It is constructed of the best Pennsylvania iron of the proper thickness; and the furnace is constructed of the best solid fire-box plate, not ordinarily used in portable engines on account of its high price.

The tubes are the best American lap-welded, and the tube sheets are made of the proper strength and thickness. The bracing at the sides, and at the top and bottom of the furnace, is done after the method adopted by the best locomotive builders.

A special merit is, that the form of the furnace—obtained by extending a water space of ample size and semi-circular form, its under side forming an ash pan—allows the water to circulate freely; thus preventing sediment from accumulating and adhering, as it does in the ordinary form of locomotive boilers, in that part of the furnace below the grate.

This latter style of boiler very soon requires new "water legs," as, there being little or no heat below the grates, the water there is in a state of rest, which allows the particles of mineral and earthy matter to adhere to each other and the iron, thereby causing, in a short time, a mass as solid and compact as stone, which soon destroys that part of the boiler.

The circulating water bottom, on the contrary, by the constant movement of the water through it, keeps these particles in a state of suspension, so that they are at once removed from the boiler whenever the blow-off cock is opened. This shaped furnace is much stronger than any other, and obviates the expense and inconvenience of building a separate ash pit.

The smoke-box is a continuation of the shell of the boiler, making it as strong and durable as any other part, which is not the case when it is made of common iron, and merely bolted on to the end of the boiler. The tubes and smoke-box are perfectly accessible for cleaning, through a door, in a in a substantial and ornamental frame which covers this end of the boiler. The furnace front is handsomely designed, and carries the fire and ash-pan doors, and is so made that it can be readily removed, having a large entrance to reach the tubes and furnace for cleaning.

The fire door is made double—its inner part consisting of a heavy iron perforated plate—the outer door being provided with a register to admit air, to ignite smoke, gases, and other products of combustion.

The steam dome is of graceful form, and of ample size to give perfectly dry steam to the engine. The safety valve, as well as its seat, is made of composition well fitted, so that it can neither rust nor stick fast, and is connected to its lever by a device, made on the principle of the link, so that it works with great freedom and uniformity. The steam dome is also provided with a first-class steam gage and whistle.

The bed plate of the engine rests upon carefully and firmly secured saddles attached to the top of the boiler. The engine is of the horizontal style, designed to secure all the requisites of elegance, simplicity, strength, and convenience. All the parts are made in the most approved and workmanlike manner, and the steam is used expansively, according to the most approved modern practice; particular attention being given to adjust the lap of the valve to give the proper cut-off, and to proportion all the passages and ports so that the highest mean effective pressure in the cylinder may result from a given boiler pressure.

The heads of the cylinders are easily accessible, no parts having to be removed in order to reach them; and the cylinders are felted and handsomely lagged to prevent loss of heat by radiation. All the usual and useful appendages found on first class steam engines, such as oil-cups for the cylinders, pet-cocks, water gage, oil cups on slides, etc., are provided.

The governor is well made, and sensitive to any variation of load, and performs its office with ease and certainty.

A water heater is placed inside the bed plate, through which the exhaust steam passes, and is finally discharged into the smoke-pipe powerfully increasing the draft.

The pump is double-acting with composition valves, which can be removed for cleaning by taking out a single set screw. An important feature is connected with these pumps. A stop-cock placed in the suction pipe being always open, the pumps are never allowed to run dry, as is frequently the case in other engines; and by the use of a waste pipe with another stop cock—connecting with the discharge pipe from the pump to the boiler, it is easy to regulate the amount of feed water required for evaporation.

The crank shaft is double, extending a sufficient distance on either side of the engine to allow a band wheel of any size to run without interfering with the boiler. It is forged of the best American iron, and its diameter is considerably greater than is ordinarily seen in portable engines of equal power. It runs in boxes giving ample bearing, to insure steadiness of motion and durability.

The connecting rod is made of hammered iron, supplied with bronze boxes, and is fitted up in the best style, and in a very substantial manner.

In short all the appliances of the best stationary engines, if we except certain refinements above noticed, are to be found on this engine, and so arranged as to avoid undue complication.

The engine and boiler are placed on a very strong truck, as shown; the bolster being under the end remote from the furnace, and the bulk of the weight being placed upon the hind wheels of the truck. The axles of these wheels have been, in other truck engines, bolted to the sides of the boilers; but this plan renders them liable to be broken off or to give great local strain to the part of the boiler to which the axles are bolted. In the engine we are describing a better plan has been adopted, and the difficulty alluded to has been wholly removed.

The axles are made of three-inch square iron, and bent so as to form a complete bearing for the curved under surface of the fire-box. At the angles where they project to receive the wheels, brackets are bolted to the boiler which abut against the shoulders of the axles, bracing them against the effects of sudden twists and shocks. No weight rests upon the brackets, the boiler being sustained entirely by the bent axle. This gives very great strength to them, and removes all strain from the boiler in going over rough ground.

A Salter spring balance is used on the safety valve lever instead of a weight, as in locomotives. The smoke-pipe is hinged and provided with a spark arrester. Each engine is also provided with a flexible suction pipe, with a rose strainer, and has a convenient and comfortable seat for the driver of the team when the engine is being hauled from one position to another. It would seem that nothing has been omitted from consideration, in the construction of this engine, calculated to fit it for every requirement of a first-class agricultural steam motor, and as such it will meet an increasing want in many parts of the country.

These engines, of all sizes, from two to forty-horse power, may be seen at 38 Cortlandt street, New York, at the office of the general agent, Mr. Edward P. Hampson, to whom orders or letters for further information may be addressed.

METEORS.

[From All the Year Round.]

The Universe, of which our solar system is but an infinitely small fraction, is one in material constitution. The spectral analysis of light has shown that the most distant visible heavenly bodies contain substances exactly the same as those which make up the solid crust of the earth. Thus, Aldebaran (the star marked 8 in the Bull), has soda, magnesia, hydrogen, lime, iron, bismuth, tellurium, antimony, and mercury. Sirius, the Dog Star, likewise confesses to soda, magnesia, hydrogen, and probably iron; and not only the stars but many of the nebulæ have been made to avow their possession of similar, if not exactly identical elements.

In the Annuaire of the Bureau des Longitudes, for 1870, M. Delaunay confirms the theory of the unity of the constitution of the universe by a different set of facts and arguments which have all the charm of novelty. For ages, nobody knew what they meant; and we read his lucid explanation with the pleasure enjoyed in guessing a riddle which has long puzzled our brains, if we may compare the solution of a play on words with the satisfaction of obtaining the grandest views of nature. In the present "notice" he treats of what we may learn from the various kinds of meteors—a term which, in its Greek original, means merely something hanging aloft.

Spectral analysis has enabled us to study the material elements of the heavenly bodies; but this is not the only means we possess of discovering directly the secrets of the constitution of the universe. Certain phenomena, now to be examined, put it in our power to make a close inspection of a considerable number of bodies distributed in space. We can even handle some of these bodies, and analyze them by the various processes which our laboratories have at their command. The results have been valuable, from their verifying, directly and undeniably, the notions already derived from other sources respecting the condition and nature of the matter dispersed throughout celestial space.

While gazing at the starry heavens, we often see a bright point dart rapidly across the constellations, and then disappear without leaving any trace. This is what we call a shooting star. Sometimes the brilliant point marks the line of its passage by leaving behind it a luminous train, which lasts a few instants, but vanishes soon afterwards. The path of the shooting star is usually rectilinear or straight, or rather it would coincide with the arc of a great circle traced on the celestial hemisphere. In a few cases, which are very rare, the path presents successive sinuosities, or takes a decided bend, making an angle, sometimes very large, with the direction it followed at the outset. In other words, the shooting star seems to travel in a serpentine course, or rapidly to change its direction, and even, in certain instances, it seems to go back again, returning towards its starting-point. Shooting stars constitute a special class of luminous meteors, which appear at all times and seasons. Not a night passes without several of them being observed. The frequency with which they show themselves, as we shall see by-and-bye, is more or less great, according to circumstances.

From time to time, but much less rarely, there occurs a phenomenon, the same in kind, but much greater in intensity. A luminous body of considerable and appreciable dimensions rapidly traverses the heavens, shedding a bright light in all directions. It resembles a ball of fire, whose apparent magnitude is often comparable to that of the moon. This body generally leaves behind it a very visible luminous train. Often, during, or immediately after its appearance, an explosion takes place, and even occasionally several explosions, which are heard at different and widely distant places on the surface of the earth. Frequently, also, the explosion is accompanied by the bursting of the ball of fire into luminous fragments, which seem projected in different directions. This phenomenon constitutes what is called a meteor proper, or, by French naturalists, a bolide—a word which we might well naturalize, as it is used in that sense by Pliny, and is derived from a Greek verb to throw, to shoot out. The phenomenon occurs by day as well as by night—only in the first case the light it emits is very much diminished by the light of the sun, and, in fact, is only perceptible when developed with considerable intensity.

On the other hand, on the earth's surface we sometimes find solid bodies of a stony or metallic nature, which appear to have nothing in common with the soil on which they live. From time immemorial the vulgar have attributed to these bodies an extra-terrestrial origin. They were believed to be stones fallen from the sky. They have been designated pierres de foudre, pierres de tonnerre, thunderbolts, because they were regarded as matter shot by lightning to the surface of the earth. Many of these pretended thunderbolts have been recognized to derive their origin from the soil itself in which they were found. Such are the ferruginous pyrites, so commonly occurring in chalky strata. But, for a certain number of them, their extra-terrestrial origin has been indisputably ascertained. The name of aërolites (stones of the air) is given to them as a reminder that they fell to the earth from the depths of the atmosphere which envelops our globe. What relationship can possibly exist between shooting stars, bolides, and aërolites? A variety of opinions has been held on this subject. What strikes us most is the vagueness and indecision with which they have been offered, the slight actual knowledge possessed respecting the phenomena under consideration, and at the same time the incredulity with which philosophers have received the accounts furnished to them by the public.

First, as to their incredulity. In Kepler's Ephemerides, we read, "7—17 November, 1623. A fiery meteor, or globe of fire, was seen throughout almost the whole of Germany, flying rapidly from the west to the east. It is affirmed that in Austria something like a clap of thunder was heard. Nevertheless, I do not believe it; for nothing of the kind is to be found in the accounts that we possess."

In the Memoirs of the Académie des Sciences for 1700, Lémery writes: "We cannot reasonably doubt that the matter of lightning and thunder is sulphur, set on fire and shot out with great velocity. As to the lightning-stones with which the vulgar will have it that the thunder is always accompanied, I take their existence to be very doubtful, and am even inclined to believe that there never have been any real ones. None of these stones are to be found on the spots that have been struck by lightning; and even if we had found one, we should sooner believe that it came from some mineral matter melted and formed by the burning sulphur of the thunder in the earth itself, than that the stone had been formed in the air or in the clouds, and shot out together with the thunder."

Next, as to the vagueness and indecision of their views. Halley several times directed his attention to meteors, and the causes by which they may be explained. In a note, published in 1714, in the Philosophical Transactions, No. 341, he relates the occurrence of two remarkable meteors, one of which was seen in Italy on the 21st of March, 1676, the other in England, in the neighborhood of London, on the 31st of July, 1708. He demonstrates that, from the directions in which the latter meteor was seen at different places, its hight above the earth may be estimated at from forty to fifty miles. Then he adds, "I have deeply reflected on these circumstances, and I consider them the most important facts that have come to my knowledge relating to the phenomenon of meteors I am inclined to think that there must exist a certain quantity of matter in ethereal space formed by the fortuitous concourse of atoms, and that the earth meets it while traveling along her orbit, before it has acquired a great rate of speed in the direction of the sun." Here he "burned," as children say; he was within a step or two of what is now held to be the truth.

Some years afterwards, on the appearance of an extraordinary meteor, seen in England on the 19th of March, 1719 (whose hight above the earth Halley reckoned at seventy-three miles), the great astronomer put forth a different explanation, to the effect that the matter constituting the meteor had emanated from the earth, through the effects of the preceding unusually hot summer. Sulphurous vapors, he thinks, have no need of air to sustain them, but mount by a sort of centrifugal force; they then form a train, like a train of gun powder, and, when inflamed by spontaneous combustion, the fire runs along it from one end to the other. And that was the best explanation Halley could give of meteors and bolides.

Mussenbrock, in his "Course of Experimental and Mathematical Physics" (translated into French, 1769), in like manner attributes a terrestrial origin to the materials of which fire-balls consist. "All bodies," he says, "which form part of the universe, emit different emanations, which rise in the air, mingle with it, and are the matter and cause of meteors." And afterwards, "As these globes of fire spread, wherever they pass, an odor like that of burning sulphur, I can scarcely doubt that they are clouds principally composed of brimstone and other combustibles issuing from volcanoes which have opened fresh mouths among the mountains, and have discharged large quantities of sulphurous vapors before they have caught fire."

The opinion of the learned in the second half of the eighteenth century respecting stones fallen from the sky, may be gathered from a report made to the Académie des Sciences, in 1769, by the celebrated chemist Lavoisier, in the name of a commission appointed to give an account of a phenomenon of the kind which had lately happened in France. First, he expresses his skepticism. "In spite of the notions accredited among the ancients, true philosophers have always regarded as very doubtful the existence of these thunderstorms. And if it was considered suspicious at a time when philosophers had scarcely any idea of the nature of thunder, it must appear still more so at the present day, now that it is known that the effects of lightning are the same as those of electricity."

He then proceeds to relate the facts. On the 13th of September, 1768, at about half-past four in the afternoon, there appeared in the direction of the Château de la Chevallerie, near Lucé, a little town in the Maine, a stormy cloud, inside which was heard a short, sharp thunder-clap, very like the firing of a cannon. Then, throughout the space of two leagues and a half, without any fire being perceptible, there was heard a considerable noise in the air, which sounded so like the lowing of an ox that many people were deceived by it. Finally, several individuals who were doing harvest work in the parish of Périgué, about three leagues from Lucé, hearing the same noise, looked up, and saw an opaque body which described a curve and then fell on a strip of grass on the high road to Mans, near which they were working. They all ran up to it quickly and found a sort of stone, about the half of which was buried in the earth; but it was so burning hot that they could not handle it. Then they all took fright and ran away; but returning some time afterwards, they saw that it had not stirred, and found that it had cooled sufficiently to admit of a close examination. This stone weighed seven pounds and a half. It was triangular in shape; that is, it presented three rounded protuberances, one of which, at the moment of its fall, had entered the sod. All the part of it which was in the ground was gray or ash-colored, while the rest, exposed to the air, was extremely black.

We have here all the circumstances of a meteor, with explosion, and the fall of a solid body to the earth, but without any luminous appearance, in consequence of its happening in broad daylight. Lavoisier, after mentioning the existence on its surface of a very thin coating of black, swollen matter which appeared to have been fused, came to the conclusion that the stone had not been exposed to a considerable degree of heat, nor for any length of time; in fact, it decomposed before it became red-hot; consequently that it did not owe its origin to thunder, had not fallen from the sky, nor had been formed by mineral matters fused by lightning. The commission gave their opinion that the stone, which perhaps had been slightly covered with earth or turf, had been struck with lightning, and so laid bare; the heat had been sufficient to melt the surface of the portion struck, but had not lasted long enough to penetrate the interior, which was the reason why the stone was not decomposed. It is clear they were determined not to believe the evidence of the persons who saw it fall. The uncertainty respecting the nature and the cause of meteors is further shown in a letter addressed, in 1784, by Charles Blagden to Sir Joseph Banks, and published in the "Transactions of the Royal Society of London." His conclusion is that the sole known natural agent, to which the production of these phenomena can be attributed, is electricity.

Such was the state of opinion respecting meteors and stones fallen from the sky, when Chladni published, in German, in 1794, "Reflexions on the Origin of Divers Masses of Native Iron," and notably of that found by Pallas in Siberia. With wonderful acuteness he maintained the thesis that everything seemed to prove that these masses of iron are no other than the substance of bolides or globes of fire; for all that was known of those meteors proved they were formed of heavy and compact materials which could not be projected in the air in a solid shape by a terrestrial force, nor be composed of diverse substances disseminated in the atmosphere. Moreover, the lumps found where these bolides have fallen, bear so striking a resemblance not only among themselves but to those of Siberia and elsewhere, that it suffices to make us adopt an opinion which is further confirmed by numerous proofs.

His reasoning respecting the origin of bolides reads almost like second sight. It is known, he urges, that our planet is composed of various elements—earthy, metallic, and others—among which iron is one of the most widely distributed. It is also conjectured that the other heavenly bodies are made of analogous materials, or even quite identical, although mingled and probably modified in very various ways. There ought likewise to exist in space much solid matter collected into small masses, without belonging to any of the heavenly bodies properly so called, and which, set in motion by projective or attractive forces, continues to advance until, arriving within the sphere of the earth's (or any other heavenly body's) influence, it falls upon it by the action of gravity. The motion of those masses of matter, extremely rapid in itself, being accelerated by the earth's attraction, causes such friction with the particles of the atmosphere as to heat them to incandescence, and make them throw off vapors and gaseous fluids, ending with the explosion of the mass.

It is a remarkable fact that aerolites are principally composed of iron. But, urges Chladni, if the above theory is correct, we must believe that other substances found in stones fallen from the sky—such as sulphur, silex, magnesia, etc.—are not peculiar to our globe, but are among the elements which enter into the composition of all the heavenly bodies. This opinion coincides, as near as may be, with the discoveries made by the spectral analysis of light. Shooting stars are also referred by Chladni to the same cause as meteoric fire-balls or bolides, with which view philosophers of the present day do not exactly agree. What they do hold would occupy too much space to be included in this paper.

A lucky circumstance hastened the adoption of Chladni's ideas. News of the appearance of a magnificent meteor in the neighborhood of L'Aigle (department of the Orme) having reached the Académie des Sciences, and some stones fallen from the sky on that occasion being submitted to it for examination, one of its members, the young Biot, was requested to proceed to the spot and ascertain all particulars respecting the meteor.

It appears that on Tuesday, 6 Floreal, year XI. (26th of April, 1803), about one in the afternoon, weather calm, there was seen from Caen, Pont-Audemer, and the environs of Alençon; Falaise, and Verneuil, a very brilliant ball of fire, which darted through the atmosphere with great rapidity. A few instants afterwards they heard in the town of L'Aigle and around it, throughout an area having a radius of more than thirty leagues, a violent explosion, which lasted five or six minutes. At first there were three or four shots like those of a cannon, followed by what resembled a discharge of musketry, after which there was a frightful rolling like that of drums. The air was calm and the sky serene, with the exception of a few clouds.

The noise proceeded from a small cloud, rectangular in shape, which appeared motionless during the whole duration of the phenomenon, except that the vapors composing it bulged out for a moment at different points, through the effects of the successive explosions. Its elevation in the air was very great; for the inhabitants of La Vassolerie and Boislaville, hamlets situated more than a league apart, beheld it simultaneously over their heads. Throughout the whole canton, above which the cloud was hovering, they heard hissing noises, like those of a stone shot out by a sling, and at the same time they beheld the fall of a multitude of solid lumps, exactly similar to the bodies known by the name of meteoric stones.

If the meteor had burst at one single instant, the stones would have been scattered over a nearly circular area; but, in consequence of the successive explosions, they were strewed over a long strip of ground answering to the meteor's course. The largest found weighed eight kilos. five grammes (about seventeen pounds); the smallest, which M. Biot brought away with him, not more than seven or eight grammes. The total number of stones which fell may be estimated at two or three thousand.

After this inquiry, it was no longer possible to entertain the slightest doubt as to the reality of stones falling from the atmosphere subsequent to the explosion of meteors or bolides. M. Delaunay has collected similar instances, wonderfully agreeing in their details, ranging from the year 1819 to 1868, inclusive; from which he deduces the consequence, that the fact of stones falling from the sky cannot be questioned. They are not darted by lightning, as the vulgar long believed, but they proceed from meteors or bolides, which suddenly appear in the atmosphere, and usually fall after the explosion of the bolides. Those meteors, moreover, are occasioned by the rapid passage through our atmosphere of solid bodies existing in space, and which the earth encounters along her orbit.

Aerolites, touched immediately after their fall, are found to be burning hot. But they cool with very great rapidity; a proof that their high temperature was merely superficial, and had not penetrated their entire mass. As to the form, it is coarsely polyhedral, with irregular sides and edges. The flat portions of their surfaces often present hollows like those produced by pressing a round body, as a marble or an apple, on a layer of paste or dough. They are also covered with a thin, black crust, usually dull, but sometimes shining like a varnish.

The merely superficial heat of aerolites at the moment of their fall, and the thin, black crust which covers them, clearly demonstrate that they have been subjected, for a very short time, to intense heat, which has melted their outer shell without penetrating to any depth within. On breaking an aerolite and exposing one of its fragments to the flame of a blowpipe, you produce on the surface of the fragment a crust exactly similar to that which covered the entire aerolite. Doubt on the subject is no longer possible. Besides which, the black crust is often wrinkled, owing to the rapid passage of the air over the melted surface.

And now, what is the cause of the intense but short-lived incandescence of bolides? Chladni, we have seen, thought it owing to the *friction* of the air; Benzenberg, in 1811, supposed it rather due to the *compression* of the air. M. Regnault, after experiments on gases flowing with great rapidity, made in 1854, came to the same conclusion, namely, that the temperature of bolides is solely owing to the heat disengaged by the compression of air. When a body moves through the atmosphere with a velocity greater than that of sound, the air's elasticity is neutralized, and compression takes place as if it were inclosed in a vessel. The violent heating of the bolide, during the short lapse of time occupied by its passage through the air, is the necessary consequence.

Showers of iron are much rarer, at least at the present epoch, than showers of stones. Meteoric iron presents itself in masses quite free from stony matter, and sometimes sufficiently pure to be forged immediately. It has even been employed in the fabrication of tools and weapons. Meteorites also contain many other materials of great terrestrial importance, such as oxygen, hydrogen, and carbon. They hence lay claim to a community of origin with the planets which revolve round the sun; which is confirmed by the recent discovery of numerous extremely small planets and the probable existence of others smaller still, which remain invisible in consequence of the trifling quantity of sunlight they reflect.

Of late years, great pains have been taken to form collections of stones fallen from the sky. We may specially cite those in the British Museum, in the Mineralogical Museum at Vienna, and in the Museum d'Histoire Naturelle, at Paris. The last contains specimens of two hundred and thirty-five falls, that is of nearly all; since the number of stone showers represented in collections does not exceed two hundred and fifty.

A Chapter on Chinese Walls.

Bishop Kingsley, in the *Central Advocate*, thus discourses on the city walls of the Chinese:

"All the cities of China are surrounded by high, strong walls, whose massive proportions a stranger has no adequate idea of until he sees them. The walls surrounding the city of Pekin are from twenty-two to twenty-five miles in length, and, on an average, fifty feet high. This wall is sixty-six feet thick, at the bottom, and fifty-four at the top, and once in a few yards there are immense buttresses to give it still greater strength. At every fifth buttress the wall, for the space of one hundred and twenty-six feet in length, is two hundred and fifty-six feet in thickness. In several places the foundation of this wall is of marble, and when the ground is uneven, immense quantities of cement, as durable, nearly, as granite, and about as hard, have been used to level up the ground. The main body of this wall is made of bricks, each twenty inches long, ten inches wide, and five inches thick. These bricks are burned very hard, and have precisely the appearance of stone.

"On the inside of this wall, as well as on others, in other cities, there are esplanades, or stairways, with gates to them for ascending them. And over all the gateways there are immense towers, as large as great churches, and much higher, constructed of these great burnt bricks. On the top of this immense wall there is a railing, both on the outside and inside, coming up to a man's waist, which railing itself is a wall, thus giving a sense of security to a person walking on the top. The outside railing is made into turrets, for the use of cannon, in case of attack. The entire top of the wall is covered with strong burned brick, twenty inches square, resembling the flagging of our sidewalks in large cities,—only, as I have said, these walks are fifty-four feet wide.

There is no way of getting into the city, only to go through this immense wall. And wherever there is a gate for the purpose of getting through, there is another wall built, inclosing a square space, compelling all persons who go into the city to go through two walls, by passages at right angles to each other. The walls are so immensely thick, that these passages through them, arched over with cut stone, remind one exactly of our railroad tunnels in the United States. At each of these great archways there is an enormous gate made of strong timbers, everywhere as much as ten inches thick, and covered on both sides with plates of iron, like the sides of our war ships. These gates are shut early in the evening, generally before sundown, and not allowed to be opened during the night for any purpose. They are fastened on the inside by means of strong beams of timber.

"I have been somewhat particular in describing this wall, because the general construction of all walls in China are similar to this one, although they are not all so high nor so thick. But there are probably a thousand walled cities in China, whose walls will average twenty-five feet high and twenty feet thick, and another thousand whose walls may be somewhat less. Then there is the great Tartar Wall, a little north of Pekin, one thousand five hundred miles long, and older than the Christian era, thicker and higher than any of the rest. There are said to be one thousand five hundred prefectural cities in China. All these are surrounded by walls built by the Government, besides the great number of cities whose walls are made at the expense of the city government alone. And when we have spoken of the walls surrounding the cities, we have by no means done with the subject. For example—in Pekin, inside the inclosing wall, there is another of miles in extent, surrounding what is called the Imperial City. Then, again, inside of this is another immense wall, surrounding what is called the Prohibited City. Within this inner inclosure is the residence of the Emperor, and all the other buildings connected with royalty. And so the Altar and Temple of Heaven are surrounded by two concentric walls, of great extent and magnitude, which must be passed by means of immense gates. Then there is the great wall, covered with dry thorn brush, surrounding what is called the Place of Punishment, where criminals are beheaded, and their heads exposed in cages for a terror to evil doers, and where other criminals are crucified, and yet others starved to death, amid the most piteous moaning and insane ravings for food. Again, the Hall of Literary Examination, where forty thousand men compete for literary degrees, and where the longest purse is more successful than the hardest study, is surrounded by another wall and entered by gates. Then all places of idolatrous worship, and they are legion, in these great cities, are surrounded by high walls. The old city of Nankin, on the south bank of the Yangtze Kiang, is surrounded by a wall eighteen miles long. The city of Tiensing, in the northerly portion of China, has a wall fifteen or sixteen miles in length. The city of Foochow, with one side exposed to the river Min, is surrounded by a high wall. Wherever stone can be had, it is used for these structures. The city of Ranchack, also on the south side of the Yangtze, is surrounded by a wall, running over the top of the mountain a thousand feet high. I also saw, while ascending the Yangtze, a monstrous wall surrounding an area on the top of a mountain, where the Chinese of that region took their wives and children for safety during the terrible rebellion that swept over a great part of China a few years ago.

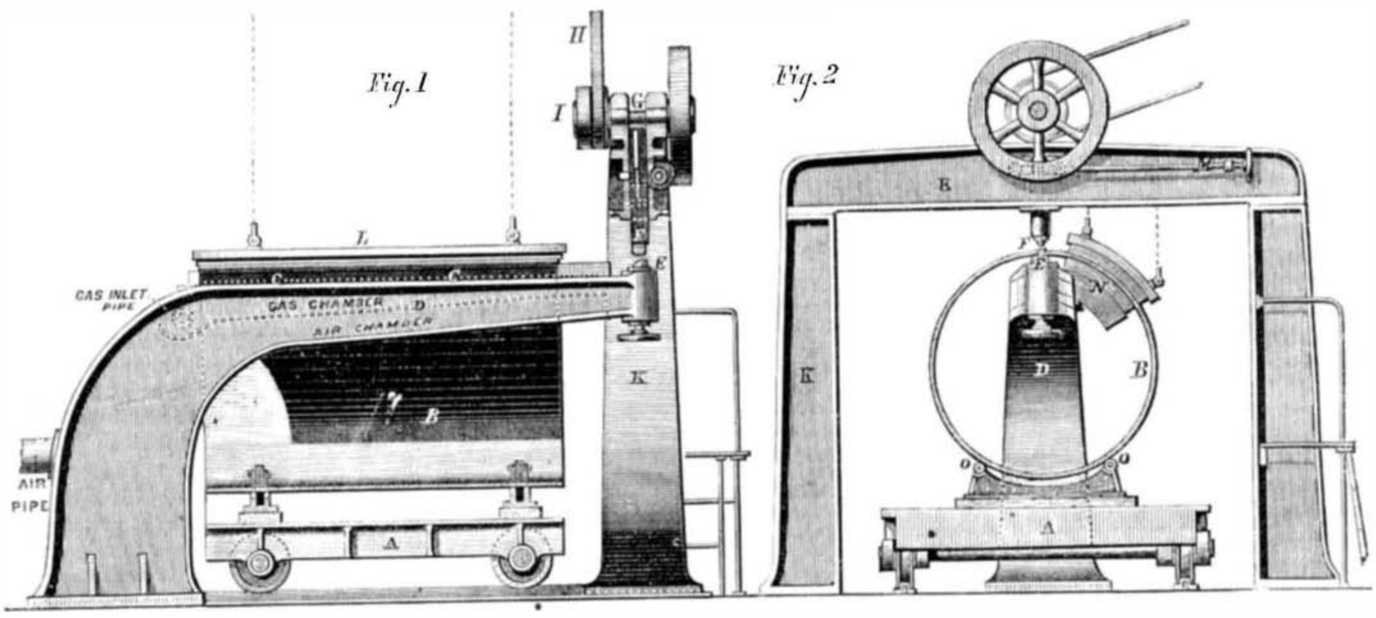
"Then, in thousands and tens of thousands of instances, in China, a high wall is built right before the door of a private dwelling, to ward off spirits of ancestors, who are supposed to be blind, and obliged to move in straight lines, and who will, consequently, stumble against the wall when they come to it, and give up the pursuit.

"After giving a good deal of attention to the subject, I am satisfied that the whole amount of wall in China, if put together, would build one twenty feet high and ten feet thick, entirely round the globe, and would require five thousand men to work steadily for two thousand years to accomplish the work."

APPARITION RINGS.—A novelty has reached London under the above appellation which is said to be an invention, the cleverness of which is unquestionable. Without any necromantic tricks, an optical delusion, pure and simple, is produced. To all appearance a link is seen to traverse the whole length of a chain, but it does not fall off, and whence it comes or whither it goes are inexplicable mysteries.

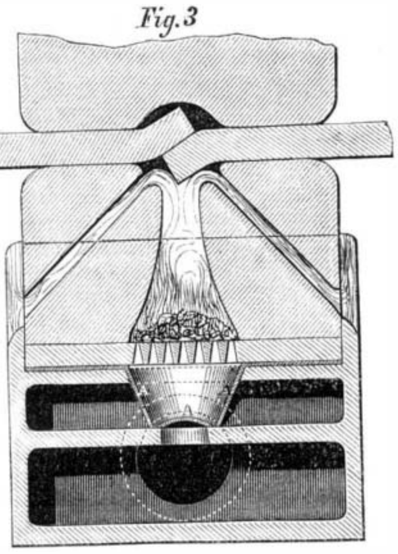
Improvements in Welding Plates.

We illustrate this week from the *Mechanics' Magazine* an invention just patented by Mr. W. S. Sutherland, Liverpool, England. It consists of a means of uniting the ends or edges of plates which are heated in a furnace of peculiar construction, while they are in contact to prevent the formation of scale on the meeting surfaces; also of a furnace for heating such plates, and the arrangements of the apparatus to bring the edges of the plates under the hammer head as speedily as possible while the plates are at a welding heat; the edges being first bent outwards, but in opposite directions, by suitable rolls or other appliance. The invention will be well understood by referring to the annexed engravings, where fig. 1 is an elevation of a furnace so arranged in connection with an overhanging girder as to facilitate a barrel of a boiler or tube to be brought into position for being welded at all the seams by the power hammer instead of being riveted, as clearly seen in the end view, fig. 2. The mechanism consists of a carriage, A, upon wheels for conveying the heated plates of the tube, B, to be welded under the hammer, so that they are united by a succession of rapid blows. The lower portion of the furnace consists of two chambers or passages, one for the fuel and the other for the air or other gas used to support combustion; these materials being led or forced into their respective chambers through the inlet pipe. The fuel and air or other gas pass through a diaphragm of wire gauze or perforated plate, the perforations being proportioned to properly mix the gases for combustion. The mixed fuel and air or other gases then pass through a perforated slab or tile of refractory materials into the combustion chamber and against the parts to be heated, and thence through the escape passages into the open air or into flues placed conveniently to receive them. The fuel is contained in and by the combustion chamber; suitable openings being left for extracting the residue. The air or gas for combustion passes from the chamber through the perforated slab or tile of refractory materials amongst the fuel, and the heated products of combustion, after heating the parts to be welded, pass through the escape passages into the open air or into flues placed conveniently to receive them. The carriage, A, carries the tube, B, to be welded, which is adjusted so as to allow the parts to be welded to pass into and opposite to the furnace, C, carried by the arm, D; this arm, D, in some cases also carries the adjustable anvil, E; above this handle is the hammer, F, worked in this arrangement by means of an eccentric on the shaft, G, which eccentric is driven by means of the strap, H, acting upon the fast and loose pulleys, I I; the hammer, F, is carried by the standards and girders, K K. In some cases the furnace is carried by chains, so as to be raised and lowered easily. There is an arrangement for adjusting the hammer to suit various thicknesses of plates. The hammer is in two portions, the lower portion being screwed into the upper portion. This upper portion slides through a worm wheel driven by a worm turned by a hand wheel and spindle. N shows the improved furnace adapted for heating the edges of tubes to be welded together, end to end. The tube resting upon the rollers, o, o, has part of the seam to be welded heated by the improved furnace, and is then easily revolved by hand or otherwise and passed between the hammer and anvil and rapidly welded. Fig. 3 shows an enlarged section of a furnace with two edges of plates in position for being heated. In this form of furnace a fuel-pan, A, is employed which is to be supplied with air to support combustion and also with gases if necessary, the gases being driven into one of the chambers below.



IMPROVEMENTS IN WELDING METAL PLATES.

Fig. 3



American Marbles.

The *Architectural Review* in discussing the subject of black marble and its treatment in architecture, says that at the present time the wealth in marble possessed by this country, instead of decreasing with the great demand made upon it for building and ornamental art purposes, is developing still more its intrinsic value in the recent discoveries of colored marbles of a superb quality which prolific Vermont has contributed to our national resources. In the rooms of the Royal Institute of British Architects, London, there are now to be seen specimens of American colored marbles which have called forth the admiration of all observers. Our present object, however, is to call attention not to the white or to the varicolored, but to the black marble which in its own way confers so much benefit on art by the very force of contrast it creates. It is generally of a fine texture (especially that which is very deep black), but it is rare to find it without calcareous spar in veins through it. The best quality occurs in beds of from three to eight inches thick; but some beds are thicker. It is tough, and contains a good deal of carbon, which imparts the color. It is greatly valued for inlaying, and is extensively used for vases, pedestals, chimney pieces, etc.

It is occasionally ornamented by etching and engraving, in which processes the polished surface is removed, and the brown color of the rough marble exposed. Powdered white lead is sometimes rubbed into the etched surface, to increase the effect. The French have a method of ornamenting marble in this way by etching with acids deeply into the marble various designs upon a properly prepared bituminous ground. When the corrosion has gone sufficiently deep, the cavities are filled up with hard colored wax, so prepared as to take a polish equal to that of the marble when cleared off. Drawings thus made on black marble, and filled in with scarlet wax, after the manner of Etruscan, have a fine effect, and are used for tables, paneling, etc. They have a method in Derby, England, where this art is carried on to a considerable extent, of exposing the brown color without destroying the polish, the effect of which is more durable than ordinary etching.

Rosewood marble, so called from its marking, resembling that of rosewood, is extremely hard and of close texture, being next in these respects to the black variety. The beds are of considerable thickness, but the most beautiful part of the marble is only about six inches thick. The *russet* or *bird-eye* marble takes its name from its color and appearance—the shades varying from light gray to brown. It contains numerous minute embedded or encrinital fossils, and is found in layers of from six to eighteen inches in thickness.

As yet, we believe there has been but one quarry of black marble worked in this country, namely, that of the Mosquito Valley, near Williamsport, Pa., which is a very compact, excellent material, but until very lately every effort to polish its surface proved a failure. We, however, have now on our table a highly creditable specimen of polished black marble from the quarry just named, and we entertain a strong hope that black marble in abundance will be found native to our soil, and worthy of a distinguished place in the art-materials of our country.

Changes in Fishes.

In the *American Naturalist*, Charles C. Abbott, M.D., gives some account of the changes in the fishes of New Jersey within a few years. A slight local disturbance sometimes quite alters the fauna. Thus in 1867 a small, never-failing brook, emptying into the Assumpink, was populated by chubs, dace, and minnows. In July a heavy, sudden fall of rain caused a rise of water, but did not alter the brook enough to attract the attention of those who lived near it. After the subsidence of the water not one of these fish could be found there, while their place was taken by roach, mullets, and red-fins, which are now abundant, while not a chub can be found.

Dr. Abbott mentions several fishes that were not inhabitants of the New Jersey streams twenty-five years ago, which are now quite abundant; and he is greatly at a loss to imagine how they can have reached these streams. He mentions the interesting case of the gizzard shad, which is sometimes carried by freshets into inland streams or ponds. A pond near Trenton was stocked with them in 1857, and is now full of specimens, weighing sometimes five pounds. They have become so different in color from the same fish as found in the Delaware and on the coast that Dr. Abbott at first thought them quite distinct; and he says they have changed considerably, but only in color, during the last ten years.

McNEIL'S IMPROVED TOBACCO PIPE.

Tobacco has come to be such a staple article of luxury that any improvement connected with its use, and having sufficient merit to bring it into popular favor, is sure of an extensive sale.

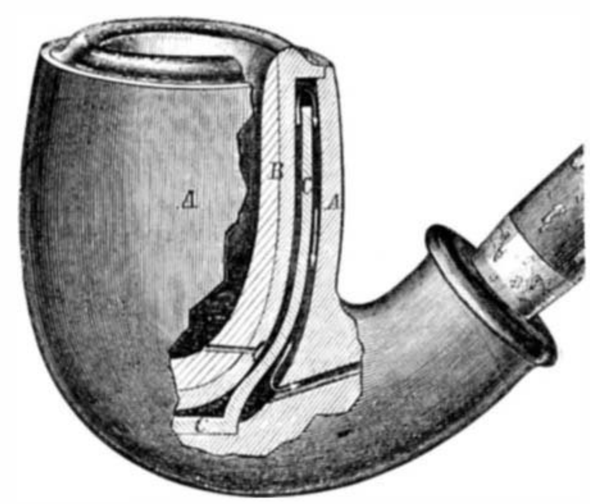
In smoking tobacco in pipes the following things take place. A portion is entirely burned, another portion is destructively distilled, and a portion of the active principle of the plant, nicotine, is distilled over with the water of which all tobacco contains more or less. A part of this moisture with its nicotine condenses in the pipe, and mingles with the tarry matter produced by destructive distillation, and the peculiar excellence of the meerschaum pipe is that it, from its very porous nature, absorbs or soaks up the oily noxious matter, and thus prevents its passage through with the smoke.

But meerschaum pipes are expensive and easily broken, and they have a trick of cracking upon so slight a provocation, that no man who buys a new one to-day can positively rely upon its being a whole one to-morrow.

In the pipe we herewith present to the attention of our readers, a provision has been made for the collection of the foul matters, and for facility in their removal in an ingenious and novel manner. The pipe bowl—in the peculiar construction of which the invention consists—is composed of three parts or shells.

The outer shell, A, is formed after any appropriate design, and a shoulder formed on the inside of the upper edge supports an inner bowl, B, which has a flange or rim upon its upper edge, as shown.

The inner bowl is made of one kind of material, or it may be lined with any suitable material, as shown in the engraving.



It will be seen that when the outer and inner bowls are placed together, they do not touch except at the upper border, leaving an unfilled space in which a third bowl, C, is placed. Suitable openings being made near the bottom of the inner bowl, the smoke passes up and down between the surfaces of the three bowls, as shown by the arrows, depositing its nicotine and moisture within the bowl, C, from whence it is easily removed when necessary, as the parts may be separated and put together again with the utmost facility.

The inventor of this improvement is Wm. S. McNeil, office 104 Wall St., New York, to whom all communications should be addressed.

The First Japanese Railroad.

Letters from Japan state that the arrangements are completed for a line of railway—the first in the country—to connect Yeddo and Osaka, the new and old capitals of the Empire, a distance of 300 miles. There are also to be branches from Yeddo to Yokohama, and from Osaga to Tsuruga. The work will belong to the Japanese Government, but is to be carried out under the advice of English engineers appointed by Mr. H. N. Lay, who has selected Mr. Edward Morel as principal engineer. Mr. Morel has been summoned from Australia, where he was engaged in works for Mr. Edwin Clarke. An English loan of one million sterling is to be raised to meet the costs, and this will be secured not only by the line itself, but by a mortgage on the Custom duties collected at the ports. From three to five years is to be allowed for completion.