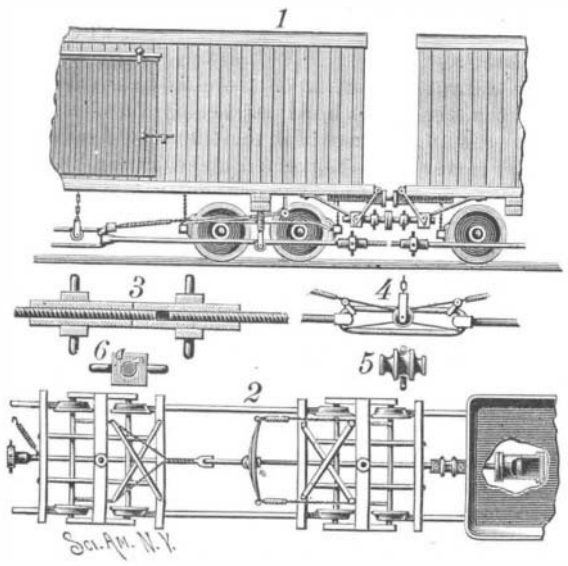
to become choked with soot, and thus rendered inoperative, and the construction is designed to afford a simple and effective means to utilize heat that would otherwise pass up the chimney.

AN IMPROVED AUTOMATIC CAR BRAKE.

A brake which is designed to be automatic, not affected by snow or ice, which adjusts itself to either direction in which the car is pulled, and which may be effectively operated when a train is moving at a high



TAYLOR'S CAR BRAKE.

rate of speed, has been patented by Mr. Frederick G. Taylor, of Cranston, R. I., and is illustrated herewith. A centrally hinged rod extends beneath the car from end to end, below the axles, supported by and reciprocating upon pulleys hung from the beams. The rods at the ends of the cars are threaded, and have couplings, as shown in Fig. 3, by which the several cars of a train are quickly united. A brake beam carrying brake shoes is suspended a proper distance in front of the wheels, and each end of one brake beam is connected to a lever fulcrumed to the extremity of a bar extended from the brake beam on the opposite side of the truck, the two levers crossing each other, and their free ends being each united to a spring secured to the bottom of the cars. A chain or rod is also connected to the free ends of the levers, the opposite end of the chain being secured to a spring fastened to a link in the center of the rod extending beneath the car. At each end of the car, below the drawhead, are brackets carrying fenders on their outer ends, the fenders being adapted to hold the cars at a given distance apart, whereby all strain is removed from the rods extending beneath the cars, allowing them to reciprocate freely at any time. These rods are reciprocated from the piston of a cylinder beneath the cab or tender, as shown in the plan view, Fig. 2, whereby the levers connected with the brake beams are drawn forward or back. Fig. 4 illustrates a construction whereby the brake shoes are put in operation on all the wheels simultaneously, no matter in which direction the brake rod is pulled.

AN IMPROVED SIGNALING DEVICE FOR MINES.

A reliable and inexpensive electro-magnetic signaling device, easily operated by any one of ordinary intelligence, and especially adapted for use in mines, is illustrated herewith, and has been patented by Messrs. Logan M. Bullitt and Oscar C. Greene. Fig. 1 represents the general arrangement of the conducting wires, batteries, and signal bell, Fig. 3 showing a side post by which the wires are supported, Figs. 4, 5, and 6 showing hand circuit closing devices, while Figs. 7 and 8 show a bell or sounder attached to a circuit closer. The bell or sounder actuated by the system is placed in proper position relative to the engine, near the mine entrance, and the incoming and outgoing electric current wires connected with it and the main battery, branch wires being employed for different chambers of the mine, extending from the main wires as required, so that the circuit is continuous to the signal bell along either of the main wires. The main wires and their branches are parallel with each other, and only a little distance apart, so that by connecting these adjacent wires anywhere along their length by a proper conductor the circuit will be closed and the signal bell sounded. Suitable hand instruments for so joining the wires and closing the circuit are shown in the small figures, Fig. 6 showing a circuit closer adapted especially to wires arranged one vertically over the other. The main battery may be made sufficiently powerful to supply the circuit on all the wires, or additional re-enforcing cups may be placed in the branch wire extension circuits, as shown in Fig. 1. This system of mine signaling has been for some time in practical use in mines of the Northern Pacific Coal Co., in Washington Territory, and is said to have given entire satisfaction. The apparatus is designed to be put up at a cost of not more than $50 per mile.

For further information relative to this invention address Mr. Logan M. Bullitt, No. 141 South Fourth Street, Philadelphia, Pa.

The New Cast Iron Guns.

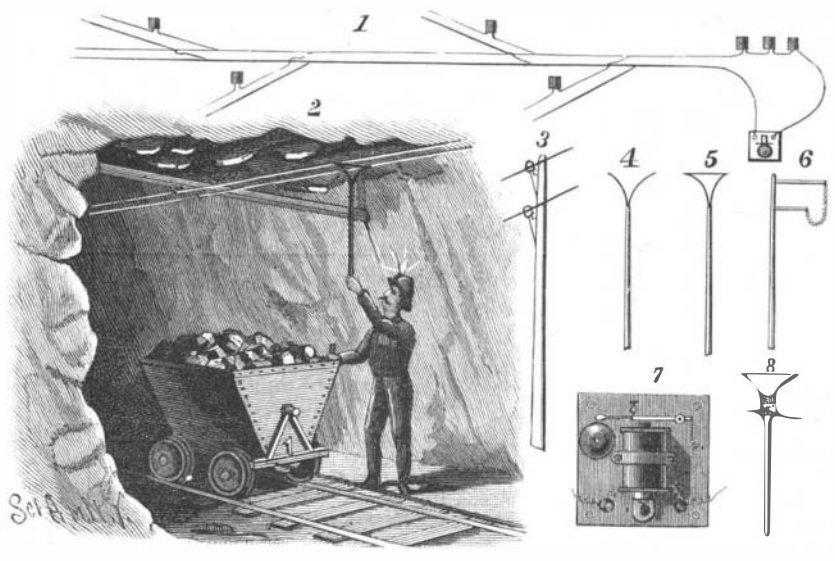
At the ordnance foundry of the South Boston Iron Works a large force of workmen is at present engaged in completing the third and last in the series of the three 12 in. cast iron rifled guns, with a steel tube and steel hoops. The work of putting in the steel tube, which is inserted at the rear of the barrel, extending through from the breech, has just been completed, after three trials, to insure getting a perfectly tight joint at the shoulder or casing of the gun. The gun was placed horizontally over a longitudinal pit, and was then covered in with boiler and sheet iron. A fire was built under it, extending from the breech of the gun to a point in front of the trunnions. The body of the gun was expanded by the heat, and the steel tube was inserted from the rear. A stream of cold water was kept circulating through the bore of the tube, to keep it cool, during the whole operation, which lasted about twenty-one hours. The gun was then cooled down at the breech to make it grip the tube, so that in contracting the front end of the tube was brought to a tight joint against the forward shoulders in the casing or body of the gun. An ingenious arrangement of bolts and set screws, together with a 100 ton jack, was used in inserting the tube and holding it in place until the cooling was completed. The gun will be transferred to the lathe in a few days to be finished, bored, and rifled, and will be delivered to the government early in the fall.

Artesian Wells in Sonoma.

A few weeks ago, according to the *Weekly Bulletin*, "a fine flow of excellent water was struck at a depth of ninety feet, on a lot a little to the east of the town of Sonoma, belonging to Mr. Gilbert. The next attempt was made at Mr. Winkle's vineyard, when at a depth of eighty-two feet a flow of 90,000 gallons per day was obtained. The tools were then moved about 150 feet south to the lands of J. Gundlach, where still greater success was met with. At a depth of one hundred and ten feet a flow of 100,000 gallons per day was reached. Both these wells are located in the foot hills, considerably above the level of the valley and supposedly in a very unlikely place to find such a result. The tools penetrated successive layers of sand, rock, and clay, the water being found below the latter. The water comes out with considerable force, and will overflow a pipe twenty feet above the surface. The fortunate owners of these wells consider them worth not less than $10,000 apiece. The temperature of the water is constantly 72° F., and what is remarkable is that it is exactly the same as that of several springs on the other side of the valley, four or five miles away. Many of the farmers and fruit growers of the valley are arranging to put down wells."

Australian Mice.

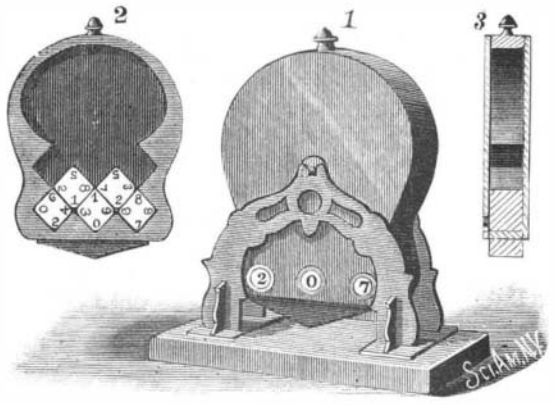
The mouse pest in Australia is much worse than the rabbit pest. The climate is so soft that they have thrived enormously, and there is said to be "hardly a residence or store that is not pestered by the plague. In some places they are so thick that, in order to get the stock properly fed, men have to watch while they are eating their provender. The week before the Coolah races the vermin got into the boxes at the station, and actually ate the bandages off the horses' legs, while from every side come tales of crops devoured so rapidly that many fields have had to be abandoned, what was left not being worth reaping."



BULLITT'S ELECTRO-MAGNETIC SIGNALING DEVICE FOR MINES.

AN IMPROVED DIE AND DICE BOX.

A closed dice box, mounted to be revolved on journals, the closed box having a chamber just the width of the dice, with recesses where the dice come to rest, so that the numbers on their sides may be read through holes in the sides of the box, is illustrated herewith, and has been patented by Mr. Reinhold F. De Grain, of No. 657 Pennsylvania Avenue, S. E., Washington, D. C. The central chamber is just enough wider than the dice to permit them to tumble freely without changing their planes, the bottom recesses being angular to correspond with the angles of the dice, as shown in the interior view, Fig. 2, the side recesses being designed to cause the dice to turn in tumbling, to show different faces. The box has a knob or thumb piece at the top, for convenience in revolving it, and a



DE GRAIN'S DIE AND DICE BOX.

weight fixed to the bottom to cause it always to gravitate to the proper position.

How Scarlet Fever Poison is Distributed.

Dr. J. Brooke, Surgeon U. S. Army, of Fort Monroe, Va., communicates the following case: "A girl aged about eight, living at this place, was some months ago attacked by scarlet fever, the disease running a typical course. For a long time no possible source of contagion could be discovered. The child had not been absent from home, had been with no one lately exposed, and no other case was known to exist anywhere in the vicinity. Subsequently I learned that one of the house servants had nursed a case of scarlet fever in a distant city just about a year before. After the case terminated she packed some of her things, including some clothing then worn, in a trunk, and left the place. A year later she had the trunk sent to her here, opened it, and took out the contents, the little girl being present and handling the things. Very soon after the latter was attacked, as stated."—*Medical Record*.

Biting the Finger Nails.

Dr. Jerome Tuthill, of Chicago, Ill., in the *Medical Record*, says: A novel accident, resulting from a habit of very common prevalence among nervous people, was brought to my notice recently. A young lady presented herself at my office complaining of a constant irritation in her throat. Two weeks previously she had been taken with a severe "sore throat," which was treated by a neighboring physician. Under his care, she says, the inflammation quickly subsided, but there still remained a sensation of irritation. Examination revealed a small fleshy-looking object, about the size of a kernel of wheat, adherent to the tissues posterior to the left tonsil, by one end. The other parts of the throat were normal. The little mass could not be detached by a cotton-covered probe, but by the use of forceps it was easily removed, and on examination proved to be a piece of finger nail, which had become covered by a cheesy deposit. A broken piece of the nail was also removed from under the mucous membrane at the same spot by a sharp-pointed probe. The patient then confessed to the habit of biting her finger nails, and, moreover, could remember that a day or two previous to the onset of her throat trouble a piece of nail which she had bitten off had become lost in her mouth, but after it had caused a fit of coughing she had forgotten about it until reminded by my discovery.

A GIGANTIC FOSSIL.—Professor F. W. Cragin, of Washburn College, recently discovered at Downs, Osborne County, Kansas, the petrified remains of a huge fossil. Professor Cragin pronounces it the most remarkable specimen found since 1877. The animal complete was a little over 16 feet in length. The jaws measure 3 feet 8 inches, the neck between 4 and 5 feet long, and the body about 9 feet long, and 3 or 4 feet through. It had immense teeth, about 3 inches in length. It had flippers quite similar to a seal's, and its feet, two in number, were short. It is plain that it was an aquatic animal of the reptilian age.

Manufacture of Gas.

A reporter of the Hartford *Courant* gives in that journal the following description of the manufacture of gas in Hartford, Conn. :

It is such a simple, easy, and altogether natural thing to strike a match and light the gas, that nobody stops to think how the gas got there until the bill comes in, and then only in the abstract. Some of the consumers may feel at that time that they are putting their hands pretty far down into their pockets, but they do not reflect upon the amount of money that somebody has to pay out every day to furnish them with an article so indispensable to their comfort. To extract gas from coal is by no means a complicated operation, but to do this, rid it of its many undesirable constituents, and make it fit for illuminating purposes, is a matter much more difficult of accomplishment.

To begin with, gas is made by a roasting process in highly heated retorts. These retorts, made of fire clay, are D shaped, are 9 feet long, 15 inches high, and 26 inches wide. They are put in arches, six to the arch, which, in gas works phraseology, are called benches. Each bench is heated by one fire. Into each retort, according to the style of the bench and the furnace for heating the same, is put once in 4 hours from 225 to 325 pounds of coal. The heat from the furnaces applied to the retorts roasts the coals and drives from it its various products in a gaseous form, leaving in the retorts a coke, about 30 per cent of which is again used in the furnaces for supplying the heat necessary for carbonizing the coal, and for other purposes about the works where heat is desirable. The remainder is disposed of for manufacturing and domestic purposes, not only in Hartford, but in all the surrounding country as well. After the gas is generated from the coal in the retorts, it passes through the ascension and dip pipes, so called, one of which connects with each retort, and into a large pipe, known as the hydraulic main, and placed on top of the benches. This main is partially filled with deposits of coal tar, a product of the coal, and water, the latter being supplied to form a seal over the mouth of the dip pipe, thus preventing the gas from coming back through the ascension pipe and keeping the air from passing in at charging time. A fallacy exists in the minds of some to the effect that air is purposely forced in, so as to increase the pressure, whereas the contrary is seen to be the fact. From this point the gas is conveyed through a large pipe to the exhausters, which is a kind of reversed blower used to force the gas from this point through the different apparatus in use, and finally to propel it to the huge holders in which it is stored ready for distribution. The next step in the process is to pass the gas through an apparatus called the multitubular condenser, which consists of a series of pipes immersed in water, the object being to lower the temperature of the gas. From the condenser the current passes to the scrubber, a machine made in the form of a hollow chest with a number of trays, upon which is laid a quantity of small branches of white birch. The twigs serve to break the globules of gas, in the same manner that a soap bubble might be punctured, and from the top water, dripping down in a continual spray, comes into contact with the gas and extracts from it the ammonia, for which it has a remarkable affinity. The temperature of the gas becomes greatly reduced by this time, and tar separates from it and is collected in boxes at the bottom, and, by a series of pipes, conducted to the tar wells.

Until about a year ago the apparatus just described was thought sufficient to accomplish the purpose, but the company, ever on the lookout for improvements, has recently adopted additional machinery for ridding the gas of tar and ammonia. One of these, a "Walker tar extractor," a rather complicated piece of apparatus, effectually removes every particle of tar that escapes the clutches of the scrubber. The ammonia is wholly removed by the next piece of apparatus with which the gas comes into contact, which is called the standard washer scrubber. It consists of a number of wheels composed of thin sheets of iron, which continually revolve in water. When rising above the water line these disks present a large wetted surface to the gas, abstracting from it all the ammonia it contains. Following the process to the next step one comes to the purifying house, where are placed four purifying boxes, each 20 × 24 feet and 4 feet deep, through three of which the gas passes successively. Inside of each is a series of trays covered with carefully prepared lime, designed to remove from the gas all traces of sulphur. Passing on, the gas goes to the large station meter, where it is all measured as made, and then conveyed to the various holders, where it is stored ready for use. The holder floats in a reservoir filled with water and gradually sinks lower and lower into the water as the gas is drawn out. When full, the holders stand almost entirely out of water.

The quality or illuminating power of the gas is tested in the photometer room, in which is placed a complete and expensive apparatus. The walls of the room are painted a dead black and daylight is totally excluded, so that the tests, which are made every day, are as accurate as it is possible to make them. The reader who has followed the process thus far will readily understand that the manufacture of gas involves a good deal of labor and necessitatesconsiderable costly machinery.

In an upper room is the place where meters, both new and old, are tested. Here are to be seen spick span meters in the flush of youth, beautifully painted and decorated, waiting impatiently to start out on their career of usefulness. They have been weighed, as it were, and found not to be wanting, and upon their clock-like faces is an expression that inspires confidence. Close at hand is a row of meters that have come under suspicion, and they stand there like guilty things waiting to give an account of themselves. In a corner is a pile of worn-out, cast-off meters, so hardened that they would not tell the truth if they could. Now, like dead men, they tell no tales.

The gauge, where the meters are tested, is a very accurate instrument, and does its appointed task without the possibility of a mistake. Hence, if consumers know that their meters are reliable from having had them tested at the works, they may rest assured that they are paying only for what they use. Your milkman, unintentionally perhaps, holds the measure tilted a trifle on one side, and you get a tablespoonful or two less than your quart every day; the dry goods clerk, in measuring off a yard of cotton cloth, not infrequently forgets to make allowance for the portion covered by his thumbs; your butcher—thoughtless man that he is!—throws a sheet of heavy wrapping paper upon the scales before weighing your meat, and so the list might be prolonged indefinitely. With the meter, however, it is *quid pro quo*, always provided, of course, that its moral sense has been preserved intact through all its years of service at your house. The company is always willing to test a meter whenever its honesty is doubted. The company has inaugurated a system of having all the meters in the city tested once in three years, which is done at its own expense and without annoyance to the consumer.

In addition to maketing the coke and coal tar for all sorts of uses, the company has recently been able to put the ammoniacal liquor into such a shape that it could be shipped. Formerly this liquor was permitted to escape into the Little River, and it is a fact worth noticing that the stream below Front Street was for 40 years entirely cleansed of the impurities which are so offensive to people living in the vicinity of Ford Street and along the rest of the river front. The authorities will soon have to provide for the proper treatment of the stream below Front Street, and, indeed, they have already contracted for the erection of a retaining wall there. The ammonia is shipped in large quantities to Syracuse, N. Y., where it is used for manufacturing purposes. It is chiefly by means of selling these various products that the company has been able to reduce the price of gas from $3 per thousand feet, which was the rate ten years ago, to the very low price at which it is now sold.

To keep up with the progress of the age and to make the gas yet cheaper, the company, finding that the old retort house, containing 16 benches, was practically worn out and of little use from an economical point of view, decided some time ago upon a new building. It has therefore caused to be erected a building about 100×68 feet with walls 16 inches thick and 32 feet high, covered with an iron roof frame and slate laid in cement. The building, which is two stories high, contains a stack of nine benches, with regenerative furnaces on the Stedman-Stanley principle. The size of the benches and furnaces, being largely in excess of the common ones in use, will greatly increase their productive power at a largely reduced cost for fuel. It will probably effect some saving in labor besides very largely increasing the comfort of the men employed. The benches are on the north side, the rear of the stack being within four feet of the wall. In this space is laid the main flue, through which the escaping gas from the furnace is conveyed to the large chimney, which is 150 feet high. On the south side have been laid the foundations for a corresponding stack of benches should they be needed in the future. Between the two is ample space for charging the furnaces. The cellar is ten feet high, and the floor above is of heavy cast iron plates laid on girders and supported by cast iron pillars. Coal will be raised to the charging floor by an elevator and put into the retorts. The coke when drawn from the retorts will be dropped through trap doors into the furnace below as needed or else conveyed to market, saving largely in the cost of handling.

The new retort house, as well as all of the improvements, were planned by Mr. John P. Harbison, the treasurer and general manager of the company, and its construction, even to the minutest detail, has been under his personal direction and supervision. Mr. Harbison, who was originally engaged at the works for a period of two weeks only, has been connected with the company since boyhood, and has conducted the affairs intrusted to him with remarkable sagacity and business foresight. He was recently elected an active member of the British Gas Institute, the largest and most influential organization of gas engineers in the old world.

The Mechanism of Zymotic Diseases.

The most recent advances in biological research afford a basis on which to erect a more or less plausible theory of the mechanism of diseases caused by micro-organisms.

The domain of parasitism is far wider than has hitherto been accepted. The principles of evolution teach us life is one ; living forms being but strands in a complicated web, no single fiber of which can assert its independent genesis and history from any other fiber, however remote, while each of these forms possesses a greater or less antagonism to other forms. So it would appear a large proportion of the maladies, whether in plant, fish, reptile, or mammal, are produced by parasitism—the antagonism of lives—the lesser lives feeding on the greater. The higher animal organisms are but communities of living points, some floating free, others stationary—these last attached to their neighbors by protoplastic bonds of marvelous tenuity, just as adjoining households may have telephonic connection, but with their individuality and their automatism unimpaired. A colony of inimical microbes obtainingaccess to this republic is similar to a hostile armed band entering a city—strife at once commences, the strangers attack and are attacked. If the strangers are all killed, no disturbance of health is produced. In any other event, the strangers increase and multiply at the expense of the normal inhabitants, the latter being rather destroyed by some special soluble toxic substance excreted by the enemy than in any other way.

Each micro-organism seems to have a particular rate of multiplication, and when a sufficient quantity of toxic material has accumulated, then the phenomena of fever and eruptions are produced. So far as experimental research has gone, there is no true incubation; there is no mysterious localization of the invading band in lymphatic gland or vessel for days or weeks. The battle at once commences, but it is only when a certain number of the strangers have got the upper hand that a sufficient disturbance of function is produced to give external sign.

In the case of the individual little mass of bioplasm, a few hours may represent several generations, so that acquired properties are very rapidly transmitted; those poisoned by the excretion of the pathogenic microbes perish, those that more or less effectually resist continue to live and propagate, until, by a repetition again and again of this process, the body may be full of resistant living particles. In that case the foreign tribe is conquered, destroyed, expelled, and what is called recovery takes place.

If now a second colony gain access to the same animal tissue, it meets with descendants of the old heroes, and the attack is immediately repulsed. This is the nature of protection from a first attack.

Vaccination is but a modification of the same process. Colonies composed of the weaker members of some malignant tribe enter the citadel, a brief struggle ensues, the inhabitants finally destroy them, and the education thus acquired renders the inhabitants able to cope with a second stronger colony. This second successful fight renders the survivors and their descendants still hardier, and so the process may be repeated until they are able to easily resist the strongest and most virulent of their assailants. This is the phenomena of protection by inoculation of attenuated cultures.

Lastly, it would seem from the experiments of M. Roux and others that the living points of the animal organism may be educated in resistance by being dosed with the excretory products of pathogenic organisms, and that the inoculation of attenuated organisms is not necessary. If this is so, it would in no way alter the conception of the mechanism of immunity ; that is, it essentially depends on the production of a sufficient number of resistant masses of bioplasm, this resistance having been acquired by inheritance from ancestors who have made successful combats against a particular microbe, just as the descendants of Dr. Dallinger's saprophytes were ultimately able to live at a temperature of 158° F.—*Public Health.*

Great Guns.

In a recent debate on the army appropriation bill in the House of Representatives, Mr. Wheeler said : "I am unalterably opposed to a large army, and I do not know a better way to prevent the necessity for an augmentation of our military force—so important to be avoided—than to keep up with the world on the question of material armament. A gun does not eat rations, wear clothes, or draw pay, but it is always on hand for duty, and can easily be moved to the place where it is most needed. There are now mounted upon vessels of foreign navies 129 guns which throw a projectile 10 miles and upward, and the caliber of these guns varies from 12 inches to 17 inches, and they throw projectiles which weigh as high as 2,000 pounds. It also appears that there are now afloat in foreign navies 66 guns which throw projectiles weighing from 900 to 1,250 pounds a distance of at least 9 miles." It is to be regretted Mr. Wheeler did not mention some of the ships that throw projectiles as he states. We fear it will be difficult to find the vessels.