to the gases, including oxygen, even giving, as Wurtz does, different volumes to the same element in the same molecule, and fails to recognize the fact that these volumes, when multiplied by 1,000, are almost perfect cubes. As Kopp also overlooked the simple test above given for compound radicals, he made no changes in the rational formula of alcohols, ethers, and other organic compounds; hence he exerted no such influence on chemical notation as Professor Wurtz's theories will do, if adopted.

It is idle to speculate on the ultimate fate of this discovery. Chemists will hesitate, we think, to accept a theory based on facts derived from a course of reasoning capable of yielding diverse results in different hands, and requiring such ingenious manipulations to make its conclusions harmonize with known facts. The corner stone of the new edifice is the molecular volume of oxygen, which is strangely enough not a perfect cube, but three times the cube of 12. What this curious coincidence may mean, Wurtz confesses himself as yet unable to understand. The manner in which he obtains the magic number 5,184 is as follows: The specific gravity of peroxide of hydrogen, as found by Thénard, is 1.452; Wurtz applies certain corrections which raise these figures to 1.4642. For reasons which he fails to state, but apparently to favor his theory, he calls it 1.4665 at 32° Fah. The equivalent of H₂O₂ is (2 × 1) + (2 × 16) = 34. Dividing 34,000 by 1.4665, we have 23,184 as the molecular volume. From this we subtract the molecular volume of water, 18,000, which gives 5,184. In tabular form:

H ₂ O ₂ ; 34,000 ÷ 1.4665 =	23,184
H ₂ O ; 18,000 ÷ 1.0000 =	18,000
Oxygen	= 5,184

Whether this discovery of Professor Wurtz is equal, as he believes, to the discovery by Kepler of his great laws, we leave to our readers to judge, and for the future to demonstrate.

E. J. H.

Photo-Printing on Wood Blocks.

The negative is, of course, taken in the usual way; but as it must be reversed on the block it should be taken through the glass, that is, the film side should be next the door of the slide, the thickness of the glass allowed for in focussing, and the spring of the slide kept from the film, in any of the well known modes. To prepare the block, dissolve five grains of chloride of barium in about half a drachm of sulphate of barium. This is then gently rubbed over the surface of the block—first with the finger and then with the ball of the thumb—so as to produce an even, thin coating, which result is easily obtained after a little practice. A coating just sufficient to whiten the surface will be found enough. Or the two salts of barium, in very fine powder, may be intimately mixed, and, by a circular motion of the finger, applied to the block, when sufficient will be found to have adhered to answer the purpose. The barium chloride is converted into silver chloride, and the surface rendered sensitive as follows: Six grains of pyroxylin is dissolved in half an ounce of ether and two drachms of alcohol; then twenty grains of silver nitrate is dissolved by heat in two drachms more of alcohol, and added. This should stand till clear, and will keep well if light be excluded. The silvered collodion is poured on and off the block in the ordinary way, and may be dried either spontaneously or by artificial heat. In consequence of the rigidity of the block the progress of printing cannot be examined in the usual way; but with a moderate amount of practice there is little difficulty in hitting the proper time without examination. By a method we have lately adopted, the progress may be examined from time to

time, and the block returned to its proper place with ease and certainty.

The printing should not be deeper than the finished image is intended to be, as it does not seem to lose anything in the fixing, but rather appears to get a little deeper. On removal from the frame, the surface of the block should be brought into contact with a solution of hyposulphite of soda in a flat dish, and moved about on the surface for a few minutes, when it will be found sufficiently fixed, requiring only to be washed with a gentle stream of water and set up to dry. Or if it be desirable to get rid of the thin film of collodion, it may easily be dissolved off by a mixture of ether and alcohol before the application of the fixing solution.—*British Journal of Photography*.

Cunning of the Adder.

A correspondent of the *Milwaukee Sentinel* states that, over thirty years ago, in Leeds, Greene county, N. Y., his attention was one day attracted by the plaintive cry of a cat. Looking into a garden, an adder was seen near the cat. The cat seemed to be completely paralyzed by fear of the adder; she kept up the plaintive cry, as if in great distress, but did not take her eye off the serpent, or make any attempt to attack or escape. Soon the snake saw that human eyes were observing him, and he commenced to crawl slowly away. "I then," continues the writer of the narrative, "concluded to release the cat from its trouble. I took a garden rake and put it on the snake's back, and held it without hurting it. As soon as I had the snake fast in this position, it raised its head, flattened it out, and blew, making a hissing noise, and something resembling breath or steam came from its mouth. When that was exhausted I removed the rake, and the adder turned over on its back, lying as if dead. With the rake I turned it over on its belly again, but it immediately turned on its back. This was repeated several times. At last it was taken out of the garden, laid in the road, and we all retired to watch its movements. It commenced to raise and turn its head slowly (looking about the while) until entirely on its belly, and started at full speed for a little pool of water in the road, from which it was raked out and dispatched."

The Ancestor of Man.

In reference to the question, from which of the quadrumanans did man originate. Professor Haeckel, in his recent work "The History of Creation," gives his opinion that the human race is a small branch of the group of *catarrhini*, and has developed out of long since extinct apes of this group in the old world. And when on this subject, he refers to Professor Huxley's remarks, which show that man is, nearly as much as the ape, a four-handed animal; for various tribes of men, the Chinese boatmen, the Bengalee workmen, and the negroes when climbing, use the great toe in the same manner as the monkey, and therefore the possession of only a single pair of hands is not to be looked on as a characteristic of the human race. He also points out a fact, necessary to be observed by unscientific people, namely, that none of the manlike apes are to be regarded as the parent of the human race, but that the apelike progenitors of the human race are long since extinct. In concluding his work, Professor Haeckel remarks on the desire of some who are not actually opponents of the doctrine of descent. "They wait," he says, "the sudden discovery of a human race with tails, or of a talking species of apes." But such manifestations, the author observes, would not furnish the proof desired; and unthinking persons would be provided with as satisfactory (?) arguments as they nowadays employ in hurling their defiance against all who are evolutionists.

Russian Hardware Manufactures.

The Russian edge tools differ from those of other countries in some peculiar shape. The common spade, for instance, is made chiefly of wood and simply tipped with iron; it is of small size, rounded at the edge, and has a plain curved handle. The ax is much larger than that manufactured by other nations, and is used, too, for all kinds of carpenter work—answering, in fact, as a plane, a hammer, and even as a saw, the last tool being rarely used by the Russian mechanic, for he can wield the ax more readily, and cut through thick logs of wood with incredible precision and rapidity. Samovars are a leading article of the Russian metal industry, these being a kind of tubular boiler, with little charcoal furnaces; they are used for making tea; the material is copper, which is almost exclusively used among the well-to-do classes for cooking utensils: tinware, hollow cast iron vessels, and pewter being but little in vogue. Horse-shoes are produced by hand at the rate of some 30,000,000 annually. Bell making is carried on with especial success, the bells being remarkable for their immense size and richness of tone. Harness fittings of European pattern are made, but only in very limited quantities, those which are used upon Russian harness being of considerably different construction.

Indelible Ink.

Two fifths of 1 lb. tartaric acid are dissolved in 61 cubic inches hot water; in one half of the solution dissolve 1 lb. oily anilin; add the other half, and then 1 lb. chlorate of potassium. Allow the solution to cool and subside until next day; filter from the bitartrate, and bring the liquid to the density of 7° B. Thicken sufficiently with gum arabic, and add to each cubic inch 1/2 lb. copper sulphate, dissolved in a little water. This ink may be at once used for printing muslin and other fabrics, upon which the black color will be perfectly developed by bleaching liquids. Chlorate of copper is also used for writing upon zinc used for signs and labels exposed to the weather.

* The atomic weight of H₂O is 18; multiplying by 1,000, and dividing by the specific gravity of ice, 0.91674, gives us 19,630, a perfect cube of 27. This is also the diameter of a molecule of H₂O in the alcohols. Hence the reason for taking the densities at the point where ice begins to melt, the volume of liquid water, 19,000, not being a cube.

Empty Empires.

Chambers' Journal has taken to discussing the question of who owns the North Pole. Its ownership, we think, if it be found at all, will probably be acquired by either the United States or England, and either the stars and stripes or St. George's cross will wave over the possible patch of earth, according as some Yankee explorer or Captain Nares first plants his foot on it. As to either banner staying there, that is another matter. We fear the indigenous inhabitants, — walrus, polar bears, and chance Esquimaux — will laugh the eagle and the lion to scorn, and no tidings of either monitors or Woolwich cannon will induce them to allow either starry flag or meteor banner to remain, after it is left to their tender mercies.

There is an old tradition in the United States navy of a dispute between representatives of the two nations over a bit of ground just about as useless as the north pole would be. Two men of war, respectively English and American, met many years ago among the South Sea Islands. Volcanic eruptions in that locality were rife, and the navigators of vessels hardly dared close their eyes at night for fear of new reefs and shoals appearing, regarding which the charts were literally "at sea." The American ship had been in the neighborhood longer than the English one, and therefore her skipper knew something of the marvelous tricks which the land occasionally played. Hence he was not at all surprised to discover one day looming up before him an island, where, according to all accounts, there should be open sea. The Englishman sighted the land at the same time, and in a few minutes a well manned cutter shoved off from his gangway and pulled for the shore. The American captain likewise sent a boat, and a lively race ensued to see which should first reach the land. As the English boat got into shallow water, her officer jumped overboard, and was followed by some of his crew, who splashed up to the beach. By the time the American boat had landed, the English flag was floating from a boat hook stuck up for a staff, and a red-coated sentry was calmly walking to and fro beside it. The English captain then sent word over to the American vessel that he had taken possession of that island in the name of the King of Great Britain. The American captain, however, claimed first discovery, and sent back a counter message that that island belonged to the people of the United States. Before morning a storm arose, and both ships worked hard to keep off the lee shore, but when the day broke, there was no lee shore to avoid. The island had gone, and with it flag and sentry. A convulsion similar to that which raised it above the sea had caused it to sink again; and two astonished captains might have been seen navigating their vessels over its former site, vainly searching for the beautiful island which each intended to present to his grateful country, and thus secure to himself imperishable renown.

NEW BOOKS AND PUBLICATIONS.

CONTRIBUTIONS TO THE NATURAL HISTORY OF KERGUELEN ISLAND, made in connection with the United States Transit of Venus Expedition, 1875-76. By J. H. Kidder, M. D., U. S. N. Part II. Washington, D. C.: Government Printing Office.

This pamphlet contains some interesting information, especially as to the fauna of the remarkable island which forms its subject.

THE AMERICAN NEWSPAPER DIRECTORY, containing Accurate Lists of all the Newspapers and Periodicals Published in the United States, Territories, the Dominion of Canada, and Newfoundland. New York city: George P. Rowell & Co., 41 Park Row.

A new edition of Messrs. Rowell & Co.'s handsome volume is now before us; and the steady increase in its number of pages shows us that the newspaper industry is not suffering from contraction. The advertising world is well acquainted with the usefulness of this manual; and it maintains its reputation for accuracy, except in one very glaring instance. It understates the circulation of the *SCIENTIFIC AMERICAN* about 15,000 copies; and it does not mention the *SCIENTIFIC AMERICAN SUPPLEMENT* at all.

THE COAL TRADE, a Compendium of Useful Information. By Frederick E. Seward, Editor of the "Coal Trade Journal." New York city: F. E. Seward, 111 Broadway.

An excellent handbook of the whole subject of coal, describing all the mining regions, the various qualities of the mineral, the working of collieries here and abroad, the rates of freight, and all other particulars. It is illustrated with maps.

THE FANCIER'S JOURNAL.—All young people and many old ones take an interest in poultry, pigeons, rabbits, birds, and other pets of various kinds. The above-named weekly publication is a journal in which all such persons are interested, as it treats these subjects in a clear and practical manner, with a thorough knowledge of breeding, rearing, feeding, etc. Each number contains information of great value to poultry raisers, dealers, and fanciers. It is published weekly at Hartford, Conn., and is furnished to subscribers for \$2.50 a year.

Recent American and Foreign Patents.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED RAILROAD SIGNAL.

Ira Robbins, Hughesville, Pa.—This invention consists in erecting along the foot of a mountain or hill (where there is danger of a land slide) a series of posts between which suitable panels are bottom-hinged so as to connect with signals near a railroad track. Unless a slide takes place, the panels remain in position and the signals are not displayed; but should one occur, any approaching train is notified in time to slow up and avoid danger.

IMPROVED ROTARY ENGINE.

Thomas C. Orr, Enfield, Ill.—The pistons are pressed back in the hub by the abutment for passing it, and are pressed out against the case after passing it by steam which passes from the steamway into the hub behind the pistons. The latter are a little larger at that end to insure sufficient pressure to overcome the pressure on the outer end. A spring is used with each piston to keep it out when steam is not acting on it.

IMPROVED MACHINE FOR PUNCHING METAL LATHS.

Le Roy Carpenter, Victor Kauffman, and Eason White, Beardstown, Ill.—Two metal rolls have punches for making slits for the plaster; also punches for making the nail holes by which to fasten the sheets on the studs, and a cutter for trimming the sheets. Said rolls are geared together and provided with a hand crank for turning them.

IMPROVED MILLSTONE.

John W. Truax, Essex Junction, Vt.—This invention improves the construction of millstones, to enable them to be more readily adjusted and balanced, and to make them more effective in operation. An illustrated description will be found on page 198, current volume.

MACHINE FOR FORMING SOCKETS ON HAMMERS, ETC.

Charles A. Williams and Joshua F. Williams, Skowhegan, Me.—This is an improved method of punching and forming the handle sockets on hammers, adzes, hatchets, and other tools with one heating. The invention consists in a machine to which is exposed the hammer or other blank after heating, first to the action of a spreading or enlarging die and punch, and then to the action of the perforating and socket-shaping die and punch.

IMPROVED WATER WHEEL.

John Shortridge, Frank W. Shortridge, and Ernest W. Shortridge, Rockingham, N. C.—This invention consists in providing a water wheel with tapering bottom parts below the bottom edge of the buckets, to rest on a turning point, and form an escape box below the wheel.

IMPROVED LOCOMOTIVE FEED WATER HEATER.

Horatio N. Waters, West Meriden, Conn., Milton W. Hazelton, Chicago, Ill., and James K. Taylor, Boston, Mass.—A corrugated tube, through which the feed water passes from the pump into the boiler, is surrounded by a steam jacket, into which the exhaust steam is forced by the back pressure of the nozzle, by means of pipes connecting it with the exhaust pipes. A spoon-shaped projection is provided to catch a portion of the steam and direct it into the jacket. The invention also consists of the method of constructing the corrugated tube for the water, and of a spiral deflecting core in the axis of the corrugated tube to divert the water into the interior portions of the corrugations to facilitate the heating.

IMPROVED RAILROAD TIE.

George D. Blaisdell, Cambridge, Vt.—This tie consists of a cast iron bar, with a box in each end for holding the rail chairs, and a rod extending from end to end of the tie, and securing the chairs in place by clamping plates.

IMPROVED MACHINE FOR MAKING NUTS.

Carl G. Gustafsson, Jönköping, Sweden.—This is an improved machine for making screw nuts of hexagonal and other shapes in rapid and effective manner. It consists of an intermittently revolving disk with dies, into which the nut blanks, cut by shears from the bar, are fed and brought by consecutive punches into the required shape.

IMPROVED WINDMILL.

Jason C. Sparks, Tipton, Iowa.—The wheel with fixed vanes is used, and wheel supports are jointed to the turntable, carrying the tail vane, so that the wheel swings around edgewise to the wind to adjust it to the varying power of the wind and to stop it.

NEW CHEMICAL AND MISCELLANEOUS INVENTIONS.

IMPROVED LAMP COLLAR.

Theodore L. Owen, Geneva, N. Y.—This is a mode of constructing a lamp collar in two parts, to one of which the burner is attached, while the other is secured to the flange of the lamp. The object of the device is to allow of the replenishment of the lamp with oil without necessitating the unscrewing of the burner.

IMPROVED INVALID BEDSTEAD.

Andrew McArthur, South Chenango, Pa.—This consists of a platform, pivoted longitudinally and transversely in a frame, so that the patient can be tilted upright or sidewise, as may be required for comfort. On the lower part are independent jointed supports for each leg, with bandage appliances, and a windlass and straps for extending the leg in case of fracture or dislocation. The upper part is provided with a bed with edges suitably formed to be strapped around the body of the patient, and in the middle portion are arm rests, contrived for adjusting to different positions for the comfort of the patient when elevated by tilting on the transverse axis.

IMPROVED COFFIN ATTACHMENT.

Samuel A. Hughes, Parker's Landing, Pa.—This consists of a hook attachment to coffins, for lowering them by the ropes or straps, instead of having the ropes or straps pass under the coffin. It is fastened to the handle plates.

IMPROVED PIANO LOCK.

Amos S. Blake, Waterbury, Conn.—This invention consists in the lock case, formed of two plates, by bending up the side and end edges, and bending over the end edges of the one plate and slipping the other plate into the seat thus formed.

IMPROVED MAT.

Arthur Thompson, Warner, N. H.—This is a mat of excelsior, mounted on and attached to a backing of paper, cardboard, cloth, or sacking, the object being to provide a cheap mat for omnibuses, street cars, and the like.

IMPROVED MEANS OF ATTACHING MAST HOOPS AND SAILS.

Edgar B. Beach, West Meriden, Conn., assignor to himself and H. B. Beach, of same place.—The usual mode of attaching the back of fore and aft sails to the mast hoops is by a seizing between an eyelet in the sail and around the hoops. The above inventor suggests an excellent substitute for this mode of fastening, which consists in two semicircular sleeves of metal, attached to the hoop, and which receive the leech rope in their semicircular portion. A clamping screw passing through both pieces, and the eyelet in the sail fastens all together.

IMPROVED BARBED FENCE WIRE.

Richard Emerson, Sycamore, Ill., assignor to himself and Chauncey Ellwood, of same place.—The invention consists in a fence barbed formed of a piece of wire bent into the form of a figure 8, with both end parts upon the same side of the middle part, and with its ends projecting in opposite directions. When the barbs have been adjusted in place upon the fence wire, the eyes are straightened out, forming a bend in the said fence wire, into which the end parts of the barbs are pressed, so that the barbs can neither turn nor slide.

NEW HOUSEHOLD ARTICLES.

IMPROVED WASHING MACHINE.

Squire Turner, Sr., Columbia, Mo.—A lower tub is made ring-shaped, and to its inner sides are attached the standards that support the upper tub. A vertical shaft passes down through the centers of the tubs. The bottom of the lower tub is made flat, and in it are placed four rollers, placed at right angles with each other, and each made in sections, which revolve upon a rod, the ends of which are attached to brackets, secured to cross bars. The bars and rollers are connected so that all the rollers and their bars may move together. The bottom of the upper tub is inclined, and in it are placed four conical rollers. Every other one of the rollers has cavities formed in it which carry down air and discharge it among the fibers of the clothes, to be pressed out, together with the water, by the following smooth rollers, removing the dirt and washing the clothes clean.

IMPROVED DISH-WASHING MACHINE.

Edward P. Hudson, New York city.—The dishes are submitted to the action of sponge rollers, and pass to an endless belt, thence to a second set of rollers. They then go to another part of the receptacle, where the water acts like a cushion and conveys them smoothly to the bottom of a strong basket, in which they settle without chipping, breaking, or being otherwise injured.

IMPROVED GRATE.

Francis Z. Hickox, Utica, N. Y., assignor of one third his right to Michael Smith and one third to John Mills of same place.—This is a shaker or stirrer, consisting of a frame fixed to slide forward and backward on vertically inclined ways under the grate, and having teeth projecting up into the fire between the bars, so as to have a forward and backward and up and down raking action.

IMPROVED CHILDREN'S COMMODE.

Allen B. Crowell, West Dennis, Mass.—This combines the advantages of a chair, walking stool, and commode. The chair is arranged within a case, with front and rear doors, closed by a cover that is used as a tray when attached to the front part of the commode. Closets at the sides serve for storing the playthings, while a cross bar at the rear, with extension guards of the side walls, allow the use of the commode as a walking stool.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED MACHINE FOR EDGING LUMBER.

Andrew E. Hoffman, Fort Wayne, Ind.—In using this machine, the lumber is laid upon a table, and is pushed back into the proper position, as indicated by the guide wire. The carriage is then thrown into gear with the proper shaft, and the saw traverses the lumber from end to end. As the saw leaves the lumber, the lumber is turned over and adjusted into proper position to be operated upon by the return saw. As the carriage reaches the end of the frame, the other saw is raised, and the sawyer causes the carriage to move in the opposite direction by throwing it into gear with the other shaft.

IMPROVED WALL.

Philo A. Knapp and Ira S. Knapp, Danbury, Conn.—These inventors propose to construct the walls and partitions of buildings, of boxes without top and bottom, filled with loose gravel. The boxes are placed one upon another and tied, keyed, or otherwise fastened together so as to form blocks, in imitation of stone or other building blocks.

IMPROVED STALL FLOOR.

Bernhard Schaefer, Chicago, Ill.—This invention consists of a movable floor, laid on the common stable floor, made of longitudinal wedge-shaped or tapering strips, that are connected by transverse bolts and intermediate wedge pieces at the ends. The floor below the flooring is cleaned from time to time by raising the sections and sweeping the dust away.

IMPROVED SIDE BAR WAGON.

Alfred W. Doty, Windham, N. Y.—This relates to that class of carriages in which the side bars are made in two parts, and connected to the box at the middle or thereabout. The box is let down between the side bars, instead of being mounted above them, as heretofore, the bars being pivoted to the sides of the box.

IMPROVED CHECK BRACE FOR VEHICLE SPRING.

Lewis P. Worrall, Sugartown, Pa.—This is a combination, with a vehicle perch and springs, of brackets having a coupling box at the base, and plates reversely curved at the ends, in order to form a double-acting brace that will allow the springs to come together without striking the perch or body, and without making any rattle.

NEW AGRICULTURAL INVENTIONS.

IMPROVED SEED PLANTER.

John H. Martin, Thomas Bunford, and Stephen S. Ege, Glen Rock, Neb.—This device operates the dropping slide of a seed planter by the advance of the machine. It enables the seed to be planted without its being necessary to mark the ground.

IMPROVED POTATO DIGGER.

James W. Young, Southfield, Mich.—This machine digs potatoes, separates them from the soil, and deposits them in the middle part of the row, so that they will be out of the way of the wheels in digging the next row. It also keeps its own teeth free from vines and weeds.

IMPROVED METALLIC SOCKET FOR FENCE POSTS.

William M. Phelps, Oronoco, Minn., assignor to himself and Daniel McAlpine, same place.—This is a metallic fence post point. Its object is to prevent the post from rotting off, and thus to cause the posts to last very much longer, and to enable any kind of timber to be used for the posts.

IMPROVED AGRICULTURAL BOILER.

Henry L. Humphrey, Frederick H. Humphrey, and Ira G. Humphrey, Monroe, Mich.—This is an improved boiler and furnace for cooking food, scalding hogs, boiling sap, boiling cider, making apple sauce, heating curd for cheese, condensing milk, trying lard and tallow, etc. The fire box is provided with a grate, and from the upper part of its rear end a wide and shallow flue extends back so that the products of combustion may be close to and in direct contact with the entire bottom of the box. Two boilers fit into the box and rest upon a steam board. By this construction, the contents of the boilers will be heated by the water placed in the box.

IMPROVED SEED PLANTER.

Alvin J. Branham, Houstonia, Mo.—This is an improved device for operating the dropping bar of a seed planter from the wheel. It may be applied to any planter in which the seed is dropped by slides, so as to make them automatic in their operation.

IMPROVED CHURN.

Jonas Cook, Mount Pleasant, N. C.—The novelty in this lies in the dasher, which includes spiral cross bars, a spiral disk and a circular disk attached to a vertical rotary shaft. The object is to throw the milk into violent agitation and thus produce the butter more rapidly.

IMPROVED CHURN.

Henry B. Ramsey, Rockville, Ind.—This churn is provided with a series of tubes, passing through the churn to a water reservoir at the bottom, to break up the currents of cream, and at the same time to serve as water conveyers.

IMPROVED BAG FILLER AND MEASURER.

Joseph J. Scholfield, Salt Lake City, Utah Ter.—This consists of a funnel-topped, sheet metal tube, with open bottom, and having springs upon the outside to hold the bag up around the tube. It is enough smaller than the bag to be put in it freely. Inside the tube is scaled with lines, showing the different measures, so that, by putting the filler in the bag and shoveling in the grain, the quantity can be readily ascertained, and the grain can be quickly discharged by merely pulling the filler out of the bag.

Business and Personal.

The Charge for Insertion under this head is One Dollar a Line for each insertion. If the Notice exceeds Four Lines, One Dollar, and a Half per Line will be charged.

Agricultural Implements and Industrial Machinery for Export and Domestic Use. R. H. Allen & Co., N. Y.

For Bolt Forging Machines and Power Hammers, address S. C. Forsyth & Co., Manchester, N. H.

25 per cent extra power or saving in fuel, guaranteed to steam engines, by applying the R. S. Condenser. T. Sault, Consulting Eng'r, Gen. Agt., New Haven, Ct.

Lawn Mowers for Hand, Pony, or Horse—Prices reduced. Largest stock in the city. A. B. Cohn, 197 Water St., New York.

Wanted—25,000 lbs. 2nd hand light T rail. E. B. Seeley, Bowling Green, Ky.

For Sale—Valuable Patent, in whole or part, for Anti-Freezing Fire Hydrant. Apply Robt. Smeaton, Milwaukee, Wis.

Wood Working Machinery and Steam Pumps cheap for cash. Henry R. Sillman, Mott Haven, New York.

Wanted—Descriptive Price List of Sewer Pipe Machines (for hand or power). Address Charles Pratt, London Pottery, London, Ontario.

Two Valuable Patents—States Rights for Sale. For particulars, address R. Jennings, 436 East Monument St., Baltimore, Md.

Draughtsman—Wanted a Situation by a constructive Draughtsman having experience in Gun and Sewing Machine Tools and general work. Best of reference. Address P. O. Box 560, Illon, N. Y.

For Sale—Complete outfit of machinery for the manufacture of cotton waste, cost \$2,200. Price \$700. Forsyth & Co., Manchester, N. H.

E. P. Bullard, Dealer in New and Second-Hand Machinery, 48 Beekman Street, New York.

By reference to the advertisement of J. C. Todd, it will be seen that he remains at the old stand, No. 10 Barclay St., and that the Todd & Hafferty Machine Company has removed to 88 Liberty Street.

For Sale—15 in. x 8 ft. Lathe, \$100; 22½ in. x 12 ft. do., \$250; 35 in. x 16½ ft. do., \$400; 9 ft. Planer, \$400; 6 ft. Planer, \$225; 12 in. Slotter, \$300; Profiling Machine (2 spindles), \$250. Shearman, 45 Cortlandt St., New York.

The Photo-Engraving Co. have been obliged to remove from 62 Cortlandt St. to a larger building at 67 Park Place. Their Relief Plates for Newspaper, Book, and Catalogue Illustrations are rapidly taking the place of Wood Cuts and are unsurpassed. See advertisement in another column of this paper.

For the best Patent Self-Opening Gates for Carriages, in any Style of Wood or Iron, address Cotton & Co., Dayton, Ohio.

For Sale—State Rights on Wehrle's Patent Centennial Illuminator. Sells on sight. Send for circular without delay to Jos. Wehrle, Belvedere House, N. Y. city.

400 Machines, new and 2d hand, at low prices, fully described in our printed list No. 6. Send stamp, stating just what you want. Forsyth & Co., Manchester, N. H.

Split-Pulleys and Split-Collars of same price, strength, and appearance as Whole-Pulleys and Whole-Collars. Yocom & Son, Drinker St., below 147 North Second St., Philadelphia, Pa.

The Batist Magnetic Engine for running Sewing Machines, Lathes, Pumps, Organs, or any Light Machinery, 1-32 to ½ horse power. Agents wanted. Address with stamp, 1,113 Chestnut St., Philadelphia, Pa.

The French Filles of Limet & Co. have the endorsement of many of the leading machine makers of America. Notice samples in Machinery Hall, French Department, Centennial Exposition. Homer Foot & Co., Sole Agents, 22 Platt St., New York.

Centennial Exhibitors, buy your Belting in Philadelphia, from C. W. Army, 148 North 3rd St., and save freight and trouble. Satisfaction guaranteed.

The Original Skinner Portable Engine (Improved), 2 to 8 H.P. L. G. Skinner, Erie, Pa.

Hamilton Rubber Works, Trenton, N. J., Manufacturers of ¼ pavement Hose, and any size, also Belting, Packing, Car Springs, and Rubber for Mechanical use. Send for price list.

First class Amoskeag Steam Fire Engine for Sale, 2d hand, \$1,300. Forsyth & Co., Manchester, N. H.

Hotchkiss Air Spring Forge Hammer, best in the market. Prices low. D. Frisbie & Co., New Haven, Ct.

Patent Scroll and Band Saws, best and cheapest in use. Cordesman, Eggs & Co., Cincinnati, Ohio.

Trade Marks in England. By a recent amendment of the English laws respecting Trade Marks, citizens of the United States may obtain protection in Great Britain as readily as in this country, and at about the same cost. All the necessary papers prepared at this Office. For further information address Munn & Co., 37 Park Row, New York city.

Gas and Water Pipe, Wrought Iron. Send for prices to Bailey, Farrell & Co., Pittsburgh, Pa.

Shingles and Heading Sawing Machine. See advertisement of Trevor & Co., Lockport, N. Y.

For Sale—Sturtevant No. 7 Hot Blast Apparatus, \$400. Forsyth & Co., Manchester, N. H.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, New York.

Steel Castings, from one lb. to five thousand lbs. Invaluable for strength and durability. Circulars free. Pittsburgh Steel Casting Co., Pittsburgh, Pa.

For best Presses, Dies, and Fruit Can Tools, Bliss & Williams, cor. of Plymouth and Jay, Brooklyn, N. Y.

For Solid Wrought-Iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, &c.

Hotchkiss & Ball, Meriden, Conn., Foundrymen and workers of sheet metal. Fine Gray Iron Castings order. Job work solicited.

For Solid Emery Wheels and Machinery, send to the Union Stone Co., Boston, Mass., for circular.

For Sale—2 Hunneman Hand Fire Engines with Hose Carriage, second hand, 5½ in. cylinder, 15 in. stroke. Price, each, \$425. Forsyth & Co., Manchester, N. H.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon, 49 Grand Street, New York.

Spinning Rings of a Superior Quality.—Whitinsville Spinning Ring Co., Whitinsville, Mass.

For best Bolt Cutter, at greatly reduced prices, address H. B. Brown & Co., New Haven, Conn.

Diamond Tools—J. Dickinson, 64 Nassau St., N. Y.

Temples and Oilcans. Draper, Hopedale, Mass.

All Fruit Can Tools, Ferracute Wks, Bridgeton, N. J.

Notes & Queries.

W. H. R. asks once more the question as to the cannon fired from the rear end of the car. If he will refer to p. 273, vol. 32, he will find a solution of the difficulty. This answers a great many other correspondents.—F. M. J. will find an answer to his question as to the dimensions of a boat and engine to carry 20 persons on p. 269, vol. 34.—L. V. R. will find directions for reducing the temperature of water on p. 82, vol. 33.—F. H. H. will find an account of the manufacture of salt-peter on p. 52, vol. 34.—M. G.'s queries are too metaphysical for our columns.—H. V. will find a recipe for aquarum cement on p. 80, vol. 31.—C. A. B. will find directions for recutting old files with acid on pp. 363, 379, vol. 28.—M. B. should read our article of flying machines, on p. 112, vol. 32.—F. Z. A. will find a prescription for moles on p. 331, vol. 31.—O. H. P. should fasten his engravings in a book with rice glue. See p. 155, vol. 32.—R. P. will find an account of the fastest passage across the Atlantic on p. 97, vol. 31. It is absurd to maintain that a sailing vessel can beat this time.—A. P. H. can clean kerosene stains from marble by the process detailed on p. 347, vol. 34.—G. W. W. & S. will find a recipe for black paint for iron on p. 253, vol. 34.—C. L. M. will find directions for gliding on china on p. 43, vol. 29.—J. F. B.'s query as to a spring can only be answered by a manufacturer.—W. S. C. should read our article on p. 386, vol. 26, as to Paris green.—E. O. K. will find an excellent representation of a cistern filter on p. 282, vol. 34.—O. H. will find directions for making illuminating gas on a small scale on p. 131, vol. 33.—I. M. I. should forward a copy of his pamphlet to Professor Proctor.—S. D. L. will find directions for ridding a house of rats on p. 67, vol. 29.—A. F. S. and a great many other querists are referred to p. 273, vol. 33, for a description of an incubator.—R. H. will find a recipe for white hard soap on p. 331, vol. 31.—J. P. L., W. I. F. J. M., B. T. B., C. F. S. D., V. C. S., N. P. A., L. C. D., B. B., and others who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) D. B. says: My locomotive boiler ought to be felted; but the grease strikes on some parts of the boiler, and I do not know how to work felt on account of the grease. What shall I do? A. With the exercise of a little ingenuity, coupled with a less liberal expenditure of lubricant, you could get the boiler into proper condition for felt-ing.

(2) G. P. M. C. says: I wish to make a small steam boiler, 14 inches in diameter and 30 inches long. How many lbs. pressure to the square inch would it stand with safety if made of sheet copper ¼ inch thick, steel of the same thickness, or iron of the same thickness? A. Copper 25 lbs., steel 45 lbs., and iron 35 lbs. to the square inch.

(3) L. M. F. asks: 1. What should be the thickness of the heads, shell, and tubes of a return tubular boiler 13 by 5 feet, with 4 inch tubes, worked at 80 lbs. pressure per square inch? A. Thickness of shell and heads, 0.875 inches, tubes 0.134 inches. 2. By putting in 4 inch tubes, would I not obtain a stronger draft than with 3 inch ones? A. Not appreciably.

(4) P. L. says: I have an oxygen gas cylinder made of ¼ inch boiler plate iron, well riveted and made. How will I test it, to know whether it will stand the pressure of gas from a given amount of chemicals? A. Fill it with water, and heat it gradually, attaching a safety valve which will open when the desired pressure is reached.

(5) P. S. N. asks: Can you inform me as to the merits of gravel or concrete houses? A. Houses answering every essential requirement can be erected with concrete walls; and where the materials are found or can be procured on or near the premises, a balance can be struck in their favor on the score of economy. In regard to the method of building them, the usual course has been to carry up the walls solidly in sections, so affording a considerable saving of labor in the handling of the materials; although quite a number in this vicinity have been erected by the system of building blocks, notably a large church near Newark, N. J. Confidence in the latter method, however, has been much impaired by the fall of a tower so constructed in Westchester county, N. Y.

(6) P. S. N. asks: 1. How are concrete structures as regards durability, heat, and frost, etc.? A. Concrete walls properly constructed become as hard as stone, and have been abundantly and favorably tested in respect to the action of the elements upon them. 2. Will you please give me the proportion of ingredients, as well as the *modus operandi* in full? A. The theory as to the proportion of the ingredients is that, when the broken stone, gravel, and sand are combined, there should be sufficient cement and water added to coat every grain of sand, etc., and fill all the interstices between them, thus binding them into a solid mass. A proportion of 5 parts stone and gravel, 3 parts sand, and 1 part cement, is supposed to effect this. Good cement and sharp sand free from loam should be used, with plenty of water. Mix in a mortar box, carry to the wall in a hand barrow, and deposit it on the wall between two stout planks held in place by proper frames; remove the plank when the cement sets, and float the face of the wall smooth. 3. Can I mold the blocks one day and lay them in the mold the next? A. In that system a much longer interval is desirable. 4. Can the chimney flues and tops be of the same material? A. Yes, if the chimneys are built large enough to give sufficient thickness of wall around the flues, and a larger proportion of cement is used. 5. Supposing a well 25 feet deep is closed 20

feet below the surface, leaving a reservoir of 5 feet into which a pipe leads to pump the water through, what is the effect on the water? A. A pipe for ventilation would be required. 6. Of what thickness should the walls be made, for a cellar 8 feet high, and for 2 stories 9 feet each? A. Cellar 18 inches, first story 15 inches, and second story 12 inches. 8. What are quick and hydraulic lime? A. Quicklime is freshly burnt unslaked lime; hydraulic cement is a cement that hardens under water, and is not deteriorated by the action of water upon it.

(7) J. L. asks: 1. Will an engine work as well at a distance of 60 feet from the boilers as it will near them? A. With a well covered and trapped pipe, the difference will be very slight. 2. How much more power and steam does it require to run a circular saw at a distance of 60 feet from the engines than it would take if the saw were 12 feet distant from the engine? A. From 10 to 15 per cent more, with a good connection. 3. The steam pipe will be exposed to open air for 40 feet between the two buildings. Will it be liable to get out of order? A. Not necessarily. 4. Would you rather have the engines at a distance from than near the boilers? A. It is best to locate the engines as near the work as convenient.

(8) T. S. L. says: The outside plastering of my house, near the ground, comes off for about 2 feet up. I have tried plastering in different seasons, so that it might dry thoroughly, but without success. What will make the plaster adhere? A. A coat of hydraulic cement in well washed sharp sand, for 2 feet up from the ground, might stand. It might be started upon a footing of slate driven into a joint of the brickwork at the surface of the ground.

(9) R. D. says: Will a ½ inch pipe 75 feet long, supplied with water from the main through a ½ inch stop, deliver as much water as if it were connected with a ¾ stop? A. No.

(10) A. W. says: We are building a church 40 by 60 feet, with side walls 16 feet high and a roof at an angle of 50°, 24 feet high in center. We are making the ceiling flat overhead. Our carpenter argues in behalf of the old style of main rafters (7 by 10 inches) king post and cross beams, the latter to be 12 feet apart; now I contend that a plan, making each pair of rafters out of joists 2 x 8 inches, with cross joists, 2 x 6, well braced above the joists, each pair to be self-supporting, and placed 16 inches from centers, will be the strongest. Which is right? A. In all cases where the tie beam is placed above the foot of the rafters, there is danger of the weight of the roof spreading the walls apart, and thus causing a general settlement in the roof itself, often eventuating in its fall. Your carpenter's plan is the correct one, providing the walls are properly built to accord with it. The trusses being placed 12 feet apart, the windows should be located accordingly—one window between each two trusses in each side wall—and a stout buttress built with the wall at the bearings of each truss. These buttresses will resist the thrust of the roof, and maintain the integrity of the walls.

(11) C. S. says: I am using charcoal for blacksmith's purposes, and I cannot get heat enough to do ordinary welding, such as a plow-share or a wagon tire. The charcoal is made of cotton wood, and has a great deal of sand in it on account of having been burnt in sandy soil. How can I manage it any better? A. From your account, it seems that you must get better fuel to obtain a satisfactory fire.

(12) G. W. H. says: 1. A spring is 1,530 feet from a fountain, with 30 feet fall. How large must the reservoir be, and what size of pipe is necessary to secure flow enough to give a jet 10 or 15 feet high, or to supply a camp of 500 persons with water? A. The reservoir might be made 50 by 50 feet, with an average depth of 6½ feet. This would allow about 25 gallons to each person. The friction of the water in the pipes would so reduce the head as to make the jet for a fountain of little account. 2. Would it pay to take the pipes up in the interval to prevent rust, camp meeting lasting only 10 days in a year? A. It would, provided you could thereby save the expense of sinking them into the ground.

(13) G. C. T. says: I propose to make a vessel on the plan of a Papin's digester. I use copper castings ¼ inch in thickness, outside and inside being turned off and properly stayed; what pressure to the inch would such a vessel bear? A. It will depend on the diameter.

(14) C. C. says: I am running an engine with locomotive boiler, taking muddy water from a pond. The deposit burns out the fire box, and I have to patch it. Is there no way to make the mud settle before the water goes into the boiler? A. Your best course would be to use a good heater.

(15) J. O. says: I have a canoe which is rather cranky. She is 20 feet long by 4 feet beam. Would two keels, one on each side of the center keel, make her less cranky, and improve her sailing qualities? A. A single keel made quite heavy would be more effective.

How are fret saws made? A. They are stamped out.

What is the red substance used by sailors for tattooing? A. Red ink or carmine.

(16) A. P. McC. says: Our schoolhouse here is warmed by steam, but it is not well ventilated. There are about 20 rooms in our house, not including corridors. Please give me a good plan for ventilating. A. You do not state whether the heater operates by direct or indirect radiation. In the latter case the radiators are in the basement, and in the former in the several apartments. When the radiators are in the basement, they are enclosed in boxes at the bottom of the warm air flues, and the cold air is introduced into these boxes from the exterior atmosphere, thus insuring a continual supply of fresh air; but when the

radiators are placed in the rooms, there is only a partial change of air, limited by the tightness or looseness of the doors and windows. When fresh air is introduced by a shaft in the basement, the fireplace flues should be kept more or less open for its egress; but in the case of direct radiation the radiators should be placed near the windows, and some means adopted to supply fresh air to each radiator, still keeping the fire flues open to insure a movement and gradual change of the air. Damper valves should graduate this movement, so as to adapt it to the state of the temperature for the time being.

(17) F. K. asks: Why are the sun's rays warmer in the valley than they are on the top of a high mountain? A. On account of the rarity of the atmosphere at the greater height.

Would highly superheated steam, when mixed in small quantities with hot air, be better than hot air only for aiding the combustion of coal gases and coal smoke from soft coal, if admitted to the fires of stoves or furnaces? A. No.

(18) F. C. L. says: A steam pony pump, of the crank and plunger pattern, has diameter of cylinder 4½ inches, diameter of pump 3¼ inches, stroke of both 6 inches, steam pipe to engine ¾ inches in diameter, feed pipe to pump and from pump to boiler 1 inch in diameter, 1¼ inch check valve between pump and boiler. Its work is to draw water 6½ feet perpendicularly from tank and force it into a boiler, which it did rapidly at a pressure of 35 lbs. to the square inch on boiler. It was necessary to remove the feed pipe from the tank below and place it into the lower end of a barrel standing about 1 foot from the pump. When the barrel was full, there was 2½ feet head of water over the pump, when the engine seemed powerless to move the pump and would not work at all unless we pulled her over the centers, even at a boiler pressure of 65 lbs. to the square inch. We then drove a plug into the end of the feed pipe, partially filling it up (say ¾), when she pumped but very poorly. The pipe was then removed from the barrel and put down into the tank below, when she pumped like a charm. My opinion is this: that, when pumping from the tank below, the inertia of the water caused the pump to only partly fill, and therefore the engine had less work to do to force the water of the partly filled pump than when there was a head of water over the pump. Is this so? A. The feed pipe is apparently large enough, if it is direct; and from your description we imagine there is some defect in the pump, such as excessive friction or bad arrangement of pipes, valves, or ports, so that the steam cannot act to the best advantage. Your explanation, to the effect that the pump cannot deliver a full barrel of water against boiler pressure, is probably correct; and this points to some defect in the steam cylinder or its connections.

(19) R. R. says: 1. I am running an old-fashioned engine 7 by 18 inches, with cut-off at half stroke. The engine is set below water line of the boiler, and 6 feet from the boiler. When I let it stand for 10 or 20 minutes, I cannot start it without opening the stopcocks to let the water off. Would it do any good to raise the steam pipes 3 or 4 feet higher? A. Very little if any, we imagine, if the pipe is properly connected at present. 2. Would it make any difference to change the exhausts from 2½ inches by 12 feet long to 2 inches by 24 feet long? A. It will probably increase the back pressure slightly.

(20) W. C. W. asks: Why is it that one of two circular wheels, having the same diameter and being on the same axle, runs faster than the other in turning a curve? A. The "why" is evident: because one wheel has to go farther than the other in the same time. The "how" is almost equally evident: one of the wheels must slip.

(21) G. N. L. says: Please tell me which would require the greater amount of force in raising ice into an ice house, a steep incline or a gentle incline. A. Using the same motor in each case, a heavier load could be raised on the gentle incline, but not as fast as the lighter load could be raised on the steep incline.

(22) W. H. asks: If a rifle barrel be accurately bored for ten or more copper cartridges, what would be the result, in the matter of deflection of the shots, if all were fired simultaneously? Would the rapid rotation of the balls in the air, in close proximity to each other, materially scatter the balls? A. No, we think not.

(23) C. F. S. asks: Would it be possible for me to obtain water enough, through a brick wall placed in a flume for the purpose of filtering, to supply a 3 inch pipe, for washing purposes? The wall is 7 feet long by 6½ feet high. A. The difficulty is that such a filter soon becomes foul and fails to perform its function. A reservoir in two compartments, where the water may lie still for a certain length of time for the impurities to settle out of it, and another to receive the pure water and distribute it, has been found to answer better in cases like this.

(24) S. C. J. says: Is it necessary to cut the rifling of a breech-loading gun deeper at the muzzle than elsewhere? A. We think not.

(25) A. S. says: I am about erecting a wheel on my plantation for the purpose of drainage. Such wheels are generally set on bricks, but I am compelled to set my wheel on wood. What is the best preserver for wood exposed, partly to water, partly to the atmosphere? I intended to use for this purpose two coats of heated coal tar, but I am informed that crude coal oil as it comes out of the mine is preferable. Is this so? A. We think the coal tar will answer very well, if you take care to keep the exposed surfaces covered, renewing the application as often as necessary.

(26) G. J. E. asks: Would cold air, forced into the bottom of a dry house filled with cut staves, dry the timber in a reasonable time, chimneys taking the damp air from the bottom? A. A constant current of air driven through a building

will absorb moisture or deposit it, according to the condition of the air itself as regards saturation. If the building be kept closed when the atmosphere is in an evidently humid condition, and a strong current maintained when the air is dry, a reasonable degree of success may be looked for.

(27) O. A. & R. say: We have a boiler 38 inches in diameter and 20 feet long; it has a fine 15 inches in diameter. Will such a boiler provide steam enough for an engine 10 x 20 inches, so as to work it to its full capacity? A. You can answer this yourself by allowing 15 square feet of heating surface to each horse power.

(28) C. H. B. asks: How can I make good copper plate printing ink? A. Take linseed oil 1 pint, put into a dry iron saucepan and boil until it will readily ignite on applying lighted paper; let it burn 10 minutes, put the lid on, and it will cease to burn; add 1/2 oz. litharge, and stir well; when cool, use it by grinding with fine lampblack, forming a thick paste; grind very fine with a muller. Boil the oil out of doors.

(29) L. E. K. asks: 1. Do gunners in naval warfare have to make allowance for the motion of their ship when shooting at another? A. Yes. 2. Do their shots have the same effect when fired from the stern of a fast moving vessel that they would if shot from the vessel's bow and directly in front? A. See our article on "Motion in a Moving Body," p. 273, vol. 32.

(30) E. H. says: It is stated that chemists have produced a degree of cold estimated at -257° Fah. How was this temperature obtained? A. Probably by means of liquefied nitrous oxide and bisulphide of carbon in a vacuum.

(31) J. R. asks: 1. What is the cheapest source from which to obtain hydrogen? A. One of the most economical methods of obtaining hydrogen is from the action of dilute oil of vitriol on scrap iron. In many cases coal gas may take the place of pure hydrogen, and the cost of production of the carbureted is very much cheaper. 2. Can you give the chemical reaction of sulphuric acid and water on iron? A. $\text{Fe} + \text{H}_2\text{SO}_4 = \text{FeSO}_4 + \text{H}_2$.

(32) O. W. asks: How can the oxyhydrogen light be rendered absolutely free from danger? I frequently make the gases and run them, each into its own bag, and subject them to about equal pressures. As an additional precaution, I employ a trap, and also a safety bottle for each gas. Neither gas can possibly return to its source of supply; where then can the danger lie, for I am told an explosion is possible? A. Where bags are employed, all that is necessary is that both the gases should be under the same conditions of pressure, which must remain constant. If these precautions are properly attended to, and the safety bottles be placed near the jet, no danger need be apprehended. It is not advisable to wire or tie any of the connections; this is a common practice and source of trouble.

(33) J. C. asks: What is the best method of testing a new shaft to find if it has any cracks in it? A. If a shaft shows any signs of a crack, heat it at that spot to a low red heat, and drop a few drops of water upon the doubtful spot; and if it is cracked, it will show plainly a black line along the crack.

(34) W. S. asks: How much power does it take to run a small planer, to dress strips of wood 2 inches wide? A. About half a horse power.

(35) J. S. asks: 1. How is ozone powder made? A. We know of no such substance. 2. How can I test for ozone? A. The usual test for the presence of ozone is its action upon paper moistened with a solution of iodide of potassium and starch.

(36) C. H. M. says: I have a colored chromo which has become defaced by a spot of ink. How can I remove the ink without taking out the color of the chromo? A. Try a little oxalic acid applied with a camel's hair brush, and absorb with good bibulous paper.

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

T. S. L. G.—No. 1 is iron pyrites in quartz. No. 2 is talc.—F. M. S. S.—The specimens did not come to hand. If the silver is present as chloride, the chloride of silver may be reduced to metal by zinc and dilute sulphuric acid.—U. D. M.—The white is kaolin, and is valuable. The other is clay, and is less so.—J. T.—Not gutta percha. It consists principally of a gum, much resembling in character Canada balsam. The coloring matter may be nearly all removed by boiling water to which has been added a little alcohol. It may then be further purified by dissolving in ether or naphtha, filtering the solution, and evaporating the ether to dryness.—G. A. F.—It is carbonate of lime, and contains no barium salts.—F. P. M.—It is galena or sulphide of lead.—A. W. S.—No. 1 is quartz containing small amount of iron. No. 2 is clay rock containing decomposed sulphide of iron.—H. W.—It is chromite iron.—T. P. S.—It is a crude pipe or porcelain clay, of some value if found in large quantities.—W. O.—It is the larva of the *limnephilus subpunctulatus*. Consult Packer's "Guide to the Study of Insects," pp. 616-620.

COMMUNICATIONS RECEIVED.

The Editor of the *SCIENTIFIC AMERICAN* acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Experimental Geometry. By A. B.
On the Electric Telegraph. By L. M. B.
On Intermittent Springs. By J. F. R., and by G. H. H.
On Moistening Tobacco. By W. B.
On Grasshoppers' Eggs. By J. F. D.
On Preserving Fish Bait. By C. F.
On Snake Bites. By J. M. M.
On Cotton Factories in Louisiana. By E. H.
On Bees Making Honey. By H. L. E.

Also inquiries and answers from the following:

A. O. S.—W. F. B.—E. U. S.—C. W. B.—C. L.—J. R.—A. B. H.—A. N. B.—H. D. E.—L. M. B.—E. H. D.—C. L. E. B.—H. M. W.—H. C.—C. J. T.—S. M.

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Inquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "Who sells wood-carving machinery? Who sells mariners' compasses? Whose is the best metal-testing machine? Who makes the best insulating compound for telegraph wires? Why do not makers of electric telegraph apparatus advertise in the *SCIENTIFIC AMERICAN*?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose, subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

[OFFICIAL]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were

Granted in the Week Ending,

May 2, 1876,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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

Abdominal supporter, C. Smith	176,808
Acid, recovering, R. E. Rogers	176,813
Adding machine, D. Carroll	176,833
Air, compressing, J. B. Crocker	176,931
Alarm, burglar, W. D. Wright	177,051
Anderson, C. I. Saunders	177,017
Animal nose bag, C. H. Williams	176,914
Animal poke, M. Hartman	176,747
Annulet, electric, E. A. Hill	176,784
Ax handles, etc., attaching, J. W. Potter	176,807
Bag, travelling, W. Simon	177,020
Barrels, crozing and chamfering, J. Greenwood (r)	7,093
Basin cock, J. F. Cory	176,774
Basin, stopper for wash, E. Webb	176,907
Basket, J. R. Hare	176,953
Bed-bottom spring, J. Eckart	176,846
Bed-bottom spring, R. M. Hall	176,957
Bee hive, C. Ellis	176,942
Bell-pull attachment, A. Whitcomb	176,910
Bevel, square, and level, S. W. Lloyd	176,870
Beverage compound, H. Reibstein	177,003
Billiard ball holder, W. B. Southworth	177,026
Blasting cartridge, P. A. Oliver	176,989
Blasting cartridge, F. W. Smith	177,024
Blouse or jumper, S. Laskey	176,969
Boat knees, socket for, D. True	176,901
Boat, portable folding, C. A. Ferner	176,849
Boats, propelling, H. Fox	176,947
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