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THE GARTSHERRIE IRON INDUSTRY.

The career of Mr. James Baird, principal of the great Gartsherrie iron-making firm, illustrates, perhaps more forcibly and vividly than any other, the immense development of the pig iron trade of Scotland, and the avenues to affluence and power which it was the means of opening up.

Born in 1802, Mr. Baird is the fifth of a family of eight sons and one daughter, whose ancestors for several generations had been farmers in the parish of Old Monkland, and whose father was a tenant on both Drumpellier and Rosehall estates of the farmers of Kirkwood, Newmains, and High Cross. All unconscious of the great destiny that was before them, the elder members of the family aided their father in agricultural operations until they had passed maturity. The father, Alexander Baird, died at the age of 68, after having seen his sons established in the Gartsherrie Works and on the high road to fortune. Seven of the brothers became partners in these works, the eighth brother, John, having preferred to stick to agricultural pursuits. All of them, with the exception of James, have long since met the shadow feared by man and gone over to the great majority.

By industry and economy, exercised almost to the verge of parsimony, the Messrs. Baird were enabled to make some little money out of their little colliery, albeit at that time coal owning was not nearly such a profitable occupation as it is in our own day. Other pits were afterwards opened out in Maryston and Gartsherrie, but no works of any consequence had yet been started in this country—now the Black Country of Scotland—for the manufacture of iron. Indeed, the iron trade appeared to concentrate rather on and towards the east coast, where the Carron Works were carried on. As for Coatbridge, which is now environed with a crescent of blast furnaces, it was, to all intents and purposes, a purely pastoral locality.

The Gartsherrie Ironworks were commenced in the year 1829, and the first furnace was put in blast in May, 1830, or simultaneously with the invention of the hot blast.

From time to time the Gartsherrie Works were extended until they reached their present exceptional proportions. They are now, says the *Practical Magazine*, to which we are indebted for the engraving, with perhaps the solitary exception of Dowlais, the largest works of their kind in the world. They comprise sixteen blast furnaces, placed in two parallel rows. The two rows of furnaces are placed face to face, with their pig beds bordering the canal, and the lines of rails for the supply of raw materials placed at a higher level behind each row. A railway bridge connects the two lines of rails crossing the canal and the lower level of the works. The blast is heated to about 800° in hot blast ovens of the pistol pipe form. This is an invention of Mr. James Baird. It was adopted first at these works thirty-five years ago, and led to a higher temperature of blast than had up to that time been reached in the Scotch furnaces. Since then the pistol pipe hot blast oven has come into general use throughout the rest of Scotland. The stoves are fired with slack. They are placed behind the furnaces at the level of the railways supplying the coal. Originally Mr. Baird placed the hot blast stove on the top of his blast furnace, and tried to utilize the flames escaping from the latter for heating the blast; but this mode did not prove a real success in Scotland until Mr. Ferrie's furnace was devised.

The ore used at Gartsherrie is pure black band, which is delivered from the mines in a calcined state. A very large stock of iron ore, varying from 80,000 to 120,000 tuns, is always kept in stock at Gartsherrie. Besides the native black band there is generally a considerable quantity of hematite used, and the firm work hematite mines of their own near Whitehaven. The black band is calcined in open heaps of about 2,000 tuns, covered over with a small material, so as to exclude an excessive supply of air. Before being charged into the blast furnace, the calcined black band is carefully sorted, and all foreign and impure matter is extracted by hand.

It is probably due to the care bestowed upon the purification of the ingredients used in the blast furnace that the Gartsherrie brand is so much esteemed. It is more like the assaying of precious metals than the rough-and-ready mode of treating the materials used in the furnaces of Cleveland and other districts. When thus carefully picked and purified, the Gartsherrie ironstone contains a very large percentage of metallic iron; and it only requires 32 cwt. of ore to the tun of iron, or even less.

The weekly production of the Gartsherrie furnaces is about 160 tuns each; they are tapped every twelve hours, and produce each about twelve tuns of iron at each cast. The production of the works for 1872 was over 120,000 tuns, about 80 per cent of this being "No. 1 Gartsherrie," which is the highest quality of foundery iron made, and at the present market value realizes from $40 to $50 in gold per tun.

Besides the establishment at Gartsherrie, the Messrs. Baird acquired the Lugar, Eglinton, Portland, and Blair Ironworks, all in Ayrshire, and in 1856 they acquired the Muirkirk Ironworks, also in Ayrshire, which, after the Clyde and Carron, are the oldest ironworks in Scotland. In 1864 the firm acquired the Portland Ironworks, with five blast furnaces, to which one has since been added. In 1852 the Blair Ironworks came into the market. These works were started by the Ayrshire Iron Company, which became bankrupt through the mismanagement of its affairs. The works of the company were increased at a rate out of all proportion to the capital. Iron was bought on credit and sold for cash at a ruinous sacrifice, and when insolvency followed it was found that there were $1,250,000 of liabilities, without any assets except the works at Dalry. These works, which originally cost $450,000 or $500,000, were ultimately sold to the Messrs. Baird for $100,000, or $350,000 less than it cost to build them. At the present time, therefore, the Gartsherrie firm own forty-two blast furnaces, capable of producing, when in full going order, from 1,200 to 1,500 tuns of iron per day. At the present time the output of pig does not exceed 800 tuns daily. Altogether, the firm employ upwards of 9,000 men and boys. And here it may be remarked that the Gartsherrie iron is more valuable than any other brand in Scotland, that of Coltness alone excepted. As a well known engineer has put it, "a tun of pig iron marked Gartsherrie will command a price in the market which is above the average of the general quotations, but which is also entirely unaffected by the smaller fluctuations in the prices of pigs, the general variations between supply and demand having no influence upon that select brand. The same pig iron, taken to any distant port, will find itself in a similar position by virtue of its brand: and the act of effacing this brand, although it could not possibly alter the intrinsic value of the material, would reduce its market price by 10 or 12 per cent."

From these premises we may almost draw a conclusion which will be tolerably certain and safe as to the probable profits of the Gartsherrie firm. Assuming that their total annual production were only 200,000 tuns—and it has often been much above this—its value, at the present quotations for pig, would be $7,500,000. It is no secret that something like one half of this enormous amount finds its way, in the shape of profits, into the pockets of the Gartsherrie firm.

From first to last Mr. James Baird has been the most active, practical, and plodding member of this great firm, and he is now the only one of his name that is associated with its management. With a constructive and inventive genius that was eminently sound and correct, if not very brilliant, he devised many improvements in blast furnace practice. We have already alluded to the assistance he rendered in the perfecting of Neilson's invention of hot blast. But that was only one of his many achievements. It was he who led the way in Scotland to the adoption of the modern shape of the blast furnace, which is very much less in bulk and cost than those used in the early history of the trade, when square bases and other cumbersome and unnecessary features, now obsolete, or nearly so, were in vogue. It has been said that Mr. Baird excelled in suggesting and applying different modes of saving labor in every department; and so skilled was he in all the various processes of manufacture, that the workmen all regarded him as a master of his handicraft.

JAMES BAIRD, OF GARTSHERRIE, SCOTLAND.

Protection from Yellow Fever.

In a report on yellow fever, recently published in the United States, it is shown that this disease has never appeared in any climate at the hight of 2,500 feet. In the island of Dominica, a hill top not more than 1,500 feet high is always healthy, even when the fever is epidemic at its base. In San Domingo, similar observations have been made. The highest elevation at which yellow fever has occurred in the United States is 460 feet, in Arkansas; and the medical men of this country now hold that the stratum of air infected by the poison is heavier than pure air, and therefore sinks, and they recommend that in unhealthy districts houses and hospitals should be built on tall piles, so as to be above the fever stratum. But where hills are near, the best remedy will be to carry the patients up to a hight of 500 feet.

FROM the experiments of W. F. Donkin, it appears that the Sprengel pump may be made to give an exhaustion down to $\frac{1}{10000000}$ in its simplest and most convenient form, namely, without an air trap and with an india rubber joint immersed in glycerin; but that if a very complete exhaustion is required, the air trap must be used, and the vessel to be exhausted must be sealed hermetically on to the pump.

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A NEW THEORY OF THE FORMATION OF DIAMONDS.

The natural history of the diamond is one of the puzzles of geology, the place of its origin being until recently as great a mystery as the manner of its formation. Happily, however, the first part of the problem has been solved; the diamond has been tracked home; and though the process by which it attained its crystaline isolation remains as obscure as ever, a clue, at least, has been gained to the conditions of its development.

We need hardly remind our readers that in South Africa diamonds are found under two very dissimilar conditions: first as water-worn pebbles associated with pebbles of quartz, agates, zeolites, and the other common attendants of the diamond in other localities; second, in circumscribed pits or shafts filled with a chalky or clayey earth, more or less hardened. The famous Colesberg Kopje is a fair example of the latter sort, several of which have been discovered in the Vaal River country. In all these cases, the diamond bed is surrounded by a rim of rock dipping outward from the center, but attaining within a short distance the horizontal position characteristic of the rocky strata of the district. Inside the rim or "reef," as the miners call it, the diamonds are found at home and untraveled; outside they are absent, or occur only in layers of gravel, itacolumite, or other products of running or dashing water.

That the gems within the shaft have rested undisturbed since their formation, save by the pick and shovel of the miner, is attested by the nature of their matrix, which at Colesberg has been mined to the depth of two hundred feet without any apparent decrease in the richness of the yield, by the sharpness of the edges and angles of the crystals; and still more by the tendency of the gems thus found to check, flaw, and even explode with violence on being brought to the surface and subjected to the action of light and air. No such accidents occur to diamonds found in drifts, for the simple reason that they are the survivors of a similar process of natural selection, all their sensitive comrades having been eliminated by exposure in past ages.

Obviously, if we can decipher the geological history of these singular diamond beds, a very long step will be taken toward the solution of the question how the diamond originated.

The record begins apparently at a time when the great interior basin of South Africa, in which they occur, was the bed of a vast inland sea. The physical geography of this region reminds one of our own Utah basin. There is first a mountain ridge from 4,000 to 10,000 feet high, roughly following the line of the coast, except where it crosses the continent toward the equator, broken only by the Orange and Limpopo rivers which drain the basin. Toward the sea the descent is abrupt, often precipitous; inward, the slope is gradual, sometimes almost imperceptible, the bottom of the basin lying several thousand feet below the average crest of the rim. Everywhere throughout the interior are abundant and unmistakable proofs of the former presence of water, filling the basin as a vast inland sea, at one time the scene of great volcanic disturbance, more recently of a process of desiccation like that which turned the Sahara from a sea to a desert, or that which dried up the sea of fresh water which, but a little while ago, geologically speaking, filled the now arid Utah basin to the brim.

The period of diamond production appears to have been while the sea prevailed, their distribution in the gravels resulting from the subsequent movements of water, to which the widespread gravel beds bear witness. While the sea yet filled the basin, volcanic action was going on more or less vigorously, evolving gases, rending the overlying rock, and producing all the other well known effects of igneous disturbance. Among the minor effects we can imagine the formation of vents or crates, to be filled, when the violence was passed, by the silty deposits of the sea bed, washed in by returning water.

Here, then, we have the conditions of future Colesberg Kopjes—*minus* the diamonds.

Let us follow the process a little further. A constant product of volcanic action, we know to be carbonic acid gas, which contains the basis of the diamond combined with oxygen—a gas capable of being liquefied by the pressure of a column of water less than fourteen hundred feet high, and the ancient South African Sea was several times that depth. We know that this same gas is frequently imprisoned in the soft mud of stagnant pools, where it lies unabsorbed, escaping as bubbles when the mud is disturbed. It is not unreasonable to assume that the less energetic discharge of this gas from the heated depths below the sea bed might be stopped in the muddy filling of the vents, where, liquefied by the pressure of the superincumbent water, it might remain until deprived of its oxygen by some process of Nature's chemistry, leaving the free carbon to crystalize as the sparkling gem so eagerly sought for by the miner.

This, of course, is a mere hypothesis, for we know of no process by which the oxygen could be so withdrawn; but in every other respect the supposition is based on known conditions, and there is apparently no other way in which the raw material of the diamond could be so readily distributed in crystalizable condition throughout these natural diamond factories. The matrix in which the diamonds are found is unquestionably of aqueous origin; and we know, from the vegetable and other substances found enclosed by diamonds, that they could have been formed only in the presence of water. The two seem, therefore, to be contemporaneous.

It is a well known fact also that diamonds sometimes contain cavities enclosing a transparent liquid. We have seen it stated, but are not sure of the authority, that diamonds of this sort have been broken and their contents found to be carbonic acid: a fact which, if true, would add materially to this new theory of their formation.

THE EXPLORATION OF THE LIBYAN DESERT.

Nearly a year ago the staid citizens of Leipsic gathered in crowds in their streets to stare at two queer-looking wagons which were remarkable for enormous hight, and which were slowly dragged through the city *en route* for the Austrian port of Trieste. These were the water carts of the great expedition, soon to start for the exploration of the Libyan desert under the command of the intrepid German traveler, Gerard Rohlfs, of Weimar, and under the liberal patronage of the Viceroy of Egypt. From the European journals of the day, we gleaned a brief account of what the explorers proposed to accomplish, which, in the first number of our last volume, we laid before our readers, mentioning, at the same time, the departure of the caravan for the oasis of Koufra, in the center of the desert. Brief notes of progress have since appeared, but in so disconnected a form that little could be learned from them. Mr. Bayard Taylor, in a recent letter to *The Tribune*, now states that the expedition has returned, and gives an outline of its journey into the interior of the vast but little known African continent.

By New Year's eve, the party had reached the oasis of Farafrah, hitherto unvisited by any European since Cailliaud in 1819. Here they celebrated the holidays, and astonished the natives by kindling a magnesium light; and then, after a rest of three days, started on the more arduous portion of their journey. A week's travel brought them to a sudden and astonishing change in the scenery, the chronicle of which reads more like a page from the Arabian Nights than a sober scientific statement of facts. "On both sides," says the writer, "arose detached limestone rocks, increasing in hight as they advanced, and assuming the wildest forms. It was a labyrinth of lions, sphinxes, pyramids, obelisks, even semi-human statues, extending for miles. Then followed a colossal gateway of rock, the summits of which were 1,500 feet high. When this was traversed, they entered a second and still grander labyrinth, terminating in a second gateway, the towers of which overhung the cleft between them. The way then widened; the tremendous walls of rock fell apart, and the path descended toward a sandy plain. In another hour there came a fresh surprise: the final descent to the level of the oasis lay before them; the vast, mournful, sandy landscape vanished as by a miracle, and wheat fields of deepest green, dark palm groves, white walls and minarets sparkled in the light of the sinking sun."

This was the oasis of Dakhel, a large area of garden land inhabited by 17,000 people. Near the town a large number of powerful springs burst from the earth, the water being at a temperature of 110°, and carried by irrigating canals over many miles of soil. A stratum of chalk underlies the whole oasis, and, wherever pierced, there a spring rises. This water, it has been supposed, came from the Nile; but the examination of the explorers upset the theory, and proved its derivation from an independent source.

Four days' journey from this favored region brought the expedition to a poor camel pasture, destitute of water or trees, which was believed to be the supposed oasis of Zerzoora. A further march of two days to the southwest showed that no further progress could be made. Nothing but mountains of shifting sand was before it: nowhere a foothold, even for the broad-footed camel. Several attempts were made to penetrate this terrible region, but without avail; so the expedition skirted along the sand sea to the northward, seeking a crossing place. This was found in lat. 25° 11' N., and long. 27° 40' E., and the locality was named *Regenfeld* (rain field) on account of a steady two days' fall of rain there encountered. Steering a course by compass and astronomical observations (there was not a vestige of a trail), the explorers continued onward. The weather, it is said, became unexpectedly cold, varying from 29° to 23° Fah. in the morning; ice was formed upon vessels of water. Finally on the 20th of February, the oasis of Jupiter Ammon in Northern Libya was reached.

The journey from Dakhel to this point occupied thirty-six days, during which period not a single well was reached, although a distance of 500 miles was traversed. The iron tanks carried contained a plentiful supply of water for men and beasts during all this time. When it is considered that no other traveled route in all the Sahara has a longer space than a seven days' journey without water, the possibility of penetrating almost everywhere by the aid of Rohlf's device becomes evident.

The oasis of Jupiter Ammon was found to have a depression of 100 feet below the Mediterranean level. From this point the expedition went to the great oasis of Kharjeh, 100 miles south and east, where photographs of the Egyptian temples were made. The inscriptions on these ancient monuments, it is said, give the names of eight Libyan rulers which have never hitherto been found recorded.

By April 15, the expedition had returned to Cairo, after traversing 1,700 miles of desert, two thirds of which distance was before totally unexplored. The oasis of Kufrah was not reached, nor is it believed that the same exists; and even if it did, the vast sand sea would prevent its practical connection with Egypt.

The results of the labors of the expedition are, in detail, said to be rich in scientific discovery. In general, however, the problem sought to be solved has only been negatively answered; that is, it is proved that the Libyan desert is absolutely uninhabitable, and cannot be explored without the most careful preparation, and good luck added thereto.

CAN YOU SWIM?

We do not mean: Can you swim for fun, or for sanitary refreshment; but can you swim for your life, with your boots on?

Swimming as an accomplishment is common; we should like to say common enough, but that would not be true so long as there remains a single individual who cannot swim at all, and unhappily such individuals are numerous. We can say, however, that swimming as an accomplishment is common compared with the art of swimming as a safeguard against drowning.

This is a distinction with a difference. There are multitudes, who are quite at home in the water in Nature's costume or with a light bathing dress on, especially when they know how far it is to the bottom and how far to the shore, who would go to the bottom with discouraging haste if suddenly pitched overboard in a strange place with their usual clothing on. The conditions are entirely different from those of ordinary swimming; and to one unaccustomed to the feeling and effect of clothing in water, the difference is very apt to nullify for the moment all his experience as a swimmer. The consequence is a sudden loss of self-control, which too often results disastrously, whereupon the friends of the victim marvel that such a good swimmer should drown so easily.

An accident of this sort occurred but a few days ago. The victim was the master of an excursion steamer, a good swimmer, his numerous friends say; yet when he found himself in the water unprepared for swimming, he acted as wildly as one wholly unable to swim. With all his swimming, he had probably never been in the water before in full dress; and the confusion of mind which ensued, when he found his limbs muffled with clothing, his buoyancy reduced, and all the usual conditions of swimming changed, kept him from making good use of the knowledge he possessed. So he tired himself and strangled himself with frantic struggles, and went to the bottom before a boat could reach him, though it was near enough to have saved one who could not swim at all, had he been cool enough to keep perfectly still.

The moral is plain. With all your swimming practice, don't neglect to accustom yourself to conditions such as you will be pretty sure to find yourself in should you ever have occasion to swim for your life. When you can keep your self afloat with heavy boots on, when you can tumble out of a boat in ordinary dress and strip in the water, and not waste your strength in suicidal attempts to overcome the resistance of clothing that cannot be removed, then you can safely answer in the affirmative the question: Can you swim?

There is a forceful proverb about teaching old dogs new tricks. We do not imagine that many adults will act upon the suggestion we have made. But the boys will, if they have half a chance. And we would urge upon parents the propriety of allowing their sons to vary their watery sports in the way we have described. They cannot put their old clothes to better use. We can say from personal experience that the boys will like the fun, and that they will never regret the saving knowledge they will gain by it.

Of course we would not exclude the girls from such knowledge, if circumstances are at all favorable. At least let them learn to make the most of the temporary advantage their clothing offers for buoyancy, and also how to relieve themselves of entangling skirts in case of emergency.

PROFESSOR HUXLEY AND HARVARD.

The rumor that the Faculty of Harvard University are endeavoring to secure Professor Huxley as the successor of Agassiz is making, it appears, quite a breeze among the English scholars. The *Academy*, one of the ablest literary periodicals, hopes there is no truth in the statement, and asks, "are the English universities so rich in really eminent professors, and so poor in money, that they can or must allow Professor Huxley to go to America to find leisure to work? . . . The universities are so rich that they could beggar the whole world. Will they allow themselves to be beggared by Harvard?"

We do not agree with our contemporary in its intimation that money would be the mainspring of Professor Huxley's action, should he consent to occupy Agassiz' vacant chair. The work of such men is not to be measured in pecuniary compensation, nor does it belong to any country, but to the entire world. We greatly mistake the spirit of our great modern investigators if, should they determine that they could accomplish greater ends and achieve greater triumphs in the cause of Science by changing their abodes to the remotest corner of the earth, either a feeling of patriotism or a desire to make money would deter them from accepting the duty. Professor Huxley's decision, we venture to say, will be based on the question of where he can do the most good, not on the matter of pecuniary gains.

DISASTROUS FLOODS.

The two heavy floods which have recently occurred at Eureka, Nev., and Pittsburgh, Pa., have been so terribly destructive to life and property that they may be fairly classed among the extraordinary calamities of the year. They are beside phenomenal in their nature, one being due to a greatly overcharged cloud breaking against a lofty range of mountains, and the other to the meeting of two vast masses of vapor which united in a deluge which is described as resembling the descent of a torrent. Both storms appear to have been local in destructive effect, although heavy rains and freshets have taken place over Ohio, Indiana, and Kentucky, and have everywhere caused damage.

The report of the Nevada deluge states that, within ten minutes after the beginning of the rain, Eureka was flooded. The water poured through the streets for half an hour, tearing up houses and uprooting trees, damaging property in the end to the extent of $100,000, and killing twenty people.

In Pittsburgh, the destruction was much more extensive. From the descriptions given of the rising of the storm, two great black clouds appeared at opposite points of the compass and slowly approached each other. Blinding flashes of lightning shot between them as they neared, until the gradually narrowing space appeared a mass of fire. The meeting was heralded by a terrible thunderclap, followed by a few heavy rain drops, and then down poured the deluge with fearful fury. Pittsburgh lies at the junction of two rivers, and its suburbs, built on the hillsides and valleys adjoining the streams, are traversed by gulches and natural water courses, which form channels for the rain to run off. Several ravines empty into Butcher's Run Valley, about two miles north of the center of Alleghany City, along which numbers of houses had been erected. Here the damage began, and the flood rushed down the bed provided for it by Nature, sweeping away everything in its path. In other valleys deluges appeared, working like disaster, and small streams suddenly became roaring torrents. Over one run, two new iron bridges and five wooden ones were carried off. Large salt works, refineries, and factories were destroyed, and barges and vessels in the rivers were torn from their fastenings and swept away. The total loss of life is placed at 219 persons, and a rough estimate places the pecuniary loss at $3,000,000.

Both floods, besides being owing to the phenomenal circumstances mentioned, were also greatly due to the situation of the towns, Eureka, at the foot of the mountains, receiving the deluge pouring down their sides; and Pittsburgh, also in a valley surrounded by high land, lay in the path of the torrents which naturally sought to empty into the rivers.

TIDES IN THE GULF OF MEXICO.

A correspondent asks us whether it be true that at Pensacola, Florida, there is but one daily tide, and inquires whether, if such be the fact, how it is that at Havana, Key West, and other points in proximity, the tides take place twice a day in the ordinary manner.

Professor Bache, in his coast survey reports, mentions that the tides of the United States are divisible into three distinct classes. Those on the Atlantic coast are of the ordinary type, ebbing and flowing twice in twenty-four hours, and having but moderate differences in hight between two successive high or low waters, one occurring before and the other after noon. Those on the Pacific coast also ebb and flow twice in twenty-four hours, but the morning and evening tides vary considerably in hight. The intervals also between successive high and low waters may be very unequal. The irregularities are due to the moon's declination, as, when the moon travels to the north of the equator, the vertex of the tide wave follows her, giving the highest point of one tide in the northern, and the highest point of the opposite tide in the southern, hemisphere. Hence, when the moon is in northern declination, the tide at any place in the northern hemisphere caused by her upper transit will be higher than that caused by her lower transit. This variation in the hights is called the diurnal irregularity, and has a period of one lunar day.

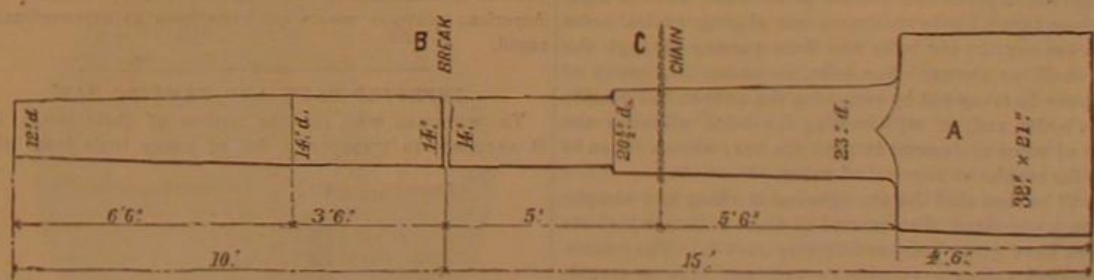
The effect of this phenomenon is to materially modify the tides, more especially on the Pacific coast and in the Gulf of Mexico. In the latter, however, the tides vary greatly according to locality. On the coast of Florida, from Cape Florida around to St. George's Island, near Cape San Blas, the tides are of the ordinary kind, with a large diurnal inequality. From St. George's Island, in Appalachicola Bay, to Dernière Island, they happen but once a day, that is ebbing and flowing once in 24 hours. At Calcasieu entrance, the double tides reappear, and exist for some days about the period of the moon's greatest declination. The tides are double at Galveston. At Aransas and Brazos Santiago, the single day tides are at perfectly marked as at Pensacola. The probable cause of these discrepancies is the formation of the islands and entrances. If the tides arrive at the same place by two different channels, and one of them is retarded six hours behind the other by traveling a longer route or through shallower water, the semi diurnal tides will be destroyed through interference of the waves, the high water of one being opposed to the low water of the other; the diurnal inequality will, however, not be destroyed, but merely modified in hight and time, leaving a single tide in the lunar day outstanding, which is small in amount. This is doubtless the case at Pensacola, where the mean tide is but one foot, and the extremes of rise and fall one and a half feet and four tenths of a foot.

In this connection, we may add that to the difference in tides of the Atlantic and Pacific oceans is due the erroneous idea that the level of the latter body of water is the higher. At Panama the tides rise over twenty feet, while at Aspinwall about as many inches is the limit. The mean tide, however, of both oceans is the same.

FRACTURE BY LONG-CONTINUED JARRING.

In one of the articles recently published in the SCIENTIFIC AMERICAN, the well known fact, that a long continued succession of even moderate shocks, or jarring, sometimes produces rupture in even large masses of iron, was illustrated by the account of the breaking of one end of a very large shaft at the Morgan Iron Works, while the other end was under the hammer. We are now indebted to the same authority for the account of a similar incident, which occurred at the West Point Foundery some months ago.

In forging masses of iron of such shape that they are difficult to handle, it is usual to weld to them a porter bar, by which they can be moved about conveniently until they are nearly finished, when the bar is cut off and laid aside until again required for a similar purpose. The same bar is often kept in use many years.



The above sketch represents a porter bar thus used at the West Point Foundery, as nearly as can be ascertained, about twenty years. The large mass of iron, A, measuring, in section, two feet eight inches by one foot nine inches, and four feet and a half long, weighing over four tuns, could not well be handled on account of its weight and its awkward shape. This porter bar was therefore welded on it, as shown in the sketch. The whole mass was then slung by the chain, in which it was nearly balanced when the point of support came at C, ten feet from the larger end and fifteen feet from the smaller end. While the hammer was at work upon the forging, the bar suddenly broke at a point ten feet from the smaller end, B.

The appearance of the fracture is described as highly crystalline and a clean break. The piece thus broken off weighed, probably, a tun and a half. The force which, applied at the extremity, would have been required to break it off by a steady pressure, would have been at least twelve tuns. The cause of this remarkable accident is, as has already been explained, the gradual separation of particles by successive shocks, each of which forces them a minute distance beyond the limit of elasticity. This action continually repeated must, sooner or later, produce rupture, although the effect of each shock is quite imperceptible to the senses. The most singular and least understood phenomenon is the structure of the metal at the surface of fracture. It is by no means well established that what are described as crystals are true crystals, or even that wrought iron can have a crystalline structure under any circumstances, as a crystal has usually, if not invariably, definite axes and facets, making fixed angles with each other, and the crystal, as a whole, is without a semblance of ductility. This phenomenon is not an uncommon one; but it is not yet well understood, and demands careful investigation by the use of the best known appliances and the application of scientific methods. The subject is one of great importance. The breakage of railroad axles in this manner has probably sacrificed many lives and much valuable property.

Could it be definitely ascertained what amount of deformation carries those particles which are most strained beyond their limit of elasticity, and could rules and formulæ be obtained which should express the existing relation in such cases, between the resisting power of the material and the forces of impact and inertia which thus attack it, a most valuable addition to our knowledge would be made. At present we can only adopt, as a general principle, the rule to make parts, exposed to shock, of such form as will distribute resistance as uniformly as possible throughout the piece, and to adopt every practical method of reducing the violence and frequency of shocks and jars. The most elastic materials are best fitted to withstand this kind of stress.

ENGLISH FOOD ADULTERATION.

The English Adulteration Act imposes a fine for the selling of any adulterated article as pure; and also provides that any mixed materials, such as mustard, cocoa, etc., shall be designated by a label setting forth the fact. A large number of dealers have attacked this law, stigmatizing it as unfair and coercive, and a parliamentary committee is now inquiring into its workings. The evidence thus far adduced is not only interesting in itself, as showing the many falsifications of the commonest articles of food, but is of especial importance to American dealers, inasmuch as it is stated that it is a common practice for the owner of a spurious article on the other side of the Atlantic, on finding that it is in danger of seizure under the law, to lose no time in getting it aboard a steamer for New York. In this way, it appears, from the statements of the New York *Herald's* London correspondent, that shipments of spurious teas, adulterated wines and spirits, and fraudulent packages of Roman cements, together with a number of other commodities, all more or less adulterated, find their way to our markets.

Tea is doctored in order to improve its appearance, increase its bulk, and add to its weight. For the two last mentioned purposes, finely ground quartz and iron or steel filings are employed. Catechu gum, an astringent substance, is also used, but the favorite ingredient seems to be "lie" tea, or old tea leaves once used and then worked over. This is mixed with low grades of new tea, and placed in cylinders under steam, together with a quantity of carbonate of magnesia, Dutch pink, and Prussian blue. The adulteration with "lie" tea is usually done in China before export, but the "facing," as the coloring is termed, is performed by people in England who become skilled in the fraud as a business. The dealers face the tea to render it black or green, according to the desires of customers. Out of 170,000,000 pounds of the commodity annually consumed in England, it is asserted that one fifth, or about 35,000,000 pounds, is open to suspicion.

British wines, according to the testimony of several analysts, are largely adulterated with potato spirit; sherry is doctored with sulphuric ether, and to other liquors fusel oil and French treacle or brandy, which is often nothing more than beet root spirit colored and flavored. Beer is now comparatively pure, and the main adulteration is simply water.

In butter, often as much as forty per cent of water is found; patents have recently been obtained for a compound called "butterine;" and two other artificial mixtures, known as "Australian" and "Dutch" butter, have appeared in the markets. The Australian stuff is bone fat extracted by steaming refuse bones. It sells for fifteen cents per pound, and smells horribly. Dutch butter is a mixture of genuine butter and American lard. There is, beside, a French butter, compounded of drippings and kitchen stuff colored with annatto.

Corn flour, a material largely used for food for children, is described as generally worthless and unhealthy. Thirty-three out of seven thousand grains, a pound, one analyst states as the proportion of nutritious matter contained, where there should be at least eight or nine hundred grains. The article is nothing more than starch, a fact proved by the circumstance that a dog fed upon it died of starvation.

Other well known adulterations in bread and milk are noted; but as these commodities do not come under the head of possible exports, allusion to them is unnecessary.

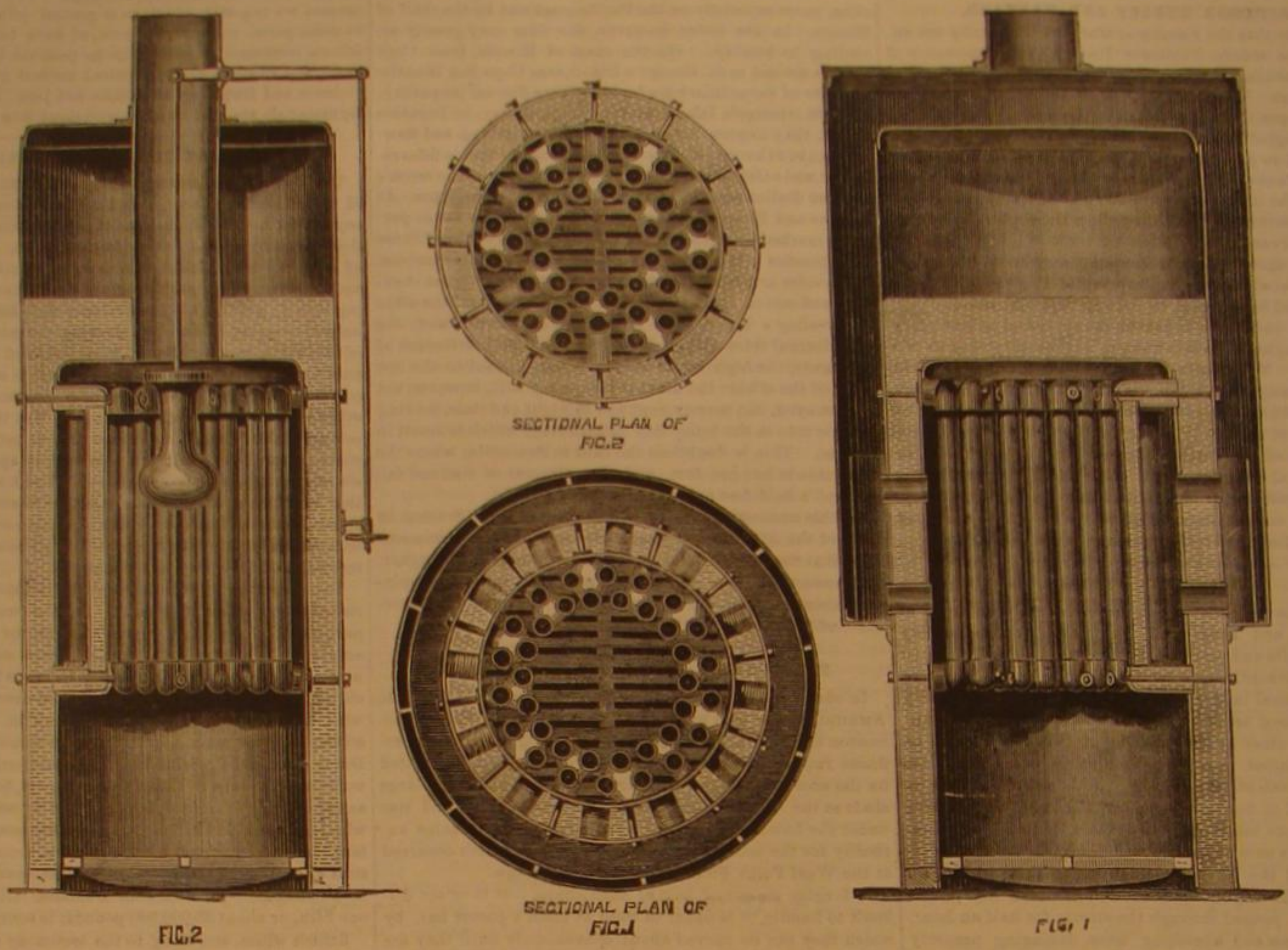
J. H. says: "Please call the attention of your numerous readers to the great danger of buying cheap cans, for fruit, vegetables, etc., as a mixture of lead and tin is used for their manufacture (instead of the bright tin), by unprincipled manufacturers."

IT is only by the thorough study of details and their mastery, that one can hope to attain eminence or position in any profession.—*Graham Smith.*

IMPROVED VERTICAL BOILER.

We give herewith an engraving of a vertical boiler, exhibited at the recent exhibition of fuel-saving appliances at Manchester, England. *The Engineer*, from which we select the illustration, states that the details of construction will be obvious at a glance. Fig. 1 and plan show an ordinary boiler; Fig. 2 and plan show a boiler in which the whole outer shell is enveloped in a smoke box which can be lifted off in a moment. Internally the boilers are nearly alike. Vertical water tubes are fixed in the fire box. This has been done before repeatedly, but not as in this case. The tubes, instead of being bent and fitted directly into the tube plate, are fitted into malleable castings, as shown, in groups. These castings are tapered and ground at the outer ends or legs, and these tapered ends are drawn into slightly conical holes in the fire box, by the bolts and nuts passing through the outer shell, as shown. Any tube, or rather any group of tubes, can be taken out by removing the nuts on the outside of the boiler, and, on withdrawing the bolts, allowing the group of tubes to descend into the fire box, whence it can be taken for repairs or renewal of tubes.

It will be seen that the arrangement is cheap and simple, and we understand that several of these boilers which are at work have given very satisfactory results. The malleable castings appear to stand very well, and give no trouble of any kind. The facilities for manufacture are obviously great, and the boiler deserves extended adoption.



HILL'S VERTICAL BOILER.

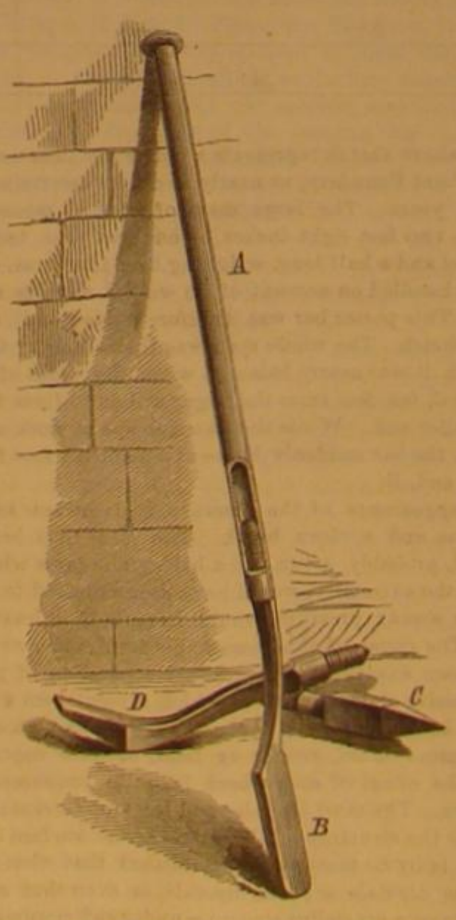
English and American Railways Compared.

The French government some time ago directed M. Malézieux, chief engineer of roads and bridges, to prepare and submit a thorough report upon the condition, cost, operation, etc., of all the English railways. This work has lately been completed, and published in the official journal of the French Engineers, the *Annales des Ponts et Chaussées*. Its interest to American readers is enhanced from the fact that a couple of years ago M. Malézieux visited the United States, and compiled a report upon American engineering structures, and that in presenting this, his second report, he has drawn largely upon the knowledge gained across the Atlantic to institute comparisons between the railway systems of England and the United States. The results of his examination into the comparative cost of working shows that 57,040 miles of railroad in the United States produced, during the year 1872, an average gross receipt of $5,160, which sum is just half that gained in England. This amount is divided between passengers and freight in the proportion of 28 to 72, in place of 44 to 56 in the latter mentioned country. It will be noticed that the passenger travel in England is as exceptionally large as is the freight transportation in the United States.

The working expenses, which in England may reach 50 per cent of the gross receipts, in the United States are 65 per cent. The net earnings then are but 35 per cent in the latter country against 50 per cent in the former. This, however, represents 5·20 per cent of the expense of construction in the United States and but 4·75 per cent in England, which the author ascribes to the fact that the cost per mile averages $55·683 in the United States, while in England it is $170,645. These figures all refer to January 1, 1873. Of the capital 38 per cent is obtained by loan in England, and 48 per cent in America. Bondholders in the United States obtain an average revenue of 6·7 per cent against 4·25 per cent in England. Dividends distributed to stockholders represent in America but 3·91 of the capital obligations, in place of 5·14. The difference of these figures is considerable in view of the irregularity in value of capital in the two countries. But in America, says M. Malézieux, railroads give such additional value to land, mines, and natural resources that capitalists whose funds are engaged in the most varied enterprises are content with the smallness of the revenue. But he considers that, without the aid of land subsidies and the contributions to loans to the roads by cities, the development of American railways would not have been so extraordinarily rapid.

IMPROVED CROW AND TAMPING BAR.

To workmen who, in the course of their labor, find it necessary to transport a kit of heavy tools from place



to place, the invention herewith illustrated will prove quite convenient, as its object is materially to reduce the weight of the implements, while, at the same time, causing them to be less expensive and to occupy less space. The inventors, Messrs. Allen Wright and Albin F. Tew, of Westfield, Chatauqua county, N. Y., propose making the handle part of the bar tubular and of sufficient diameter to suit the hand naturally. The tamping attachment, B, crow, C, and claw, D, are all provided with screw shanks, so that they may be readily attached to the handle. A head is secured to the upper portion of the latter either permanently or detachably, and serves the ordinary purposes.

The Great Centennial Exhibition.

The Director of the Centennial Commission officially announces that the exhibition will open April 19, 1876, and close October 19 following, and has issued a circular containing the general regulations for exhibitors. Articles to be entered are divided into ten departments, as follows: 1. Raw materials, mineral, vegetable, and animal. 2. Materials and manufactures used for food, or in the arts, the result of extractive or combining processes. 3. Textile and felted fabrics—apparel, costumes and ornaments for the person. 4. Furniture and manufactures of general use in construction and in dwellings. 5. Tools, implements, machines and processes. 6. Motors and transportation. 7. Apparatus and methods for the increase and diffusion of knowledge. 8. Engineering, public works, architecture, etc. 9. Plastic and graphic arts. 10. Objects illustrating efforts for the improvement of the physical, intellectual, and moral condition of man.

Application for space must be made to the Director General. There will be no charge for the same, but exhibitors must provide their own show cases, shelving, counter shafts, etc. Transportation, etc., is at the expense of the exhibitor. Goods will be received from January 1, 1876, and none will be admitted after March 31, 1876. For heavy articles requiring foundations, arrangements should be made as soon as the buildings are begun. Patent medicines, empirical productions of any nature, and dangerous substances are excluded. Sketches, drawings, or photographs of entries will not be permitted, except by joint assent of the exhibitor and the Director General. Goods must remain until the close of the exposition, but subsequently must be removed before December 31, 1876. All communications should be addressed to the Director General, International Exhibition 1876, Philadelphia, Pa.

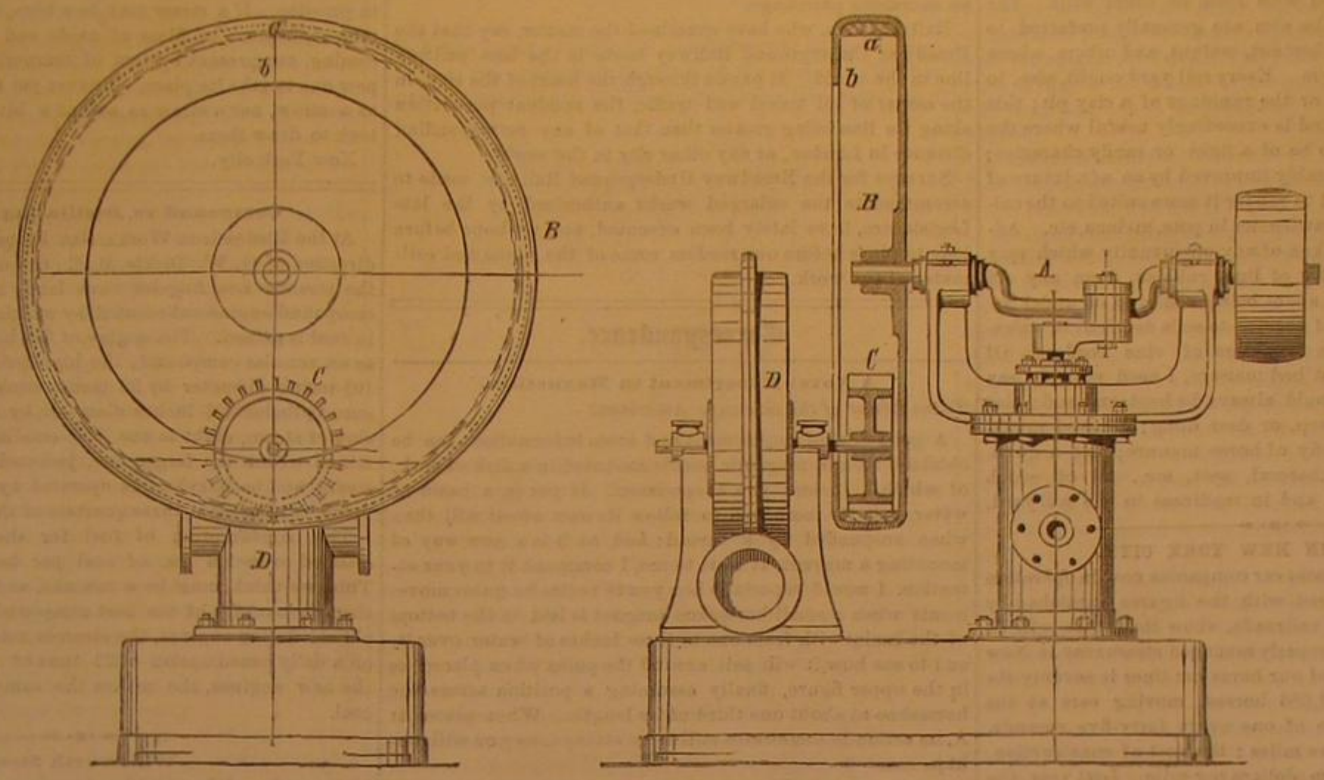
The New York State Agricultural Fair.

The New York State Agricultural Society announces that its thirty-fourth annual fair will be held at Rochester, N. Y., from September 14 to 18 next. Entries close on August 15. A very large number of premiums are offered, especially for fine cattle. Manufacturers of agricultural implements will doubtless find it to their advantage to exhibit, as the fair will attract a large gathering of farmers from all parts of New York, Ohio, and Canada. We notice that a gold medal is offered for a combination of machinery, driven by steam, for plowing or otherwise preparing the ground for sowing. The requirements are that such machinery shall do as good and as cheap work as is now commonly done by horse power, and shall be adapted for use in the State of New York.

A WATER BELT FOR TRANSMITTING MOTION.

A curious mode of transmitting motion by means of a water belt is represented in the annexed engraving, which we extract from the *Revue Industrielle*. The device is that of an English inventor, Mr. J. Robertson, and is said to work with perfect freedom from noise and vibrations. The piston of the engine is connected with the driving shaft, A, on one extremity of which is attached a large hollow pulley, B. The outer face of the latter is cut away from the center so as to leave only a flange of the width shown at *b*. Through the opening passes the shaft of a fan blower, D, on which, and inside the hollow pulley, is a pallet wheel, C. The pallets on the latter do not touch the inside of the hollow pulley.

In operation the water, *a*, of which a small quantity is placed in the pulley, B, is caused, by centrifugal force, to spread itself against the inner periphery, and to be carried around with the wheel. Into this water, as shown in the sectional view on the left, the pallets on wheel, C, dip, and are thereby acted upon by the force of the same, causing the wheel, C, to rotate. The hollow pulley is of sheet iron, and is revolved at the rate of 500 turns per minute. No water whatever, it is stated, is ejected from the apparatus, and it is only necessary to supply the small amount lost by evaporation to keep the device in working order.



WATER BELT FOR TRANSMITTING MOTION.

American Inventive Genius.

In Switzerland no patent law exists, much to the disgust of native inventors, who are obliged to seek protection for their improvements in this and other countries. Mr. Adolph Ott, a native of Switzerland, but long resident in New York, is now at home, laboring to procure the passage of patent laws by the Diet, and has lately published at Zurich a pamphlet on the subject, in which he makes the following tribute to the inventive genius of America:

"No nation can boast of having accomplished so much towards the general progress of industry as the American. If you make inquires about the origin of the most important improvements in any branch you please, you will find in five cases out of ten that it was made on the other side of the ocean. In our boasted watch industry the substitution of machines for manual labor took place only through the impulse given by Americans. The modern system of grain mills is of Yankee origin, and so is the whole india rubber industry. The present system of the construction of iron bridges is the result of American genius. Look at the boring machine that performs its work at the St. Gothard tunnel uninterruptedly; it came to us from the other side of the ocean, and so did the system of electric blasting. As to the printing telegraph, it is due to Professor Samuel F. B. Morse, an American who died recently. The system of railways like that on the Righi Kulm, which promises to be of so much importance to Switzerland, was invented by Mr Sylvester Marsh, a New England man. With regard to fire arms, the United States has presented us with the most important improvements. The best wood-working machinery is of American origin, this being also the case with numerous agricultural implements, not to speak of household machines. To a western man, Mr. Samuel Danks, we owe the mechanical puddler, an invention in the manufacture of iron which is only second in importance to that of Bessemer. In an article in the *Journal of the International Exposition*, the well known engineer Perels calls the American machines for making tools sent to the Vienna Exhibition "perfect instruments of precision," and according to him the hand saws are distinguished by a truly astonishing form and accuracy. In the making of scientific instruments, the United States are equally advanced. To Professor Jno. W. Draper we owe entirely new self-registering meteorological instruments, which, though more simple, are not less accurate than the best in use in Europe. The American watches compete already to a considerable extent with the Swiss and English. In view of this entirely unparalleled inventive activity, an American was not quite wrong in saying, in the International Patent Congress in Vienna: "It has been stated from the opposite side that a German had invented printing when there was no patent law. This is true, but it required three centuries thereafter to invent the printing machine. Surely n America, it would not have required over five years."

The Perils of Flying.

M. De Groof, the flying man, lost his life recently at London, England. He had ascended in a balloon, and his part of the performance was to fly down to the earth after the balloon attained a great altitude. The unfortunate inventor had constructed a pair of wings made of cane and silk, each 37 feet long by 4 feet wide, and also a tail 18 by 3 feet in dimensions. The wings were inserted into two hinged frames, which were attached to a wooden stand, upon which the aeronaut stood and manipulated them by means of levers. The theory was that, when started from any high altitude, the machine would reach the earth by a very gentle incline, passing over a great distance and eventually landing without concussion. At a first trial of the device, on being dropped from a balloon, the earth was reached in safety, but on the present repetition of the experiment, De Groof seemed to lose control of his wings, and the apparatus collapsed and fell, dashing the man to pieces on the street pavement below.

A NEW SECTIONAL BALLOON.

Mr. James Hartness, of Detroit, Mich., has recently patented a novel form of balloon, the main object of which is to prevent accidents due to bursting while in the air. Instead of making a single globe, he constructs the body of the balloon in sections, exactly similar to those of an orange, each one of which is inflated separately, and all joined together complete the sphere. A section is shown separately in Fig. 2, and several joined together in Fig. 1. An axial opening is left at the extremities, at the middle of which the sections, the inner edges of which are made of suitable shape for the purpose, are connected by straps, *b*. Through this opening a rope ladder extends, so that the aeronaut may have access to all the valves, one of which is arranged in each section. The poles shown passing up through the aperture are designed as a support for the balloon during the process of inflation.

Fig. 1.

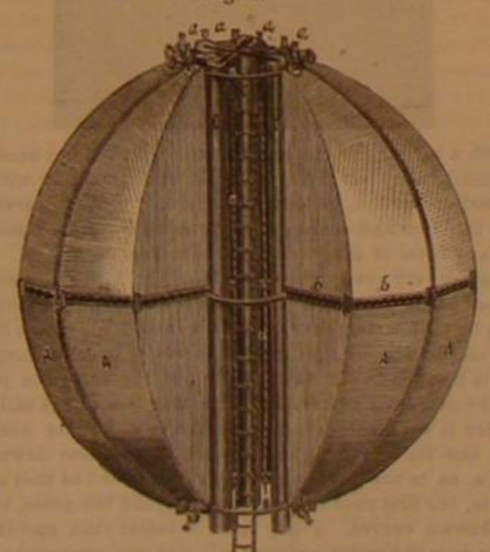


Fig. 2.

It will be seen that, owing to the small amount of pressure which each section has to withstand, the fabric may be made much lighter than would be necessary in a balloon of corresponding size constructed in the usual way, while, as in compartment ships and sectional boilers, a rupture occurring at any point is confined to a single section, the others, remaining uninjured, retaining their buoyancy.

Patented Car Improvements.

There were one or two points in the proceedings of the Car Builders' Association, at its late meeting, in which a peculiar sensitiveness was developed about discussing the merits of patented devices. The impression seemed to prevail with many of the members that such devices were not only inadmissible as legitimate topics for discussion, but that committees, in making their reports, must not indorse or recommend any such devices for adoption, no matter what might be their actual merits. This, in our judgment, is a mistake which cannot be too soon corrected: nor do we think that, in order to do so, any alteration of the constitution of the Association is necessary. That instrument, as it is now, merely forbids the admission of patentees or their agents to advocate their claims at any of the meetings of the society, but does not prevent the members from freely expressing their views in the regular course of discussion upon any invention or device, whether patented or not. To suppress all discussion with respect to patents would seriously hamper the Association in the exercise of its proper functions, and so far destroy its usefulness. It must necessarily be progressive, or disband. It is not the business of the Association to make or unmake the fortunes of inventors or patentees, or to discriminate between rival claims, except on the score of actual merit, and as the interests of railroads may be affected thereby. If the Miller platform or the Westinghouse brake is a good device now, let it be indorsed and approved; but as soon as either is surpassed by something better, let it be condemned. There is no evading this obvious duty. The Association has got to recognize patented inventions and pronounce upon their respective merits, so far at least as they apply to railway cars, or be exposed to comment and criticism, such as may be found in the SCIENTIFIC AMERICAN of July 18.—*National Car Builder*.

Soils and Fertilizers.

Turfy loam, being rich in decomposing vegetable fiber, forms a soil acceptable to almost all families of plants, forming, as it were, the staple or ground work to which other soils or ingredients may be added. Some cultivators, says a correspondent of *The Garden*, prefer using turfy loam as soon as it is taken from the field or pasture, to form the principal ingredient in the formation of vine borders, and for melon culture, etc., justly considering that many of its useful properties are wasted, by its retention, of perhaps years, in the soil yard, before it is supplied to growing plants. It is obvious, however, that it would be inconvenient for the cultivator to have to repair to the field or pasture supposing that he had permission to do so, whenever he might require even a small portion of this soil; and most plant grower will only be too glad to take an opportunity; when it offers itself, to lay in a stock of this soil to last them for several years.

When this is carted into the soil yard, it should be stacked up in the form of a ridge, and might, with advantage, be thatched with some littery material, so as to prevent it from becoming saturated with cold rains during winter, or from being desiccated during dry summer weather. If a portion of good farmyard manure can be secured simultaneously with this soil, a layer of the same might be made to alternate with a layer of the loam, and this would form a most useful compost for many purposes; as, when it had laid some six or more months, it would then be found to be in excellent condition, without further additions, to use for the potting of fruit trees of various sorts, strawberries, roses, and other kinds of plants requiring a rich and somewhat tenacious soil; while, to render it suitable for other varieties of plants, river or silver sand, leaf mold, peat, etc., could be added in the proportions required.

PEAT, LEAF MOLD, AND OTHER MATERIALS.

In establishments where collections of heaths and other hard-wooded plants are cultivated, "fibery peat" soil is indispensable; and, in many parts of the country, peat, of the desired quality, is exceedingly difficult to procure. The black bog soil, which is sometimes substituted for it, is absolutely worthless, and any attempt to cultivate hard-wooded plants in such material will be sure to end in failure. Where good peat cannot be found, it is always advisable to purchase it from nurserymen or others who may be in a position to supply it, and this can always be done for a trifling outlay. The best description of peat generally contains more or less silver sand; but, if found to be in any degree deficient in this respect, sand can then be added to any desirable extent; and as regards silver sand of the best quality, there are only a few places in which it is to be found. It can, however, always be purchased, and is not expensive; while, for many purposes, sharp river sand, where it can be obtained, forms a good substitute. Leaf mold, or soil composed entirely of decayed tree leaves, is also an essential material in every garden establishment; and, generally speaking, there is little excuse for a gardener not having an abundant stock of this always on hand. It is seldom, however, in good condition for potting purposes until it is two or three years old; and, even then, it should seldom or never be used alone, but mixed with loam or other soils. The leaves of the oak and the elm are generally preferred to those of the ash, horse chestnut, walnut, and others, whose leaves are of a softer tissue. Every soil yard ought, also, to contain a portion of clay, or the runnings of a clay pit; this improves with keeping, and is exceedingly useful where the natural soil is inclined to be of a light or sandy character; the latter will be considerably improved by an admixture of clay, which will be found to render it more suited to the culture of fruit trees and strawberries in pots, melons, etc. Advantage should also be taken of any opportunity which may occur to secure a quantity of lime rubbish, from any old buildings which may be about being removed or under repair, as this material is of service to soils deficient in calcareous matter, and in the formation of vine borders. Of well rooted stable or hot bed manure, I need scarcely say a considerable portion should always be kept on hand; also a portion of dry cow, sheep, or deer dung; decayed mushroom beds, composed chiefly of horse manure; also a quantity of broken bones, charcoal, soot, etc., all of which should be kept separate, and in readiness in the soil yard.

RAILWAYS IN NEW YORK CITY.

"The statistics of the horse car companies now in operation in this city, when compared with the figures furnished by the London underground railroads, show that there will be immense profits from a properly managed steam road in New York. The total length of our horse car lines is seventy-six miles. They employ 11,086 horses, moving cars at the busiest hours at the rate of one every forty-five seconds. The speed per hour is five miles; the cost of construction, three eighths of a million dollars per mile. Last year, the passenger travel amounted to 192,000,000 persons, being two and a half millions per mile. One some roads the ratio was still larger. The Sixth Avenue road carried four millions per mile, and the Third Avenue line, below Central Park, carried five millions. The average fare on the different lines and their connections is 5½ cents, while the total expense per passenger is 4 15-100, leaving a net profit of 98 100 cent. The business of the horse roads has increased 255 per cent in ten years.

In London, there are 19 3-10 miles of underground roads. The motive power employed is 70 engines. Trains run every four minutes, during the busiest hours of the day, at an average speed of fifteen miles. The cost of construction per mile, after deducting sales of surplus real estate, is three and a half million dollars. Sixty-five million passengers were carried last year, at the rate of three and a half millions per mile. The average fare is five cents, and the total expense per passenger 2 31-100 cents, leaving a net profit of 2 69-100 cents for each passenger carried. In the underground roads, the increase of business in ten years has been 360 per cent.

A comparison of these statistics gives a most favorable showing to the steam railway. While the expense of construction and equipment is larger in the case of the latter the operating expenses are very much less. The expense of transportation per passenger by the steam engine is about one half of that reported by the horse roads, while the net profit is nearly trebled without any advance in the fares. At the same time the speed is fairly trebled. The steam road is popular, too. Rapidly as travel has increased on the surface lines in New York, the increase on the London underground railway has been half as large again. The people have had practical proof of the speed and safety of the latter, and patronize it accordingly.

This comparison shows the large profits which lie within the reach of any corporation that shall be the first to go to work and give New York the benefit of rapid transit. There are no estimates in the figures just presented. They exhibit work that has been done and profits that have been pocketed. According to these statistics, steam roads might acquire a net profit of over five million dollars, annually, by carrying the same number of passengers that now yield the horse roads a profit of less than two millions. A competent engineer, who has carefully studied the subject of rapid transit, estimates the gross revenue of a road to Forty sixth street at $4,319,400 per annum, with $1,916,000 as the annual cost of operating, leaving a net income of 23 78-100 per cent on the calculated cost. There would also be added to this the extra fare for carrying first class passengers, baggage, express parcels, or the mails.

This exhibit appears as reasonable as it is gratifying. If it be also taken into consideration that the population in the city limits will be largely increased as soon as rapid transit becomes a fixed fact, the probability of large returns on investments in this direction becomes a certainty.

A golden harvest awaits the corporation that shall enter upon the work. Labor is ripe for it, and capital will not hesitate to lend a helping hand in due time. There is no such opportunity for enterprize and profit elsewhere in the land. It were a waste of time to enlarge upon the benefit of underground rapid transit to the community. The profit it promises is the argument of the hour."

The above is from the *Daily Graphic* of this city. It is gratifying to be able to add that the Legislature, at its recent session, granted some additions to the charter of the Broadway Underground Railway Company, which it is expected will, before long, enable that corporation to begin the work in earnest. The authorized first section of the road is from the Battery, at the extreme southern end of the city, under Broadway to Central Park, with a side branch to the Grand Central Depot at 42d street. Considering that it now takes the passenger a dreary hour, by horse car, to traverse this distance, 4½ miles, and considering that by the underground railway it may be done in ten minutes, it requires no great stretch of the fancy to predict that the new road will enjoy an enormous patronage.

Railway men, who have examined the matter, say that the Broadway Underground Railway route is the best railway line in the world. It passes through the heart of the city, in the center of all travel and traffic, the resident population along its line being greater than that of any corresponding distance in London, or any other city in the world.

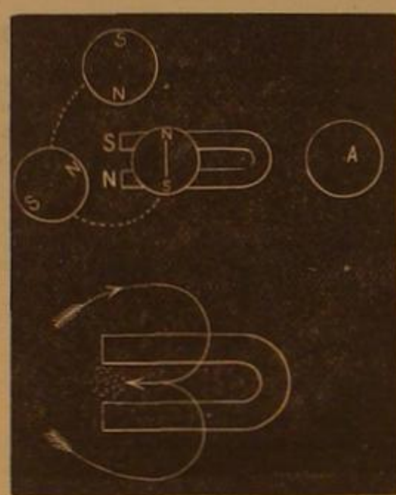
Surveys for the Broadway Underground Railway, made to accommodate the enlarged works authorized by the late Legislature, have lately been executed, and we hope before long to place before our readers some of the plans and estimates of the work.

Correspondence.

A Novel Experiment in Magnetism.

To the Editor of the Scientific American:

A good deal of amusement and some information can be obtained from a magnetic needle mounted in a disk of cork, of which I inclose you a specimen. If put in a basin of water, it is far more free to follow its own sweet will than when suspended by a thread; and as it is a new way of mounting a magnet, at least to me, I commend it to your attention. I would especially beg you to notice its queer movements when a small horseshoe magnet is laid in the bottom of the basin with from one to three inches of water over it, and to see how it will sail around the poles when placed as in the upper figure, finally assuming a position across the horseshoe at about one third of its length. When placed at A, its action is sometimes still more strange, as you will perhaps see.



With a bar magnet, its motions are different, but amusing and instructive; but in any mode of experimenting with it, its perfect freedom to assume its proper position serves to show the lines and centers of force with far more clearness than any form of magnetic toy I have ever seen.

Another very pretty experiment (see the lower figure) is to put one of the magnets in the basin with about one eighth of an inch of water over it; take a small file and a bit of iron, and let the filings drop on the water over the magnet. This is a much better way than to put the filings on paper and the magnet underneath. The way the filings sail into position is very interesting; they like to enter into position from the outside and near the center, and float down the middle, as in the direction of the arrows; and as they accumulate, the first ones are forced out beyond the poles, in the well known curves. Filing them is better than sprinkling filings over the water, as they fall each one separately. In sprinkling filings on the water, they fall in aggregations in which they are not as free as when each atom of iron is separate. H. P. HENRY.

Pittsburgh, Pa.

REMARKS BY THE EDITOR: We have tried all these experiments, and, although the movements we observed are not precisely those described, they are still very amusing and interesting.

The Largest Locomotive in the World.

To the Editor of the Scientific American:

I see in a recent issue of your paper that a correspondent makes the statement that the largest locomotive is one on the Philadelphia and Reading railroad, which has two cylinders, 20 x 26, and twelve driving wheels; and that the whole weight is sixty tons. He probably has never heard of the "Janus," constructed by William Mason, of Taunton, Mass. It was built for the Union Pacific railroad, but could not be used there; and where it is now, I do not know.

Sandwich, Ill. GEO. H. FRIZZELL.

REMARKS BY THE EDITOR.—We are much obliged to our correspondent for reminding us of the Janus, which, as he states, was built at the celebrated Mason Machine Works, Taunton, Mass. Mr. Mason informs us that the Janus has four cylinders, 15 x 22, and twelve drivers 3½ feet diameter, and no other wheels. Its weight, when the tanks and coal bunkers are full, is 84 tons. It is now working on a coal road in Pennsylvania. If anybody can produce a larger locomotive, we hope they will trot it out.

Hardening and Tempering Tools.

To the Editor of the Scientific American:

You have been talking to us in your "Practical Mechanism," by Joshua Rose, in a way that we can understand, and upon subjects in which we are directly interested, and, as I think, to our benefit. But please keep out the oxides. We do not want them in the shop; we know of straw and blue colors as different tempers because we always find them so in practice. If a straw may be a blue, and a blue a straw, temper, because of films of oxide and the time they were coming, our present system of tempering is gone, with no new one to take its place. I never yet found a blue as hard as a straw, nor a straw as soft as a blue, whatever time it took to draw them.

New York city. TOOLS.

Compound vs. Oscillating Engines.

At the Risdon Iron Works, San Francisco, Cal., under the direction of G. W. Dickie, M. E., the oscillating engines of the steamer Los Angeles have lately been removed, and a compound engine substituted, by which an important saving in fuel is gained. The engine, of 337 horse power, is known as an annular compound; the high pressure cylinder being 19½ inches diameter by 28 inches stroke, and the low pressure cylinder 43½ inches diameter by same stroke; expansion of steam, eight to one, the smaller cylinder being contained within the larger one, jacketed with high pressure steam, and both cylinders operated by one balanced slide valve, cutting off at three quarters of the stroke.

The consumption of fuel for the new machinery is claimed to be 1 6 lbs. of coal per hour per horse power. This, we think, must be a mistake, as it is considerably less than the average of the best compound engines. With the old oscillating engines, the steamer made nine knots an hour on a daily consumption of 22 tuns of Sydney coal. With the new engines, she makes the same speed on 5 tuns of coal.

Whitworth Steel.

Some idea of the solidity of compressed castings of Whitworth metal may be gleaned from the fact that, five minutes after the application of pressure,—about twenty tuns to the square inch,—a column of fluid steel becomes shorter by 12·5 per cent, or 1½ inches to the foot. Sir Joseph Whitworth, as a writer in *Iron* states, holds the proportion that for certain purposes a metal must be used having a certain tensile strength and a certain percentage of ductility. Hence the metal cast at the Whitworth works is classified according to its possession of these qualities, and arranged for convenience in four groups, distinguished by colors, red, blue, brown, and yellow, and by numbers, No. 1 of each group representing the most ductile metal, and No. 3 the least so. Of Low Moor wrought iron, the tensile strength per square inch is 27 tuns, and ductility or percentage of elongation, 38. In good cast iron the same qualities are represented by 10 and 0 75. Various samples of Whitworth steel similarly tested gave from 36 to 72 tuns tensile strength, and from 33·3 to 14 per cent elongation. There is shown a singular relation between the tensile strength and ductility of the metal, the one generally increasing as the other decreases, a circumstance which, it is suggested, may possibly deserve investigation.

The Polyspheric Ship.

This is the name of a novel vessel, recently invented in England by Mr. Charles M. Barnes. The bottom is flat and fitted with three inclined planes with square ends, the effect being as though three teeth of a gigantic saw were moved through the water with the sloping portion of the teeth first.

The inventor has tested the device by means of small models impelled by rockets. A 7 pound model was driven, by a 3 pound 3 ounce rocket, a distance of 105 yards in 3 seconds, or at the rate of 63 knots per hour. The motion is said to resemble sliding over ice. There is scarcely any water disturbance, and the decks were apparently motionless. When drawn slowly over the water, the vessels offered more resistance than models of the ordinary shape; but when the equilibrium, between the horizontal pressure of the inclines forward and the pressure of the water in the contrary direction, is destroyed, the model at once rises in the water and passes over the mass of hitherto obstructing fluid.

Valve for Gases and Corrosive Liquids.

This valve is adapted to cases where liquids have to be forced into vessels under pressure. A piece of glass tube, about 3" long and $\frac{5}{16}$" internal diameter, has a bulb blown in the middle, and the ends are cut off square. A piece of india rubber tube 3" long, and of such a thickness that it will just pass into the bulb tube, has one end tied with string or platinum wire. Just below the ligature a transverse slit is made, so that the end is nearly cut off. The uncut part serves as a hinge. A small pellet of cork or india rubber is put into the end beyond the slit. The tube is then stretched on a piece of glass tube, and the whole forced into the bulb tube, till the valve occupies the interior of the bulb. Any pressure in the tube raises the valve on its hinge, while any back pressure closes it tightly. For pressures up to 30 lbs. on the square inch it is perfectly airtight. Beyond this the author has not tried it.—*Roland H. Ridout, in the Chemical News.*

A MOUTH without grinders is like a mill without a stone. A diamond is not so precious as a tooth.—*Don Quixote.*

PRACTICAL MECHANISM.

NUMBER VI.

BY JOSHUA ROSE.

TAPS AND DIES.

Taps should be forged of hammered square bar steel, and forged to as near the finished size as possible (so that they are large enough to true up), for the reasons already given with reference to tool steel.

The threads of taps of the smaller sizes should be finished by a chaser, so as to insure correctness in the angles and in the depth of the thread.

The taper tap should not be given more taper than the depth of the thread in the length of the tap, or it is liable to be used upon holes that are too small, which places more duty upon it than is necessary and than it should be required to perform; rendering it, in consequence, liable to break from the excessive strain, and causing the square end of the tap, where the wrench fits, to twist and the corners to become rounded.

A tap which has clearance placed upon its thread, by the screw-cutting tool or by a chaser, will cut very freely, and will answer for rough work: but such a tap does not cut a really good thread, and generally leaves the diameter of the thread in the hole larger than the diameter of the tap itself, because the tap is liable to wabble, and the least excess of pressure, on one end of the tap wrench more than on the other, causes the tap to lean towards the end of the wrench receiving the most pressure, and hence to tap a hole larger than itself. Especially is this liable to occur if the tap wrench has more than one square hole in it so as to enable the same wrench to be used on more than one size of tap: for in such a case, the holes being not in the center of the wrench, the weight of the wrench and the pressure placed on the end of the wrench will exert more pressure on one side of the tap than the other, in consequence of their greater distance or longer leverage from the tap. The same effects (from the use of such wrenches) are experienced in using taps having no clearance in the thread; but the thread in this latter case is so much nearer a fit to the hole that it serves as a guide and keeps the tap steady.

The only clearance necessary is to ease off the tops of the teeth of the tap back from the cutting edge, which will give the teeth sufficient clearance to make them cut clean, and leave the sides of the thread to fit the thread being cut, and thus prevent the tap from moving laterally.

The plain part of a tap, that is, that part from the thread to the end of the square where the wrench fits, should be turned down a little smaller in diameter than the bottom of the thread (unless in the case of very small taps), so that the tap can pass right through the hole in all cases where the hole passes through the work, thus saving time by obviating the necessity of winding the tap back, and furthermore preserving the cutting edges of the tap teeth by avoiding the abrasion caused by their being rubbed backwards against the metal of the hole. For special work, where the holes to be tapped do not pass through the work, and it is therefore compulsory to wind the tap backwards to take it out of the hole, the plain part of the tap may be left larger than the diameter of the thread, the advantage being that the squares of several different sizes of taps may be made alike, and therefore to suit one tap wrench.

Taps for use in holes to be tapped deeply should be made slightly larger in diameter than those used to tap shallow ones, because in deep holes the tap is held steady by its depth in the hole, and because whatever variation there may be, in the pitch of the threads in the hole and those on the bolt, is, of course, experienced to an extent greater as the length of the thread (that is, the number of threads) increases.

It is an excellent plan to finish the threads of a tap by passing it through a sizing die, that is, a solid die kept for that special purpose; but very little metal must be left on the tap for the solid die to take off, or it will soon wear and get larger. In making such a solid die, let its thickness be rather more than the diameter of the tap it is intended to cut, and make allowance for its shrinkage in hardening, for all holes shrink in hardening, while taps swell or become larger from that process; an allowance for this must therefore be made both in the case of the tap and the die. In the case of the solid die, it will be found that not only does the hole become smaller, but the external dimensions of the entire die have become larger by reason of the hardening, so that while the term shrinkage is correct, as applied to the hole, it is incorrect as applied to the die, the fact being that the metal of the die (the same as the metal of the tap) has expanded, extending its dimensions in all directions, and therefore in the direction of the center of the hole, hence causing a decrease in its diameter or bore.

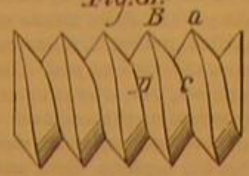
Three flutes are all that are necessary to small taps (that is, those up to an inch in diameter), which leave the tap stronger and less liable to wabble, especially in holes that are not round, than if it had four flutes. Taps of a larger size may have more flutes, but the number should always be an odd one, so that the tap will do its work steadily.

ADJUSTABLE DIES,

that is, those which take more than one cut to make a full thread, should never be used in cases where a solid die will answer the purpose, because adjustable dies take every cut at a different angle to the center line of the bolt, as explained by Figs. 31 and 32.

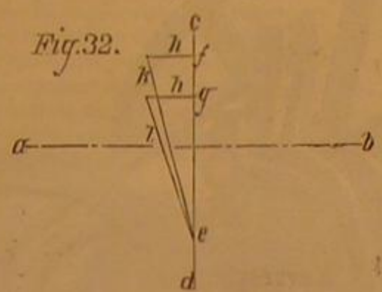
Fig. 31 represents an ordinary screw. It is evident that the pitch from *a* to B is the same as from C to D, the one being the top, the other the bottom, of the thread. It is also evident that a piece of cord wound once around the top of the thread will be longer than one wound once around the bottom of the thread, and yet, in passing once around the

Fig. 31.



thread, the latter advanced as much forward as the former, that is, to the amount of the pitch of the thread. To illustrate this fact, let *a b*, in Fig. 32, represent the center line of

Fig. 32.



the bolt lengthwise, and *c d* a line at right angles to it: then let from the point, *e*, to the point, *f*, represent the circumference of the top of the thread, and from *e* to *g*, the circumference of the bottom of the thread, the lines, *h h*, representing their respective pitches; and we have the line, *k*, as representing the angle of the top of the thread to the center line, *a b*, of the bolt, and the line, *l*, as representing the angle of the bottom of the thread to the center line, *a b*, of the bolt, from which it becomes apparent that the top and the bottom of the thread are at different angles to the center line of the bolt.

The tops of the teeth of adjustable dies are themselves at the greatest angle, while they commence to cut the thread on the bolt at its largest diameter, where it possesses the least angle, so that the dies cut a wrong angle at first, and gradually approach the correct angle as they cut the depth of the thread.

From what has been already said, it will be perceived that the angle of thread, cut by the first cuts taken by adjustable dies, is neither that of the teeth of the dies nor that required by the bolt, so that the dies cannot cut clean because the teeth do not fit the grooves they cut, and drag in consequence.

DIES FOR USE IN HAND STOCKS

are cut from hubs of a larger diameter than the size of bolt the dies are intended to cut; this being done to cause the dies to cut at the cutting edges of the teeth which are at or near the center of each die, so that the threads on each side of each die act as guides to steady the dies and prevent them from wabbling as they otherwise would do; the result of this is that the angle of the thread in the dies is not the correct angle for the thread of the bolt, even when the dies are the closest together, and hence taking the finishing cuts on the thread, although the dies are nearer the correct angle when in that position than in any other. A very little practice at cutting threads with stocks and dies will demonstrate that the tops of the threads on a bolt, cut by them, are larger than was the diameter of the bolt before the thread was commenced to be cut, which arises from the pressure, placed on the sides of the thread of the bolt, by the sides of the thread on the dies, in consequence of the difference in their angles; which pressure compresses the sides of the bolt thread (the metal being softer than that of the dies) and causes a corresponding increase in its diameter. It is in consequence of the variation of angle in adjustable dies that a square thread cannot be cut by them, and that they do not cut a good V thread.

In the case of a solid die, the teeth or threads are cut by a hub the correct size, and they therefore stand at the proper angle; furthermore, each diameter in the depth of the teeth of the die cuts the corresponding diameter on the bolt, so that there is no strain upon the sides of the thread save that due to the force necessary to cut the metal of the bolt thread.

Recent Researches on Flame.

M. G. Hirn has been experimenting upon the optical properties of flame, and theorizing upon the incandescent bodies of the sun's atmosphere. (*Ann. Chim. Phys.*, XXX, p. 319.) In considering these researches we must remind the reader of Davy's theory of the luminosity of flame. It is that, if any solid substance be ignited to a sufficiently high point, let us say 1,000° Fah., it becomes luminous, while gaseous matter requires a much higher temperature. But if solid particles be introduced into a gas of a high temperature, they instantly begin to throw off light in all directions; and as the temperature of the particles rises so does the color vary through all the gradations of the colors of the spectrum. Thus, commencing with a red heat, it passes through yellow and what is termed a white heat, while a very intense heat produces violet rays. Such is Davy's theory, which, to a certain extent, is accepted at the present day. It has, however, been qualified by the researches of Dr. Frankland, who was first to point out that we can have highly luminous flames which do not, or would not, probably, contain solid particles. As examples, let us take the pretty familiar experiments of the combustion of phosphorus or bisulphide of carbon in oxygen. Most of our readers who have attended a course of lectures upon chemistry will remember the dazzling light given off in these experiments. So rich are the lights obtained in this manner in actinism that they have been used very successfully in taken instantaneous photographs.

The researches of Dr. Frankland may be generalized as follows: That gaseous substances have a point of incandescence which depends chiefly upon the density of the gas, and it follows that gases of low density become luminous much more readily than those of a high density; also, that gases which are not luminous at all at our ordinary atmospheric pressure (let us say hydrogen, for instance), when submitted to increased pressure become luminous. Thus a jet of hydrogen, burning in a vessel in which the pressure was increased, gave a light, by which a newspaper could be read two feet from the flame, on producing a pressure of two atmospheres.

Some connection may be observed, between the theory of Davy and the experiments of Frankland, from the experiments of Dr. Andrews, who has lately demonstrated the continuity of the liquid and gaseous state; or in other words, that, when operating upon gases capable of taking the liquid form with great pressure, a certain stage is at last reached where there is no perceptible physical difference between the liquid and gaseous conditions. Dr. Draper, of New York, in experimenting upon Davy's theory, has, however, found that, if, on heating a strip of platinum to a temperature of 1,280° by the voltaic current, a red heat was obtained which extended up to the line F (yellow) in the solar spectrum, at 1,325° the spectrum was prolonged into the bluish green; at 1,440°, beyond the line G; and at 2,190° a pure and intense spectrum, reaching as far as H in the violet, was obtained. These high temperatures were measured by the expansion of platinum wire itself.

Now, it is extremely easy "in the mind's eye" to conceive the intense actinic power of the rays emanating from the incandescent vapors of the sun, whose beams are the storehouse of actinic power which actuates, we may safely say, this world of ours. We may extend these theories on luminosity to the sun itself without a great stretch of imagination; for it would seem to be merely one gigantic mass of incandescent elements, similar in every respect to those we meet with in our earthly experience. But here the temperatures which we would consider intense are only to be compared to the color spaces observed upon the face of the sun; the red and white heats of our forges would appear black by contrast to the intensely ignited mass beyond if placed upon the face of the sun. What were some few years since thought to be breaks in the photosphere of the sun are now known to be incandescent clouds of vapor of a lower temperature than the brilliant background. There is hardly a gaseous element, even at a low pressure, which is not capable of becoming intensely luminous; in fact, we can conceive no limit to the phenomenon.

M. Hirn accepts the theory of Davy, and believes that the greater part of the luminosity of flame is due to solid particles being formed or precipitated into the incandescent flame. If there were opaque solid particles in flame, light would be reflected and would become polarized. Arago, years ago, observed that light from a flame is not polarized, and M. Hirn has confirmed these observations. Therefore, the latter named experimenter comes to the conclusion that the solid particles, as they became incandescent, become perfectly transparent; and the rather curious observation that a flat flame, such as we meet with in a fishtail gas burner, radiates light quickly in all directions, although so irregular in shape, is thus explained. The real shadows produced by particles of carbon, says M. Hirn, which have escaped combustion, or the fumes of burning phosphorus, when compared with the striated and feebly colored shadows given by flames of very considerable solidity, show that the precipitated particles do not affect the transparency of flame, and, consequently that, when they become incandescent, they become at the same time diaphanous (transparent).

A slight contradiction is noticed in connection with the magnesium light, which projects a real, and not simply a striated, shadow. Were this radical change in the optical properties of the solid particles not to take place—that is to say, the change from opacity to transparency—it is obvious that not only would such particles hinder the transparency of flame, but they would only illuminate from a very thin envelope.

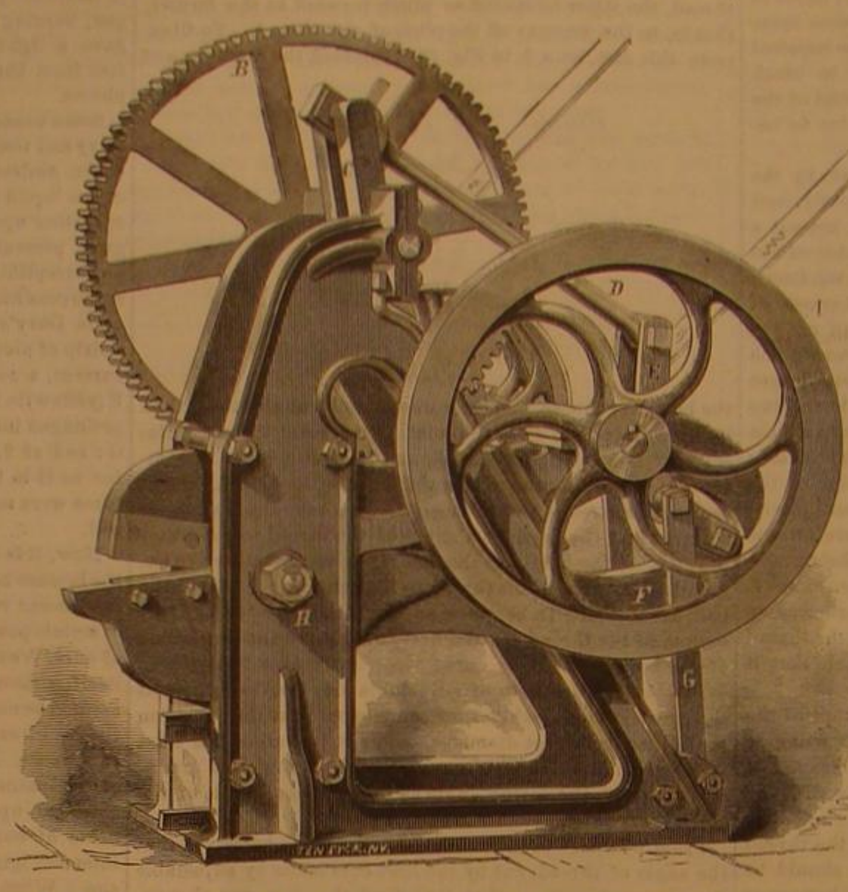
It is easy to perceive the importance which these facts acquire when the temperature of an incandescent body, such as the sun, is studied. If the particles were opaque, they would serve as screens, one for another, of all those situated in a straight line. Only the nearest to us would send out light; and these, besides being under less pressure, would be really less luminous.

It must also be recollected that other investigations than those referred to above tend to show that the upper layers of the sun's atmosphere are the coolest, and consist of hydrogen, sodium, and magnesium; that we have layers of iron and calcium at a higher temperature; and again, layers of nickel, cobalt, copper, and zinc at a higher temperature still. M. Hirn's observation about magnesium is curious, and hardly seems to agree with the observation of Mr. Lockyer in the examination of one of the bright stripes called "faculæ." In this bright surface upon the sun's disk, Mr. Lockyer observed a cloud which his spectroscope determined to consist of magnesium vapor. We, however, see at once how the different layers of vapors pass rays through their diaphanous or transparent brethren, and thus we get the full effect of the incandescence of those metals which are so rich in chemical force.

—*British Journal of Photography.*

IMPROVED METAL CUTTING AND PUNCHING MACHINE.

The novel apparatus which forms the subject of the annexed illustration differs from machines designed or like employment in that, instead of consisting of a single movable jaw (the upper one), which acts in connection with a rigid bed, it is virtually a huge pair of shears, in which both of the blades partake of the motion. In order to communicate power to the arms of the shears, there is an ingenious and quite novel mechanical combination which, together with a solidly built frame, completes the device.



REYNOLDS' METAL CUTTING AND PUNCHING MACHINE.

Power is applied to a belt pulley on the opposite end of the shaft which carries the fly wheel, A. Also on said shaft is a pinion, which engages with the large gear wheel, B, and thus, rotating the crank at C, moves back and forth the connecting rod, D. The latter is pivoted in the upper end of a double curved bar, E. The lower extremity of said bar is also pivoted to the lower shear arm, F. The upper shear arm passes through the bar, and within the latter and immediately below the arm is a roller upon which the curved portion of the arm rests. The pivot pin which secures the roller also holds the upper end of the bar, G, the lower extremity of which is pivoted to the frame.

The arms of the shears do not cross, but are provided with projections, which lap, and through which the pin, H, passes. By this arrangement, opening the arms forces the cutting edges together.

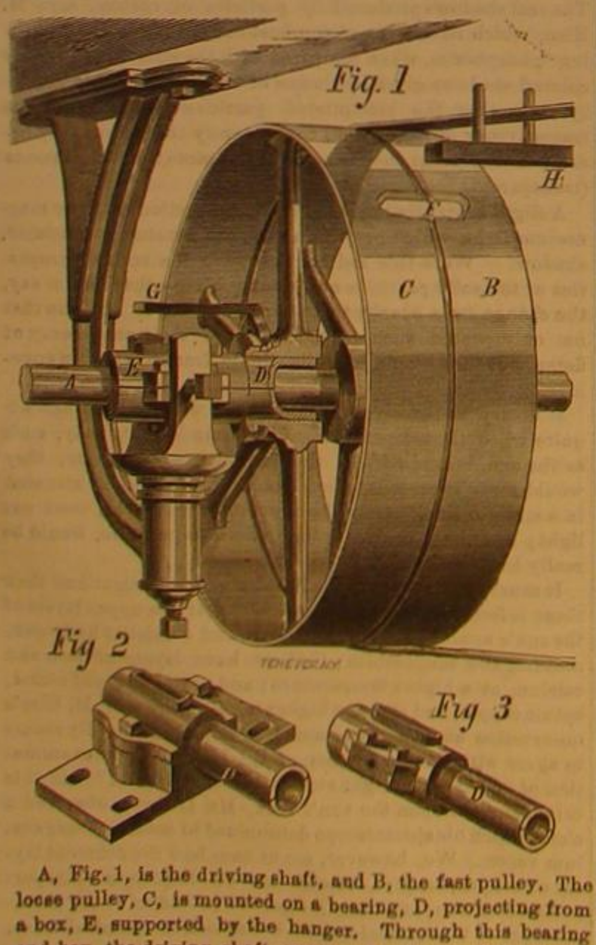
In operation the to-and-fro motion of rod, D, is communicated to curved bar, E. When the latter is thrown outward or to the right, its roller, acting against the curved portion of the upper shear arm, raises the same, while the lower end of the bar necessarily forces downward the lower shear arm, F. It is hardly necessary to explain that the combination of bars, E and G, with the shear arms, is calculated to admit of the application of very strong and uniform force to the jaws of the shears.

But little power is required to operate the machine, and its work is rapidly accomplished. It is stated that an apparatus weighing 1,700 pounds will cut bar iron one inch thick by three inches wide. The jaws, instead of carrying cutter blades, may be constructed to hold a punch and die, thus rendering the machine available for punching, as well as cutting, purposes. The device is also constructed to be operated by hand power, in which case the gearing as described is suitably modified.

For further particulars regarding rights, purchase of machines, etc., address Mr. H. C. Richardson, 59 and 61 Grand street, Brooklyn (E. D.), N. Y. Patent allowed through the Scientific American Patent Agency.

HOLDEN'S IMPROVED LOOSE PULLEY.

The essential feature of the improved loose pulley represented in the annexed engraving is that it, with the belt, remains in a state of rest except during the few seconds when the belt is shifted from loose to fast pulley. By this arrangement the belt revolves only when actually in use, and hence the wear of the same, together with the expenditure of lubricating material, otherwise required for the bearing, is saved.



A, Fig. 1, is the driving shaft, and B, the fast pulley. The loose pulley, C, is mounted on a bearing, D, projecting from a box, E, supported by the hanger. Through this bearing and box, the driving shaft passes. As shown through the portion broken away at F, the adjacent edges of the peripheries of the two pulleys are beveled, so that, when it is desired to shift the belt from loose to fast pulley, both pulleys may be caused to revolve together by forcing the pulley, C, slightly toward the pulley, B, by means of the shipper, G. After the belt is shifted, pulley, C, is drawn back on its bearing, and again comes to a state of rest. In shifting the belt from fast to loose pulley, the latter is not moved, as the belt is carried over by means of the ordinary shipper, H. The bearing and hub of the loose pulley are clearly shown in section in Fig. 1. Fig. 2 is a pillow block with a projection to receive the loose pulley, and Fig. 3 is a box and bearing, the same as in Fig. 1, shown removed from the hanger.

Patented May 5, 1874, by Messrs. W. H. Holden and T. C. Sheldon. For further particulars address W. H. Holden & Co., Box 327, Fitchburg, Mass.

The Music Stool Battery.

Land and Water publishes the following item, but declines responsibility for its truth by vaguely ascribing it to "a local paper."

"A valuable invention has just been patented by a post office official. It is an improvement in turret ships, the principal feature being that the battery rises and falls. Like many other inventions and discoveries, this one had its origin in accident. The inventor was out shooting one day, and both barrels of his gun went off simultaneously, the rebound causing him to spin round with considerable velocity. When he turned home he happened to sit on the music stool, and this piece of furniture also spun round in the well known manner. The movement reminded this clever official of his earlier spin. He was a gentleman capable of putting two and two together. Therefore he fastened his double barreled gun to his rotary piano stool, and banged away in his back garden, obtaining eventually a result which places him in the enviable position of being able to treat with two governments for the sale of his patent, for both England and Russia are anxious to become possessed of the rising and falling battery of this sharp post office official."

This invention bears a striking resemblance to the revolving cannon mentioned by Mr. Orpheus C. Kerr. That valuable weapon was pivoted in the middle and loaded at both ends, and, when fired, revolved with astonishing rapidity, causing promiscuous slaughter in both armies. It was intended to test the gun before a congressional committee; but as the individual deputed to fire it mentioned that he had a large family dependent upon him for support, the trial was indefinitely postponed.

Action of Earth and other Substances on Organic Matter.

At a recent meeting of the Chemical Society, a paper on the action of earth on organic nitrogen, by E. C. Stanford, was read, in which the author gave details of his experiments on mixtures of earth and decomposing animal matter. From these it appears that the earth is but an indifferent dryer, the mixture continuously losing nitrogen, which is evolved as ammonia principally; the earth also does not act as an oxidizer, and no nitrification take place. Dr. Frankland stated that when decomposition was in the direction of putrifaction, ammonia was always produced from the nitrogenous matter, but much nitrogen also escapes in the elemental form. The action of charcoal is very different; seaweed charcoal mixed with excrementitious matters and allowed to dry is found to retain almost the whole of the nitrogen. These facts are of interest to sewage economists and the advocates of the dry earth system.

Four Hundred Miles in a Balloon.

Professor Donaldson, the aeronaut, recently accomplished a very successful voyage in his new balloon "Barnum." Starting from the Hippodrome in this city, in the afternoon at 4 o'clock, the final landing was made the next day at 6 P. M., near Saratoga, N. Y. The party consisted of five persons, Donaldson and four reporters of the daily journals. Stops were made at various places on the route. The journey lasted 26 hours, during which time about 400 miles was traveled. The highest altitude reached was 9,000 feet.

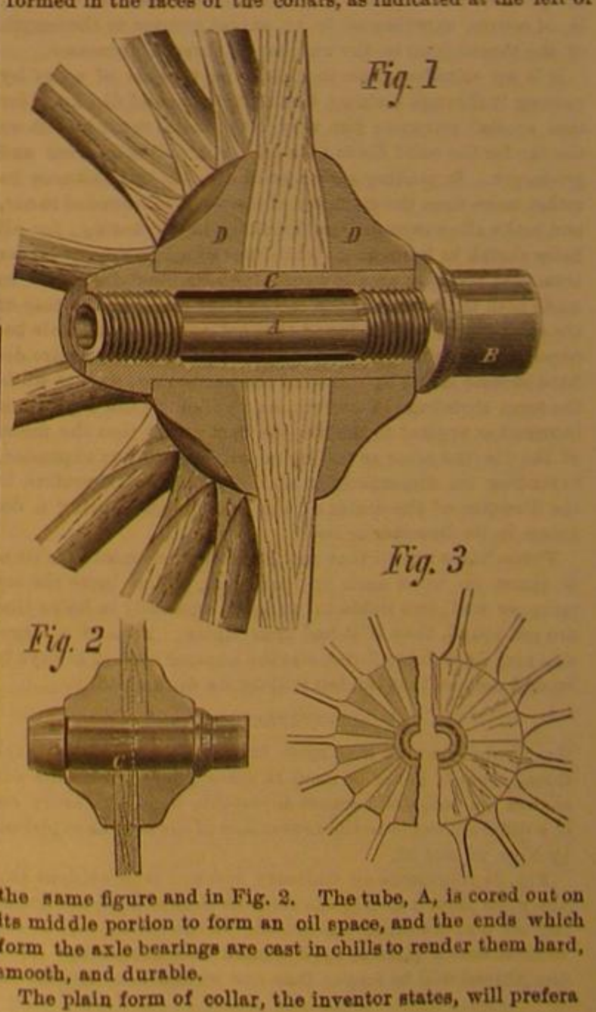
The Requisites for Good Mortar.

To obtain a good mortar, says Graham Smith, as much depends on the character of the ingredients and the manner of mixing them as on the goodness of the lime itself. It does not necessarily follow that, because a lime is good, the quality of the mortar will be good also. The best lime ever burnt would be spoilt by the custom, common among some builders, to mix with it alluvial soil and rubbish taken from the foundation pits of intended buildings. The sand should be hard, sharp, gritty, and, for engineering purposes, not too fine; it should be perfectly free from all organic matter, and with no particular smell. Good sand for mortar may be rubbed between the hands without soiling them. The water should also be free from all organic matter, and on this account should never be taken from stagnant ponds. The presence of salt in sand and water is not found to impair the ultimate strength of most mortars; nevertheless, it causes the work to "nitrate," or, as it is commonly termed, "saltpeter," which consists of white frothy blotches appearing on the face of the structure. It also renders the mortar liable to moisture, and for these reasons should never be present in mortar intended for architectural purposes, although for dock walls and sea works it may generally be used with advantage and economy.

Sand is used to increase the resistance of mortar to crushing, to lessen the amount of shrinking, and to reduce the bulk of the more costly material, lime. Water is the agent by which a combination is effected, and, as sand does not increase in volume by moisture, it necessarily follows that no more of the aqueous element should be employed than is absolutely necessary to fill the interstices between the sand, and render the whole into a paste convenient for use; and the greater strictness with which this is adhered to the more compact and durable will be the mortar.

DAVIS' IMPROVED HUB.

The invention, engravings of which in section we herewith present, is a simple and novel form of hub, composed of few parts, which may be quickly adjusted together so as firmly to retain the spokes. In Fig. 1, A is an inner metal tube forming the axle box and having a head at B. C is a larger and outer tube, into which tube A is screwed, as clearly shown. The middle portion of the hub consists of two collars, D, fitted on the tube head, at B, and binding the spokes between them. The spokes may be made large at the parts clamped between the collars, so as to fill the whole intermediate space, as shown to the right of Fig. 3, or the ends may be constructed smaller to enter grooves or mortises formed in the faces of the collars, as indicated at the left of

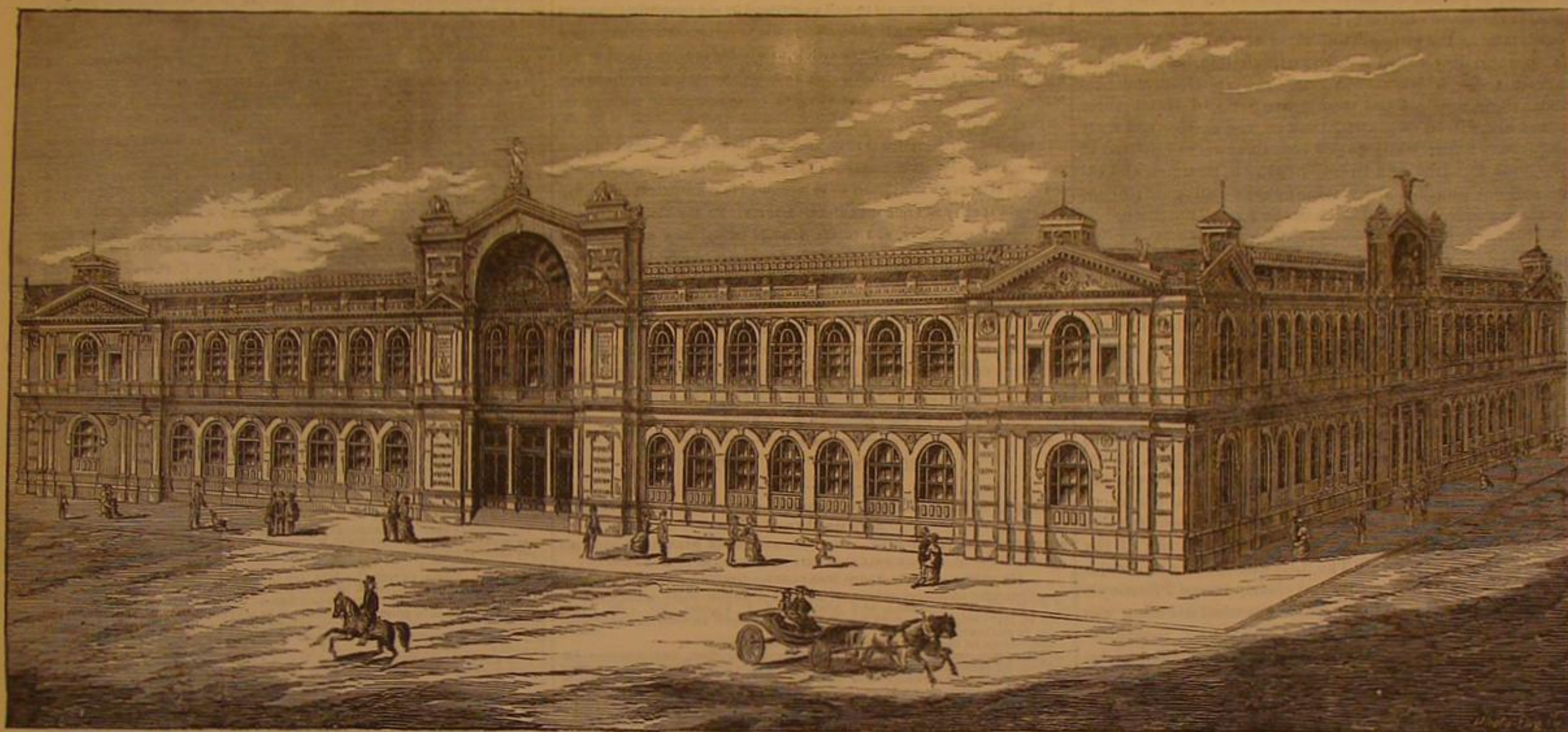


the same figure and in Fig. 2. The tube, A, is cored out on its middle portion to form an oil space, and the ends which form the axle bearings are cast in chills to render them hard, smooth, and durable.

The plain form of collar, the inventor states, will prefera bly be used when the spokes are to be adjusted in a single plane, and the slotted faced when the wheel is to be built staggered. Patented through the Scientific American Patent Agency, June 30, 1874. For further particulars regarding sale of rights, etc., address the inventor, Mr. John W. Davis, Newton, Catawba county, N. C.

THE CHILIAN EXPOSITION.

The second International Exposition of the Republic of Chili, a brief mention of which has already appeared in these columns, opens at Santiago on September 16, 1875. The large South American trade which yet remains undeveloped, and the constantly increasing demand which the progressive republics of that continent are making for American productions and inventions, will, we think, offer great inducements for our manufacturers and inventors to contribute to this enterprize. Special arrangements have been made for the transportation of articles for exhibition, at low rates; and the passage of mechanics and special workmen, in charge of goods, will be in part defrayed by the Exposition Committee. No rent is charged for space, and storage and power are offered free. The Exposition closes December 31, 1875. The condition and number of general premiums have not, as yet, been determined, but three liberal special prizes are to be awarded as follows:



BUILDING FOR THE GREAT EXPOSITION AT SANTIAGO, CHILI, 1875.

First. One thousand dollars, in gold, for the best style of narrow gage railroad, not exceeding three feet, shown by fixed and rolling stock, including locomotive and tender sufficient to accommodate and carry 6 to 100 tuns up gradients of 1 in 50, with curves of 164 feet radius

Second. One thousand dollars, in gold, for the best system of measuring and distributing water for purposes of irrigation, in specified or proportional quantities. The invention must be accompanied by the necessary apparatus to demonstrate its applicability to the requirements of Chili.

Third. Five hundred dollars, in gold, for the best exploring drill, adapted to mining operations of coal, iron, copper, silver, gold, etc.

The city of Santiago in Chili is situated in a most picturesque valley at the foot of the Andes, and is adorned with beautiful parks containing lakes, gardens, fountains, theaters, libraries, amusements of all kinds, observatories, etc. In one of these parks, the size of which is two square miles, the Exposition will be held. The structures include several buildings, the main one of which covers over 60,000 square feet of ground. It is over eighty feet in hight, is constructed of stone, brick, and iron, and contains many spacious galleries. An efficient fire brigade will be constantly in attendance during the Exposition. The street railways which pass round the park have branches extending within the edifice in order to facilitate the conveyance of heavy machinery and other cumbrous goods.

Full particulars can be obtained of the Chilian consuls at New York, Baltimore, Washington, and Philadelphia. We give herewith an engraving of the main exposition building, which is of considerable architectural beauty.

The Builder of the First Telegraph.

A few days ago a telegraphic despatch from Maine announced the decease in that State of Mr. G. E. Smith, who constructed for Professor Morse the forty miles of magnetic telegraph from Washington city to Baltimore, which constituted the original of the vast system of telegraphs now extended throughout the world. That line was completed for use in the last week in May, 1844, the first news despatch having been sent over the wire on the 29th of May. The quite recent death of the constructor of that line naturally carries the mind backward over the thirty years of the existence of the magnetic telegraph, and brings into bold view the feeble beginning of the marvelous progress of this peculiarly American work. After the patient but persistent efforts of Professor Morse for several years, Congress in 1843 made an appropriation of $30,000 for an experiment with the Morse telegraph between Washington City and Baltimore, and it was this line that was completed in the spring of the following year. The money, grudgingly granted in the midst of scoffs and jeers and references to "animal magnetism," etc., has been frequently referred to as a munificent gift in the interest of Science and the diffusion of intelligence. Perhaps it was, but it may serve at once to illustrate the magnitude of the growth of the telegraph, and how greatly the government profited by its generosity, to say that quite recently, within a period of five years, the Western Union Telegraph Company alone paid to the Treasury in taxes $850,000, and in gold duties, on imports of telegraphic wire, 328,000 more. Thus the investment of that $30,000 repaid itself in those two items alone, in those five years alone, and from one company alone, more than thirtyfold.

Going back to the forty miles of wire between Washington and Baltimore, which measured the whole dimensions of the magnetic telegraph this day thirty years ago, we are better able to appreciate the two hundred thousand miles of wire which form the immense network of the telegraph over the United States to day. Of these two hundred thousand miles of American wires, which would encircle the globe more than eight times, about one hundred and seventy thousand belong to one company. In June, 1844, there were two operators at work; in June, 1873, there were nine thousand nine hundred and thirty persons employed by one American company, and about twelve thousand by all the American companies. In this exhibit of the growth of thirty years, we limit the figures to the statistics of our own country, leaving the Old World out of view altogether.

In some other respects, the change wrought by the telegraph in less than the period of one generation is still more striking. It requires no strain upon the memories of even the junior partners of some of our old business houses and offices to recall the anxious times when they were more or less at the mercy of shrewd and active men who used carrier pigeons, relays of fast horses with their hardy express riders, semaphore signals from hill top to hill top and along the coast, and other similar expedients for getting advance views of important events, with all the resulting advantages. In those days fluctuations in the prices of commodities in the great markets of the world were frequently secrets known only to a few, who sold their knowledge to another few, and thus a small knot of men in every commercial center were enabled to buy the property of their uninformed neighbors for far less than its value, or sell their own for far more than its value. Now all business men get their information simultaneously, and, if they wish it, they can get it from all the markets and money centres of the world. The merchant at our Commercial Exchange is in immediate communication with corn, cattle, cotton, produce, shipping, and commercial exchanges everywhere in our own country and abroad. The banker on Third street has his wire extending from his office to New York, Chicago, San Francisco, New Orleans, London, Paris, Frankfort, Berlin, Amsterdam, Constantinople, Bombay, Calcutta, Rio Janeiro and Shanghai, and all cities and countries between. He sits there with instant knowledge of the financial, commercial, political, and other important current events of Europe, Asia, Africa, Australia, the East and West Indies, and South America, as well as of his own country. The telegraph, the Associated Press, and the newspapers within that organization concentrate this universal intelligence, and lay it before the whole public simultaneously at least twice every day; and all this marvelous change and the vast and wonderful system that has brought it about is, as the decease of the builder of the pioneer line sharply reminds us, the growth of but thirty years.—*Public Ledger*.

A Wonderful Oil Well.

The Titusville (Pa.) *Herald* thus describes a wonderful oil well that has been opened recently in that vicinity.

The road leading to the Parker well from Petrolia is in moderately good condition; and soon after leaving Central Point, the traveler observes the words "no smoking permitted here" in conspicuous places. After about two and a half miles a ride, the top of a hill is reached, where a loud, roaring noise is distinctly heard, and eighty rods further on brings us in sight of the well. A dense fog or mist envelopes the derrick, engine house and tanks, while fully one thousand persons are there, gazing on the wonder of Armstrong county. The derrick has conspicuously placed upon it, in large letters, "Boss Well," and "Creswell City." There are two 250 barrel tanks full of oil; also two 1,200 barrel tanks, one of which is full. Three dams, one below the other, catch the dripping; and the rivulet beyond, we are told, for ten miles of a circuitous route to the Allegheny River, is covered with oil.

There are two 2 inch pipes connected with the well, one of which is shut completely off, and out of the other flows a steady stream of oil with immense force. There is no perceptible intermission in the flow; and as it gushes into one of the 1,200 barrel tanks, the foam and spray envelop the whole surrounding atmosphere in a dense mist.

"A trustworthy gager informed us that he had gaged the well three times since the stream was turned into the 1,200 barrel tank, and he found it doing 1,750 barrels, and he estimated the leakage to be at least 50 barrels per day. He further stated that in his opinion the well started off out of the two 2 inch pipes at the rate of 2,500 barrels per day. He also claimed that, although this was almost incredible, he believed that, if the full stream were turned on now, it would do at least 5,000 barrels.

"The well is claimed to be the largest ever struck in the lower region. A farmer walked up to us and offered to sell his adjoining farm of 100 acres for $100,000, which ten days ago, for farming purposes, would not have brought $1,000. The surveyors are at work laying out Creswell City.

"The Parker well stands two and one eighth miles due east of the most eastern well of the fourth sand development, and about two and three quarter miles east of Petrolia. The number of wells drilling on this belt, east of the most easterly well on the McGarvey farm, are six, namely: Two on the Snow farm; one on the Steel farm; the Gushford well, 1,000 feet deep; the Crawford well, 300 feet deep, and the Prentice well, 1,450 feet deep. The latter is half a mile due west of the Parker well, and is due next week."

The Reason Why.

It is always desirable that facts should be supported by a reason. The editor of Arthur's *Home Magazine* give the following questions and answers, which are pertinent to this season of the year:

Why is fruit most wholesome when eaten on an empty stomach?

Because it contains a large amount of fixed air, which requires great power to disengage and expel it before it begins to digest.

Why is boiled or roast fruit more wholesome than raw?

Because, in the process of boiling or roasting, fruit parts with its fixed air, and is thus rendered easier of digestion.

Why are cherries recommended in cases of scurvy, putrid fever, and similar diseases?

On account of their cooling and antiseptic properties, and because they correct the condition of the blood and other fluids of the body when there is any tendency to putrescence; at the same time, like all fresh fruits, they possess a mild aperient property, very beneficial to persons of a bilious habit.

What effect have vegetable acids upon the blood?

They cool and dilute the blood, and generally refresh the system. All fruits contain acids and salts, which exercise a cooling and invigorating influence. Apricots, peaches, apples, pears, gooseberries, and currants contain malic acid. Lemons, raspberries, grapes, and pine apples contain citric acid. The skins of grapes, plums, sloes, etc., contain tannic acid, which has a bitter taste.

Why should salt be applied to vegetables intended for pickling, previously to putting them in the vinegar?

Because all vegetables abound in watery juices, which, if mixed with the vinegar would dilute it so much as to destroy its preservative property. Salt absorbs a portion of this water, and indirectly contributes to the strength of the vinegar.

Why is bread made from wheat flower more strengthening than that made from barley or oats?

Because, as gluten, albumen and caseine are the only substances in the bread capable of forming blood, and consequently of sustaining the strength and vigor of the body, they have been appropriately called the food of nutrition, as a distinction from those which merely support respiration. Wheat contains eight hundred and twenty five parts of starch, three hundred and fifteen of gluten, albumen, and caseine, and sixty of sugar and gum; while barley contains twelve hundred of starch, one hundred and twenty of gluten, albumen and caseine, and one hundred and sixty of sugar and gum; hence wheat is much richer than barley in the food of nutrition.

The Discovery of Oxygen—Celebration of the One Hundredth Anniversary.

There was a large gathering of American scientists at Northumberland, Pa., on July 31, to celebrate the one hundredth anniversary of the discovery of oxygen by Joseph Priestley. The proceedings commenced in the main hall of the village academy with an address of welcome by Colonel Taggart, of Northumberland. Professor Charles F. Chandler, of Columbia College, New York, was called to the chair, and Professor A. R. Leeds, of the Stevens Institute, Hoboken, N. J., was appointed secretary; telegrams were exchanged with Birmingham, England, where a statue of Priestley was at the time being unveiled by Professor Huxley, and Professor H. H. Croft introduced the business of the day by reading a paper on "The Life and Labors of Joseph Priestley," in which he rapidly but clearly traced Priestley's great life and works. His fondness for chemical dabbling was pursued, like all his work, on a plan of his own, regardless of the schools; his wonderful discoveries, embracing at least two thirds of the now known gases, showed conclusively the compound structure of the air. He traced also the theological wars in which Priestley's controversial propensity kept him constantly engaged. Like Ishmael, his hand was against every man, and every man's hand was against him; and, though his powerful intellect vanquished one enemy after another, and the volumes hurled against his foes numbered more than a hundred, new opponents constantly arose. The Church banned him, society thrust him out, until at the age of sixty one, feeble, worn out, his house burned from over his head, his books and papers destroyed by howling mobs, injustice and opprobrium heaped upon him, he fled to America, where he met a joyous welcome, which must have sounded passing strange to his ears, accustomed to years of constant strife. Some of his family having settled at the Forks of the Susquehanna, he followed them here, and found a land of peace and restfulness. The third and fourth generations of the great chemist's descendants still reside in the town.

Professor J. Lawrence Smith, of Louisville, Ky., offered and had adopted the following resolution:

Resolved, That a committee be appointed to confer with the committee of the Centennial Exhibition, to correspond with the chemists and professors of cognate sciences in Europe, in order to induce a large representation of them to visit this country in 1876.

Professor T. Sterry Hunt, of Boston, read a paper on "The Century's Progress in Theoretical Chemistry." The lecturer traced the progress of the art from its earliest stages, and defined Stahl's phlogistic hypothesis, in which Priestley placed such unwavering faith. The three great chemists of the century just expired were Scheele, Priestley, and Lavoisier. Of these the two first were great experimenters, but failed to interpret their discoveries properly. Priestley, though the founder of a new school himself, adhered firmly to the old philosophy, and died the last defender of phlogiston. Lavoisier seized, with a marvelous comprehension, the true significance of the facts made known by his contemporaries, greatly enlarged the field by his own researches, and like another Newton, showed the great harmonies which govern all the changes of matter in the mineral, animal, and vegetable kingdoms. Lavoisier justified by the aid of the balance the old doctrine of Hermes, that in the changes of matter nothing is lost and nothing is gained. With Wenzel, he made chemistry a quantitative science, and the great laws of definite and multiple proportion made known by Dalton showed that all things were ordered by weight, by number, and by measure.

A second session was held in the evening of the day, at which Professor Joseph Henry was to have presided; but being prevented by ill health, Dr. Henry Coppie, President of the Lehigh University, filled the chair, and delivered in the open air an eloquent and glowing tribute to the chemist in whose honor the ga ring was held. In the lecture hall, Dr. J. Lawrence Smith reviewed the whole progress of chemical science during the past 100 years.

On the following day, August 1, Professor Silliman read an essay on American contributions to chemistry; and various other papers on the history of the subject were given, and many interesting letters and other relics of Priestley were exhibited.

Another New Comet.

Now that Coggia has passed for ever from our view, it is gratifying to know that a new comet has just made its appearance. It was discovered at Marseilles, France, July 26, and first observed in this country by Professor Swift, Rochester, N. Y., July 30. He says: "It is quite large and bright for a telescopic comet, and has a strong central condensation, but, as far as I could judge by observation, both in the solar and lunar twilight, it has no nucleus or tail. It is in the fourth coil of *Draco*, and moves at the rate of about one degree a day."

IMPORTANCE OF ADVERTISING.

The value of advertising is so well understood by old established business firms that a hint to them is unnecessary; but to persons establishing a new business, or having for sale a new article, or wishing to sell a patent, or find a manufacturer to work it: upon such a class, we would impress the importance of advertising. The next thing to be considered is the medium through which to do it.

In this matter, discretion is to be used at first; but experience will soon determine that papers or magazines having the largest circulation, among the class of persons most likely to be interested in the article for sale, will be the cheapest, and bring the quickest returns. To the manufacturer of all kinds of machinery, and to the vendors of any new article in the mechanical line, we believe there is no other source from which the advertiser can get as speedy returns as through the advertising columns of the SCIENTIFIC AMERICAN.

We do not make these suggestions merely to increase our advertising patronage, but to direct persons how to increase their own business.

The SCIENTIFIC AMERICAN has a circulation of more than 42,000 copies per week, which is probably greater than the combined circulation of all the other papers of its kind published in e worie.

DECISIONS OF THE COURTS.

United States Circuit Court.---Eastern District of Pennsylvania.

PATENT FIRE EXTINGUISHER.—THE NORTHWESTERN FIRE EXTINGUISHER COMPANY *et al.* *vs.* THE PHILADELPHIA FIRE EXTINGUISHER COMPANY.

[In equity.—Before Judge McKennan.—Decided April, 1874.]

Suit brought on letters patent reissued to Dawson Miles, administrator of P. F. Carlier, deceased, and Alphonse A. C. Vignon, No. 4,994, dated July 16, 1872 (original patent No. 88,844, dated April 13, 1869), for improvement in extinguishing fires.

The claims of the reissued patent are as follows:

1. The improvement in the art of extinguishing fires, hereinbefore described, by throwing upon the fire or conflagration a properly directed stream of mingled carbonic acid gas and water by means of the pressure or expansive force exerted by the mass of mingled gas and water from which the stream is derived.

2. We claim a strong vessel provided with a proper plug or lid, by which an orifice in it can be closed, and a stopcock, through which its contents can be ejected, and a flexible tubing or hose for directing the stream as ejected at the will of the operator, these parts being substantially such as described, and capable of operating as specified.

3. We claim a strong vessel provided with a proper plug or lid for closing an orifice in it, and also with a stopcock, in combination with another vessel or tube, the combination being substantially such as specified, and the construction being substantially such as described, so that the vessels may keep separately the ingredients for making carbonic acid gas, and that when their contents are mingled they may be discharged in a stream of carbonic acid gas and water.

4. We claim, in combination with the vessel's lid or plug and stopcock combined, and capable of operating as in the above third claim, a hose and nozzle, so applied, as described, that the mingled stream of carbonic acid gas and water may be suitably directed, as hereinbefore set forth.

5. As the preferred arrangement of our apparatus, we claim a strong vessel provided with a lid or plug and a stopcock near the bottom thereof, in combination with a vessel or tube arranged in the interior thereof, the arrangement being substantially as described.

6. We claim a strong vessel provided with a lid or plug and a stopcock, in combination with a vessel or tube arranged in the interior thereof, and a rod passing through the wall of the outer vessel, and capable of operating substantially as described.

7. We claim a strong vessel provided with a lid or plug and a stopcock, in combination with the vessel or tube arranged in the interior thereof, and a rod and cock or valve, the whole being and operating substantially as described.

8. We claim the elements or parts of a whole apparatus specified in the fifth claim, and arranged as therein specified, in combination with a flexible hose and nozzle, and with handles or loops, whereby the apparatus may be supported and the stream directed, substantially as specified.

9. We claim, in combination, a strong vessel, a lid or plug for closing the same, a stopcock near the bottom of the vessel, a hose and nozzle, and handles or loops, whereby a volume of water charged with carbonic acid gas may be confined and transported, and a stream thereof directed, in the manner and for the purposes described.

10. The keeping of the acid and alkali or alkaline solution in separate and distinct vessels, but in such proximity to each other that they may be immediately brought into contact when the apparatus is required for use, one mode of accomplishing which we have above set forth.

11. A closed receptacle, made of suitable material, containing one of the gas-generating ingredients, placed within the main reservoir containing the other gas-generating ingredient, to be discharged of its contents in the manner herein set forth, or by other equivalent means.

This bill is founded upon a reissued patent to Dawson Miles, administrator of the estate of Phillipe F. Carlier, deceased, and Alphonse A. C. Vignon, as joint inventors of an "improvement in extinguishing fires." They are described as residents of the city of Paris, and subjects of the Emperor of France at the time of the invention. The answer denies that there was any person named Phillipe F. Carlier, and avers that François Phillipe Carlier was the name of Vignon's associate in the alleged invention; and for this misnomer it is urged that the patent is void. *

Assuming, then, that the Christian name of Carlier was François P., he is demonstrated to be the same with Phillipe F., by conclusive proof of his connection with the subject of the patent, and of the impossible applicability of the additional description to any other than Vignon's associate. There is, therefore, no doubt of the personal identity of the patentee, and the most that can be said is that, by a transposition of his double Christian name, he is not thereby accurately designated. But this will not void the patent, where it supplies upon its face an added description, by which the patentee may be certainly identified. The patent must, therefore, be treated as valid. *

The main enquiry in the cause relates to the novelty of the invention claimed by Carlier and Vignon. I have no doubt they were original inventors; but were they the first?

The earliest date to which their invention is carried back is June, 1862. Although there is no evidence in the cause fixing this date, yet, from what incidentally appears and for the purpose of determining the priority of their invention, it may fairly be taken as the time when invention was completed.

What, then, did they claim to have invented? This is very clearly described in the reissued patent in controversy.

"It consists," says the specification, "first, in the process or method of extinguishing fires by means of a jet or stream of mingled water and carbonic acid ejected from a closed vessel in a suitable direction by means of the pressure or expansive force of the mixture contained in the vessel; and, secondly, in the construction of apparatus for containing and delivering this extinguishing medium, which apparatus may be made of an exceedingly portable nature, and kept always charged and ready for use at a moment's notice at the particular locality which it is desired to protect." *

To show that the invention thus claimed is not novel, the defendants have exhibited in evidence a rejected application of Dr. William A. Graham. It appears that on the 23d of November, 1837, Dr. Graham applied for a patent for a method of extinguishing fire, by projecting upon it a stream of mingled carbonic acid gas and water, and filed a specification, in which he fully described the mechanical devices to be used in effectuating this method, and the process of operating them. On the 25th of November, 1837, his application was rejected, for reasons stated by the Examiner, which now seem strange enough. This decision was reaffirmed on the 16th of December following. On the 29th of December, 1837, an amended specification was filed, and thus the case stood until December, 1851, when a model and drawing and a third specification were filed, and the application was renewed and finally rejected. These several specifications and the drawing are all in evidence in the cause; and it is urged that they, of themselves, are effective proof of prior invention by Graham.

But it does not follow that a rejected specification and drawings are, under all circumstances, inadmissible as evidence. By themselves they are inconsequential, but when the inventor's idea is perfected by a practical adaptation of it, in the form of mechanism, they are valuable guides in ascertaining the date of the invention, the design of the inventor, and the principle, intended functions, and mode of operation of his mechanism, and they must, therefore, necessarily be considered in connection with it.

So, in the present case, Dr. Graham embodied what he supposed he had discovered in a practical form; for the proofs establish beyond question that as early, at least, as 1853 he constructed apparatus which he then exhibited.

As early, at least, as 1851, a model and drawings of the apparatus described in the specification were filed by Dr. Graham in the Patent Office. With the aid of all these there certainly could be no difficulty in constructing the necessary apparatus for the practical application of the invention. Indeed such apparatus was constructed by Dr. Graham as early at least as 1853, and it was produced at the hearing, with the immaterial substitution of a piece of new hose for the old piece originally attached to it, its identity having been incontestably established.

It appears that, in 1852 or 1853, Dr. Graham made a trial of his apparatus near Lexington, Va., in the presence of a large number of witnesses, by setting fire to a large pile of straw, and then throwing upon it a stream of mingled water and carbonic acid gas projected from his extinguisher by the expansive force of the gas. That this trial was successful is apparent from the fact that the progress of combustion was promptly arrested, and the failure to extinguish the fire entirely was manifestly due solely to the insufficient capacity of the extinguisher, as compared with the magnitude of the ignited material. The incompatibility of carbonic acid gas with fire needed no proof, because it was an indisputable fact; the problem to be demonstrated was the practicability of the proposed method of discharging and directing carbonic acid gas in combination with water upon an ignited mass, whereby the well known properties of both these substances could be made usefully available. So far as this result was concerned the trial made must be considered as having proved the utility and efficiency of the invention.

But equally if not more satisfactory proof on this point was furnished at the hearing of this case. The same appliances, used by Dr. Graham on the occasion referred to, had been made exhibits in the case, were produced in court, and were subjected again to the test of trial. They consisted of a metallic fountain, or closed vessel, charged with carbonic acid gas and water, to which was attached leather hose ending in a bunch of nozzles, and alternately a single nozzle. When the stopcock opening into the hose was turned, a stream of mingled gas and water at once issued from the nozzle, and, by means of the expansive force of the contents of the vessel, was projected to a distance exceeding that stated by Dr. Graham in his specification, until the vessel was emptied.

Against the pressure of all these proofs I cannot resist the conclusion that Dr. Graham devised an original method of extinguishing fires by the combined agency of carbonic acid gas and water, and that he "perfected and adapted" his invention by embodying it in the form of mechanical appliances capable of operative and successful use.

It was urged, however, that the efforts of Dr. Graham are to be treated as abandoned experiments. An experiment may be a trial, either of an incomplete mechanical structure, to ascertain what changes or additions may be necessary to make it accomplish the design of its projector, or of a completed machine to illustrate or test its efficiency. Obviously, in the first case, the incompleteness of the inventor's efforts, if they were then abandoned, would have no effect upon the rights of a subsequent inventor.

But if the experiment proves the capacity of the machine to effect what its inventor proposed, the law assigns to him the merit of having produced a complete invention.

It is hereinbefore shown that the theory of Dr. Graham attained this practical condition, and there, apparently, his efforts ceased. But why? Repulsed from the Patent Office by the arbitrary assumption that his enterprise was impracticable with the employment of any mechanical auxiliaries whatever, without pecuniary resources, his "poverty, not his will, consented" to an abandonment of further effort to secure the full benefit of his invention to himself and to the public. But this will not help the complainants. The most that can be predicated of his inaction is that he abandoned his invention to the public, although I do not affirm this hypothesis. But if he did, it will not reduce his matured invention to the grade of a mere experiment, and open the way to the complainants to appropriate the title of first inventor. *

From what has been already said, the first claim of the patent cannot be sustained. Graham was prior to Carlier and Vignon in devising the "improvement in the art of extinguishing fires" embraced in this claim, and the merit of novelty cannot, therefore, be accorded to the latter.

The other claims are for mechanical combinations.

The ninth is for a combination of a strong vessel, a lid or plug, a stopcock near the bottom of the vessel, a hose and nozzle, and handles or loops, "whereby a volume of water charged with carbonic acid gas may be transported and a stream thereby directed, in the manner and for the purposes described."

The tenth is for "the keeping of the acid and alkali or alkaline solution in separate and distinct vessels, but in such proximity to each other that they may be immediately brought into contact when the apparatus is required for use."

All these claims, except the last, are for combinations of devices, none of which devices are alleged to be new, and while the coefficiency of all of them is necessary to effectuate the ulterior design of the patentees, they are subdivided into groups and claimed as several inventions. Indeed the specification is a notable example of ingenious multiplication of claims, so as, it must be presumed, to embrace and protect the invention in every possible aspect of it.

It is not to be doubted, however, that a valid combination may consist of old elements, which have not been before similarly arranged, or, if they have, that a novel result is produced by their conjunction. Either the instrumentalities employed or the effect caused by their operation must be new to constitute a patentable combination. If substantially the same devices have been used before for a like purpose, or if they are applied merely to effectuate a method known and practiced before, such employment of them will not be protected by a patent. *

Were these elements, then, similarly combined before and used for an analogous purpose? I am convinced that an inspection and analysis of some of the defendants' exhibit, and especially of Nichols' "portable soda water fountain," patented in 1854, must result in an affirmative answer to this question. The devices which compose the combinations claimed in the complainants' patent are substantially embodied in Nichols' apparatus, and in it they are arranged and operated in substantially the same way as in the complainants.

The object of Nichols was to construct apparatus in which acid and an alkali could be kept in separate vessels, but in such proximity to each other that they could, at the will of the operator, be brought into immediate contact; carbonic acid gas thereby generated and a body of water contained in an inclosing vessel impregnated with it, and that the acidulous water could be discharged through a suitable opening by the elastic pressure of the gas and used as a beverage. The essential elements of his apparatus are a strong metallic vessel of portable dimensions, to be filled with water, with an opening in its top; a plug to be screwed into this opening; another vessel enclosed within the strong one to contain diluted acid, and connected with it by an exterior pipe which extends into and to the bottom of it; a tube or smaller vessel, for holding an alkali within the acid chamber with an open bottom, which is provided with a tight-fitting lid attached to a rod extending up through the top of the vessel, by which the bottom can be opened and closed at pleasure; and a stopcock to permit and direct the discharge of the contents of the strong vessel in a mingled stream of carbonic acid gas and water. To operate this apparatus the strong metallic vessel is nearly filled with water through the opening in its top, the alkali chamber is taken out of its place within the acid chamber, into which latter is poured a quantity of diluted acid, an alkaline substance is put into the alkali chamber, against the bottom of which its metal covering is tightly drawn by means of the rod attached to it, and it is then replaced and tightly screwed into the acid chamber. By a revolution and slight pressure of the rod, the bottom of the alkali chamber is brought into contact with the acid in the chamber below. Carbonic acid gas is at once generated and is conducted through the pipe provided for that purpose to the bottom of the water vessel, where it is intermixed with the water and from which it is driven, as desired, through the discharge pipe by the expansive force of the gas. *

It is plain to my mind that it is only necessary to add a hose and nozzle to the discharging stopcock in the Nichols fountain to make it as effective a fire extinguisher as the complainants'. * The obvious addition of so simple an element to the devices which coexisted in the old machine and perform all the fundamental functions of the subsequent one, cannot constitute the combination of a new and patentable one.

But it is urged that the prior construction of structures of this class cannot affect the question of novelty here, because they were not applied to the extinguishment of fires, and their use and that of a fire extinguisher are entirely diverse. It must be observed that there is a marked analogy in the means employed and the result produced by both machines up to the point of divergent application. The function of both is the prompt generation of carbonic acid gas and the impregnation of water with it, and the same projectile force is employed to expel the acidulous water from the vessel containing it. In the one case, a stream of this water is directed into a vessel, where it may be used as a beverage, and, in the other, upon a mass of ignited matter. This difference, then, in the ultimate application of the same agencies, marks the line of distinction between them.

Now, the art of extinguishing fires by means of carbonic acid gas and water intermingled was not new, for it had previously been practiced by Graham; and the real question, therefore, is: Does the application of old mechanical devices, without material change, to a use in which they were not employed before, but which was known and had been practiced, constitute a patentable invention? A decisive answer to this question is furnished by Mr. Justice Story, in Bean *vs.* Smallwood (2 Story, 408), where he thus states the law:

Now, I take it to be clear that a machine, or apparatus, or other mechanical contrivance, in order to give the party a claim to a patent therefor, must in itself be substantially new. If it is old and well known, and applied only to a new purpose, that does not make it patentable.

And, in Curtis on Patents (3d ed., sec. 56), the result of the authorities is thus accurately stated:

Of course, if any new contrivances, combinations, or arrangements are made use of, although the principal agents are well known, these contrivances, combinations, or arrangements may constitute a new principle, and the application or practice will necessarily be new also. But where there is no novelty in the preparation or arrangement of the agent employed, and the novelty professedly consists in the application of that agent, being a well known thing, or, in other terms, where it consists in the practice only, the novelty of that practice is to be determined, according to the circumstances, by applying the test of whether the result or effect produced is a new effect or result not produced before.

It is apparent, therefore, that where an effect or result has been before produced, the mechanical agencies by which it is reproduced, if they are not in themselves new, are not the subject of a patent.

This rule is decisively applicable to the present case, both as to the result achieved and the means employed to effectuate it; and the claims for both being thus invalid for want of novelty, the bill must be dismissed with costs.

[*Edmund Burke* and *Keller & Blake*, for complainants; *Chas. B. Collier* and *D. L. Collier*, for defendants.]

Recent American and Foreign Patents.

Improved Railway Rail Joint.

Bartholomew C. Crowley and John D. Kelley, Renovo, Pa.—The chair plates, clips, and fish plates, are made of wrought metal, in one piece, the plates being long enough for extending across two ties and resting at the ends on them, while the clips are of the usual length, and located at the middle, where the rails meet in them, thus combining the chair and fish plates. The knee-shaped guard chairs, of cast metal, are bolted up to the fish plate on one side by one of the bolts used for fastening them, and also bolted or spiked to the tie. The end bearing against the fish plate, and also the shoulders bearing against the flange of the rail and edges of the chair, are rounded, to allow the chair to be closely bound to the several parts, and at the same time allowed to move forward and back, as the rail expands and contracts, without cramping unduly.

Improved Steam Pump.

William Atkinson, Gardner, Ill.—This invention relates to means whereby greater simplicity, less liability to stoppage, and greater economy in the operation of pumps, may be secured. This is considered by experts to be a very noticeable improvement.

Improved Lint Cotton Opener, Cleaner, and Straightener.

James B. Wendel, Memphis, Tenn.—This invention relates to and consists in means whereby lint cotton may be opened, cleaned, and straightened by a single continuous operation.

Improved Gas Machine.

Robert L. Cohen, Philadelphia, Pa.—This invention relates particularly to the construction of the blower or device for forcing air through the carburetting liquid, whereby such uniformity of pressure is produced as ensures a steady, unwavering flame, in place of a flickering one, as in most other machines.

Improved Leather Glazing Machine.

Wright Walter, Yonkers, N. Y.—This invention consists of a rotary wheel, carrying the agate glazing rolls on its face, to revolve against the morocco, leather, or other substance to be dressed, lying below the wheel on a spring bed or platform. The glazing rolls are mounted on a spring band of metal at the middle of the spaces between the arms of the wheel on which the band is stretched. Under each roll is an adjustable spring bearer, to regulate the pressure of the glazing roll on the leather. These bearers are adjusted a little short of the band, so that when the rolls first strike the leather on the table the band will yield more readily, and thus not deliver blows as heavy as if directly supported by the beams. The beams are also provided with adjusting screws by which to cause the agates to bear evenly on the leather throughout the whole length.

Improved Gate Hinge.

William S. Whiting, Jr., of Seymour, assignor to Frederick L. Allen and William H. Richardson, Waterbury, Conn.—By this improved gate hinge, the gate may be readily swung to either side without difficulty, and closed or shut by its own weight. The invention consists of a supporting bracket fastened to the gate post, and provided with curved V or wing-shaped slot for guiding the pintle of the bracket plate of the gate, and preventing the gate from getting out of place. The pintle plate swings by side recesses around fixed pins of the supporting plate. When the gate is in closed position, the pintle is in the vertex of the slot, and both recesses are in contact with the guide pins. By swinging the gate to either side, the side recesses and pintle swing around the corresponding and slotted part until the extreme limit of motion is obtained.

Improvement in Laying Cement Pipes.

Jacob Loeffler, New York city.—By this invention, a continuous and solid pipe may be constructed directly on the ground, dispensing with special places of production, loss of breakage by shipment, and other difficulties. The invention consists of a molding flask, constructed of detachable exterior sections, suitably supported on the ground, and eccentrically adjustable core sections, which are flanged in such a manner that an overlapping joint of the pipe sections is produced as they are formed consecutively, one after the other. The core sections are withdrawn from the finished pipe sections, by contracting them, by means of a central shaft and cam eccentrics.

Improved Ventilator Cap.

Gerald Kavanaugh, New York city.—This invention relates to the construction of caps for ventilator pipes or flues, and consists of pyramidic shaped and overhanging sections connected with the top of the flue, combined with a central section consisting of two pyramids, the bases of which are connected, the sections being supported by means of straps or stays. It is claimed that this cap will allow a current of heated impure air to escape, while admitting a current of cold fresh air to enter.

Improved Self-Adjusting Dam for Dental Use.

Jacob L. Chevalier, Newark, N. J.—The frame of the device is formed of wire bent into a coil, and with its ends bent outward. To the ends are attached U-shaped frames of such a length as to embrace two or three teeth. The inner arm of the upper frame is made the shorter, on account of the curvature of the roof of the mouth. The outer arm of the upper frame is made with an extension bow, that it may be extended or contracted. The arms of the frame are covered with rubber bags, stuffed, to form pads, which stuffing may be readily adjusted. To the inner arm of the lower frame of the side dams is attached a rubber flap to rest upon and prevent the tongue from coming in contact with the tooth being operated upon. Five of the dams constitute a set—two for each side, and one for the front.

Improved Washing Machine.

John Contrell, New York city.—In a box of rectangular form are placed on edge three movable ribbed plates, to which is given a horizontal longitudinal motion. The clothes to be washed are placed between the reciprocating plates. The proper quantity of water being in the machine, the clothes will be forced between the ribs of the plates, and, being thus held, will receive an alternate back and forward motion nearly identical with hand motion The reciprocating ribbed plates are connected at their ends by perforated flexible diaphragms, to prevent the clothes from getting between the box and the ends of the plates. Tubes are attached to sections, arranged near the bottom of the machine, which extend to a steam generator, by means of which a circulation of water is maintained.

Improved Iron Truss Bridge.

Edward Hemberle, Chicago, Ill.—The top chord of a bridge truss is made of ⌶-shaped rolled beams, jointed together at the ends and straight in the middle of the truss, from a point one and a half panel lengths from the end of the truss; from this point to the end, the chord is bent in a circular arc down to the shoe. The arc is held in shape by two or more tie rods entering at the bottom chord pin, to distribute and transmit the load from the point to the arc. The top chord is spliced and connected over the pin by a wrought iron plate, bent in double angle form to fit the web of the beams, bolted on the ends of the two beams so that its flanges project downward to receive the pin, for connection of the tie rods and struts of the truss. This plate is bolted to the under side of the chords by two short bolts, making a temporary connection to the top chord. On top of the chords, at the joint of the sections, there is a cast block, fitting into the trough of the ⌶-beam, which is bolted down, by two bolts, passing through the block to the web of the beam and the wrought iron connecting piece. The block has lugs cast on the top, in which the top lateral ties are secured.

Improved Earth Auger.

William Sandlin, Minden, La.—This invention consists of a spirally flanged auger of the usual construction, provided with a pivoted and exchangeable bit for producing wells of different diameters, and connected with a cylindrical sand box, having band springs applied at the outer side for retaining the box stationary in the well. Small rollers at the upper curved ends of the band springs are carried through slots of the box between two disk-shaped collars of the auger shaft, on which the collars turn, while also raising and lowering the box with the auger. The ends of the band springs are attached by ropes or chains to the auger shaft to prevent the catching on projecting parts of the well during the raising of the auger and sand box.

Improved Glass Melting Pot.

Robert Richardson, Brooklyn, N. Y.—The pot is made with a cover about the same as the ordinary covered pots, but with two or more large openings at the junction of the cover with the sides of the pot, and with raised portions of the cover projecting over said openings, so as to prevent the falling of any matters from the top of the furnace and the flue into the pot. A small opening is made through the top of the wall surrounding the mouth of the pot, to permit of the escape back into the furnace of any portion of the heat currents that may, in consequence of draft through openings, tend to come out at the opening in the furnace wall through which the glass is taken from the pot.

Improved Medical Compound.

Benjamin F. Ulmer, Savannah, Ga.—This invention consists of a composition composed of ground dandelion, ground butternut bark, ground senna, ground serpentaria, ground star aniseed, ground fennel seed, and ground coriander seed, mixed together and moistened with pure glycerin, water, cologne spirits, and sirup prepared from the domestic black root of the Southern States. The remedy is administered as a liver corrector or vegetable aperient, and is found useful in all bilious complaints.

Improved Tyre Tightener.

Absalom Hollingsworth, Alba, Mo.—This invention is an improvement in the class of tyre tighteners in which a wedge is employed to draw the two ends of the tyre together. The improvement relates, first, to providing both ends of the tyre with lengthwise slots and the felly with radial slots, one to receive the wedge and the other to permit adjustment of a screw clamping bolt; second, to a U-shaped bar or staple applied to the slotted end of the felly, to operate in conjunction with the tightening wedge.

Improved Manufacture of Enameled Dial and other Plates.

Joseph H. Robinson, Liverpool, England.—The foundation of the dial is made of thin sheet iron, which is stamped out by means of a press and suitable dies, with the edges turned up all round, so as to form a kind of shallow tray to hold the enamel on the face of the plate. The necessary holes are punched at the same time. The plate, having been made chemically clean, receives an enamel composed of white lead, arsenic, flint glass, saltpeter, borax, and ground flint. These substances, having been all reduced to powder, are mixed together, melted in a crucible, and run into cakes, which are afterwards pulverized. A sufficient quantity of the dry pulverized enamel is sprinkled on the face of the plate, which is then placed in a muffle. When the enamel is fused, the plate is withdrawn from the muffle and allowed to cool; and when cold, it will have a hard, white, glazed surface, and is then ready for receiving the lettering and figuring.

Improved Vehicle Seat.

James A. Curtis, Greencastle, Ind., assignor to himself, Robert Renick, and Gasper Renick, same place.—This invention consists of a sliding back seat on ways on the top of the buggy body, with spring clamping levers to fasten it at any point. The levers extend from each side to the middle of the seat, where a locking bolt is contrived for binding them against the ways by turning it so as to cause a cam to press down on the levers. The front or jump seat is provided with short swiveled legs connected with longer legs of the same, so that, when the seat is thrown forward, the shorter legs will be detached from their sockets and turned on their pivots to adapt them to support the seat in its changed position.

Improved Pocket Book.

Alexander M. Le Vino, New York city.—This invention relates to an improvement in pocket books, by which they may be manufactured without stitching, in a neater or more durable manner; and it consists in the connection of the partitions, which are made of a continuous blank, with sector-shaped extension side flaps or tongues, arranged symmetrically at each section thereof, with the outer side flaps or gussets. The main advantage of a pocket book constructed in this manner consists in the extension of the partitions across the full width of the same, and its exposure to wear and tear at the outer edges of the partition, being the points of greatest resistance, while the sections of the side flaps or gussets are folded or crimped to the inside, and thereby fully protected.

Improved Rotary Engine.

Edward Myers, New York city.—The cylinder is provided with heads in the ordinary manner, and with a central partition. The shaft passes through the centers of the three heads. In the inner sides of the two outer heads, and in the opposite sides of the central head, are formed circular cavities, concentric with respect to each other, eccentric with respect to the heads, and tangent to the inner surface of the cylinder between the ports. Hollow drums are made to fit into the cavities and abut against the heads. In the ring ends of the drums, close to the circumference of said ends, and extended longitudinally through said shell, are formed round holes, in which are placed cylinders which are slotted longitudinally to receive the shanks of the pistons, which receive the shaft and carry the same with them in their revolution. The outer end of the pistons is made with flanges upon its opposite sides, fitting into a recess in the face of the drums, and its outer surface is curved to correspond with the inner surface of the cylinder. The steam chest has two branch ports leading into the cylinder upon the opposite sides of the central head. As the steam is admitted through one of the ports, it forces the piston around the inner surface of the cylinder, the steam in front of said piston all the time exhausting through the other port. The movement of the piston will rotate the shaft and drum about their separate axes. The eccentricity of the drum and shaft with respect to each other, and the location of the ports with respect to said axes, gives space for the steam as it expands. To avoid this useless weight, the head of the piston may be made separate from its stem, and secured to it by screws, so that the head may be detached and the stem inserted and withdrawn through the interior of the drum; or a portion of one end of the drum, around the hole for the slotted cylinder, may be cut out and replaced by a piece secured by screws, so as to be readily detached and replaced. This allows the piston and cylinder to be removed together from the drum, the piston stem passing out edgewise.

Improved Plow.

Moses F. White, Douglassville, Texas.—This invention relates to turn plows, and consists in several features of improvement, by which the preparation and tillage of the soil may be done at less than the usual expense, and with more than the usual convenience to the farmer. By this invention, the cutter may be easily changed in depth or inclination and securely held at any point of adjustment.

Improved Plow.

Moses F. White, Douglassville, Texas.—The object of this invention is to provide an improved plow for cultivating cotton or other crops which are grown in rows or drills of the requisite distance apart. The improvement consists in the arrangement of a plate or share with an adjustable bar which forms what is commonly designated the point, and a grooved standard having lateral flanges having a broad flat foot to which the share is attached.

Improved Windmill.

John A. Jelley and Josiah N. B. Parris, Atalissa, Iowa.—This invention relates to that class of windmills which automatically adjust themselves to the wind. It consists of a set of vanes journaled upon a revolving plate, to which is pivoted a large main tail having a smaller supplemental tail at or nearly at right angles to it. When the wind blows too hard, it forces around the smaller tail, which, by means of a projecting arm, changes the direction of the main tail, and causes the revolving plate to turn and present the vanes more obliquely to the wind, thereby correspondingly reducing their velocity. Said tails are also controlled in their position by means of separate independent gearings of ropes, which are fastened to the same and pass around sheaves, contained within arms attached to the revolving plate, and are fastened within reach of the workmen below.

Improved Screw and Pivot Chair.

William T. Doremus, New York city.—The chair seat rests upon the rubber springs, which are seated on a cross bar and bolted thereto. In the center of the cross bar is formed a long socket, in which fits a screw which passes through a plate and into the pedestal. By suitable construction this screw is securely connected with the base, so that it will be firmly held. This construction also enables the pedestal to be made low, to better adapt the chair for being upholstered; and also enables it to be made lighter than is possible when the screw is attached to said base.

Improved Corn Planter.

John Clarridge, Mount Sterling, O.—To the free end of a lever which governs the dropping valve, and to the projecting side of the distributor, are pivoted the rear ends of two rods, the forward ends of which are attached to a slide. By suitable construction, as the slide moves forward the distributor is operated to drop the seed into the cavity of a standard, and the valve is closed to receive the seed. As the slide moves to the rearward, the distributor is turned to receive seed for another hill, and the valve is opened to drop the seed previously removed to the ground. The slide moves forward and back between four friction rollers pivoted to a plate attached to the front cross bar of the frame. To the end parts of the plate are attached two blocks as thick as the slide for the cross slide to work upon. The cross slide is held down upon the blocks by keepers. In the lower side of the cross slide is formed a cam groove to receive a pin attached to the slide, so that the latter may be moved back and forth longitudinally by the transverse movement of the cross slide.

Improved Cooking Stove.

James R. Williamson and John L. Williams, Jessup, Ga.—The stove is divided, by vertical partition plates, into compartments, of which the outer ones are arranged as fireplaces, with grates, ash boxes, front dampers, and doors constructed in the usual manner. The inner compartments are divided into the lower and upper sections, the lower sections being used as ovens, and provided with a door, hinged so as to swing in horizontal position, to be supported therein by chains of sufficient strength to support the bake pans thereon. The upper sections connect recesses of the partition plates with the fireplaces, and draw the flames through the same. The upper sections are cleaned from soot by a front opening and door above the door of the ovens. A chamber extends below the ovens, connecting by slotted apertures with the fireplaces and with the chimney. Pivoted dampers serve to open or close apertures, and admit thereby the fire to heat the ovens or exclude the same, as desired. The chamber may easily be cleaned by taking off the door. The rear wall is provided with draft openings near the top plate, which are opened or closed by dampers, so that cooking may be carried on in all the pots and ovens, or in any part thereof.

Improved Can for Cooling Milk During Transportation.

George W. Fluke, Mount Pleasant, Iowa.—The object of this improvement in cans for cooling milk during transportation is to utilize the cooling capacity of the ice or water which was allowed to run off in the milk can as in the improvements patented by same inventor under dates of March 3 and May 19, 1874. The present invention consists of an ice water receptacle, placed circumferentially around the milk can, and below and in connection with the bottom of the ice chamber or receptacle at the side of the can, for conducting the ice water around the lower part of the can, and discharge by an exit perforation at the upper part and near the end or partition of the water chamber.

Improved Horse Power.

Andrew Jackson Pierce, Cherryvale, Kan.—This is an improved horse power so constructed that it can be conveniently taken down, set up, and carried from place to place, and which will allow as many horses to be attached to it as the work to be done may require. This consists of a polygonal center block fastened to the ground, from which radiate a number of sills. Each sill carries a standard, and the standards support a frame in which are a number of vertical flanged pulleys. An endless chain passes around all the pulleys and also around a large gear wheel. From the latter motion is imparted to the mechanism to be driven. The draft bars are attached to the endless chain in any required number.

Improved Car Coupling.

John Pendergast, Spring Grove, Minn.—This invention consists of a drawhead with curved jaws which are fulcrumed to a slot of the drawhead back of the link cavity, so that the overlapping ends of the jaws pass through side slots of the mouth of the drawhead into the same, and couple thereby the link. The rear arms of the jaws are attached to a strong elliptic band spring, which is again applied at its rear part to a connecting bar sliding in a longitudinal guide perforation of the drawhead, and projecting beyond the front part above the mouth, so as to close the jaws when being carried back by the concussion of the drawheads, and be locked in this position by a pivoted spring lever catching into a notch of the sliding bar. On releasing the lever or treadle the link is instantly uncoupled by the spreading of the spring jaws.

Improved Clover Separator.

Zephaniah Miller, Canal Fulton, O.—In operating this machine, the clover is thrown on a stationary toothed feeding apron, whence it is carried on and over a cylinder to the teeth of the stemmer concave, when the stems are torn from the heads, and both are carried to a stationary conducting apron, and then to the separator, the broad teeth of the apron preventing any stems or pods from falling into the cylinder case. The feed bottom catches the heads which have fallen through between the slats of the separating belt, whence they are carried by the slats of said belt into the cylinder case, and then to the hulling teeth, by which the seeds are thrashed from the heads, when both are thrown over into the seed and pod conveyer. They fall thence into the seed separator, and are prevented from rising on the cylinder above the stationary toothed apron by its broad teeth. Thus the two operations, that of stemming and hulling clover, are performed by one beater cylinder. The pods and seeds pass from the conveyer to the platform and belt, by which they are delivered to the winnowing mechanism located under the platform.

Improved Sewing Machine Table.

James M. Baird, Wheeling, W. Va.—The object of this invention is to utilize the available space in the cover of the sewing machine, and to furnish an improved fastening of the same to the table; also to extend the table in such a manner that the cover may be placed in the rim like a leaf, and thereby out of the way. Beveled lugs slide into grooves at the inside of the cover, and lock in connection with a beveled cam, which is pivoted to the table and fits into a corresponding groove of the cover, securing the box firmly to the table. In the direction of the arm and needle bar are arranged parallel drawers. The top of the cover projects sufficiently to have the width of the table, and rest thereby on extension pieces, like the leaf of a folding table.

Improved Cotton Cultivator.

Theodore C. Burnham, Waco, Texas.—To the axle is attached a cone chain wheel, around which passes an endless chain, which also passes around a chain wheel, the journals of which revolve in the frame. To the front cross bar of the frame is secured a rod, which is hinged to the end of a block that rides upon the axle in a cavity formed in the side of the cone chain wheel, the said rod having a bend formed in it to pass around the rim of the said wheel. To the chain wheel are attached bevel gear wheels, which gear with vertical shafts. To the lower ends of the latter are attached circular cutters, made slightly convex upon their upper side and slightly concave upon their lower side, and in one side of each of which is formed a semicircular notch about six inches in diameter. The cutters are so arranged that the notches of the two cutters may be directly opposite each other, so as to leave an uncut space about six inches in diameter every time the notches of the cutters come together as the machine is drawn forward. Plows are attached to the forward part of the frame, in proper position to bar off the plants in front of the cutters, which cutters will thus have to cut only through the ridge of soil left between the furrows made by the plows. Guards are supported at the inner sides of the plows to guard the plants from being injured by rubbish or stones thrown against them. Suitable means support the cutters and plows of the said frame away from the ground, for convenience in turning and passing from place to place.

Improved Railroad Track.

Henri A. Corbin, Paris, France.—The ties by which the rails are connected are composed of a rod and tube, the former passing through the latter, and also through the rails, and having screw nuts applied to its ends. The ends of the tube abut against the inner side of the rails and thus hold them rigidly apart, while the screw rod equally prevents their separation. The rails are made of angle iron, one side or flange of which forms the base that rests on the ground. They are connected in sections by fish plates which are riveted or bolted to the ends of one pair of rails, and pivoted to the contiguous ends of the next pair.

Business and Personal.

COL1PLACEHOLDER

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Answers to Correspondents

E. T. C. can remove rust stains from calico by the process described on p. 148, vol. 27.—G. F. can fine his ale by the recipe given on p. 75, vol. 31.—G. W. P. will find directions for making a good black ink on 203, vol. 29.—M. will find details of a millstone cement on p. 246, vol. 30.—S. will find directions for making gutta percha varnish on p. 379, vol. 30.—J. M. W. does not forward any description of the invention on which he asks an opinion, but merely testimonials as to its merits.—W. P. B. and many others will find booksellers' addresses in our advertising columns.—J. S. B. will find full directions for tinning cast iron on p. 76, vol. 30.

S. T. B. says: A French chemist says: "By fabricating coke, nitrogen can be made." What is the meaning of fabricating coke? A. It means the making of coke by expelling from coal the principal gaseous and liquid matters that it contains. In the manufacture of gas, the coal is placed in retorts and heated; and when the gas passes out of the coal, the residue remaining in the retorts is called coke.

F. B. C. asks: What are ocher and umber? A. Ocher is a variety of fine clay containing iron. The common colors are yellow and red, the latter being colored by sesquioxide of iron, and the yellow variety by the hydrated sesquioxide. Umber is an ocherous ore of iron, of a brown or blackish brown color, consisting of oxide of iron, oxide of manganese, silica, alumina, and water. They are found principally in Europe, although they are widely distributed. The ocher is found in beds some feet in thickness, which lie generally above the oolite, and are covered by sandstone or quartzose sands, more or less ferruginous, and are accompanied by gray plastic clays, of a yellow or brownish color: all of them substances which contribute more or less to its formation. There are many large mines of it in this country, at Bennington, Vt., and in various other places. Umber is found in Europe, especially in the island of Cyprus, and also in this country in large quantities. They are used as pigments, and as dryers in varnish; also, sometimes, in coloring porcelain.

J. C. W. asks: 1. When a person is writing several hours every day, inhaling the air from ink which is drying so near him, does he receive into the lungs and the blood anything from the ink which may have a deleterious effect upon the heart or any other organ? A. Not from any of the common inks. 2. If only pure water evaporates from ink, would that moisture be likely to affect the lungs of any person bending over the drying paper from morning till night? A. No. 3. According to the sense of smell, when ink is freely used, the indications are that something more than pure water rises from ink in drying. If injurious to health, what would be its specific effect? A. Not injurious to health any more than minute particles of dust and saline matters, or traces of organic matters received from other sources.

P. H. S. asks: Can a calcium light be made so as to be carried in the hand on a foggy day? A. It has not, nor ever can be until some simpler form of apparatus is invented, which will combine the advantage of compactness with the ability to furnish cheaply the continuous flow of gases necessary.

How can a pattern of a pot be drawn, the bottom to be 7 inches in diameter, the top 3¾ inches across, and the pot 7 inches high? A. This question is somewhat confused. See Warne's "Sheet Metal Worker's Assistant."

Can colored candles be made to burn with a flame of the same color? For instance, for red, nitrate of strontium might be dissolved in boiling alcohol and the wick soaked in it. Boracic acid might be used for green. Can the colors be intensified in any way? A. We doubt very much as to whether the object desired can be accomplished, for various reasons, and certainly not in the way you speak of, from the fact that strontium nitrate is nearly insoluble in alcohol, consequently very little effect would be produced by a wick steeped in so weak a solution. So also with boracic acid, which, even in the most concentrated solutions, only tinges the edge or border of the flame.

How can I deposit a thin coat of platinum on metal by a plating process? Can I put it on as a wash, after dissolving in nitro-muriatic acid? A. Your best method would be that of electroplating; the best solution to employ is the nitro-muriatic, to which sufficient soda is added to render it neutral. The object to be coated should be cleansed by potash before the process is commenced. A fine platinum wire connected with the positive pole of the battery is placed so as to dip into the solution; the object to be platinated is placed by a wire in connection with the zinc or negative pole, and also placed in the solution. If the battery be not too strong, in a few minutes the object will be coated with platinum.

W. H. C. Sr. says: There is a man in our neighborhood who says that, if a boiler with both heads out were set up on end in a body of water (it matters not of what depth, provided the upper end is above water and the lower end sunk in the mud deep enough to prevent water from leaking in), when the boiler is pumped clear of water, the boiler will rise from the mud immediately after being pumped out and refill. I contend the contrary. Who is right? A. We incline to your opinion. It is an experiment that can very readily be made with a piece of tin pipe.

D. K. S. says, in answer to J. J. K.'s question in regard to the British man of war sunk at Hell Gate about 1747: I would state that it has been visited by divers for several successive years; with what success as to money obtained, I cannot tell. It is buried deep in the mud and difficult to get at, and can only be visited in good weather and at certain times of tide. I have several relics in my possession which were taken from her.

J. O'D. asks: I have often felt the want of ventilation in railway cars, and I have wondered why the companies did not do something towards remedying the evil. But I am not surprised now, having read your article on the subject in a recent number. I was not aware that so many methods had been tried without success. Would it not be well for the companies to offer a prize for a successful invention, that would bring all the inventive talent to bear on the subject? We should then, I believe, soon have a good method of ventilation. A. The suggestion of our correspondent is an excellent one. Let the railway companies unite in offering a prize say of *fifty thousand dollars*, and doubtless the desired invention would be forthcoming.

J. H. McD. asks: The follower on a steam engine of 32 inches diameter (of a condensing engine on a steam boat), pulled off the follower bolts, nuts, and fastenings with it, and broke the cylinder, as the piston was coming up with the steam under it, and a vacuum of 26 inches over it (on the follower). It is a disputed question whether the vacuum on the top of the follower had any tendency to pull the follower, or in any way remove it off its seat. A. It did not have any tendency to pull the follower, but did render it easier for the follower to be pushed by the pressure on the other side.

S. F. R. asks: If there is a certain quantity of water in a boiler, and that amount of water be converted into steam, would there be the same amount of water when condensed if there were no means of escape? Is there any decrease in water by boiling it? A. There would be the same amount afterwards as before, under the given circumstances.

H. L. K. asks: 1. Is an artesian well sunk in the same way and by the same apparatus as a common drive well? A. Not generally. Artesian wells are usually of such depth as to require the hole to be bored by a boring designed for the purpose; whereas the hole of a drive well is commonly made by driving the tube into the ground. 2. Is the same kind of piping used in both? A. No, the pipe for artesian wells is put together in sections, in consequence of the extreme length; the pipe for a drive well, being short, is usually in one piece, one end being closed and pointed so as to enable it to drive. 3. What is the diameter of the pipe used in sinking an artesian well? A. The size varies from 2 to 5 inches, as a rule.

W. H. K. Jr. asks: What ought be the thickness at top and at bottom of two square brick stacks, respectively 100 feet and 140 feet high, each having an 8 inch square flue for the entire hight? A. For the 100 feet stack, make the walls 8 feet thick at bottom and 16 inches thick at top, the brickwork being of hard brick and cement mortar.

A. L. D. M. asks: I have a boiler 56 inches long and of 28 inches diameter, with 20 tubes of two inches diameter; the dome is 16x20 inches, of iron ¼ inch thick. How many pounds steam will be safe to work at highest rate? A. About 80 lbs. per square inch.

M. H. R. says: To become a surveyor, is it necessary to study at a university? If not, what should I do to become one? A. It would be better for you to obtain some instruction at a good engineering school. But many surveyors learn their profession by actual practice in the field (which, of course, would be necessary after leaving school) without the preliminary education of which you speak. If you are determined to become a good surveyor, you are pretty certain to succeed, whichever course you take.

H. C. T. asks: I wish to supply a tank, situated on top of a levee, with water from a river, the tank being 100 feet from the river, the levee sloping at an angle of 45°. What will be the cheapest way of supplying the tank, by machinery? A. An ordinary steam pump, if the quantity of water required is small, and a centrifugal pump, or well designed pumping engine, for small quantities.

F. G. H. asks: If a toy balloon were cut loose to go whither it would be blown, what would be the result? Will balloons burst if they rise as high as possible? A. Yes; but they seldom reach a sufficiently high altitude, because of the loss of gas.

R. K. asks: The lightning rod on my house runs underground several feet. Would it be any advantage to put a wheelbarrow full of wrought or cast iron turnings at the end of the rod, letting it bed itself in them? A. It would undoubtedly increase the safety of your house if you place a mass of conducting material, as you propose, into connection with the lower end of your lightning rod. Better dig a trench and spread the iron along in it.

J. J. S. asks: Is magnetic iron sand worked practically at any place in the United States? In Vermont we could obtain large quantities daily. Being very pure, it would be an inducement to establish works. A. Not to any extent. Much iron sand is titaniferous, and it would be necessary before mining to see whether it was all magnetite, or contained an injurious amount of titaniferous iron.

E. C. M. asks: Would a boiler be subject to damage by having a slight blast underneath? If so, to what extent? The blast is to be used for the purpose of smelting ore. A. It is not usual to employ a blast in this manner; generally the blast is employed to clean off the bottom of the boilers. Two probabilities present themselves. First, that the blast would increase the rapidity with which the boiler would burn out. Second, that if your blast were mixed with the products of combustion, it would be injured so far as its further employment in the smelting of ores was concerned.

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collapse, it will of course rise from the ground. This is, in other words, the same thing as saying: Cannot a hollow globe be constructed of sheet metal, of uniform thickness, if circular, or of proportional thickness if elliptic, sufficiently strong to resist upon its outside or convex surface, a pressure of not more that fifteen pounds to every square inch? If the answer to this proposition be an affirmative one, in actual practice demonstrated by experiment, then the greatest difficulty in aeronautic science is removed. After this point of aerial ascension is practically settled, and the balloon constructed on some such plan as to be easy to manage at any altitude, I believe we shall go ahead with aeronautics, and not before. A. One of the earliest flying machines ever made had four sheet copper balloons attached to the corners.

D. M. asks: What can I coat sheet zinc with (that will not be dissolved by water) to take away the smell and taste which it gives to water and other things in a refrigerator? Can the taste of the zinc be got rid off in some other way? A. Use paraffin varnish. A solution of paraffin may also be used.

N. L. T. asks: 1. I have a horizontal boiler of copper 1 foot long by 10 inches diameter, the copper being 1 3-16 inches thick. How much pressure will it stand? A. About 100 lbs. per square inch, if the joints are brazed. 2. The safety valve has a hole of 3-15 inch in diameter, and with the weight at the end of the lever it takes 21 ozs. (avoirdupois) upward pressure to raise it. How many lbs pressure are there? A. More data are required, namely, the weight and dimensions of the lever, the weight of the valve and ball, and the distance of each from the fulcrum.

J. H. B. asks: How can I clean off the rust from a revolver, and prevent it rusting hereafter? A. Clean the rusty parts with brick dust, then brown the parts that have become brightened in cleaning by rubbing them with a rag wetted with nitric acid. To prevent future rusting, have the parts lacquered.

H. G. L. asks: 1. In a recent issue, I have seen that correspondents ask how to estimate the horse power of an engine, and in some cases you answer that sufficient data are not given. On p. 314 of your vol. 30, a correspondent asks what would be the horse power of an engine that has 36 inches stroke and 16 inches diameter of cylinder, running 45 revolutions per minute with 70 lbs steam. What is lacking to enable you to estimate the horse power of the same? A. The mean effective pressure of the steam on the piston. 2. Will you please give us the formula and work out the following example for the benefit of your readers: What would be the nominal horse power of an engine of 17 inches bore of cylinder, 17 inches stroke of piston, with 65 lbs. steam pressure, running at 85 revolutions per minute, using common slide valve? What have we omitted in this example, to supply the necessary data? A. The ordinary rule for finding the nominal horse power of a non-condensing engine is as follows: Nominal horse power

$$= \frac{\sqrt[3]{\text{stroke in feet}} \times (\text{diameter in inches})^2}{20}.$$

Hence sufficient data are given. The actual horse power, however, depends upon initial pressure, point of cut-off, amount of wire drawing, back pressure and compression, none of which data are furnished by you. 3. In a recent issue you say that an engine with 24 inches stroke running 90 revolutions per minute has a piston speed of 240 feet per minute. In this reply I differ with you. Then 24 ×2=48÷12=4×90=360. Am I right? A. You are right.

Suppose a steam hammer has a cylinder 18 inches bore x 22 inches stroke, with lifting block (attached to piston rod) weighing 1,800 lbs. What would be the force of the blow in lbs. struck? If a weight weighing 865 lbs. be elevated 23 feet and let fall (of its own weight), what would be the force of the blow struck in lbs.? Will you give us the formula for these examples? A. We do not know of any formula by which you can solve these examples.

G. M. asks: Does clearance between piston head and cylinder, more than sufficient for the safe working of the engine, help to keep the engine from knocking when it passes the ends, or does it do any good in any way? A. No.

S. D. Jr. asks: What are the rules for proportioning engines? Will a boiler of 3¼ inches diameter x 15 inches length be of sufficient capacity to drive an engine of 1¼ inches bore x 2½ inches stroke? The boiler is heated with 3 or 4 gas burners. A. It is difficult to give definite rules for such small boilers, as a great deal depends upon the manner in which they are constructed and set. Allow from 15 to 20 square feet of efficient heating surface for each horse power of the engine.

W. T. W. asks: If a pendulum 39 inches long strikes once in a second, how long would the pendulum have to be to strike once in a minute? A. 11,300 feet.

C. D. asks: Please give me a simple rule for calculating the pressure on safety valves of steam boilers. For instance, what would be the pressure of valve with weight of lever 4 lbs., length of lever from fulcrum to weight 22¼ inches, from fulcrum to center of valve 2¼ inches and weight on lever 20 lbs.? A. You do not send enough data, the weight of the valve and stem and the position of the center of gravity of the lever being required. But neglecting the weight of the valve, and supposing the center of gravity of lever to be midway between the fulcrum and weight: Pressure on valve ×2¼=4×11·25+20×22¼. Whence pressure on valve=198 lbs.

E. S. W. says: All books say that an artificial horizon, to be used with the sextant on land, should be made of mercury, or some other fluid. Would it not be equally well to use a mirror or looking glass placed on the ground and leveled by a small spirit level? A. When one considers the error caused by even a very slight divergence from the proper level in measuring the altitude of an object millions of miles away, and remembers that it is very probable some inaccuracy of adjustment will occur, he will be very likely to agree with a friend of ours, who said that the method reminded him of the farmer who guessed at the weight of a stone, after using it to ascertain the weight of his pig.

J. A. H. Jr. asks: Is it necessary that parties running a steam launch or small steamboat (for their own pleasure or convenience, and not as public carriers) should comply with the steamboat law requiring the employment of a captain, pilot, and licensed engineer? A. We think not.

G. R. C. asks: What would be the effect on a volume of steam going through a pipe if it came to a place where the pipe turned a right angle? A. The pressure would be reduced, on account of the resistance due to the bend, and some of the steam would, in general, be condensed.

H. P. C. says: I have made a very nice kind of black ink with extract of logwood, bichromate of potash, and prussiate of potash, and for a while it works well. But now it has grown thick as mud, and molds. What can I put in it to keep it thin and liquid, to prevent its molding? A. The thickening is probably due to evaporation. Your bottles should be kept well stoppered. Try a little carbolic acid.

H. B. T. asks: What power of engine will it take to force a stream of water 4 inches in diameter to a distance of 85 feet through a pipe, the first 60 feet to be forced at an angle of 45°, and the remainder, 25 feet, to be forced perpendicularly into a tank? A. It depends entirely upon the quantity of water required to be forced up the pipe in a given time, which quantity will always be answerable to the capacity of the pump and its number of strokes per minute; this latter will be regulated by the proportion between the area of the pump piston or plunger as compared to the area of the steam piston. The more the area of the latter exceeds the area of the former (the lengths of their strokes being equal), the faster the pump will run; the area of steam piston is commonly the same as that of the pump piston; if the water requires lifting only for forcing, the steam area may be made twice or three times the pump area. Your first element is therefore the quantity of water per minute required to be forced up the pipe.

I. D. McC. says: Suppose that a boat is floating on perfectly still water, and that the boat has a sail in the fore part and a large bellows in the back part. Now if air is forced upon the sail from the bellows, would it cause the boat to move? A. The boat would not move by forcing the air against the sail. But by removing the sail and discharging the air from the bellows against the atmosphere, then the boat will move.

C. W. J. asks: In the case of mill rocks, when the lower rock is stationary, the upper doing the work, is the attraction of gravitation diminished when the rock is in motion? Does it require a greater strength of support to sustain the weight of the upper rock when in motion than at rest? It is contended by some that the weight is less; and they endeavor to maintain their argument by citing, as an illustration, the governor balls of a steam engine, stating that the centrifugal motion destroys, to some degree, the weight of the governor. A. The weight is the same, whether the stone is at rest or in motion.

G. A. N. asks: 1. Would a boiler made from 3-16 iron, 10½ inches in diameter and 26 inches high, with 26 tubes 12 inches long and of 1 inch diameter, with tube sheets ¼ inch thick, be of sufficient power to drive an engine of 2 inches bore and 7 inches stroke? A. No. 2. What will be the fire surface of such a boiler? A. It will depend upon the manner in which it is set. The fire surface may be the surface of the tubes and one end of the boiler, and may have the surface in the shell of the boiler, in addition.

E. V. asks: Is it possible to compress steam of a low temperature, say 220° Fah., by any of the known means (for example, by a pump) to a pressure of say 90 lbs. per square inch, without increasing the temperature, and have any such experiments ever been made? A. It can be done by making provision for removing the heat of compression by some method of refrigeration. We do not know of any experiment on the subject.

P. R. asks: In case of shutting down for 1 or 2 weeks, is it injurious to the boiler not to blow off, but to let the water stand till starting up again? A. If the water is pure, it may be left in the boiler; but if it contains minerals in solution, it is better to blow off and clean the boiler. 2. Which is the best time to blow off, with a pressure of steam or not? A. The best plan, if the water will run out without pressure, is to let it stand for 12 hours after hauling the fire. 3. What effect does oil going in with the feed water have on the boiler? A. It frequently causes priming.

What is meerschaum? A. It is a hydrous silicate of magnesia, occurring chiefly in Asia Minor.

I have suffered for the last eight years with a bunion or something of the kind on my foot. How can I get relief? A. Shoes made by a man who understands the anatomy of the foot are sometimes efficacious in cases of this kind.

A. V. asks: Would a sewing machine making a stitch similar to hand sewing be more popular than the present kind? A. Some people might prefer it.

Suppose I had a hollow iron ball, 1 foot diameter with the shell ¼ inch thick, what force would it require to hold it 3 feet under water? A. You can readily make the calculation. The weight of the ball tends to keep it down. The weight of an equal volume of water tends to force it up.

I am an amateur mechanic, and wish to make a cupola on a small scale for casting small articles. Could I do it economically? A. Not unless you have had some practical experience in the matter.

Is there a reward offered for an apparatus for detecting cheating on the part of conductors on railways and street cars? If so, by whom, and how much is it? A. There is no reward publicly offered; but the managers of railway companies will doubtless be willing to compensate any one who brings them a useful invention for the purpose set forth in your question.

Would it not be a good idea to use molds for castings made out of wood and saturated with silicate of soda? A. No.

Where can I get a book on chemistry for beginners? A. You will find notices of publishers of such works in our advertising columns.

J. S. S. asks: Is it economy to keep 60 lbs. pressure of steam in boiler when 40 lbs. will do the work required? I am running a steam grist mill and 40 lbs. steam in boiler will drive the rock; but I contend that it is economy to keep 60 lbs. in boiler. A. You do not send sufficient data. If you have an automatic cut-off engine, it would be more economical to maintain the higher boiler pressure.

S. R. says: A man was killed in a well last summer by gas. The well was completed, being laid in brick and water lime mortar; the plank curbing and pump were fixed in the same, and the well was probably airtight, with the exception of a very small crack between two planks. The first cold snap that came, a sharp whistling sound could be heard. Our neighbors are superstitious. We thought the air contracted in the well and the outside air rushed in through the crack. We placed straws across the crack, and they sucked down. Can you explain it? A. The crack probably connects with some crevice in the earth, which communicates again with some larger chambers or caves in the ground; and there being other openings in other localities, opportunity is given for the wind to blow through them.

M. S. C. Jr. asks: 1. Of what horse power do they usually make narrow gage railroad engines? A. One hundred horse power, and over. 2. How much more can a railway engine draw than a road engine of the same horse power? A. From 8 to 10 times as much. 3. What is the average cost of a narrow gage railroad engine, and how much does it cost, more or less, than a road engine? A. It is about the same as the cost of one of the larger sizes of road engines.

B. G. says: I have a pump barrel, 3-16 inch thick by 5 inches diameter, length 10 inches. Will it be strong enough to make a cylinder for a small engine, and about how many pounds of steam to the square inch will be safe for it? A. You can use it for pressures of from 20 to 25 lbs.

T. S. S. asks: Do the drive wheels of some locomotives have a lining of wood underneath the tyre? If so, what is the idea? A. Some passenger car wheels are made in this way, but we are not sure whether the plan is employed in the case of locomotive drivers. The object is to deaden the shock and noise.

L. G. K. says: I am running a twenty-five horse engine, and we have to use hard limestone water, which is so hard that we cannot run more than three or four days without blowing out dry and filling up the boiler again. Will a little lime in the tank from which I feed the boiler be of any use in checking the boiler from foaming? If not, what will prevent it? A. A feed water heater, arranged to deposit the mineral substances of the water before it entered the boiler, would be serviceable in this case.

W. R. asks: Will an iron wire ½ inch in diameter and 500 feet long be strong enough to draw a load which would require the strength of one horse to pull? The wire is to be supported on rollers 100 feet apart, each roller to be removed as the load reaches it; the wire to be wound around a large stationary wheel turned by water power. If the ½ wire will not answer, what size will? A. It would be better to use a wire rope ⅝ inch in diameter.

C. F. D. asks: Will you give me a rule for lining up propeller shafts? A. We copy the following rule from the "Cadet Engineer," by Long and Buel: Put two straight edges on the slides, one at each end; run a line through their center points, and continue it beyond the shaft. Set a T square on one of the straight edges, making one edge of the blade cut the center point. Then erect a perpendicular, at the center of the shaft, to the line previously run, by locking it out of wind with the edge of the T square (or arranging it so that, when viewed from a distance, it covers the edge of the T square for the whole length). Then swing the crank, disconnected from the rod, on the centers and half centers, and measure the distances of its face from the two lines. If they vary at different points, the shaft is not in line, and must be adjusted until the distances are the same for all points of the revolution.

I have heard engineers speak of working up indicator cards. What working up is there to do after the card has been taken? A. It is usually desirable to ascertain the mean pressure, back pressure, point of cut-off, etc.

H. B. asks: Is there such a thing as a pickle or solution, capable of removing the sand that adheres to iron castings? A. Place your castings in equal parts of oil of vitriol and water; and after they have remained there two days, wash them with clean water, and the sand will be removed.

A. C. says: I have now in use a steam boiler, 24 feet long by 4 inches diameter, with two 14 inch flues; and I want to put in its place a boiler 10 feet long by 48 inches diameter, with 75 flues 2½ inches in diameter, with a dome 24 inches diameter by 28 inches high. I wish to know if, with equal draft and setting, the 10 feet boiler will make much more steam than the long one, with less fuel. I drive now 2 engines with my present boiler, 10x16 inches, making 160 revolutions, cutting off at ½ stroke; but I have to burn too much fuel. One boiler maker tells me that the short tubular boiler will make more steam than the old one, with a great deal less fuel, and another boiler maker says that the short boiler is too small and will have to be crowded too much to do the same work as the long two flue boiler. Please give me your opinion. A. We advise you to continue to use the old boiler as long as it is serviceable. We incline to the opinion of "another" boiler maker.

G. L. D. L. asks: What would be the proper speed of an emery wheel, 13 inches in diameter, with 2 inches face, to do the most efficient service with safety? A. About 1,200 revolutions a minute.

J. E. P. asks: Would not a single cylinder engine of such proportions as to allow the admitted steam to expand to atmospheric pressure be as economical and effective, other things being equal, as one of the compound system? A. Yes.

J. A. says: I have at my house a large underground brick cistern. Water comes from a French roof, with the upper part tinned, sides slated, conductors (bright tin) inside to the ground, and glazed earthen pipe in the ground. The water is drawn out of a tight brick box, serving as a filter, through a block tin pipe. When the cistern was built, the top of the roof had had several coats of lead paint. I then had all the painted tin and painted eaves troughs covered with one of the patented slate paints, which covers well and appears to be a solid coating. The cistern has now been in use 1 year. The water is somewhat yellow and still tastes slightly of cement; but is odorless and soft. Am I safe in using the water for drinking without fear of poison from the roof? A. The water is probably affected by particles disintegrated from the brick and cement mortar; probably the sand used in the mortar was loamy. We do not think that the lead paint, if covered with a coat of slate paint, since become hard and firm, can much affect the water. An additional filter at the discharging end of the pipe might be used to advantage, and the present filter cleaned out and supplied with new material.

J. T. J. asks: What is the percentage of power or fuel lost by wire-drawing steam from 100 lbs. pressure per square inch to 60 lbs.? A friend contends that there is no loss, providing the engine is large enough for its work. A. If you suppose steam of 100 lbs. pressure: (1), To be expanded in the cylinder, so as to make the mean pressure 60 lbs., and (2) to be wire-drawn, before admission, to 60 lbs., and to be used in the cylinder without expansion: The loss from wire-drawing will be the difference in the amounts of steam required in the two cases, which you can readily calculate for any given case. In such a case the loss from wire-drawing would be excessive. In general, however, the steam is expanded as well as wiredrawn, which modifies the loss, though it is always more economical to expand the steam than to reduce the pressure by wire-drawing.

I. E. W. asks: How many square feet are there in a spiral screw, winding 5 times around a shaft 15 feet long and 3¼ inches diameter? The depth or width of the screw is 8 inches, and the diameter of screw and shaft together 19¼ inches. About 101 square feet.

L. & J. ask: Should an architect charge for extra work on a building ordered by owners but entirely outside of specifications, and not superintended by the architect? We have a case in hand on our new office, and think there is no justice in the attempt of the architect to charge for such service, not having rendered any. The work disputed on is such as the digging of cistern, catch basin, ceiling around elevator, overhead in basement, laying brick flooring, etc. The verbal agreement was a certain percentage on contract prices. There were no changes in plans or specifications to architect. We feel that, having ordered and superintended the work ourselves, we should not pay commission on it. Your answer will settle the question satisfactorily to both of us. A. You do not say whether the architect superintended the building generally. An architect's commission is divided usually into compensation for office work and for superintendence, from 2½ to 3½ per cent for the former and 5 per cent for the whole. Office work is considered the furnishing of plans and specifications, and sometimes working drawings; the percentage for this should be taken on the whole cost of the building, unless so great an addition is made to it as to involve the necessity for an additional plan and specification for said addition from other parties. But in respect to superintendence, the case is different; that part only should be taxed which is actually superintended by the architect.

J. S. W. asks: I am constructing a bath house in a running stream of fresh water; can I build the foundation walls and the bottom with bricks and common mortar, providing that I allow the mortar in the walls to thoroughly dry before turning in the water, so that it will be sound and substantial? I know that there is a cement used for walls which are to be inundated, but I desire to use common mortar if it is practicable. A. It will not be safe to use common lime mortar for brick work under water. You should use a good hydraulic cement and clean, sharp sand, free from loam. It will be the most economical in the end.

If a hole of an inch in diameter be drilled through a fresh, green ⅜ inch plank, will its edges shrink? In other words, will the hole become larger, or remain of the same size? A. The board will shrink without reference to the hole, and the result will be that the hole will become after the shrinkage somewhat narrower but of the same length as at first.

D. & W. P. E. say: Our houses are supplied with water through a 3 inch iron pipe coated on the inside with gas tar; but although the pipe has been laid 2 years, the water, having little or no mineral deposits in solution, continues to taste very disagreeably of the tar. Can we place any chemical solution in the tank supplying the water, which will remove the taste yet not be injurious? A. It is doubtful whether you can do anything that will be successful with the present pipe.

We have a frame building, roofed with shingles which have been opened by the sun in large cracks; as our mill is close enough to be burnt if this building was, we would like to ask if there is any cement or composition with which to fill the cracks, which will be fireproof and at the same time not be dislodged by rain or frost? A. There are several patent compounds in the market, which are said to be efficacious in such cases.

We have an elliptical reservoir, 20x30 feet and about 4 feet deep; the sides are composed of ordinary 18 inch mortar wall, banked on outside with dirt, and covered on inside and top with Rosendale cement (2 parts cement to 1 of sand); but last winter the frost cracked off the cement on the top and sides, making the reservoir leak like a sieve. What would be best to do to make it tight? A. It will probably be necessary to draw off the water and relay the stones.

G. W. C. says: G. N. S. can straighten a gun barrel by constructing an apparatus something like a bow for shooting an arrow. The cord is to be made of silk thread and quite fine. Put the cord through the barrel and strain it with the bow. The barrel must be smooth and clean. Hold it up, and let the bow hang under the barrel; and you can easily see where the crook is, and with a blacksmith's hand hammer, on an anvil or the end of a hard wood block, can straighten your barrel.

G. M. says, in answer to H. E. K., who asks for the best way to make putty of the colors of different woods, walnut, ash, etc.: In my experience, I have found that the best way was to soften up white putty with linseed oil, and then work in dry color or colors until the desired shade is reached. It can be done in small quantities as it is needed, with very little trouble.

B. W. says, in reply to H. P.: If a mixture in the proportion of a quarter of a pound of lime, made into a paste and added to a spoonful of powdered alum, be put into 200 gallons of water, it will soften the water, and precipitate vegetable and other matter.

J. H. says, in reply to C. L., who asks how to can green corn: The following method cannot be excelled: Dissolve 2¼ ozs. tartaric acid in a pint of water. Of this solution, use one tablespoonful to every pint of corn while the corn is at boiling heat. When opened for use, add one teaspoonful soda to every three pints of corn.

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

J. S. McC.—No. 1 is a readily fusible amphibole, with a specific gravity of 3 16. No. 2 is specular iron ore. No. 3 is specular iron ore imbedded in quartz.—L. S. P.—The powder contains common salt and a number of other substances in small quantities. It is utterly useless for the purpose for which it is sold. As it does not prevent in the slightest degree the explosion of these light oils, its sale should be regarded as criminal.—H. M. S.—We are unable, without having the entire plant, to identify it, to see whether any notice of its possessing a fiber had been taken hitherto.—G. H. G.—It is galena, or sulphide of lead.—F. W.—It consists principally of hydrated sesquioxide of iron, with a small amount of silica and clay.

A. F. P. C. says: I have not succeeded in preserving fish which is oily, on account of the oil becoming rancid in a short time. If this difficulty could be overcome, a very large business might be done in drying salmon in California. It would hardly do to extract the oil, but it might perhaps be neutralized without destroying the flavor of the salmon.—J. T. P. asks: 1. What kind of sealing wax is best to use in sealing glass jars? I have lost much fruit by the wax not adhering to the glass. 2. Why will tomatoes not keep well in glass?—J. A. T. asks: 1. Is the disease called pip among chickens on the tongue? 2. Will it produce death unless cured? 3. What is the remedy therefor?

COMMUNICATIONS RECEIVED.

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

On Tempering Steel and Copper. By J.S.M.
On the Nickel Plating Patents. By A. D.
On the Atmosphere. By H. W.
On Moles. By W. S. N.
On Hardening and Tempering Tools. By J. P.

Also enquiries and answers from the following:

A. D. H.—W. E. K.—F. L.—F. A. B.—W. D. P.—A. J. Q.—N. M.—A. D.—R. Y.

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 enquiries analogous to the following are sent: "Please to inform me where I can buy sheet lead, and the price? Where can I purchase a good brick machine? Whose steam engine and boiler would you recommend? Which churn is considered the best? Who makes the best mucilage? Where can I buy the best style of windmills?" All such personal enquiries 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

July 14, 1874,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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Washing machine, J. C. Burgner	153,045
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Windmill, S. M. Abbott	152,937
Window sash, reversible, J. McNamee	153,100
Wire, straightening and cutting, J. Greenwood	152,989

APPLICATIONS FOR EXTENSIONS.

Applications have been duly filed and are now pending for the extension of the following Letters Patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

30,398.—BURGLAR PROOF SAFES.—J. R. Floyd. Sept. 30.
30,594.—DOOR LATCH.—T. Slaight. October 21.

EXTENSIONS GRANTED.

29,137.—CAB COUCH.—W. A. Brown.
29,162.—PLOW.—L. Green.
29,180.—HOISTING APPARATUS.—T. Lemman.
29,200.—STEERING VESSELS.—F. E. Sickels.
29,212.—SPRING HINGE.—A. Acker.

DISCLAIMER.

29,180.—HOISTING APPARATUS.—J. Lemman.

DESIGNS PATENTED.

7,535.—BAS RELIEF.—T. Kappeler, Cambridge, Mass.
7,536 & 7,537.—MUFFS.—G. H. Prindle, Philadelphia, Pa.
7,538 to 7,540.—LAMP BRACKETS.—F. R. Seidensticker, West Meriden, Conn.
7,541 to 7,546.—CARPETS.—R. R. Campbell, Lowell, Mass.
7,547.—CARPET.—C. S. Lilley, Lowell, Mass.
7,548 & 7,549.—CARPETS.—D. McNair, Lowell, Mass.
7,550 & 7,551.—GLASSWARE.—D. Bennett, Baldwin township, Allegheny county, Pa.
7,552 to 7,557.—CARPETS.—R. R. Campbell, Lowell, Mass.
7,558 & 7,559.—CARPETS.—D. McNair, Lowell, Mass.
7,560 to 7,563.—CENTER PIECES.—J. O'Neill, San Francisco, Cal.

TRADE MARKS REGISTERED.

1,872.—HATS AND CAPS.—J. S. Fayerweather & Co., Danbury, Conn.
1,873.—ALE.—C. P. Hawkins, New York city.
1,874.—BEVERAGE.—G. N. Irish, Brooklyn, N. Y.
1,875.—FLOUR.—Metzger & Co., Platte City, Mo.
1,876.—GREEN PAINT.—Woods, Son & Co., N. Y. city.
1,877.—CIGARS.—C. Brewer & Sons, Boston, Mass.
1,878.—CHEWING GUM.—Curtis & Son, Portland, Me.
1,879.—FLOUR.—Bain et al., St. Louis, Mo.
1,880.—CUTLERY.—Hermann & Co., New York city.
1,881.—TOBACCO.—Beck et al., Chicago, Ill.
1,882.—BOOKS.—McNair et al., Philadelphia, Pa.

SCHEDULE OF PATENT FEES.

On each Caveat	$10
On each Trade Mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On application for Extension of Patent	$50
On granting the Extension	$50
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On application for Design (7 years)	$15
On application for Design (14 years)	$30

CANADIAN PATENTS.

LIST OF PATENTS GRANTED IN CANADA

JULY 16 TO 20, 1874.

3,658.—D. M. King, Mantua Station, Portage county, O., U. S. Improvements on potato diggers, called "King's Potato Digger." July 16, 1874.

3,659.—L. Dauze, Montreal, Montreal Dist., P. Q. Improvements on cooking stove, called "Mechanic Stove." July 16, 1874.

3,660.—D. Zeigler, Lewistown, Mifflin county, Pa., U. S. Improvements in Mechanical movements, called "Zeigler's Improved Mechanical Movement." July 16, 1874.

3,661.—W. G. Dunn, Greensburgh, Decatur county, Ind., U. S. Improvements on joints of rails for railways, called "Dunn's Adjustable Combination Railway Joint." July 16, 1874.

3,662.—E. E. Bean, Boston, Suffolk county, Mass., U. S. Improvements in gas lighting apparatus, called "Bean's Pneumatic Electric Gas Lighting Apparatus." July 16, 1874.

3,663.—J. C. Todd, Toronto, Ont. Improvements in toy guns, called "Todd's Improved Dog Gun." July 16, 1874.

3,664.—W. Briggs, Montreal, Montreal Dist., P. Q., and L. Senécal, Coteau St. Augustin, Hochelaga county, P. Q. Improvement on manure and hay forks, called "Briggs' Combined Manure and Hay Fork." July 20, 1874.

3,665.—E. A. C. Pew, Welland, Welland county, Ont. Improvements on peat machines, called "Pew's Peat Coal Machine." July 20, 1874.

3,666.—G. Stacy, Montreal, Montreal Dist., P. Q. Improvements on chisel pointed cut nails and machines for making the same, called "Stacy's Chisel Pointed Nail." July 20, 1874.

3,667.—T. W. Shaler, Brooklyn, Kings county, N. Y., U. S. Improvements on signal lanterns, called "Shaler's Signal Lantern." July 20, 1874.

3,668.—W. Baxter, Jr., Newark, Essex county, N. J., U. S. Improvements on compound engines, called "Baxter's Improved Compound Engine." July 20, 1874.

3,669.—W. E. Kelly, New Brunswick, Middlesex county, N. J., U. S. Improvements on steam generators, called "Kelly's Sectional Boiler." July 20, 1874.

3,670.—G. Forsyth, Seaforth, Huron county, Ont. Improvements in the manufacture of picket fences, called "Forsyth's Improved Wire Picket Fence." July 20, 1874.

3,671.—R. Dunlop, St. Thomas, Elgin county, Ont. Improvements on steam and gas fitting wrenches, called "Dunlop's Improved Steam and Gas Fitting Wrench." July 26, 1874.

3,672.—J. E. Harriman, Bangor, Penobscot county, Me., U. S., assignee of M. L. Norton, same place. Improvements on lath machines, called "Norton's Improved Lath Machine." July 20, 1874.

3,673.—H. Palmer, Westminster, Middlesex county, Ont. Improvements on a machine for destroying potato bugs, called "Palmer's Potato Bug Killer." July 20, 1874.

3,674.—C. E. Patric, Springfield, Clark county, O., U. S. Improvements on a machine for sowing grain broadcast, called "Patric Broadcast Seeding Machine." July 20, 1874.

3,675.—R. Benner, Hamilton, Wentworth county, Ont. Improvements on the art or process of veneering, called "Bennett's New Process of Veneering." July 20, 1874.

3,676.—A. McCannel, Caledon, Peel county, Ont. Improvements in self-opening gates for railway crossings, called "McCannel's Self-Operating Railway Gate." July 20, 1874.

3,677.—L. O. Cantin, Montreal, P. Q. Improvements in machine for burnishing photographs, called "Cantin's Photograph Bu isher." July 20, 1874.

3,678.—J. Rourk n gston, Frontenac county, Ont. Improvements in mospheric engines, called "Rourk's Automatic Atmospheric Engine." July 20, 1874.

3,679.—J. F. Stairs, Halifax, N. S. Improvements in material for calking, called "Stair's New Stock Oakum." July 20, 1874.

3,680.—T. J. Blake, Pittsburgh, Allegheny county, Pa., U. S. Improvements in the manufacture of smooth back shovels, called "Blake's Smooth Back Shovel." July 20, 1874.

3,681.—G. B. Cornell, Chicago, Cook county, Ill., U. S. Improvements in wrenches for inserting bung bush , called "Cornell's Bush Wrench." July 20, 1874.

3,682.—C. Jerome, Chicago, Cook county, Ill., U. S. Improvements in moth proof fur cases, called "Jerome's Moth Proof Fur Cases." July 20, 1874.

3,683.—R. P. Colton, Gananogue, Leeds county, Ont. Improvements on harrows, cultivators, and analogous implements, called "Gananogue Improved Harrow." July 20, 1874.

3,684.—J. M. Foss, St. Albans, Franklin county, Vt., U. S. Improvements on railway locomotive engines, called "Locomotive Draft Regulator." July 20, 1874.

3,685.—T. Ford, Plattsville, Oxford county, Ont. Machine for cutting the tapering plug end of well tube joints, called "Ford's Pump Tube Jointer." July 20, 1874.

3,686.—J. D. Richardson, Houston, Harris county, Texas, U. S. Improvements on springs, called "Richardson's Tensile Spring." July 20, 1874.

3,687.—J. Ruthven, Levis, Levis county, P. Q. Improvements on carbureters, called "Ruthven's Improved Gas Machine."

3,688.—O. K. Wood, West Chazy, Clinton county, N. Y. U. S. First extension of No. 2,524, for "The Queen of the Harvest Separator." July 20, 1874.

3,689.—O. K. Wood, West Chazy, Clinton county, N. Y. U. S. Second extension of No. 2,524, for "The Queen of the Harvest Separator." July 20, 1874.

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