The Bursting of Guns.

We have received a communication on this subject from a gentleman who has had excellent opportunities to investigate the matter, and has made many experiments to elucidate it. During the late war a large number of the projectiles used by the respective armies were ill adapted for service. Many of them broke in the gun onthe shock of discharge, others burst outside the gun prematurely, while many did not burst as intended.

Cast iron is the metal usually employed for projectiles for guns. It is highly crystalline, and the size and character of the crystals depend upon the process of extraction of the iron from the ore, and on the amount and nature of foreign materials held in chemical or mechanical combination with the metal. Repeated meltings will change the size of the crystals; it is therefore necessary that the character of the metal should be well understood. Very soft material for projectiles upsets on the shock of concussion, and very hard metal is apt to fracture.

The mode of applying sabots, and the material of which they are made are important. A hard sabot will transmit the shock of concussion to the shot itself, and tend to break off wedge-shaped portions or upset the base. Our correspondent speaks highly of the Thomas brand of iron which has a tensile strength of 18,000 lbs. per square inch, and the Hopkins' brand of cold blast, charcoal iron having a tensile strength of24,000 lbs. to the square inch. He has never found any difficulty with either in practice.

Even sabots of papier maché, soft lead, or rubber, may, under certain conditions, cause the bursting of a gun by premature fracture, as when the gun has a gain twist if too fast, or the projectile is too heavy for the gun and the charge. Papier mache sabots, as usually manufactured in this country, contain potash combined with rosin as a binding material. The alkali absorbs and retains moisture, swelling the sabot.

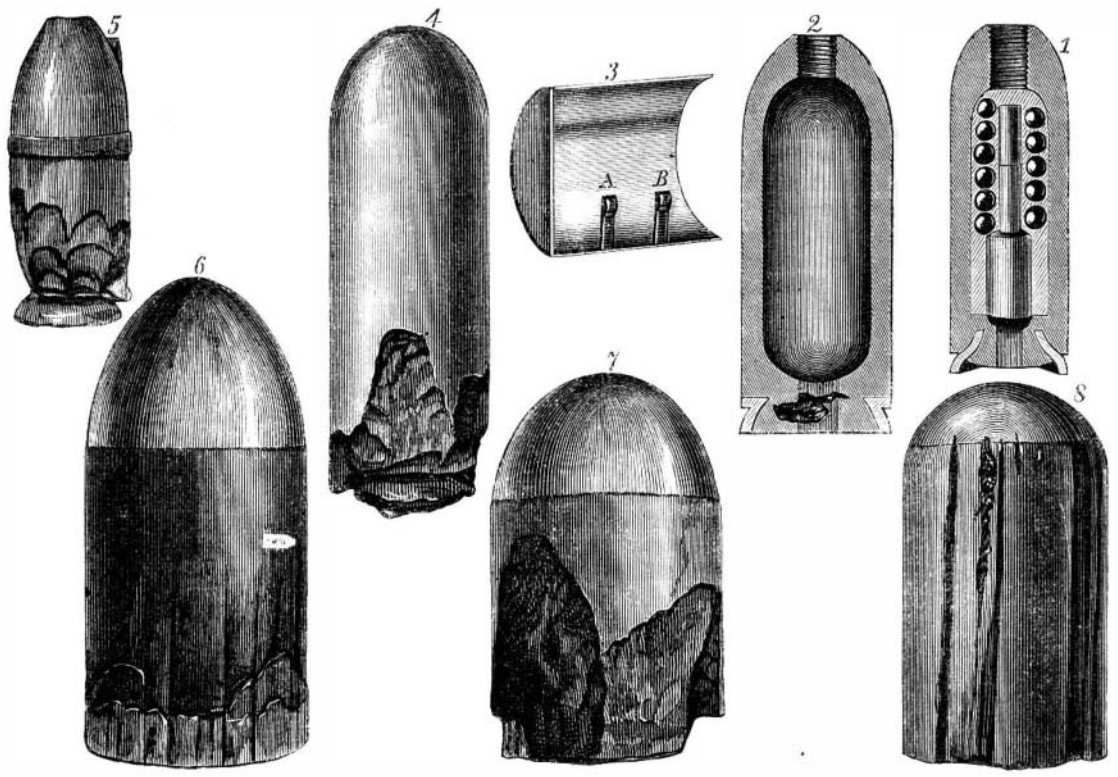
If a gun be loaded, the projectile having a papier maché sabot, and not fired until several weeks have elapsed, the sabot would have time to absorb moisture and swell, thus tending to burst the walls of the gun when acted on by the explosive force of the powder. A soft lead sabot has also a straining effect, especially when the gun is foul; it has no lubricating quality, but on the contrary retains grit, and is employed by the lapidary for this quality. Probably the bursting of rifled guns is often due to the wedging of the sabot in the projectile.

Fig. 1 is a sectional view of a 3-inch Parrott case shot. It will be seen that the sabot enters the base of the shot as a wedge. This is known as the Reed sabot. It is found in practice that this sabot has a tendency to break off pieces from the base of a projectile, which act as wedges, so that the projectile, itself, will take the grooves in the gun. Fig. 2 is a sectional view of a Parrott 20-pounder shell. It will be seen that the sabot does not enter the base as a wedge. But even this form does not save the shell.

Some believe that the unequal distribution of heat caused by the combustion of powder tends to the bursting of a gun. In Fig. 3 our correspondent shows a simple device for testing this question. He styles it a "gun pyrometer." The engraving is a sectional view of a metallic cartridge capable of holding one pound of powder. A and B are slips of common tinned iron; on A is soldered a composition of tin and lead which melts at 212°, and on B is a metal which fuses at 450°. The case, being charged with gunpowder, is placed in the piece and fired. On the removal of the cartridge case the metal fusible at 212° has melted and run down slightly, while that which melts at 450° has not changed. This has been repeatedly tried and in no case were the slips of tinned iron warped or injured by the heat, or the metal on B injured. It would seem that the repeated experiments which have been made by our correspondent with this pyrometer tend to show that a very small amount of heat is communicated to the gun at each discharge by the combustion of the powder. No doubt considerable heat is generated in rifled ordnance by the friction of the sabot and projectile, particularly in rifled guns, and in some cases the friction is so severe that the edges of the lands crumble, and the projectile will consequently jam in the gun, straining it more or less; still, the wedging or upsetting of the bases of projectiles may prove more destructive or injurious to the gun than the premature bursting of a shell while in the gun.

Fig. 4 represents a shot which was fired with one of the wedge-shaped Reed sabots seen in Fig. 1. It is a 30-pounder projectile and shows how the sabot broke off wedge shaped fragments. Fig. 5 is another illustration. In this case the base is preserved, but there is the same wedge-like fractures. Fig. 6 is an 8-inch Parrott shell. It will be observed that the wedges are formed, but held in position. Fig. 7 is an 8-inch solid shot, the sabot of which was of hard gun metal. The wedges extend up nearly the whole length of the cylindrical portion of the shot. Some of these hard metal sabots were removed and others of soft metal, composed of tin, lead, and copper, were substituted, and in no case were wedges formed. Fig. 8 represents a solid shot for an 8-inch Rodman. It has grooves to fit those in the gun. This shot requires no sabot. It will be seen that the condition of the grooves prove that they left the lands of the gun. On the fiftieth round the gun was burst.

The tendency of every shot in a rifled gun is to go straight forward; *i. e.*, leave the lands of the gun. Rotation of a shot is a forced motion, unnatural to the projectile, and it will be seen that with a high initial velocity the tendency of shot in such guns is to strain the walls. Then there is the strain from the upsetting or expansion of the base of shot, particularly of those using a sabot which acts as a wedge. Where the shot and gun, both, are of iron the friction on the lands of the rifling must be very great, and the action of the liberated gases and the direct line of the shot would tend to burst the gun; but the wedging of the fragments disengaged from the base of the shot must have an injurious effect on the gun. It seems as though the form and material of the sabot is a very important matter, and as it is easily seen that they affect the durability of the piece, greater attention to this matter should be given than that which it has heretofore received.



GUN PROJECTILES AND SABOTS.

The Galibert Respiring Apparatus.

The portable atmospherewhich we described lately, appears to be making its way into this country, as an aid to firemen—and why not to divers?—as well as to miners. The apparatus was subjected, the other day, in Chicago, to a public test in the presence of the Fire and Police Commissioners, representatives of the insurance interest, and others.

One of the cells of the central police station was made airtight, and in it was kindled a fire with straw and sulphur, which filled the place with smoke very dense and excessively irritating. Mr. T. Galibert, a brother of the inventor who lives in Chicago, pulled out the apparatus from the case in half a minute, inflated it in another minute and a half, equipped himself in forty seconds, and rushed into the cell. The door was closed on him and he was left to his fate, the stench coming through the door, which was open only an instant, being so intolerable that the watchers were glad to escape to the open air. Five minutes elapsed, and the watchers began to grow uneasy—ten minutes, and they could brook the suspense no longer. They called out to the man in the dungeon, to know if he were all right. He answered with a cheerful whistle, and was allowed to stay. At the end of about sixteen minutes he came out. Save that his eyes were a trifle red from a little of the fumes which had passed under the goggles, he was just the same man as when he entered. His pulse was 130.

John Kern, a member of the Hook and Ladder corps, then assumed the apparatus and entered the cell. He staid in it nine and a half minutes, saying on coming out that it seemed as if he could have kept on breathing half an hour, but that the fumes penetrated under the goggles and made his eyes ache. We may remark that this would not be the case in the smoke from an ordinary fire.

It was noticed that the operator had both hands free to work or carry out valuables, the bag at his back being a very slight incumbrance, being scarcely the size of the human body, and offering no obstruction to the passage of the wearer. The price asked for the apparatus is $150 each set, or nine for $1,000.

"WIRBEL-BEWEGUNG."

What is wirbel-bewegung? Who knows anything about wirbel-bewegung? The secret has just been extracted that the round world and they that dwell therein, the big whales and little fishes, gorillas and anthropologists, the sun, the moon, the stars—nay, the foundations of the wide universe itself, are all wirbel-bewegung. The readers of *The Engineer*, the editor, the paper, the printing-ink, and the printer's devil, are wirbel bewegung root and branch. Historical personages, Henry VIII., the Holy Maid of Kent, Mr. Disraeli, the Cock-lane Ghost, Mr. Gladstone, the Thirsty Woman of Tutbury, the Vicar of Haverfordwest, the great Mogul, the reform league, Landseer's lions, and Balaam's ass, are all nothing more nor less than wirbel-bewegung. Who made the discovery? Professor Sir William Thomson, of the Atlantic cable, who first announced it a few days ago, to an assemblage of learned philosophers, with Sir David Brewster at their head, at a crowded meeting of the members of the Royal Society of Scotland. The first publication of such an announcement in England is of itself a mighty task, but now that the first burst is over and the secret out, breathing time may be allowed, and the details calmly considered in fresh paragraphs. We are now as exhausted as the hero of old, who took a run of three miles to jump over a hill, but having reached the bottom of it sat down to rest, and then walked over at his leisure.

A lump of any solid simple substance is reasonably assumed to be built up of a number of atoms of that substance, but such particles have never been seen, being infinitely beyond the ken of the most powerful microscope, so on this point there is fine scope for the exercise of the imagination. Let a poker made of the simple substance iron be made red hot in the fire, and it will grow longer than it was when cold; hence its constituent particles have the power of motion. In fact, heat in a body can be proved to be nothing but motion, and as absolute absence of heat represents a degree of cold that has never been attained upon earth, the atoms of all bodies are known to be in a state of motion. What that motion is, or what the atoms are like, nobody knows, so it has been assumed by many philosophers that the particles are incompressibly hard and infinitely rigid. "But," it has been argued, "it is impossible to imagine an atom so small that it cannot be cut in two; therefore, matter may be infinitely divisible." In this case it would not be matter at all, but a series of forces emanating from points, so that the universe may be built up of laws rather than of material substances. As it is, therefore, quite as impossible to prove as to disprove the existence of solid matter, the dilemma forms a very pretty puzzle, and the leading votaries of physical science at the present day are divided, without much dogmatism on either side, into two classes, the materialists and the immaterialists, and the ranks of the latter seem day by day to be gaining ground.

Professor Thomson based his communication upon the admirable discovery of Helmoltz of the law of vortex motion in a perfect liquid, that is to say, in a probable fluid destitute of viscosity or fluid friction. Helmoltz has proved mathematically an absolute unchangeability in the motion of any portion of a perfect liquid, in which the peculiar motion he calls "wirbel-bewegung" has once been created. Professor Thomson, therefore, boldly throws down the gauntlet, by condemning "the monstrous assumption of infinitely strong and infinitely rigid pieces of matter," and suggests that Helmoltz's rings are the only true atoms. Further, he managed, in the presence of the audience, to make some large vortex rings in the imperfectly elastic fluid, air, and to render them visible to the audience in the following curious way:—He took a large wooden box filled with smoke—any smoke will do, such as that obtained by burning magnesium, or by placing two jars in a box, one filled with ammoniacal gas and the other with hydrochloric acid gas. At one end of the box there was a round hole, and at the opposite end another and larger opening. Every time a cloth or piece of wood was flapped against the larger opening, of course a sharp puff of air laden with smoke in suspension shot out through the opposite round hole. These puffs instantly took the form of smoke rings and floated about the room, and were frequently seen to bound obliquely from one another, shaking violently from the effects of the shock. They rebounded from each other and trembled in much the same way that two india-rubber belts would do under the same circumstances. Had these rings been formed of a perfect fluid they would, as Helmoltz has demonstrated, have kept up the wirbel-bewegung motion to all eternity.

"A full mathematical investigation," said Professor Thomson, "of the mutual action between two vortex rings of any given magnitudes and velocities, passing one another in any two lines, so directed that they never come nearer to one another than a large multiple of the diameter of either, is a perfectly solvable mathematical problem, and the novelty of the circumstances contemplated presents difficulties of an exciting character. Its solution will become the foundation of a proposed new kinetic theory of gases." He proved that if two such vortex atoms were interlinked, nothing could ever separate them, for one line of vortex motion could never pass through another line. Thus such a double atom might much vary in shape yet remain essentially the same.

Here, then, is a new basis for all physical science with a vengeance. Since the time when a perfectly elastic fluid was acertained with tolerable certainty to permeate the universe, and to convey the vibrations of light from the sun to the earth, philosophers seem to have rapidly grown more etherial in their ideas respecting the construction of solid bodies. The discovery also of the grand law of the conservation of energy, of the total indestructibility of force, has brought the minds of men of science into a state which prepares them to listen with considerable attention to novel ideas like that of vortex atoms, which bases the existence of solid bodies upon an all pervading energy rather than upon crude lumps of matter which have never been seen. Those who have had much to do experimentally with the imponderable forces, especially electricity and magnetism, the latter of which now presents phenomena shrouded in the densest mystery, are inclined to think the theory of solid atoms of hard matter far too crude to meet in any degree the observed facts. What is the reason that this mysterious force deflects magnetic needles in the observatories at Kew and Lisbon at the same instant of time? Does the force come from the sun? Does it traverse the hypothetical ether in vibrations like those of light? Mr. Varley, who probably knows as much about electricity and magnetism as any man living, has no faith in the idea of the existence of hard rigid lumps as ultimate atoms, and has in his researches, discovered that these imponderable forces have some properties which are commonly ascribed only to solid matter.

So wirbel-bewegung is vortex motion. In all ages mysterious powers have been ascribed to the circle. A serpent with its tail in its mouth has long been considered the fittest emblem of eternity. Dancing dervishes, devotees of wirbel-bewegung, for centuries have achieved a meritorious amount of devotion by spinning around upon one leg. The lamas of Thibet pray by machinery, their petition being printed upon small windmills, which rotate right merrily in every passing breeze. Sometimes, it is true, the wind chances to fail, but a band over the smoke-jack in the chimney furnishes the necessary mechanical power, to grind the prayers. The world is circular, and travels round the sun in a circle, the moon twists round the earth in a circle, the sun dances round his axis in a circle. and is supposed himself to travel in a circle, round the star Alcyone, the center of another circle, so there is plenty of precedent for Professor Thomson's idea that atoms whirl in circles, and that the heads of philosophers spin round in an endless wirbel-bewegung. Astrologers and other clever men found this out long ago, so made their bodies spin round when performing their incantations. Dr. Aldrovando, first physician to Prester John, leech to the Grand Lama, and hakim in ordinary to Mustapha Muley Bey, is recorded by one of the fathers of the Church, to have thus, by unholy rites, obtained power over the spirits of the nether world.

"On one side was an article bearing a strong resemblance to a coffin; on the other was a large oval mirror in an ebony frame, and in the midst of the floor was described in red chalk a double circle, about six feet in diameter, its inner verge inscribed with sundry hieroglyphics, agreeably relieved at intervals with an alternation of skulls and cross-bones. In the center was deposited one skull of such surpassing size and thickness as would have filled the soul of a Spurzheim or De Ville with astonishment. A large book, a naked sword, an hour glass, a chafing dish, and a black cat, completed the list of movables. The doctor seated himself in the center of the circle upon the large skull, elevating his legs at an angle of 45 degrees. In this position he spun round with a velocity to be equaled only by that of a tee-totum, the red roses on his instep seeming to describe a circle of fire. The best buckskins that ever mounted at Melton soon yielded to such rotary friction—but he spun on—the cat mewed, bats and obscene birds fluttered overhead."

Now here is a clear case of wirbel-bewegung, known to a scientific man of the days of old. Now-a-days, whenever a discovery is made, some good-natured friend of the promulgator always rises to say it is not new; as was the case with Mr. Wilde's new magneto-electric machine, so here is a clear case against Professor Thomson. Probably he made his discovery by going through the ceremonial incantations laid down by the illustrious Dr. Aldrovando, but this is one of those grave secrets which his tailor only can unravel. The scientific world now travels onward at a rapid rate, and who knows whether before long the canny folks in Glasgow may not see their learned townsman building himself a house of solid matter, made by banging smoke-rings out of a wooden box with a damp towel?—*The Engineer*.

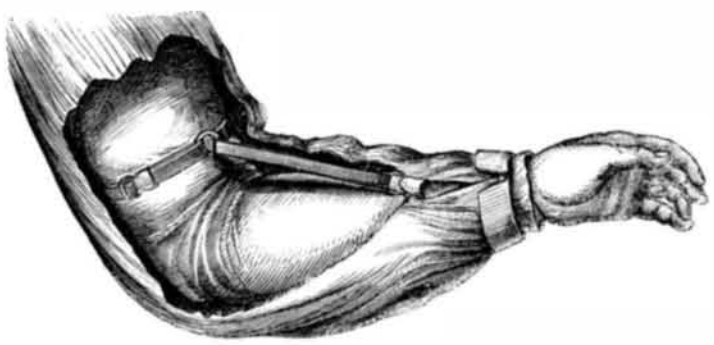
THE PALM OF THE INDIAN ARCHIPELAGO, according to M. Maxime du Camp in the *Revue des Deux Mondes*, furnishes from the envelope of its trunk and stalks a peculiarly valuable fiber for covering telegraph cables. An anchor fished up after 60 years submersion, had a piece of native cable from this substance attached, which was as strong as when new. A sugar manufacturer in Java has used a mattress of the same material in the river which supplies water to his establishment, as a filter, for the last twenty-five years, submerged during four months and hung up in the torrid sun the rest of the year; yet the mattress is as sound and strong as ever. The application proposed is about to be tested, as the submarine cable between Batavia and Singapore has been covered with a tissue of *aren*, as it is called by the natives, and in a few years will afford some evidence in regard to its value.

A RODMAN GUN FOR THE BRITISH GOVERNMENT.—One of these guns of 15 inches calibre has been cast for the British Government for experimental purposes, and will shortly arrive in England.

POWELL'S SLEEVE SUPPORTER.

In the labors of the household, the store, shop, and laboratory the annoyance of long or drooping sleeves is one which all more or less feel. The plan of slipping an elastic over the arm is not half efficient, and the rolling up or tucking of the shirt or dress sleeve is apt to deface the smoothness of the fabric.

The engraving shows a simple device for keeping the sleeve in a proper position when at work, that appears to answer the requirements without the annoyances of the temporary contrivances generally employed. It is merely a strip of flat silk elastic, one end of which is attached to a slide of sheet metal and the other to a hook. The hook end passes



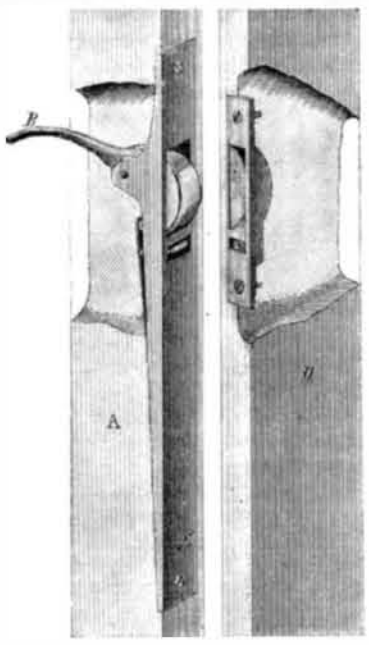
through a ring engaging with the loop formed by the slide and the elastic itself. The loop formed by the slide and ring is slipped over the arm above the elbow and the hook drawn through and attached to the opening above the wristband.

It will be seen that the movement of the hand controls the elasticity of the band and also that the tension can be regulated by the slide. It seems to be just what is needed by hundreds, as it can be used under all circumstances. It was patented through the Scientific American Patent Agency March 19, 1867, by Thomas Powell, Milroy, Rush Co., Ind., whom address for other facts relating to the device.

BUTTERWORTH'S IMPROVED WINDOW SPRING.

The breaking of window weight cords, the difficulty of putting in new cords, and the annoyance of rattling window sashes have stimulated many inventors to provide a substitute for the sash weight and at the same time to produce a lock for the sash to hold it in position. The engraving shows one which was patented March 24, 1863, by J. C. Butterworth Jr., of Providence, R. I. It is simple and always direct acting.

On the sash frame, A, is a plate of metal mortised into it, and carrying a spring lever, B, having at its outer end a segment of a circle the face of which is of elastic rubber intended to have a bearing against the window frame in which the sash slides and to hold the sash firmly against the other side of the window frame. This segment is held in place by a flat spring of steel, riveted to the plate at C, and bearing at



the other end against the segmental portion of the lever. Riveted to this spring is a projection of metal that passes through a corresponding aperture in the plate on the window frame, D, to lock the window when closed. By placing these plates at desirable distances on the window frame, the window can be locked at any point desired. The plate on D, has a semicircular recess to receive the segment of the lever, B, at any point to prevent unnecessary strain upon the spring.

By raising the end of the lever, B, the segment is receded and the sash left free, so that the sash can be readily raised; by releasing the lever the spring forces the rubber surface against the window frame or engages the projecting snug with the mortise in the plate on the window frame. The lifting instead of the depression of the lever assists the contrivance in raising the window, being in this respect superior to those window latches which operate in a reversed manner.

J. C. Butterworth Jr., Providence, R. I., will furnish the springs or give any information desired relative to the price, action, etc., of this device.

THE ATLANTIC AND PACIFIC TELEGRAPH COMPANY has been organized to build a new line through from New York to the Pacific. The division from New York to Buffalo is to be completed by the first of next September.

HUB-BORING MACHINE.

This contrivance is intended for wheelwrights and carriage makers who do not have stationary machinery or power to assist them in their business. It is a hub-boring machine worked by hand. The usual way to bore hubs by hand is to use first an auger which bores a straight hole and then to ream out the hub thus made with a conical pod auger or semicircular conical reamer. To do this two tools are neccessary but with this machine only one. The cutters are carried on the shank, A, on which is a stop, B, to regulate the depth of the shoulder. The lever nuts, C, clamp the hub, and their screws are secured to a disk in which traverses an eccentric that, by a set screw, D, and a plate seen in front determines the taper of the hole to be bored. E is an open nut by which the cutters can be drawn back to the butt of the hub without turning the handle or shank.

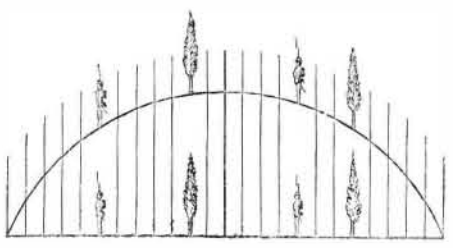
To bore a box, set the machine on the hub, then measure the distance from the eccentric plate to the nut, E. Make a drawing of the iron box which is to be seated in the hub, giving an outline with center and side lines extending down to the face of the open nut, E, giving the small end of the hole intended a continuation to the top of the diagram. Set the cutters one half the diameter of the small end of the hole gaged from center of the shaft and bore through the hub. Then move the eccentric plate by the set screw, D, to half the taper required and bore through again. The result will be a taper to fit the box.

The work can be done quickly and with certainty of satisfactory results. When accustomed to the machine, the workman will not require a drawing, but will be able to judge by the eye how to set the cutters.

For further information address Ira B. Gage, of Constantine, Mich.

UPRIGHTS ON A PLANE AND ON A CURVE.

A correspondent from New Hampshire writes as follows: "I would ask your opinion of the picket fence question discussed lately in the columns of the New York *Ledger*. Mr. Bonner cannot be convinced that it would not require a greater number of pickets of a given width, placed a given distance apart, to build a fence over a hill than if they were placed on a level plane running from the same points on either side of the hill. I say it will take the same number for each, and would like your opinion."



We have not read the discussion referred to, but we think our correspondent is correct. By reference to the above diagram in which the curve represents the hill, or reversed, a valley, it will be seen that the same number of upright objects, either fence pales, men, or trees can be placed on a level as on a curve; that it requires no more to occupy the same horizontal distance on the convex or concave curve than on the plane. That the surface distance is greater on the curve than on the plane is apparent, but in the case of upright or vertical objects the horizontal distance is the same in both cases. No more trees can be planted on a hill side than on a level representing the same horizontal distance. The diagram appears to be a perfect demonstration of the matter.

MORE UNPLEASANT COMPARISONS.—Among the many tokens, small and great, of the arousing of a German giant to take the place of England in commercial, political and perhaps maritime supremacy, are mentioned the twin significant facts, that while business is languishing in England, the Berlin Railway Plant Company and a Stettin shipbuilding concern, the "Vulkan," have both made enormous dividends in the last year, being respectively ten and eleven per cent.

GOOD WORKMANSHIP.—A locomotive constructed in the workshops of the Orleans Railway company, has run 93,150 miles, in three years, without submitting to any repairs. The engine is to be exhibited at the Exposition, and is worthy of it.