METHODS OF ESTIMATING DISTANCES.

There appeared recently, in *La Nature*, a simple method of estimating distances, with illustrations and formulæ, for use of the military in the field. The method was as follows: Small silhouettes of standing and kneeling soldiers are cut out from stiff card-board, and painted black, or the actual uniforms may be shown in color; the standing soldiers to be about one inch in height, and the kneeling ones two-thirds of an inch. These figures and the average height of of soldiers (say 65 inches) have a constant value, and in the formula given stand h and H respectively. A distance, for illustration, is now paced off, by the person holding the silhouettes, of say 3 meters, or about 10 feet, from the person who is to make the observation, and the silhouettes are adjusted to just cover the soldiers seen in the distance. This base line, l, of ten feet, being given, the ratio will stand: $x = l\frac{H}{h}$, or required distance, and for this value of l should be 650 feet. By proportion it is shown thus:

$$\begin{matrix} h & & l & & H \\ 1 \text{ inch} & : & 10 \text{ feet} & :: & 65 \text{ inch} : x = 650 \text{ feet.}\end{matrix}$$

It will be seen by this operation that l must vary with x.

There is another method of estimating distances which the writer of this adopted several years ago merely for pastime. As some surprisingly accurate measurements have been made by this method, and as some of the ideas appear to have a bearing on the question of a possible absolute ratio of measurement, pertaining to, and variable with, each individual, it is given herewith, for the purpose of inquiry and thought. The experiments at the time were based upon this idea, that the true focal distance of every eye will furnish a true working ratio for all distances, provided practical application of the same can be realized. In this method, H, the diameter or height of a distant object, and l, the focal distance of 10 inches, will each be constant; but h will have to vary with x, or, $x = H\frac{h}{l}$, provided the normal focal distance l of the observer is 10 inches. To make the matter still clearer to the mind, let us consider that for every unit of distance an object decreases in width $\frac{1}{10}$, or for 10 units a decrease of 1 is found. By this, it can be readily seen that a focal ratio is obtained for a measurement in units; whether in inches, feet, or miles; as the diameter of the distant object shall determine.

In this simple way an approximate distance of the moon or sun, as well as terrestrial objects, may be worked out in a few minutes.

My method of operation was as follows: Having, after repeated trials, fixed upon 10 inches as the true focal distance in my case, a simple sight piece and measuring apparatus was constructed, consisting of a ten inch wooden rod or eye rest, to the end of which was attached a movable slide or gauge, exposing an opening in an upright metal diaphragm, which was firmly attached to the end of the rod; by moving the gauge in and out, the diameter of a distant object could be easily sighted, and the open space could be then measured by a micrometer. Several measurements having been obtained, the mean is taken to be the true one.

Further, to illustrate: Suppose the same distance is taken as in the measurement given with the silhouettes, taking the formula $x = H\frac{h}{l}$, and substituting the figures, we have $x = 5·5 \text{ feet } \frac{0846}{10} = 650$ feet. That is, the focal measurement of a soldier 5·5 feet in height is found to be 0·0846 of an inch, and one-tenth of this gives the ratio for every foot of distance.

A good way in estimating short distances is to select a window of a dwelling. The average width of windows is about 3 feet; at the distance of half a mile one should just cover 0·011 of an inch in the micrometer.

Any object may be selected, the average width or length of which is known, such as barns, houses, haystacks, stone walls, sections in rail fences, or a common barway, telegraph poles, etc.

If a focal distance of less or more than 10 inches is used in sighting and measuring an object, it should take the place of 10 in the formula given above; the approximate distance obtained in either case should be the same. Suppose some pleasant night we wish to find the distance of the moon from the earth. For this purpose a glass micrometer ruled with dark lines should be used, ruled either to the $\frac{1}{64}$ or the $\frac{1}{100}$ of an inch; after several trials, an average diameter should be obtained of about 0·09 of an inch; this of course will vary somewhat with the moon's distance. Now the approximate distance will be:

$$x = 2,162 \text{ (moon's diam.)} \div 0·09 = 240,000 \text{ miles.}$$

Let us next smoke our micometer, and during the day time take a look at the sun.

Suppose our measurement stands 0·093 of an inch, the distance obtained in the same way as above would be:

$$x = 850.000 \text{ (sun's diam.)} \div 0·093 = 92,391,000 \text{ miles.}$$

There is considerable misapprehension on the part of most people concerning the great difference between the apparent visual diameter of the moon and the sun and that to be obtained by micrometric measurement. But few people will believe that the actual measurement of either is less than the tenth of an inch, until a fair trial has been made. In a similar way, with the aid of a telescope, and the diameters as given by the astronomers, we may partially verify the approximate distances of the planets. There are many ways in which this little formula will amuse as well as instruct.

G. R. C.

Our Trade with Japan.

Middle aged readers can readily recall the time when the empire of Japan and the heart of Africa were equally unknown to the world, and the memory of Perry's notable unsealing of the ports and commerce of Japan must be fresh in their minds. It was a triumph of American diplomacy, and to-day there comes to these shores $14,000,000 worth of goods annually, while the amount and value of these imports augment rapidly. A feature of the Japanese trade seems to be that those engaged therein almost invariably make money. It is a trade which calls for special fitness, and once established seems better than the average silver mine.

Of Japanese imports, during the season ending December 31, 1883, New York took nearly $6,000,000 in value; Chicago, $2,500,000; San Francisco, a half million; and Canada say three and a half millions. Their value goes to show that in exchange for the half million dollars' worth of refined petroleum sent to Japan last season, Uncle Sam gets an assortment of invaluable articles. First in value and importance is crude camphor, a substance that more closely resembles a cheap grade of white sugar than anything else. It was imported to the value of half a million dollars last season—33 241 piculs.

Japanese vegetable wax is another important product of the awakened island. It is a rival of paraffine wax in many ways, and is consumed in great quantities by New England cartridge makers, and by manufacturers of celluloid. Of this substance, over 2,600 piculs were imported last season, worth nearly $300,000. The cuttlefish bone, without which the life of the imprisoned canary would be stale, flat, and unprofitable, is still another product of Japanese origin. Over 1,600 piculs were imported last season, worth $246,000. This article showed an increase in the amount imported of 100 per cent over the previous year's trade. Then comes Japanese fish oil, a competitor of our menhaden oil. The wonderful abundance of fish in Japanese waters, and the fact that labor can be procured for a few cents daily, enable exporters to send this oil 10,000 miles, and still compete with that expressed from fish that swarm along the Atlantic coast. Of this article, over 100,000 piculs were imported, worth $246,000. Isinglass, due to the abundance of fish already referred to, was imported from Japan last season to the extent of nearly 9,000 piculs, worth $264,500.

The metal antimony, of prime necessity in medicine, is yet another valuable product of Japan, and the last season brought out nearly 30,000 piculs, worth $138,000. The type founder is a large consumer of this peculiar metal also, for it possesses the singular property of retaining its volume when cooling after melting, while other metals shrink. This endows metal alloyed with antimony with the attribute of retaining a clear cut impression of the mould, so requisite in type making. Among the articles which are found among the Japanese merchants' samples is a silvery powder. This powder glistens from the surface of modern wall paper, imparting a beautiful appearance, and it serves to enhance the charming snow scenes depicted on Prang's Christmas cards. This substance is Japanese mica, ground to powder, and when used as described gives the article it is spread upon all the sparkling beauty worn by the surface of snow under the moon's rays.

The list of Japanese goods includes a long array of articles, some of them as unique as the country from whence they come and the people who make them, but the *Independent Record* asserts that above are the leading articles of interest to our trades.

Working to Advantage.

It is amusing to notice how easily a workman who understands some of the mechanical principles that govern the behavior of matter, will handle a difficult undertaking with no other strength than his own, assisted with a little forethought and head work. A large water wheel shaft lying in a wheel pit, and loaded down with pulleys and a large gear wheel, was brought out by a single workman and placed across the beams of iron, while the rest of the machinery was in motion, and sent off to the shop without any one ever noticing the difficult undertaking. When this same piece of machinery was first set in place, a dozen hands took part in the undertaking and stirred up the whole concern for material to work with, and arranged a slide with pulley blocks strong enough to launch a vessel on dry land, pulled and hauled everything to pieces, cut and injured everything that came within their reach, to say nothing about the other little incidents that would last a village gossip for a week, such as a few broken bones, a lame foot, with the doctor's bill thrown in.

But the shaft found its place, however; and when the time arrived for a change in its position, as well as additional fits to be made, a chain made fast to the beam overhead and fast beneath the shaft through the open spaces in the pulleys to another at the other end, enabled the workman to roll the shaft up out of the pit by turning the gear wheel, while he himself backed up the ladder till the load was placed carefully on the planks that had been left, with a little forethought, where he could slip them in place with his feet. Such an undertaking is certainly a risky one, and we would not advise such a proceeding, especially when the machinery on all sides was in motion. Instances of this kind have been noticed where it was almost impossible to understand how such difficult undertakings could have been accomplished with the material they had to work with, while others, of a very simple nature, have brought mishaps and failures, with nearly everything any one could ask for to work with.

A large gear wheel, several feet across, was to be placed over the end of an upright shaft, and nearly a whole day had been expended in making the preparations for moving the wheel on rollers and elevating with jack screws, when two strong hands took hold of the wheel and placed it in its position on the shaft while the others were taking their noon hour, by first balancing the wheel on one edge of the hub and rolling it on this portion of the wheel up the incline of a stout beam, without meddling with the blocks and roller ways that had been all the forenoon in preparation.

A heavy column was once elevated into its upright position by a small lad, with no other help than his own strength and a little calculation, after those who had been employed to raise the structure had given it up in despair, by taking advantage of the rocking motion allowed in the position the column was to occupy, which allowed this youthful specimen of grit to set up each shore, on either side, by moving one at a time as the column was crowded on to the other, till at last it stood upright upon its base.

Hundreds of instances of this kind can be related where the success was owing to the careful manner in which the whole performance had been laid out at the commencement, and followed with care and forethought that protected the whole proceeding from accidents and mishaps, while others have come to an untimely end in their endeavors, through negligence and carelessness on the part of the work hands, who had no definite idea as to what they were driving at.—*Boston Journal of Commerce.*

The Utilization of Natural Forces in Electric Lighting.

In the discussion of the paper on "Domestic Electric Lighting," read by Mr. W. H. Preece at the recent meeting of the British Association in Montreal, Sir W. Thomson referred to the facilities afforded by the proximity of the Lachine Rapids, situated five miles distant, for lighting the city by electricity generated by the aid of natural forces. An experiment in this direction is now being made at Bellegarde, in the department of the Saone-et-Loire. Some two and a half years ago M. Dumont, a manufacturer of the town, was granted permission to utilize the waters of the Valserine (a stream in the vicinity), with the view of obtaining a supply of motive power; and the necessary works were commenced. They were finished last year, and are described in *La Nature.*

The course of the stream lies between high rocks, and the water is dammed up by means of a wall about 40 feet wide at its base, and having three sluices for regulating the direction and volume of the current. The water has a fall of 165 feet, and flows out at the rate of 1,100 gallons per second; being equivalent to a hydraulic power of 2,000 horses. This force it is intended eventually to divide between three turbines, one of which (of 600 horse power) has already been fitted up, and is employed in driving the machinery used in the lighting of the town by electricity. The current is generated by two small Gramme machines; and the lighting is done by Edison incandescent lamps placed in the ordinary street lanterns. No accumulators are employed, so that the current passes to the main conductor (which is carried round the town on poles) directly from the generators; its strength being regulated, not by them, but by the turbine which drives them. The lighting is said to be brilliant; but there are several inconveniences attending it. In the first place, the lamps (even those of the private consumers) are either all alight or all out at the same time. Then there have been some rather untimely extinctions; while occasional variations in the luminous intensity of the lamps have testified to certain irregularities in connection with the machinery. Leaving these out of consideration, M. Dumont may be said to have succeeded fairly well in lighting a town by electricity generated by the aid of natural forces. He hopes, however, to go beyond this, and afford, by means of electric cables, a supply of power to those works whose proprietors may be willing to take it of him.

Idunium.

"Idunium" is the name proposed by Professor Websky for the metal just discovered by him as one of the components of native vanadate of lead. The mineral is rather a scarce one of a yellow color, and contains several other metals, of which zinc, iron, and arsenic are among the most prominent. Idunium resembles vanadine in several respects, both physically and chemically, while the only oxide hitherto examined forms stable salts with alkaline bases, and thus would appear to possess distinctly acid properties. It will probably be known by and by as "idunic acid," and as its general characteristics and reactions correspond to those of vanadic acid, its formula will probably be Id_2O_5.

To News Agents.

If for any reason your news company fails or declines to supply back numbers of the SUPPLEMENT, send the order direct to this office, and we will have it promptly filled. The SUPPLEMENT is never "out of print." We supply all the back numbers. The news companies have no valid excuse for not furnishing any copy of the SCIENTIFIC AMERICAN SUPPLEMENT that may be called for.

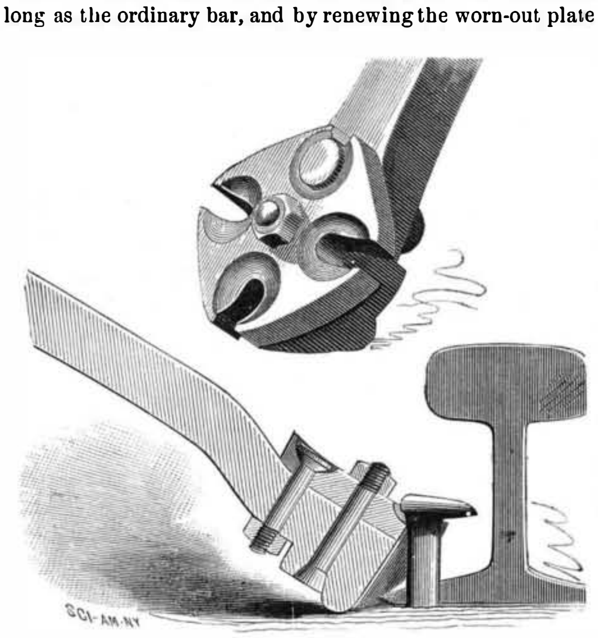
The Value of the Coefficient of Expansion.

An illustration of the way in which a coefficient like 0·000006, that of the expansion of steel, may become a big thing with a few degrees of rise of temperature and long lengths has been seen, says the *Engineer*, on the new Midland line between Irchester and Sharnbrook, recently opened for goods traffic. The rails were laid during winter time, and insufficient room was left for expansion, consequently the summer heat expanded the rails to such an extent that the road burst out of line. Traffic had to be at once stopped and the permanent way altered and properly spaced. Accidents from the "spreading" of rails are far more frequent that is supposed on roads in this country. Your compiler long ago showed the vital necessity of regulating the space allowed for expansion at the ends of rails by constant reference to the height of the thermometer on the spot and during the whole process of laying the rails.

CLAW BAR.

The square face-plate of hardened steel has its corners bent upward, rounded, and recessed to form claws for receiving the body and head of a spike; the under side is slightly convexed to fit snugly upon the curved upper side of the bar, to which it is united by means of a pivot bolt and nut. The bar is formed substantially the same as an ordinary claw bar for drawing railroad spikes, with a recess in the end for the body of the spike. Through the bar, directly in the rear of the pivot bolt, is a hole, through which is passed a bolt whose head rests in one of the claw recesses of the face-plate; the under side of the bar is rabbeted to form a bearing for the nut. If the claws which are in use should break, by removing the rear bolt another pair of jaws may be brought over the recess in the bar. The recesses in the face plate may be of different widths to adapt the bar to spikes of different sizes.

It is evident that this claw bar will wear four times as long as the ordinary bar, and by renewing the worn-out plate



HARDWICK'S CLAW BAR.

can be quickly refitted for use; and as the plate can be more nicely finished and better tempered than the end of the common bar, still greater durability is insured.

This invention has been patented by Mr. James L. Hardwick, lock box 569, Cedar Rapids, Iowa.

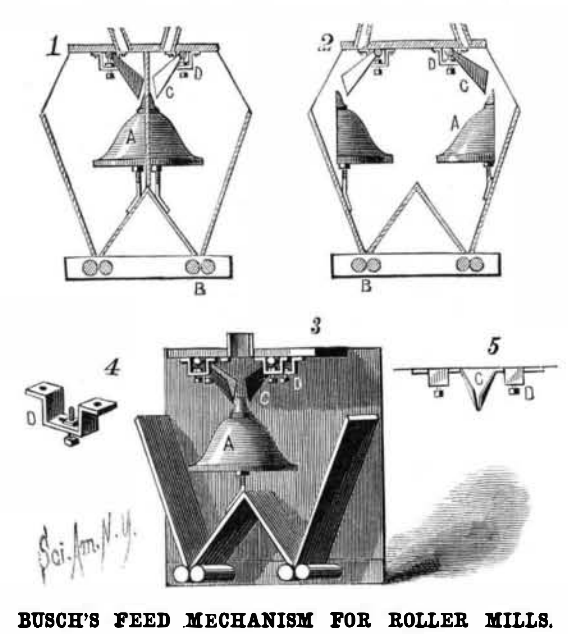
Bessemer Steel Works in the United States.

There are 21 Bessemer steel works in the United States and 1 in process of building. These 21 works contain 46 converters, and 3 converters are building. The total annual capacity of the works completed is 2,490,000 net tons of ingots. The plant building is that of the Benwood Iron Works, a-Benwood, W. Va. The States that have Bessemer works are: Massachusetts, one, with two 4 ton converters; New York, one, with two 7 ton converters; Pennsylvania, nine, with twenty-two converters, and one building, ranging in size from 2 ton to 10 ton; West Virginia, one, with two 5 ton converters, and one building, which will have two 4 ton converters; Ohio, three, with five converters, ranging in size from 4 ton to 10 ton; Illinois, four, with nine converters, ranging from 6 ton to 10 ton; Missouri, one, with two 7 ton converters; Colorado, one, with two 5 ton converters.

The first Bessemer plant in the United States was erected in Troy, N. Y., and made its first blow February 15 1865; the second was erected at Steelton, Pa., and made its first blow June, 1867; the third was erected in Cleveland, Ohio, which made its first blow October 15, 1868. The largest Bessemer plant in the United States is that at Steelton, Pa., which contains two 7 ton and three 8 ton converters. The next largest are the Edgar Thomson, at Pittsburg, and the North Chicago, at Chicago, which have three 10 ton converters. The domestic works are now more than able to supply all domestic demands for Bessemer steel, and one of them recently received a 10,000 ton order from Canada for rails.

FEED MECHANISM FOR ROLLER MILLS.

The engravings illustrate a feeding device for roller mills, patented by Mr. Julius Busch, of Marine, Ill., which will deliver the material evenly to the rolls. The material is directed to the grinding rolls, B, by cant boards. Adjustably supported from the cant boards or the sides of the hopper by a threaded rod having an adjusting nut is a half-bell shaped

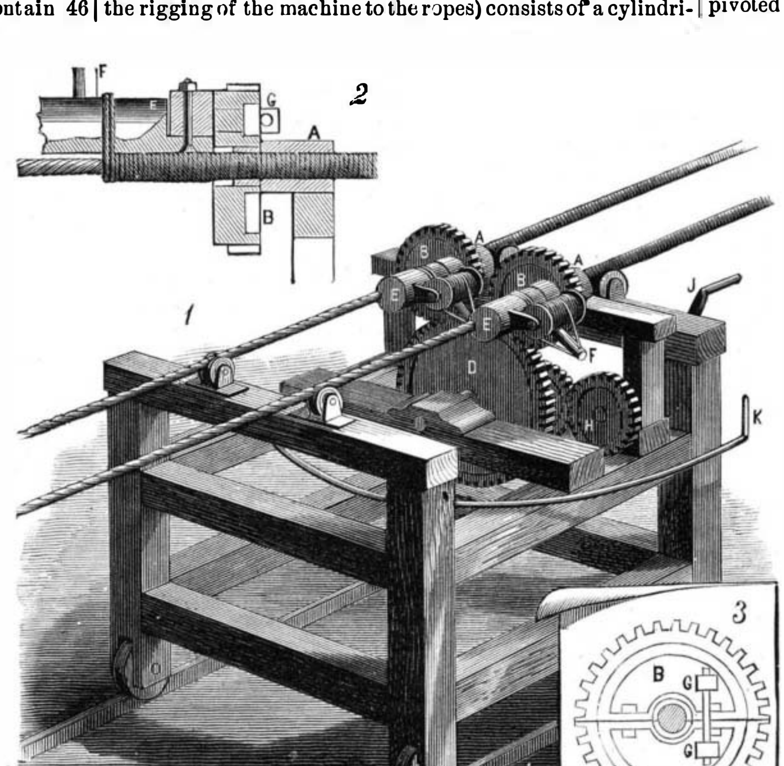


BUSCH'S FEED MECHANISM FOR ROLLER MILLS.

distributer, A, as shown in Figs. 1 and 2; or as shown in Fig. 3, two of these distributers may be combined. Fixed to a rod supported within slotted brackets, D, is an inclined spout, C, the lower end of which is directly over, or nearly over, the apex of the distributer upon which the material is delivered. The rod is prevented from turning by the action of screws and nuts resting upon the bottom of the brackets, the inclination of the spout, to deliver the material higher or lower, having been previously affected. The slots in the brackets permit of the lateral adjustment of the rod to admit of the lower end of the spout being located farther from or nearer to the distributer, according as the end of the spout is raised or lowered. A smaller distributer may be placed upon the apex of the large one when fine, soft material is being fed to the rolls; two of these may be united for use with the distributer, A, Fig. 3. Material is fed to the hopper through delivery spouts. For coarse, sharp middlings the distributer, A, only will be needed. The middlings from the spout, C, striking upon the curved face of the distributer, will be spread in a thin, even stream, which, falling upon the side of the hopper or the cant board, will be delivered in an even stream to the rolls. For fine, soft middlings the smaller distributer may be placed upon the apex of the other, and the spout so adjusted as to deliver near the upper apex.

ROPE SERVING MACHINE.

The frames are supported upon wheels adapted to run on suitable rails for moving the machine along the ropes that are arranged in guides, A, on the top beam. Mounted on each guide is a toothed wheel, B, which is geared with a master wheel, D, operated from a crank, J. Each of the wheels, B, carries a boss extending a short distance from the side parallel with the rope to which the tension device, E—called by the inventor a "mallet"—is pivoted to bear on the rope. This device (Fig. 2 is a section of one of the guides and tension devices, and Fig. 3 shows a tension device and reel carrier divided in two parts and bolted together to facilitate the rigging of the machine to the ropes) consists of a cylindrical block of wood of considerably larger diameter than the rope, and having a groove along the side next to the rope, in which the rope is made to bear by the yarn which, in passing from the spools, F, is carried around the mallet and the rope a couple of turns, first passing through an eye in an arm projecting from the mallet. The spools are pivoted in arms projecting from the mallet and from the boss, so that the spools and mallets are carried around the ropes.



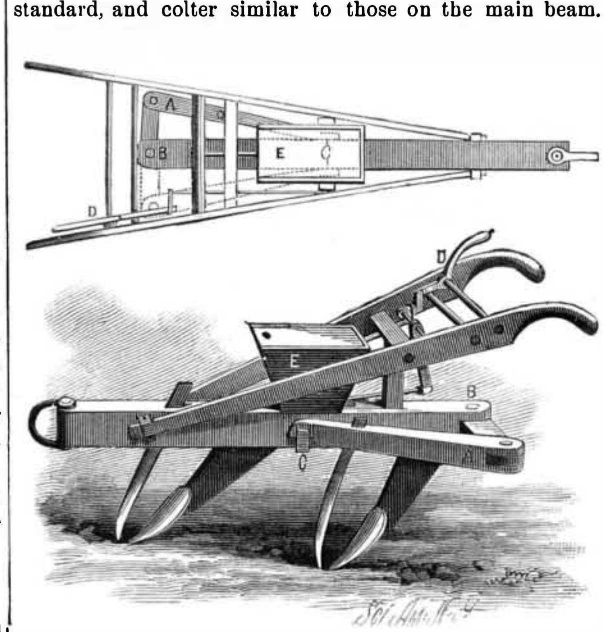
McQUARRIE'S ROPE SERVING MACHINE.

The guides are made in two parts, the upper of which may be taken off to facilitate the adjusting of the ropes, and the wheels, B, are also divided for the same purpose. To enable the attendant to turn the winding wheels while walking by the side of the machine, and also to enable the crank to be applied so as not to be interfered with by the ropes, the train of wheels, H, is geared with a wheel on the shaft of the master wheel, D, the crank being applied to the shaft, H. The machine will naturally feed along by the pressure of the coils laid on the ropes against the yarn being laid on; but it will need to be pushed to some extent by the attendant, and the push rod, K, is so arranged that the force is applied at the middle of the front end; the rod extends back, so that the operator can push the machine with the left hand while turning the crank with the right.

Further particulars regarding this machine may be obtained by addressing the inventor, Mr. Archibald McQuarrie, Post Office, Buffalo, N. Y.

AN IMPROVED PLOW.

The accompanying engraving shows a plow which, although suitable for use on level ground and as a cultivator after planting, is more particularly intended to be used as a sidehill corn planter. The inner plow beam carries, near its forward end, a share secured to a standard, and a colter. The corn hopper, E, is provided with a slide operated from the handle, D, by means of intermediate connecting rods and levers. A supplementary plow beam, A, carries a share, standard, and colter similar to those on the main beam.



STEVENSON'S IMPROVED PLOW.

This plow beam is arranged to lie to one side of the rear portion of the main beam, as shown by the full lines in both cuts, or to either side of the main beam, as shown by the full and dotted lines in the plan view, to do the hill-side or special work required of the plow and planter. To accomplish this purpose the beam is fitted to turn horizontally from the rear end of the main beam to opposite sides of the latter. The ends of both beams are slotted and connected by a link pivoted at each end. When the beam, A, is swung to a position in line with the main beam, its share and colter face in a reverse direction to the forward share and colter; but when it is swung to either side, the shares and colters face in the same direction with the rear ones to one side of those forward. The movable beam is held in place by a tooth on its free end, engaging with a latch, C, on either side of the main beam. A very important advantage of this combined plow and planter is that the share on the beam, A, may always be located on the upper side of the hill when at work, to operate as a covering shovel.

This invention has been patented by Mr. James N. Stevenson, of Salvisa, Ky.

Petrified Wood.

The petrified wood which is so abundant in Arizona, Wyoming, and Rocky Mountain regions, is utilized in San Francisco, where there is now a factory for cutting and polishing these petrifactions into mantelpieces, tiles, tables, and other architectural parts for which marble or slate is commonly used. Petrified wood is said to be susceptible of a finer polish than marble or even onyx, the latter of which it is driving from the market. The raw material employed comes mostly from the forests of petrified wood along the line of the Atlantic and Pacific Railway. Geologists will regret the destruction of such interesting primeval remains, and some steps ought to be taken to preserve certain tracts in their original state.