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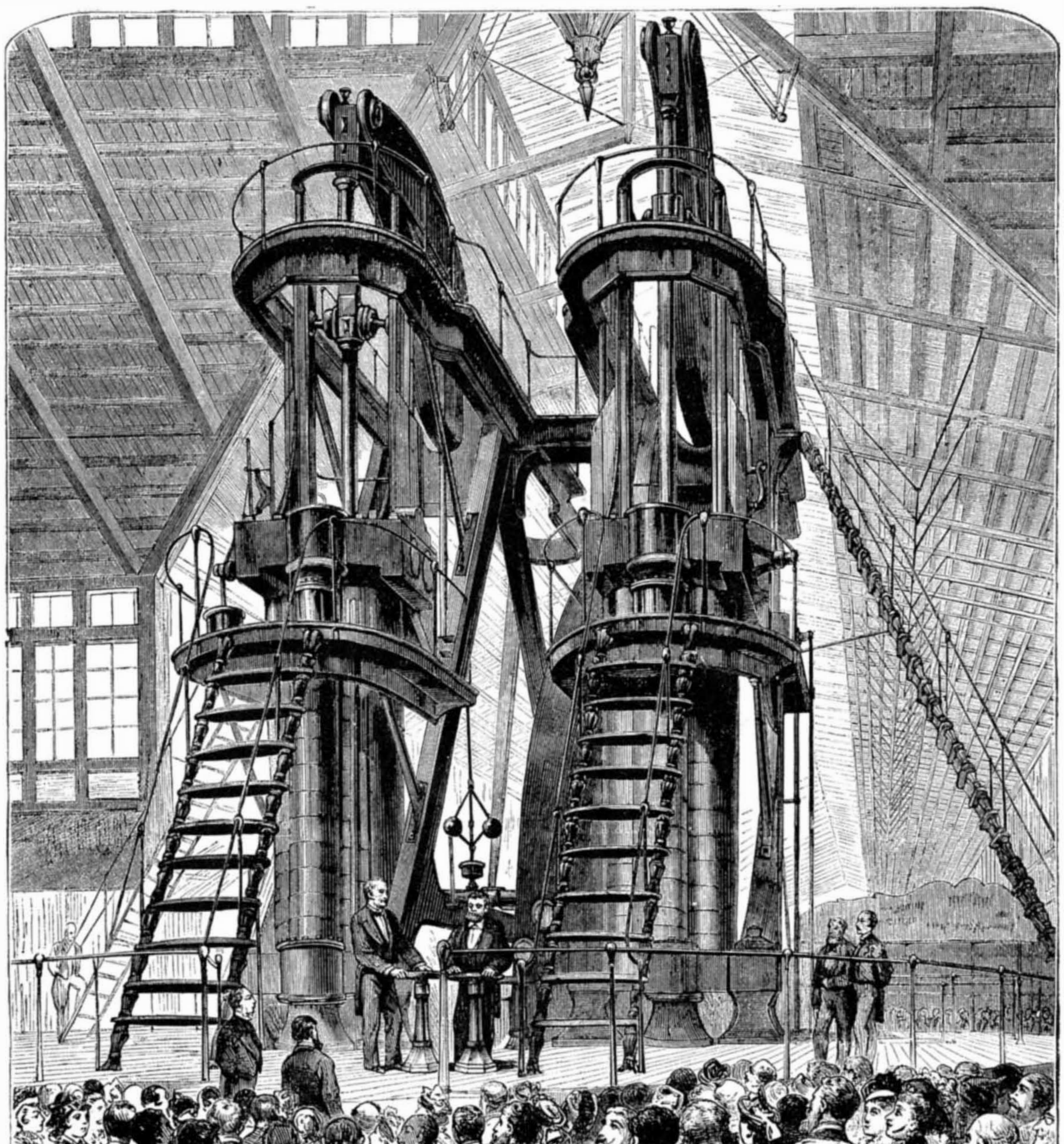
THE CENTENNIAL EXHIBITION--THE GREAT CORLISS ENGINES.

In the annexed engraving are represented the great Corliss 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 Corliss 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 in 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 tuns, 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 tuns each. The beams are 9 feet wide in the center, 27 feet long and weigh each about 11 tuns; 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 6¼ 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 i; 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 trios 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 Corliss 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 operates the valves. The weight of the entire machine, with its shafts, is over 700 tuns.



THE CORLISS ENGINES AT THE CENTENNIAL EXHIBITION.

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 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 necessaries of life to the visitors, this money will first go into the hands of retail 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 jewelers 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 hight. 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 hight 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 hight 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

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(Illustrated articles are marked with an asterisk.)

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TABLE OF CONTENTS.

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LIQUID GLUE.—One part phosphoric acid, specific gravity 1·120, diluted with two parts water, is nearly neutralized with ammonium carbonate, 1 part of water added, and then, in a porcelain vessel, sufficient glue dissolved in the liquid to obtain a sirupy consistence. It must be kept in well closed bottles. The addition of glycerin or sugar would cause the glue to gelatinize.

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 photo graphs of the visible spectrum have been obtained by Mr. Lewis M. Rutherfurd, of New York city. The map 82 inches in length embraces more than 2,500 sharply defined lines. Mr. Rutherfurd 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. Rutherfurd'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. Rutherfurd, 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 remakably 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 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 Superindendent 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 antennæ 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 whirring 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 Napiers, 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 gage 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 cumbrous 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 tuns, the largest in any year between that time and 1842, when it was only 297 tuns: the lowest being 1844, but 211 tuns. The fact of there being an appreciable increase in last year's imports over 1874 of 70 tuns 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 $1\frac{3}{4}$ lbs. to $5\frac{5}{8}$ lbs., were worth 60 or 62 cents per lb.; defective, 40 or 44 cents. Rhinoceros horns, of which $3\frac{1}{2}$ tuns 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 $7\frac{1}{2}$ 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 hight, 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.

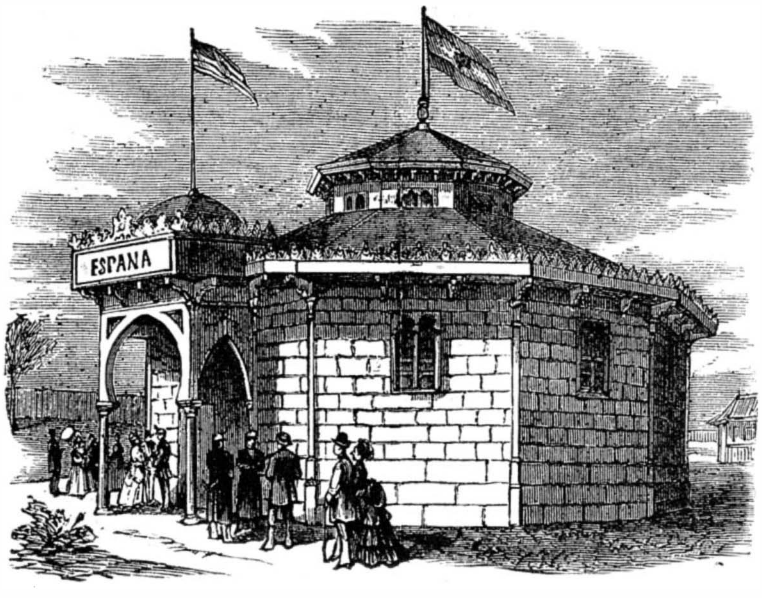
The Spanish Commission has also constructed the octagonal building shown in the annexed engraving. The structure is well proportioned, and the slight amount of exterior ornamentation is characteristic of its nationality. This structure is separate from the one inside the main building above referred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

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 Chicago 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.

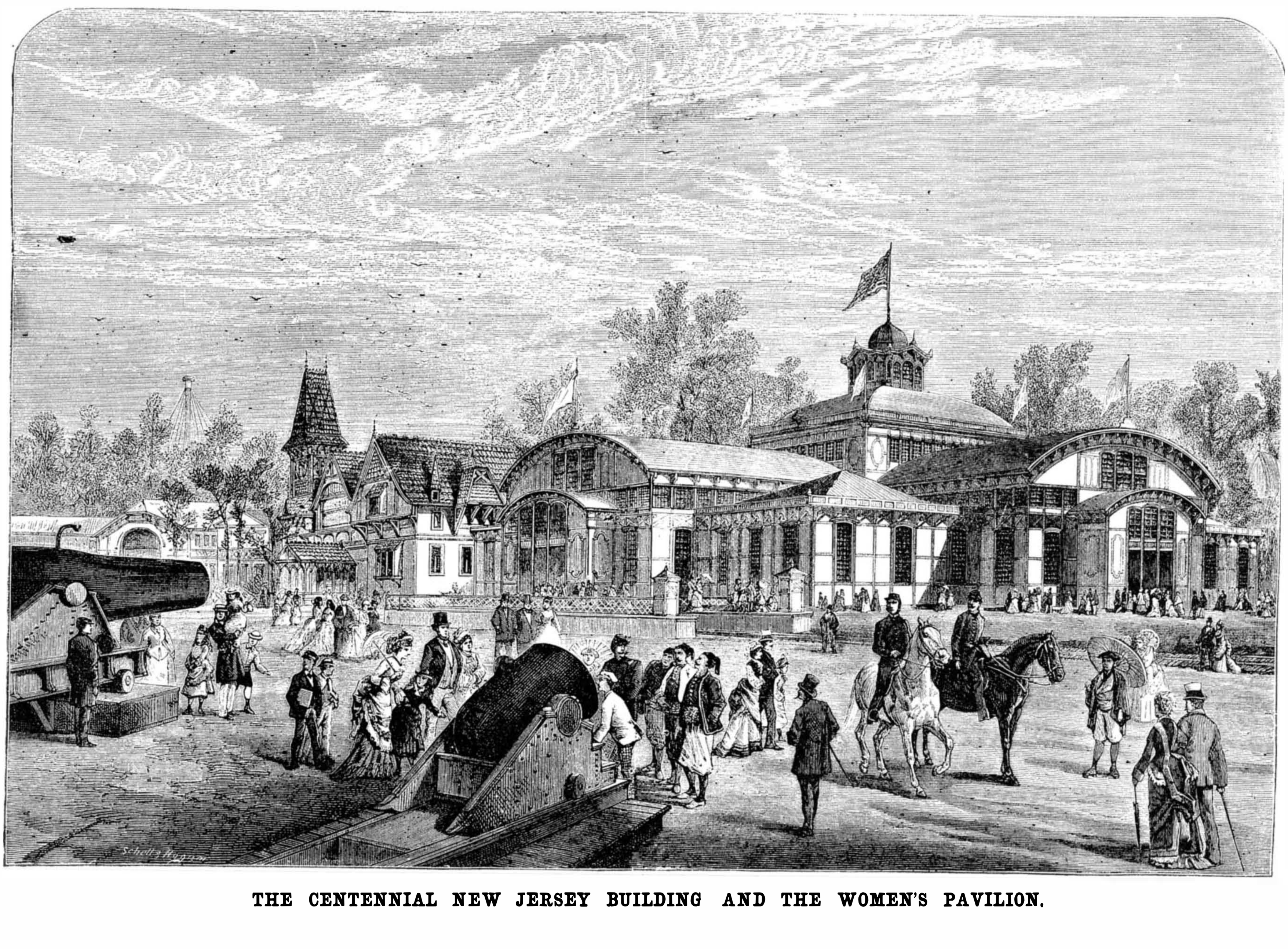
W. E. Debenham describes a method of fixing powder and other colors after they are applied.

"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.

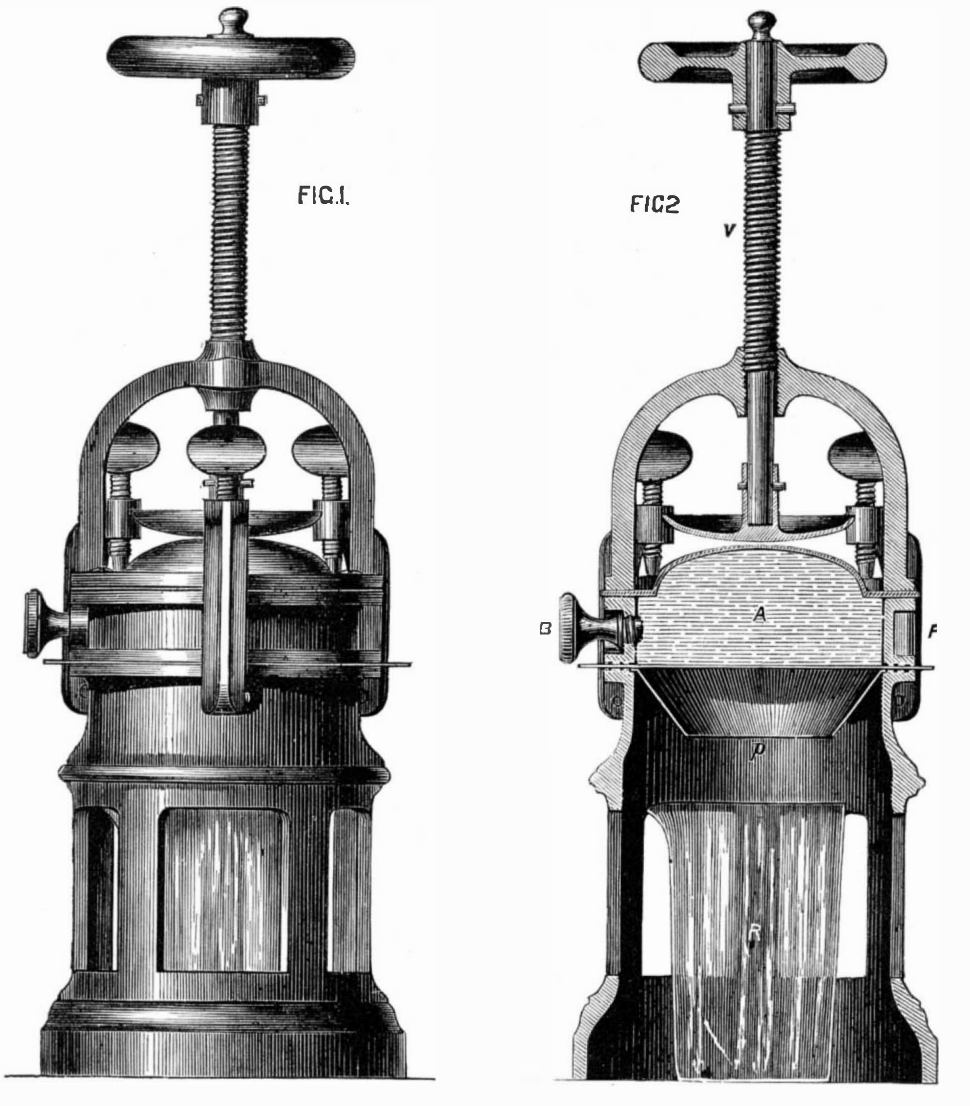

THE CENTENNIAL NEW JERSEY BUILDING AND THE WOMEN'S PAVILION.

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 2½ 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 2·8, and for the second 1·3, the difference, 1·5, or 1½ degrees, must be multiplied by 40 if we have taken 2½ 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 20 if we have taken 10 per cent, which gives 15 per cent of tannin.

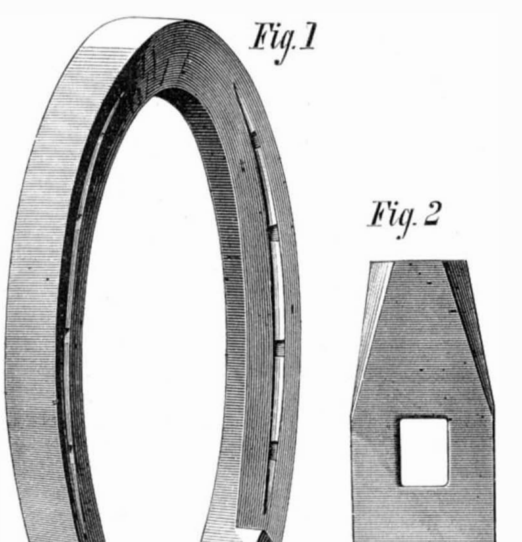
The tannometer referred to is practically a hydrometer, which is supplied with the instrument. With it were detected the valuable properties of *balsamo carpon*, which, when gathered ripe and the gum taken off free from the fiber of the pod, contains 80 per cent of tannic acid. It is this gum which weights 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.



MUNTZ'S TANNIN-TESTING APPARATUS.

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.

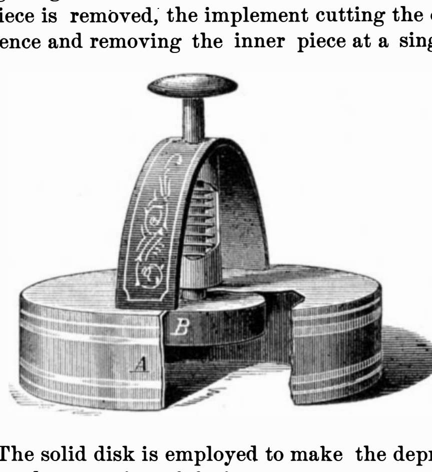
The calks of the shoe are located as usual. The holes for the nails are much further back from the edge than in the ordinary shoe. The portion between the nail holes and edges is flat. The remainder slopes inward, as shown in Fig. 1. The swage is represented in Fig. 2, and has a groove corresponding 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 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 opera-



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.

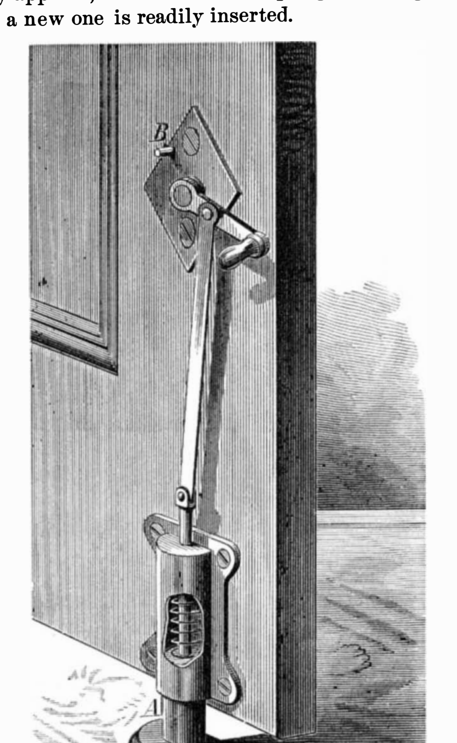
A lecture on swimming was lately given at the Marylebone Baths, London, by R. H. Wallace-Dunlop, C.B. The feature of the lecture was the introduction of what was termed plate swimming.

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 orm 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 versâ*, 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 taw, 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 $\frac{1}{24}$ 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 tuns, has a breaking strain of from 22 to 24 tuns, and an elongation of from 10 to 15 per cent, a forged piece of manganese bronze bore a strain of 12 tuns, a breaking strain of 30 tuns, 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 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.

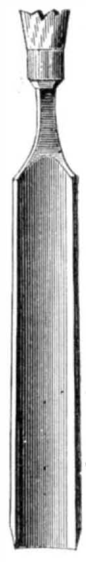
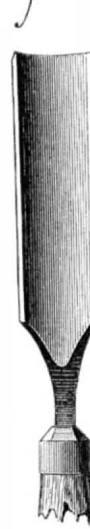


Fig. 20.

Fig. 21.



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, give 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

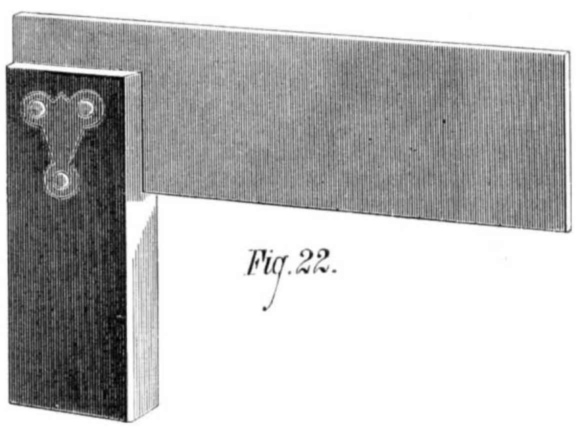
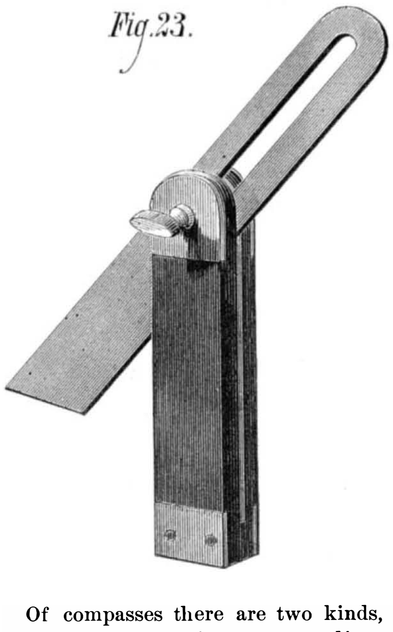


Fig. 22.

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. 24.

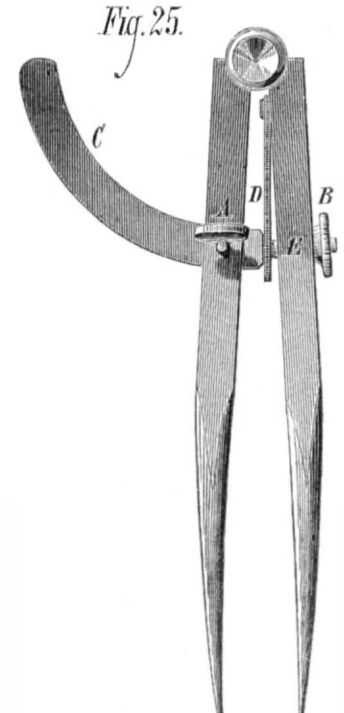
Fig. 23.



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 thumbscrew, 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.

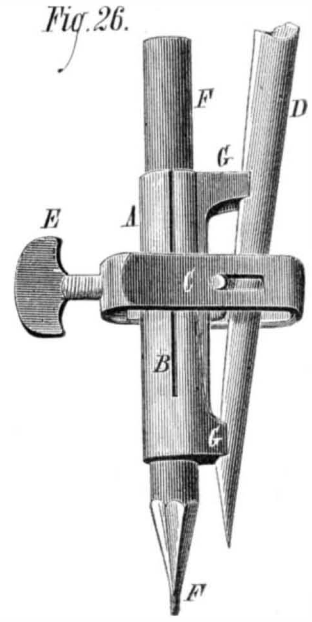
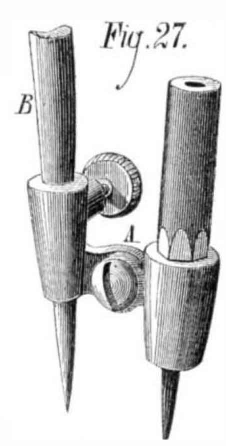
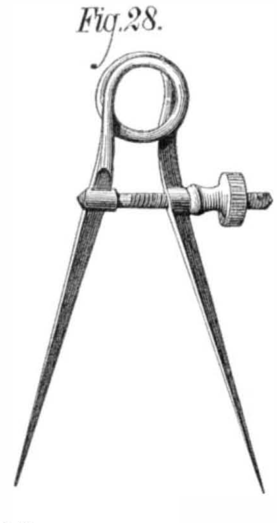


Fig. 27.



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.

Fig. 28.



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. 20, in stead of making it broad, flat, and thin, as formerly.

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.

Fig 1

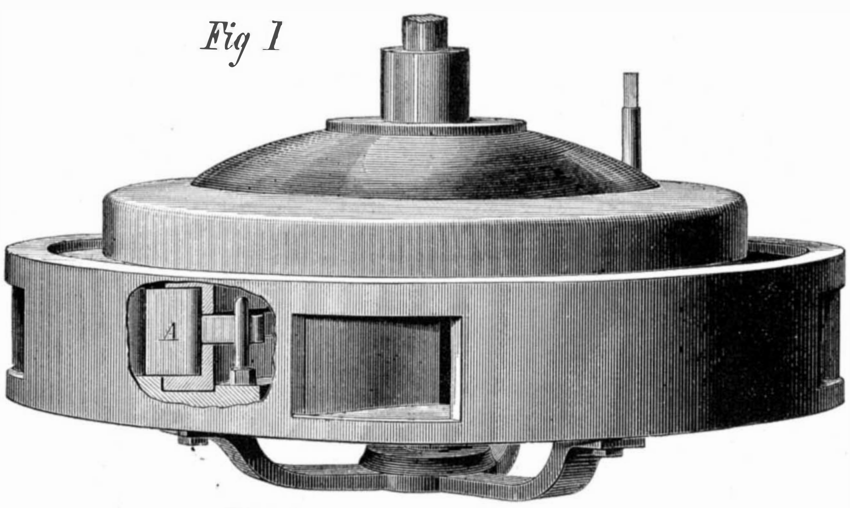
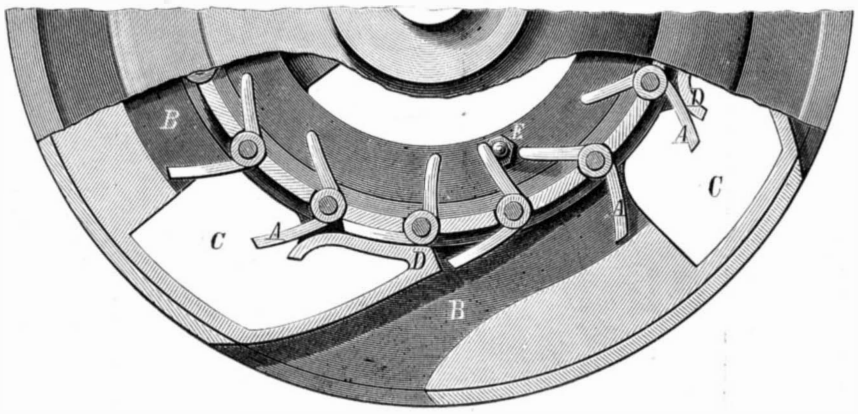


Fig. 2



WALTNER'S WATER WHEEL.

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.

BROWN'S COTTON STALK PULLER.

Flower Pots.

We learn from the *Hamburger Gartenzeitung* that the fabrication of flower pots from a mixture of cowdung and earth is 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 $2\frac{3}{4}$ inches broad by $2\frac{1}{4}$ 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 produced. 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 ultra-microscopic as though they had no existence. I have tested this with an exquisite $\frac{1}{50}$ 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 solety 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.

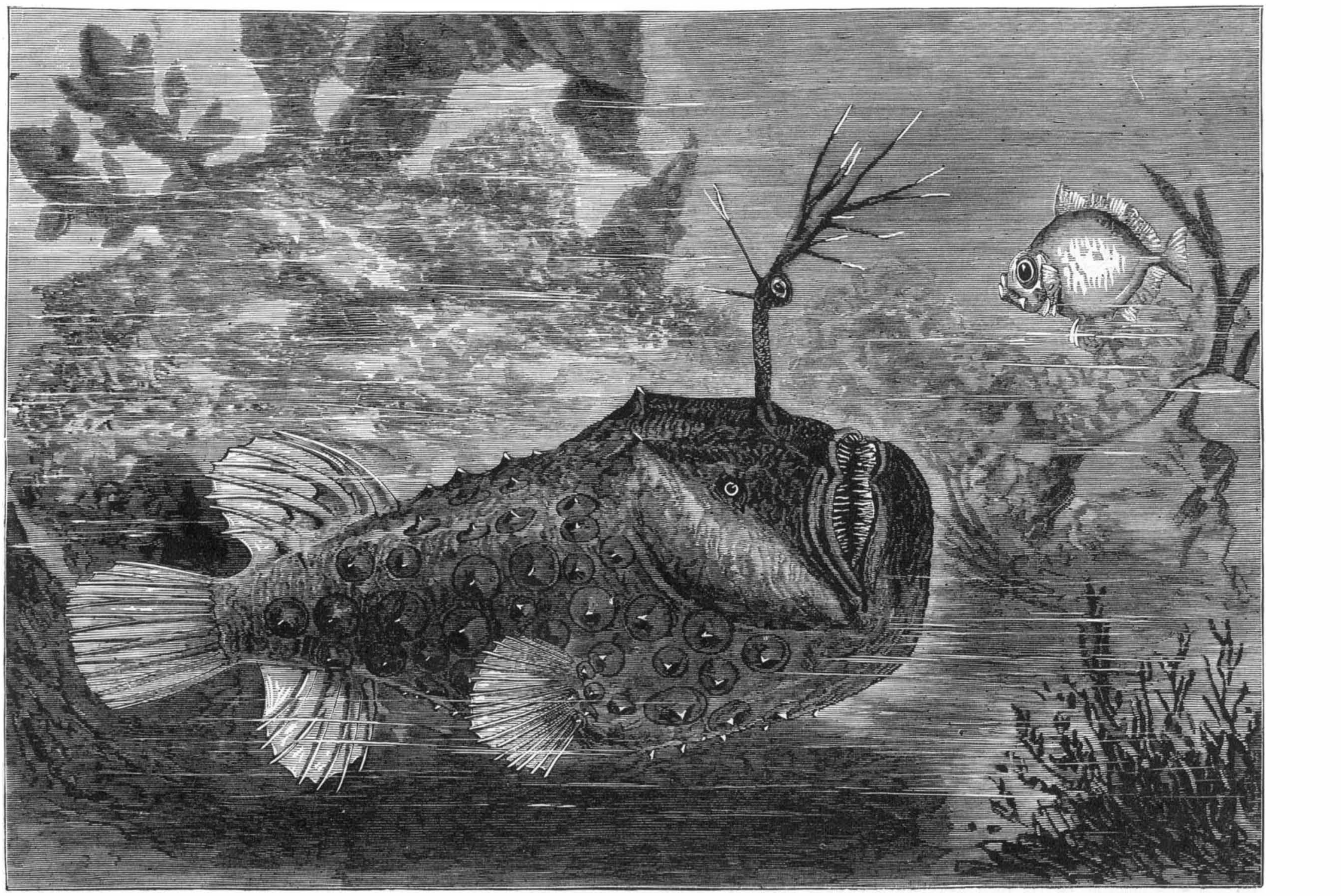
Japanese Iron.

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, uutil 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 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 vctim 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.

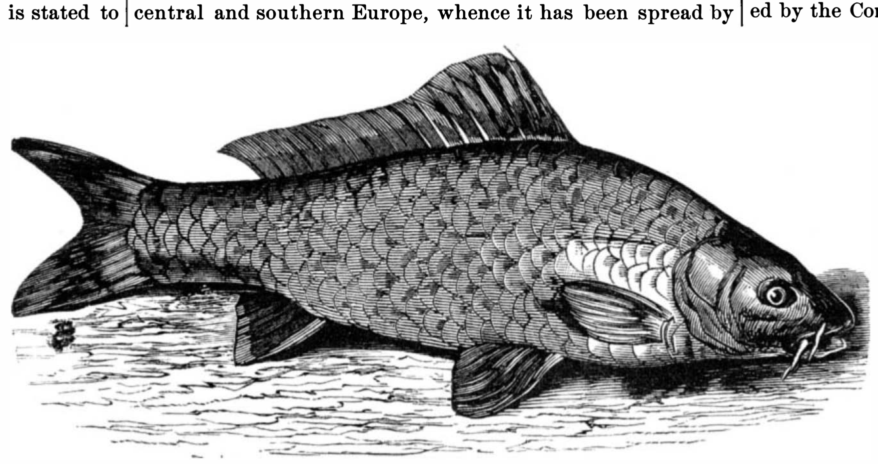


THE CHIRONECTIFORM OR ANGLING FISH.

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 mall appropriation for fish propagation, gives some interesting facts regarding the scale on which the work of his 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 tuns. 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. 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 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 larvæ of aquatic insects, worms, and soft plants, though the fish will eat almost any vegetable food in artificial ponds.



THE CARP.

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 ground be too hard for such a manœuver, 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 expense 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.

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 Na F + Al_2 F_3, occurs at Evigtok in gneiss, chiolite, 3 Na F + 2 Al_2 F_3, 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-holding 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. Iles 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 $\frac{1}{250}$ 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 oxydizing 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, Du Bois Baudrian, 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 20^3. 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 NH_4 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, H_2O, is a real compound radical like cyanogen.* Another startling result of this law is that we find that CH_2 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, $\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$, or water in which an atom of hydrogen is replaced by ethyl, we should write it H_2O, $2CH_2$, or two molecules of the hydrocarbon radical CH_2 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 complicate formulæ of organic chemistry, the laws of Wurtz will be of great value in establishing the true formulæ. The striking changes that he proposes in the formulæ 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 formulæ. For example, although ice has the formulæ of H_2O, as at present, he would write free water in its liquid state as $H_{10}O_5$; the peroxide of hydrogen he writes $H_{10}O_{10}$, hydrochloric acid H_2Cl_2; and to common salt he is obliged to give at one time the formula Na_2Cl_2, at another $NaCl_4$, 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 basylic or electro-positive vary the most. The volume assigned to a molecule of hydrogen in water is $6,408 = (18 \cdot 574)^3$. 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, 29^3; in ammonia gas, N_2H_6, he puts three hydrogen molecules at 18^3 and three at 19^3. 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 24^3, it became respectively 24^3 and 25^3. When combined with nitrogen, which is 20^3, it became 18^3 and 19^3, 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-condensible 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 H_2O_2 is $(2\times1)+(2\times16)=34$. 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:

$$H_2O_2 \;;\; 34{,}000 \div 1{\cdot}4665 = 23{,}184$$
$$H_2O \;;\; 18{,}000 \div 1{\cdot}0000 = 18{,}000$$
$$\text{Oxygen} \qquad = 5{,}184$$

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.

* The atomic weight of H_2O is 18; multiplying by 1,000, and dividing by the specific gravity of ice, 0·91674, gives us 19,683, a perfect cube of 27. This is also the diameter of a molecule of H_2O in the alcohols. Hence the reason for taking the densities at the point where ice begins to melt, the volume of liquid water, 18,000, not being cube.

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 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 quadrumana 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 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. Horseshoes 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 $\frac{1}{5}$ lb. oily anilin; add the other half, and then $\frac{1}{5}$ lb. chlorate of potassium. Allow the solution to cool and subdue 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 $\frac{1}{25}$ 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.

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,—walruses, 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. Saward, Editor of the "Coal Trade Journal." New York city: F. E. Saward, 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, Hughsville, 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 consist 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 coffins. 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 barb 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 barb 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 CHILDRENS' 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 borrd. 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.

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. 299, 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 saltpeter on p. 52, vol. 34.—M. G.'s queries are too metaphysical for our columns.—H. V. will find a recipe for aquarium 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. 34. 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. 255, vol. 34.—C. L. M. will find directions for gilding 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 felting.

(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 $\frac{1}{16}$ 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, 0·6875 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 ¾ 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 plowshare 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 6¼ 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 hight.

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 3½ 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 ⅝), 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 2¼ 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 6¼ 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. & B. say: We have a boiler 38 inches in diameter and 20 feet long; it has a flue 13 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 ½ 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 carburet is very much cheaper. 2. Can you give the chemical reaction of sulphuric acid and water on iron? A. $Fe + H_2SO_4 = FeSO_4 + 2H$.

(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 chromic iron.—T. P. S.—It is a crudepipe or porcelain clay, of some value if found in large quantities.—W. O.—It is the larva of the *limnophilus 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. H. R.—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.

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 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	176,895
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
Andiron, C. I. Saunders	177,017
Animal nose bag, C. H. Williams	176,914
Animal poke, M. Hartman	176,747
Annunciator, electric, E. A. Hill	176,784
Ax handles, etc., attaching, J. W. Potter	176,807
Bag, traveling, 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	176,951
Bed-bottom spring, J. Eckart	176,846
Bed-bottom spring, R. M. Hall	176,857
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. Reibestein	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
Boot-edge finishing tool, C. Reinel	176,810
Boot heel, J. Samuels	177,015
Boot trees, clamp for, C. A. Ensign	176,848
Box cover, W. L. Hubbell	176,863
Breakwater and pier, A. M. Elliot	176,941
Bridge, C. S. Palmer	176,991
Bridge, J. W. Post	176,806
Bridge, draw, J. W. Post	176,805
Broiler, E. O. Thomas, Sr	176,819
Buggy, side spring, J. C. Oliver	176,802
Burner, lamp, A. Angell	176,920
Burner, lamp, B. F. Flint	176,850
Bustle, A. Carter	176,771
Butter package, W. J. Allason	176,731
Button, L. C. Curran	176,932
Buttons, making collar, J. W. Presbrey	176,808
Calf weaner, D. H. Johnston	176,790
Cane and stool, combined, J. Smith	177,025
Capstan, J. H. David	176,934
Car axle box, W. W. Whitaker	177,046
Car brake, Ducournau & Strata	176,937
Car coupling, H. Howson	176,861
Car coupling, J. B. Meadley	176,874
Car coupling, Misso & Warner	176,877
Car coupling, F. S. Pennybacker	176,888
Car coupling, J. A. Richard	177,006
Car coupling, S. D. Ucker	177,035
Car for one rail railways, D. B. James	176.864
Car heater and ventilator, C. F. Whorf (r)	7,088
Car propeller, A. Maynard	176,798
Car starter, W. Hilbebrand	176,749
Car stock chute, R. Rogers	177,009
Carpet beater, H. Freeman	176,853
Carriage, jump seat, J. R. Patten	176,804
Carriage, light, J. C. Heater	176,956
Carriages, etc., sash holder, N. Platt	176,995
Carriages, shifting rail for, A. M. Whipple	176,764
Cart, hay, E. B. Bigelow	176,922
Cement, hydraulic, C. F. Dunderdale	176 938
Chair, folding, N., C. O., & A. Collignon	176,929
Chair or lounge, sofa, J. B. Wood	177,050
Chandelier, oil, J. Callopy	176,831
Churn, McManus & Merryman	176,801
Cigars, lighting, J. Radford	177,001
Clamp, T. H. Marsh	176,752
Clock, electromagnetic, W. M. Davis	176,740
Clothes dryer, J. R. Rusby	176,814
Clothes pin, Hunter & Entwistle	177,788
Clothes pounder, F. G. Clarke	176,928
Clothes wringer, H. Nash (r)	7,090
Clothes wringer, N. B. White (r)	7,098
Clutch box, H. Martin	176,976
Confectionary, making, S. Croft	176,775
Cooler or warmer, milk, Hubbard *et al*	176,862
Core stricker, Smith & Wade	176,760
Corks, removing wires from, J. Franz	176,852
Corn stalk chopper, etc., B. S. Hyers	176,960
Corn knife, W. Millspaugh	176,875
Corset, L. Schmitt	177,019
Corset loom, Gahren & Zorn	176,949
Cotton gin feeder, J. W. Webb	176,908
Cracker box, show, E. & C. Maginn	176,974
Cranberries, etc., gathering, A. K. Gile	176,950
Cuff fastening, S. Houghton	176,786
Cultivator, A. Rigby	177,007
Cultivator, hand, J. K. Dugdale	176,845
Cultivator, rotary, J. C. Stone	176,897
Cupboard, J. Ansley	176,921
Currycomb, C. W. Saladee	177,012, 177,013, 174,014
Currycomb, G. B. Turrell	176,902
Cuspadore, I. G. Booth	176,734
Deflector and evaporator, S. Fairman	176,943
Desk, H. H. Elberg	176,847
Digger, potato, F. Rimpler	177,008
Door fastening, barn, P. A. Peer	176,887
Door spring, J. G. Edgell	176,940
Drilling and well boring, P. Helm	176,859
Drill chuck, W. Frost	176,854
Eaves trough hanger, J. S. Miller	176,979
Effervescent liquid apparatus, C. Greiner	176,782
Electrotype heater, J. E. Parker	176,886
Elevator, A. B. Darling	176,841
Elevator, T. O'Hagan	176,986
Elevator, straw and cob, J. Q. Adams	176,916
Engine, hydraulic, E. West	176,822
Engine, motive power, P. W. Williams	176,823
Engine, portable and road, B. Yoch	177,052
Engine, rotary, J. Moore	176,878
Engine, expansion gear, C. J. Carlo	176,832
Envelope machine, H. J. Wickham	177,048
Fan, exhaust and blower, F. Murphy	176,755
Fence, portable, J. M. Overpeck	176,990
Fence post, E. Sims	177,021
Fermentation, preventing, J. J. Suckert	176,898
Fifth wheel, J. Burt	176,770
Filter, etc., cistern, W. B. Wilson	177,049
Fire escape, W. McAllister	176,799
Flour packer, H. A. Barnard (r)	7,086
Fork, horse potato, G. C. Clark	176,838
Fruit dryer, G. W. Bowman	176,925
Fruit dryer, O. F. Tiffany	177,032
Fruit jar, J. H. Anchors	176,766
Fruit, preserving, Mefford & Peebles	176,754
Furnace door, C. F. Degelman	176,741
Furnace grate, G. W. Todd	176,761
Furnace, hot air, G. H. Johnson	176,964
Furnace, puddling, McNair & Graff	176,977
Furnace, reverberatory, R. Pearce	176,994
Furnace, blast, W. A. Stephens	177,028
Gang plank, G. Malone	176,872
Gas apparatus, carbureting, J. G. Haymaker	176,955
Gas, increasing pressure of, C. A. Murray	176,982
Glass tile for decorations, T. G. Aickin	176,730
Governor, H. Howe	176,957
Grain binder, Friedlaender *et al*	176,781
Grain binder, D. McPherson	176,800
Grain drill, E. Kuhns	176,967
Grain drill seed cup, Kuhns *et al*	176,965, 176,966
Grapple, stone, C. Campbell	176,737
Grate, J. A. Lawson	176,971
Grate, J. Lewis	176,750
Grinding and amalgamating pan, C. Cummings (r)	9,092
Grinding, tool holder for, C. M. Fisher	176,946
Grubbing machine and capstan, R. W. Burk	176,926
Gun machine, J. P. Taylor	177,030
Gutters, making wood, E. H. Rollins	176,892
Hame fastener, D. C. Meeker	176,753
Hammer, blacksmith's forging, J. Koplin	176,867
Hammer, steam, T. Hill	176,860
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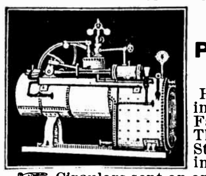

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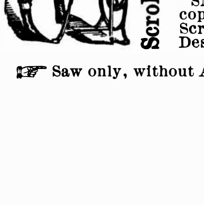

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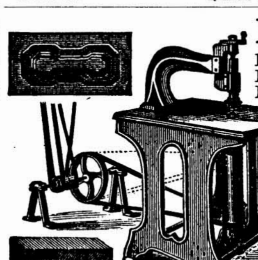

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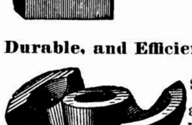

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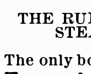

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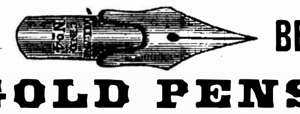
THE  BEST

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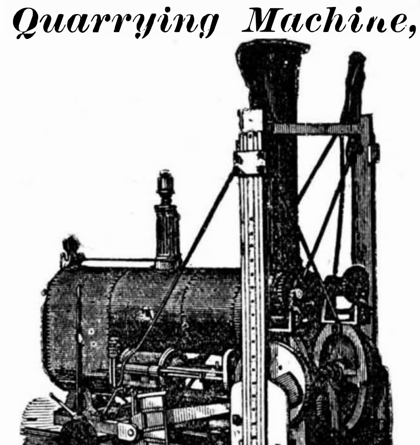

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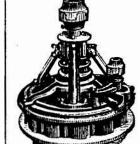

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