sceptre of Russia. It was this famous stone that suggested Wilkie Collins' novel, "The Moonstone."

But the most wonderful stone is the Braganza, or King of Portugal's diamond, which was found in Brazil in 1741. Mawe says it weighs 1,680 carats (some accounts make it 1,880 carats), and that in Brazil its value is estimated at £300,000,000! But unkind people suggest that it is not a diamond at all, but only a topaz; and the Portuguese Government, for reasons best known to themselves, resolutely refuse to allow it to be tested, or even to be seen.

Connected with the subject of doubtful diamonds, a good story is told of a monster which was found by a negro at Villa Rica, in Brazil, in 1809. The finder begged permission to present it in person to the emperor, and was accordingly fetched in a royal carriage, and honoured with a military escort. He laid his gift at the emperor's feet, and every one who saw it was astounded at its size. It weighed 2,560 carats, or nearly a pound. Its value was estimated at countless millions. Mr. Mawe, an eminent English mineralogist, happening to be at Rio de Janeiro at the time, begged permission to prove its value by scientific inspection. Permission was granted, but before he could be admitted into the room where it was deposited, he had to produce an order signed by the whole Cabinet of ministers. One sentinel after another was passed, and the chamber at last reached where, under the guard of three officers, each with a separate key to three chests, one inside the other, he was shown the incomparable stone. Producing a cutting diamond, Mr. Mawe *scratched* the great crystal —the untold millions vanished like a beautiful dream.

The various writers on diamonds differ very materially in their accounts of some of the more famous stones, in fact scarcely any two of them entirely agree, and it has therefore been thought judicious by the writer of this paper to side with the preponderance of evidence in cases where serious discrepancies are found to exist.

EDWARD OXENFORD.

THE GATHERER.

Rubber-clad Men-of-War.

A singular experiment is about to be made on board H.M.S. *Skylark*, under the superintendence of Lieut. Custance, which if successful may entail an additional encumbrance on our war-vessels. The idea is so exceedingly simple that one wonders it has not been thought of before. That portion of a ship which is beneath water is liable to occasional penetration by shot; but as the decks even of our strongest armour-plated vessels are seldom if ever covered with the same kind of iron plates as those which defend the outside, it follows that they are peculiarly exposed to what is called a "plunging fire." The projectiles thus hurled might force their way through the decks and pass out at the bottom of the vessel. An occurrence of this kind would of course almost immediately sink the ship, for a leak would be sprung in the most impossible place for stoppage, especially during a conflict. It has been suggested that if the bottom of a war-vessel were covered with india-rubber, even if a shot penetrated a vessel in the manner above described, the leak resulting would be sufficiently closed in by the pressure of the water on the rubber. In order to test the value of the suggestion Lieut. Custance is about to employ the following experiment:—One end of an iron tube will be closed with an india-rubber diaphragm eight inches in thickness, and be made perfectly water-tight. This end of the tube will then be sunk in the water until the india-rubber is in a position similar to what a vessel would be if covered by the same material. The bow-gun of the *Skylark* will then be depressed sufficiently to allow a sixty-four pound shot to be fired through the india-rubber diaphragm, when, if the tube floats, it will be evident that india-rubber can close up a shot-hole. The result may be important, for, as we have found earthworks to be the best means of arresting projectiles on land, it would be singular if for a similar reason we exchanged an iron casing for a thick india-rubber layer on the outsides of all our men-of-war! India-rubber we can grow, but iron we cannot.

A Hidden Quotation.

In the following lines a well-known quotation from a modern poet is hidden—one word in each couplet:—

A GLIMPSE OF NATURE.

A little lake fenced round with hills,
And fed by half a hundred rills,
That laugh and prattle as they hie,
Scarce knowing yet man's watchful eye.
A little spot of Nature's best,
Hid far away like tiny nest
Low-perched 'mid grasses, bush-o'ergrown;
A little world of things unknown
To those who gaze but from afar,
And know not what earth's beauties are;
Who barely see what nearest lies
And walk the world with self-dimmed eyes.
Far otherwise with him who walks
Closely observant; Nature talks
To him with no uncertain sound,
Shows him the things that lie around
Close to his path on every side,
Tells him where unguessed beauties hide,
And bids him look about to see
The sources of her harmony.
His life can never be all sad,
Who has such friend to make him glad;
For, springing up about his feet,
Companions make the moments sweet.

W.

A New Use for Insulators.

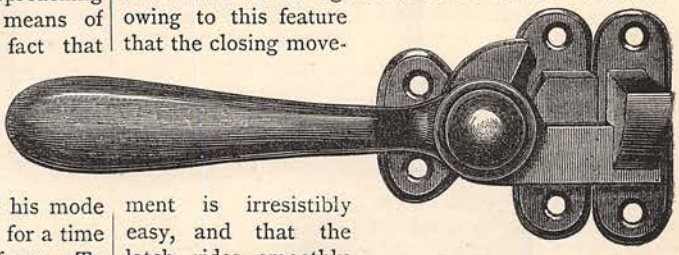
There is no more troublesome or distressing disease than rheumatism, whether muscular or fibrous. Many remedies have been suggested for its cure or alleviation, but it can scarcely be said that any one course of treatment is exactly suited for successful application to the great variety of forms in which the disease manifests itself. Indeed, speaking of rheumatism, we may almost parody the well-known maxim, and say, *Quot varietates tot remedia.* Probably each physician has his own way of approaching it; and so, too, has Mr. Thomas, by means of his Electric Insulators. Acting on the fact that electricity plays a prominent part in the support of physical life, and that to a deficiency of this property in the system is due that loss of health which is equivalent to disease, especially to that form of it known as rheumatism, Mr. Thomas makes his mode of treatment solely turn upon the retention for a time of the electricity in the body of the sufferer. To secure this result, a glass stand, something like that which is used to raise a piano or table a few inches, is placed under each foot of the bedstead or couch upon which the patient lies. The bed (or couch) is then drawn clear of the wall, and particular care is taken that the bed-furniture and linen on no account touch the floor or other articles standing near, such as chairs, &c.

These instructions having been followed, the electricity in the sufferer's body is insulated—that is, it cannot depart, glass being a non-conductor. In severe cases the attendant must not touch the patient or the bed with either dress or hand unless it is covered with silk, otherwise the electric current will escape.

A Latch and a Catch.

The shutting of a door or gate has often enough led to much inconvenience. For instance, if you have paid a visit to the hot-house to see what progress your promising vines or choice exotics were making, and if you have, as you supposed, left the door securely fastened, it would be rather annoying to find, perhaps next day, that the latch—as latches sometimes will—had missed its catch, and that consequently the cold had got access to your precious fruit and flowers. Now such a result would be impossible in all cases where the self-acting door-latch was in use. A familiar Scottish song humorously depicts a state of things bordering upon domestic strife, which would have been scarcely probable had the ingenious contrivance, presently to be described, been known to the parties who were sufficiently obstinate to quarrel about the barring of the door.

The self-acting fastener consists of a latch and a catch, each made of metal, and that of various kinds. They are to be screwed upon the door or gate, and there is therefore no risk of disfiguring the door by misfit or the accidental cutting away of too much wood. The principle upon which the fastener—which is the patent of Mr. Montague Davenport—works is very simple. It consists of a sort of lever, the opposite end of which serves as a handle for releasing the latch from the catch; the latter being, of course, screwed to the post, the former to the door. To prevent the latch from travelling too far back, a stop is inserted, against which, as against a very diminutive buffer, the handle acts—its return being speedier the narrower the range in which it works—and, by being thus kept horizontal, it is ready to glide down the catch the moment the door is "made-to," as the Germans have it. The nose of the catch is on the swerve—that is, is rounded downwards with a slight inclination inwards—and it is owing to this feature that the closing movement is irresistibly easy, and that the latch rides smoothly home. In fact, it is difficult to see how the gate, when drawn or pushed to, can do anything else but shut. The action, as already intimated, is automatic, the latch catching of its own accord by reason of the weight of the handle. There are no springs to get fractured by frost or rust; while corrosion, in the case of iron fastenings, is provided against by a coat of a specially-devised preparation. The self-acting door-latch is possessed of great strength, and there cannot be much chance of its wearing rapidly. Mr. Davenport has invented a double fastener, to close both from the inside and outside, which acts upon precisely the same principle as the patent fastening which we have described.

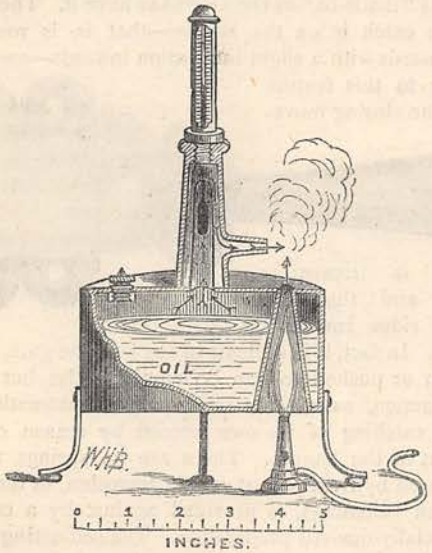


A Test for the Ignition of Oil.

Many to whom the names of Sir William Thomson and Professor Tait are unfamiliar could no doubt give a definition of the term "friction," as used by physicists, that would be quite good enough for all practical purposes. Friction may briefly be said to consist in the resistance that is offered by two bodies working upon each other, and where it exists there is always loss of energy—great or small according to the amount of resistance. In Applied Mechanics this point is of much importance, for in all cases where large heavy machines have to be driven their power may be sensibly affected by it. In order, therefore, to keep it as low as possible, the machinery has to be thoroughly "lubricated," so that its various parts may work freely among themselves. One of the commonest and best of lubricants is oil, and that oil is considered most satisfactory, after tests for other properties, whose non-liability to ignition stands highest. Some light mineral oils are absolutely dangerous, because of the low temperature at which their vapours take fire. Indeed, there is reason to believe that some cotton-mills have been destroyed from this very cause. But a remedy has been provided by means of which it can be easily ascertained whether or not an oil is safe.

Mr. W. H. Bailey, who has devoted much attention to this subject, has adapted an instrument for testing

the igniting-point of oil, and a reference to the engraving will render any detailed explanation needless. The oil is put into a small copper vessel, which is filled only about three-quarters full, as oil expands much when heated. A spirit-lamp or Bunsen burner is then placed underneath, and ere long vapour is seen to issue at the little tube at the side, the vertical and horizontal arrows indicating the point where



the vapour comes under the influence of the heat from the burner. As this vapour ascends, it passes the bulb of a thermometer which records the temperature, and so enables the experimenter to note the point of ignition. Oils are considered unsafe as lubricants if they ignite at a temperature lower than 212 degrees Fahrenheit. It may be added that the instrument here illustrated was to some extent suggested by Regnault's apparatus for testing the boiling-point of thermometers, and Mr. Bailey's may be employed for that purpose by using water instead of oil. It may also be used to indicate altitudes, such as the height of mountains above the level of the sea, by noting the varying boil g-points of distilled water.

A Self-adjusting Windmill.

To agriculturists the windmill shown in the engravings is likely to be of great use. It is of simple construction and according to the strength of the wind will adjust itself. The arms bearing the sails are so connected that an excess of wind will fold the sails together, and the motion of the sails is retarded by a brake wheel; and the hollow revolving standard is so arranged that, held vertically, it is free to be acted on by the slightest change in the course of the wind. Fig. 1 shows the wings expanded, with a sectional view of the revolving standard. In Fig. 2 the wings are closed—and a glance at A will show that the out-arm alone is fixed to the shaft, the other arms being at liberty to revolve thereon. The sails, however, are connected near the edges by leathern straps allowing them to spread out only to the size allotted to them. The rear end of the shaft has a crank arm which communicates with the pump rod. On the rear of the rear arm the brake wheel B is secured, in contact with which is the pivoted brake C, governed by a rod leading

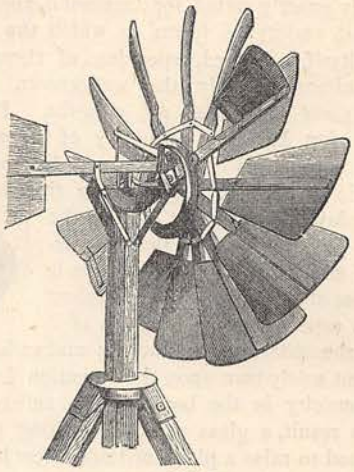


FIG. 1.

down the standard supporting the mill. The tail-board serves in the usual way to turn the wheel in the direction of the wind. The windmill has been suc-

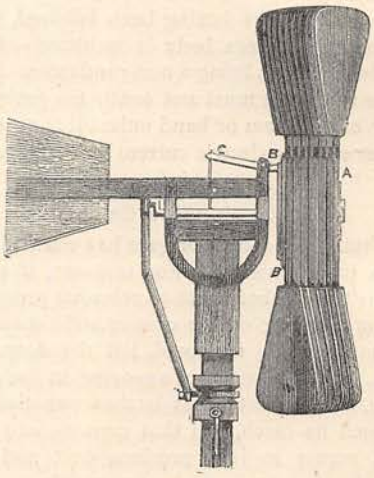


FIG. 2.

cessfully tested, and it is pronounced to be excellently suited for raising water for cattle, supplying water to houses, and to perform many other necessary duties for the agriculturist.

An Ornamental Trade.

The industries which depend upon the caprices of fashion rarely attain to any great extent, but the modes in which they are carried out are often (and possibly in consequence) more varied, fresh, and interesting than those which are reduced to system and pursued on a large scale. In the north of England the romance of trade has fled before the method which

has now settled down upon its chief industries of coal and iron, and which is crushing out the quaintness of life in the lead-mining districts; but in the small and peculiar industry locally called "jetting," and jet-working, the extent of that industry, and the nature of the district in which the material is found, leave it much in the condition in which so fluctuating an industry has been carried on in the north for scores of years. The finding of the jet is carried on now in some of the most secluded of the little dales in and on the borders of the great treasure-trove of Cleveland, under conditions of almost isolation in regard to the work, which is in a considerable degree speculative. The working of the jet into the ornamental shape it takes is becoming more and more methodised; and it has acquired in the town of Whitby a proportion which an ornamental industry rarely takes.

Jet was found at one time largely on the north-east coast near Whitby, and it was obtained by the easy but destructive process of "dessing" or quarrying down the face of the cliff in which it was embedded. It was also found in the Cleveland Hills, but more especially in the southernmost of the two spurs which penetrate inland from the Cleveland coast; and for long the bulk of the native jet obtained has been got from the latter depository. The mode of working is very simple, but for so limited an industry the arrangements of the working parties vary considerably, as do also the modes and remuneration. The jet-master rents a length of the foreground of a hill, and by that renting he acquires the right to penetrate to any extent he chooses into its interior, and thence extract the article he is in quest of; but the custom prevents him working more than a given number of men in such a length, so that there is a practical restriction. Running a level shaft into the hill-side for four or five score yards, cross-sections are driven from this, and the miners literally hew down the earth from these, retreating before it, and extracting with practised eye the jet, following up the horizontal seams, which resemble nothing so much as glue. Except in cases where a sort of co-operative system of mining prevails, the pay is something like a labourer's, for labourer's work, with the discomfort and the slight danger of mining work added. The jet-master has the risk, and has the reward; for though there have been instances where men have "toiled hard all the year" and found nothing, yet, on the other hand, when the price of jet has been high, there have been "finds" of seams which in the aggregate have amounted to £1,000. The importations of the article from Spain, cheaper if softer, have tended to bring down the price, and the diminution in the demand in recent years has been considerable.

Whitby for years has been the seat of the jet manufacture. In the little Esk-side town, the industry attained so remarkable a growth that its annual value to that place was estimated at £100,000; and it employed about 1,300 people, or a twelfth part of the population; but in the last two years, for the causes named, it has not preserved its former importance. When the jet, in its rough state, is brought into the workshop it is cleared of "scar" and dirt with chisels, then sawn to the sizes befitting the desired object. After being rubbed on small grind-stones, treadle-driven, it passes into the hands of the carvers. A visit to their rooms shows the various processes, and the variety of the articles and patterns produced thereby. With light chisels, leather-bound, some of the simpler patterns are being cut into shape; the "heads" of brooches are being traced from the pattern in front, flowers are having holes drilled by foot-turned lathes, and an endless variety of articles and designs produced. And in recent years there has been much done to improve the artistic quality of the designs, and to cultivate in the minds of those who execute them a love of art founded on knowledge. After the design has been thus cut, and the brooch, pin-head, piece of necklace or bracelet, has been thus perfected, it is polished by being held against revolving wheels lined with chamois leather, the interstices and hollows with list, and lamp-black giving the final touch before the article is carded or strung in the ware-rooms. Of the change that the operation makes in the value of the article, it may be said that the crude jet varies considerably in price, that whilst it may vary from two to ten shillings per pound, the finished article will have a value as high as £4 per pound, in certain cases, varying downwards with the diminution in size of the pieces and the skill of the designer. It must, however, be remembered that a considerable proportion of jet is wasted in the cutting out of some articles; and that, on the other hand, the chief centre of this ornamental trade derives great benefit from the dealings it necessarily has also in the articles which occasionally form the settings of jet.

Answer to Double Acrostic on p. 254.

ENOCH ARDEN.

E mili A
N apie R
O d D
C ap E
H ele N.

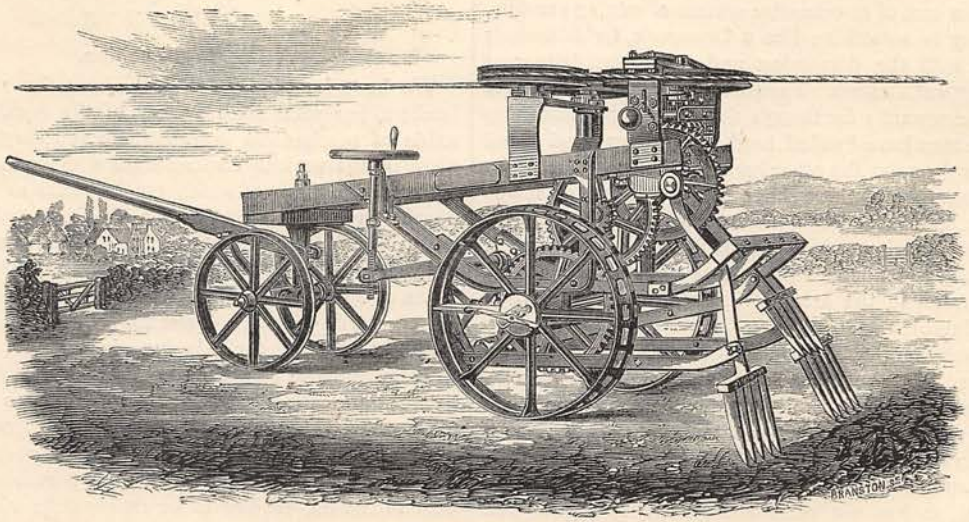
A Digging-Machine.

We have heard a good deal about the march of intellect, but what shall we say of the equally rapid stride of mechanical inventiveness? Every passing week brings us into acquaintance with fresh marvels of ingenuity, many of which are as useful as they are novel. Here, for instance, is a digging-machine, invention of Mr. J. H. Knight, by which a vast amount of work can be got through in a comparatively short space of time. The machine is mounted on a sort of carriage, with a pole in front for steering, and wheels specially adapted for gripping the ground. These wheels run loose on the axles until made fast thereto by what are called "clutches," of which there is one to each wheel to facilitate the turning of corners. On the top of a frame are three pulleys that revolve by a high-speed hemp rope driven by a portable engine, which does not require to be reversed for running in a contrary direction. On the lower end of the central

or driving pulley is fastened a pinion, which communicates the motion to the spur-wheel on the crank-shaft that actuates the digging-forks. This shaft is cranked in the centre, and has two other cranks at its ends, all three forming an angle of 120 degrees with each other. The shaft thus gives an oscillatory motion to three wrought-iron connecting-rods terminating in cross-ends, into which are fitted the tines of steeled iron forming the forks, which, by means of a hand-wheel, worm, and lever, can be raised or lowered, according to the depth of spit required, or lifted clear of the ground when not in digging action. Motion is conveyed to the machine by an endless rope from an 8 horse-power agricultural engine, moored as in steam-ploughing. The rope passes round a pulley on the driving-shaft of the engine, and also round the pulley of an anchor-carriage for securing the needful tension, and is then led to the machine direct, being supported in a straight line by pulleys carried on a movable stand, the direction being changed by angle-pulleys at the corners of the gradually increasing rectangle described by the rope. By passing round the driving-pulley, the rope causes the machine to propel itself by means of the land or bearing-wheels. The spent rope is carried on pulleys back to the engine, the tension being kept up by the anchor-carriage, which is in charge of the driver. The speed of the rope is about 3,000 feet a minute, and that of the machine about 100 feet, or one-thirtieth. The forks are driven into the ground one after the other, and send the earth flying behind more quickly than the eye can follow. One might fancy that the forks would simply descend into the ground and rise again without turning over the earth, but this is prevented by a pivot and lever arrangement, and also by the fact of the forward movement of the machine.

An Enchanted Metal.

Among the most remarkable features of the progress made in modern times, are the new metals which have been added to the ancient list. Gold and silver, copper, iron, lead, &c., these have been familiar for thousands of years, but it is only comparatively recently that the existence of other metals has been demonstrated. The last discovered is called Gallium, and possesses such singular properties as to seem enchanted. In general appearance it looks like lead, though it is not of so blue a colour, and might be termed an exaggerated lead on account of the extreme facility with which it can be melted. An amount of heat less than that of the hand (86° F.) reduces it to a state of fusion, when it resembles quicksilver. Though subjected to cold down to zero, it does not become hard again, but remains a liquid metal till touched with a piece of solid gallium, when it returns to its original condition as if beneath the wand of a magician. A species of alum may be derived from it, not to be distinguished from common alum without chemical analysis. Gallium is flexible, and can be hammered like lead, or cut with a knife ; but it only becomes slightly tarnished in a damp atmosphere. It crystallises in the shape of an octahedron. At present it is a rare metal, only about a dozen grains having been extracted from half a ton of zinc-blende from the Pyrenees. The discovery is a great triumph and a testimony to the truth of scientific theories, because it was foreseen by three independent observers some time before demonstration. Mr. Newlands, an English chemist, had several years before expressed his belief in the existence of a metal of the kind. M. Mendelejeff, a Russian, predicted from a study of the atomic numbers of the elements, that a metal would be found to fill a vacant space in the series, and actually gave its probable specific gravity, which agrees closely with the result of experiments with gallium. Finally, M. Lecoq de Boisbaudnan, following up an original system of spectrum analysis applied to zinc-blende for this very purpose, produced the metal itself, and gave it from France (Gaul), the country in which the discovery was made, the name of gallium.



THE DIGGING-MACHINE.