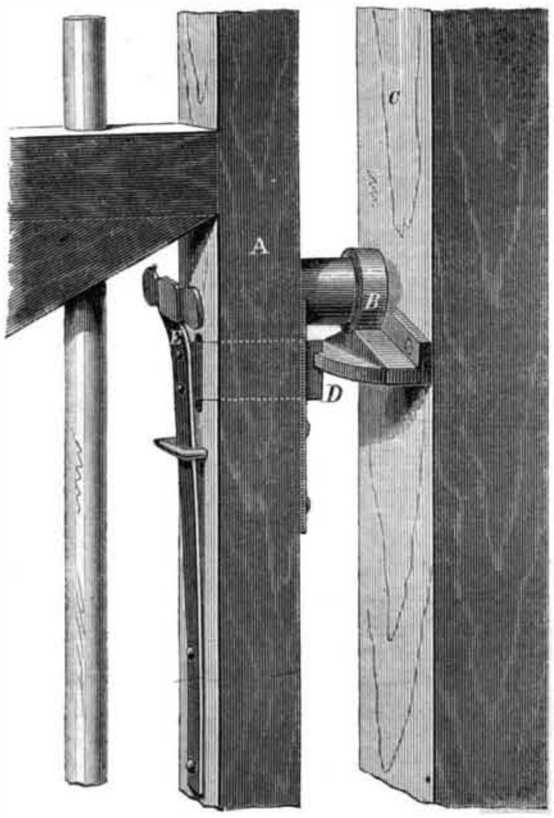
HENDRICKS' PATENT GATE CATCH.

The primary object of the device illustrated in the annexed engraving, is to afford a sure and sufficient support to the gate when closed, to prevent the loosening and permanent inclination of the hinge post. It also affords a ready means of opening the gate, and secures its effective latching when closed.



On the stile, or upright, A, is a slotted plate, screwed or bolted to the wood, and carrying a stud and roller, B. On the post, C, is a snug, or plate having a double incline, slightly hollowed at the apex to receive the perimeter of the roller, B. A projecting horizontal flange having inclined sides and a notch in the center is for the use of the catch, D, that is a part of the spring, E, which holds the catch in the notch. When the gate is to be opened, the spring, E, is pushed back, thus unlatching the gate and allowing it to swing in either direction. When closed, the roller, B, rests on the snug which then sustains the weight of the gate. It is not necessary that the gate should swing both ways; it may be furnished with this device adapted to suit the exigencies of any case. The device is cheap, easily attached to any swinging gate, and always reliable.

Patented through the Scientific American Patent Agency, Dec. 15, 1868, by Benjamin Hendricks, who may be addressed at Huntington, L. I.

The New Mode of Firing Gun-Cotton.

An interesting practical exhibition of the newly-discovered properties of gun-cotton when fired by concussion, instead of by the direct application of flame or heat, was afforded recently at Woolwich. The huge 36-in. Mallet mortar, weighing 52 tuns, which was placed in the marshes in 1857, and designed to fire a shell of 2,548 lbs. (empty), has, for some time past, been sinking in its great wooden bed, owing to the gradual decay of the wood. It was thought dangerous to run the risk of its falling upon any visitor by leaving it in this position. But weights of 52 tuns cannot be moved for nothing. To erect sheers and the necessary appliances for raising the mortar would have entailed an expenditure estimated at about £50. Under these circumstances, recourse was had to gun-cotton to destroy the bed, and precipitate the fall of the mortar. Four charges of 4 ozs. each, four of 6 ozs., and one of 8 ozs. (total, 48 ozs.) were placed on the wooden bed, and exploded by means of mining fuses charged with detonating composition. The material being rotten was especially unfavorable for the exertion of explosive force—for the force had, so to speak, nothing to act against. But what could be done was done. The huge bed was shattered, and particles flew in all directions. The mortar, although it altered its position, refused, however, to fall, being held, to some extent, by a thick wrought-iron screw bolt. The next experiment was made upon this bolt. A one-lb. disk of compressed gun-cotton was tied to the bolt and exploded. The explosion was thus wholly unconfined. Nevertheless the bolt was broken in two places, a result which exceeded the most sanguine anticipations. Still the huge mortar remained in its position. A third operation had, therefore, to be made. This time two 1-lb charges were disposed under the left trunnion, and the 1-lb. charge was so placed as to give the mortar a kick behind. The explosion of these charges completed the work. The monster mortar slowly and gracefully bowed forward and fell to the ground. The gun-cotton had thoroughly done its work, at a cost of 14*s.* 6*d.*—*Scientific Review.*

The Use of Zinc in the Reduction of Gold Ores.

M. D'Heureuse has been for some time experimenting in the use of zinc as a substitute for quicksilver in gold mining. According to the *Scientific Review*, he now finds that in the amalgamation process only about half the gold is extracted from the rock. Melted zinc appears to take up all the gold, allows slag and rubbish to float at its surface, requires little heat to keep it melted, and from its volatilenature can be distilled in a retort to separate the gold and re-collect the zinc itself. The mode of operating is simply to introduce gradually the gold-bearing rock, in a pulverized state, into a bath of melted zinc. This metal immediately attacks and dissolves nearly every particle of gold, while the *débris* rise to the surface of the bath, and can be skimmed off. When sulphurets are present, the rock must be previously roasted. Surely nothing can be more economical and effective than this when plenty of zinc ore is at hand.

Sugar from Pumpkins.

We condense the following from a Southern cotemporary for the benefit of our readers:

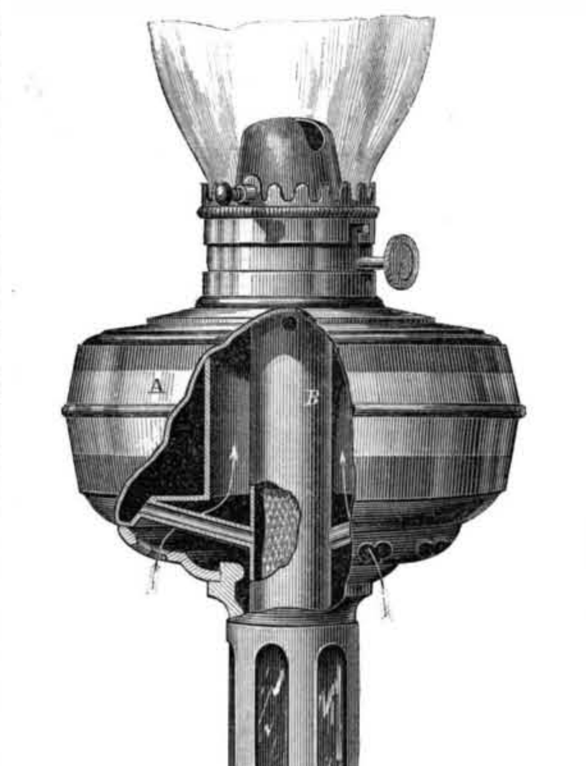
During late years, several more or less successful attempts have been made to introduce into the United States, sugar-producing plants to replace the cane. The beet root and sorghum are among the number, but one of the most valuable, which is cultivated in every cornfield in the Middle States as a side product, has been quite neglected. This plant is no other than the common pumpkin, the *Cucurbita pepo* of botanists. Its period of harvesting lasts longer than that of the beet, it is easier preserved and its refuse is just as valuable for the feeding of stock. Pumpkins weigh from 50 to 60 pounds; they furnish about 4 per cent of sugar; their contents in juice is 80 per cent. This juice indicates from 10 to 11 on Baumé's areometer.

The sugar obtained from pumpkins is of a good grain and color. Before refining, it has a slight flavor of melon. The sirup is of a very dark green color, nearly black, and tastes like cane sugar.

In Hungary, since the year 1837, several manufactories for making sugar from pumpkins have been in operation. The treatment of this fruit is perfectly identical with that of the beet root, and the machinery used for the purpose the same.

PERKINS AND HOUSE'S NON-EXPLOSIVE KEROSENE LAMP.

Any device, any plan of lamp, or any method of management that can render the form of hydrocarbon known as kerosene non-explosive, and insure safety to life and property, is certainly worthy attention and deserving of general adoption. The design of the style of lamp of which the accompanying illustration is a representation, is to provide a perfectly safe means of utilizing the light-giving qualities of kerosene. The lamp may be of any style of form or decoration desired, the essentials of the improvement not interfering with these qualities.



The globe, A, is of metal, therefore proof against breaking. It contains the oil, which is fed into a central tube, B, that holds the wick. The connection between the reservoir and the tube, B, or the wick, is made by pipes (shown where the shell of the lamp is represented as broken away), too small to permit flame to pass to ignite the oil in the globe, on the principle of the Davy and other gas safety-lamps. The air (oxygen) necessary to combustion, instead of being taken in near the flame, just below the cone, as usual, passes in, as shown by the arrows, through apertures at the bottom of the lamp, enveloping the central tube and keeping it and the oil it contains as cool as the surrounding atmosphere, thus preventing the generation of explosive gas by a higher temperature.

It is claimed that this lamp is absolutely safe, gives a superior light, and is economical in oil; results assured by the following facts: Safety by conducting the oil from the reservoir, or body of the lamp, to the wick by tubes impassable to flame; in case of overturning all the oil that can be spilled is that contained in the wick tube. By the reception of the air at the bottom of the lamp, the combustion of the oil is more perfect than in lamps in general use, according to experiments made by Prof. E. S. Snell of Amherst College, who ascertained that the amount of light obtained from this lamp is from forty to fifty per cent greater than from others using the same quantity and quality of oil. Its economy of oil is shown not only by the foregoing, but by the fact that only the amount necessary for the flame is taken up by the wick.

Patented December 11, 1866. For agencies, information, etc., address Votaw & Montgomery, at Springfield, Mass., or Cleveland, Ohio.

BEET ROOT SUGAR.

No. VI.

[TECHNOLOGY.—PART III.

DEFECATION, CONCLUDED.

The quantity of sugar contained in beet root juice varies between certain limits, the determination of which is important. Many various processes, chemical, mechanical, and optical, have been proposed for the attainment of this object, and tables have been computed and published in various works to facilitate the matter. The simplest, however, although a purely empirical method, is the direct use of Baumé's areometer (also called Baumé's hydrometer, saccharometer, or densimeter), which furnishes, by a very simple calculation, data which we found to approximate sufficiently to the truth, for all practical purposes.

The rule is as follows:

1. Float the Baumé areometer, in the saccharine solution, or beet root juice, and read off the degrees of density marked on the scale of the instrument.

2. Multiply the number of degrees thus noted by two, and subtract from the result the same product divided by ten.

The result obtained is the percentage of sugar in the liquid, very nearly.

If, for instance, the juice indicates a density of ten degrees, Baumé, we have:

$10 \times 2—[(10 \times 2) \div 10] = 20—2 = 18$ per cent sugar.

If the instrument had marked only 4·8; the per cent of sugar would have been thus found:

$4·8 \times 2—[(4·8 \times 2) \div 10] = 9·6—0·96 = 8·64$ per cent of sugar.

The importance of the determination of the quantity of sugar contained in beets induces us to furnish the exact correspondence existing between each degree of Baumé's areometer and the percentage of sugar in a saccharine solution, as given in the books. It is as follows:

Degrees, Baumé.	Per cent sugar.	Degrees, Baumé.	Per cent sugar.
1	1·72	21	38·29
2	3.50	22	40·17
3	5·30	23	42·03
4	7·09	24	43·92
5	8·90	25	45·79
6	10·71	26	47·70
7	12·52	27	49·60
8	14·38	28	51·50
9	16·20	29	53·42
10	18·03	30	55·36
11	19·85	31	57·31
12	21·71	32	59.27
13	23·54	33	61·32
14	25·34	34	63·81
15	27·25	35	65·19
16	29·06	36	67·19
17	30·89	37	69·19
18	32·75	38	71·22
19	36·40	39	73·28
20	34·60	40	75·35

The lime used for defecation must be of as pure a quality as possible, and free from potash, a fact which is determined by previous chemical analysis.

To prepare it, stir it well into the water added for the purpose of slacking it, so as to convert it into a smooth, creamy mixture, to which water is then added, until the whole bulk of "milk of lime" marks a certain determined density on Baumé's areometer. This density must, when once adopted as a standard, be kept constant during the campaign. The strength of the mixture varies between 14 and 20 degrees Baumé in different establishments, but must be so regulated that the quantity of lime used shall be intermediate between one-half of one per cent and one per cent of the total weight of the beet roots worked up in the factory.

The lime ought to be slaked in considerable masses at one time to insure uniformity of composition, by successive additions of *hot* water (river or rain water if possible). When it has attained the desired consistency, it must be passed through a metallic screen sieve to remove the solid particles, small pebbles, etc., which may accidentally have been retained. It must be used freshly prepared. A good plan, where the lime is not chemically pure, is to let it rest and settle for a while after having been slaked and watered, to run off the supernatant water, and to repeat the addition of fresh water several times in succession. In this manner any contained potash (which abounds in wood-burned lime) is effectually washed out of it. We have found that heating the milk of lime to the boiling point, before admitting it into the defecating pans, accelerates its action, which it also renders more perfect.

It is known by the manufacturer that the right proportion of lime has been added during defecation, when the defecated juice is of a light, clear, transparent, amber color. If, on the contrary, this juice is of a green or greenish hue, and contains many floating opaque particles, the quantity of lime has been insufficient.

A few practical trials will soon set matters right in this respect, under the supervision of an intelligent manager, who who ought to know how to approximate his dose of lime to the quality of the juice he is working.

An excess of lime being detrimental to the economical production of sugar, considerable nicety of judgment and practical experience are required in order to determine the proportion of this substance which ought to be employed; a quantity which varies according to many circumstances, the scientific discussion of which is impossible in the pages of this journal.

THE SCUMS OF DEFECATION.

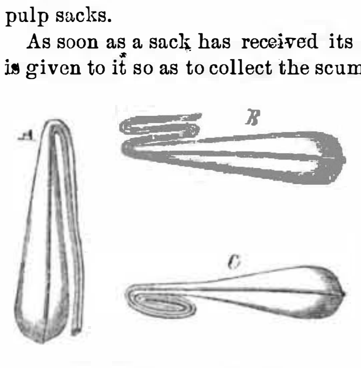
The scums formed during the process of defecation of the beet root juice being rich in saccharine matter must be made to give up as much of their valuable contents as possible. For this purpose they are collected in a special reservoir provided with a wide-mouthed faucet, through which they are filled into sacks. These sacks, made of a strong, close-woven tissue of raw flax, are laid to drip in special tanks, where about two-thirds of the included juice is run out of them in the space of a few minutes. They are then submitted to the action of powerful presses.

The liquid obtained from the presses and tanks is taken directly to a *monte-jus*, from whence it is conveyed to the carbonatation pans, while the juice from the reservoir is best passed through a small quantity of grained bone-black, covered with a loose permeable cloth, before being run into the same *monte-jus*.

Scums are worked while hot from the defecating pans, and must never be allowed to cool before they are pressed.

As the contents of the scum sacks is of a slimy, slippery nature, which would work its way out during the pressing without certain precautions, it is necessary to fold them in a different manner from what we indicated in speaking of the pulp sacks.

As soon as a sack has received its contents, a smart shake is given to it so as to collect the scum at the bottom, it is then folded through the middle, as seen in Fig. A, and laid on a table, where it is further folded, as is shown in Fig. B, after which the whole folded portion is tucked underneath, as in Fig. C. It is then ready to be placed between two sheet-iron trays, or in some cases mattings, and taken to the presses.



The "dead" scums constitute a very valuable fertilizer, rich in nitrogen and lime, and is hoarded with care until needed for use in the fields or for sale to the farmer.

The specifications for the "scum" department of a factory for working 150,000 lbs. of beet every twenty-four hours are as follows:

1. One reservoir for receiving the scums from the defecating pans, with large faucet, and a capacity of 70 cubic feet. Cost, $60.

2. Two cast-iron tables for manipulation of scum sacks. Cost, $50.

3. Two iron presses, with bronze screws. Cost, $400.

4. One *monte jus* and its special reservoir, each of a capacity of 20 cubic feet, for scum juice. Cost, $130.

The total cost, in gold, of the "scum" department of a 500-acre factory would be $640 in gold.

CARBONATATION.

The beet root juice, after it has been freed from many obnoxious substances by the process of defecation, is still far from constituting pure "sugar and water," and still contains both organic and inorganic matter, beside a portion of the lime which has been used in the former operation. All of these are more or less detrimental to the final crystallization of the sugar and must now be got rid of.

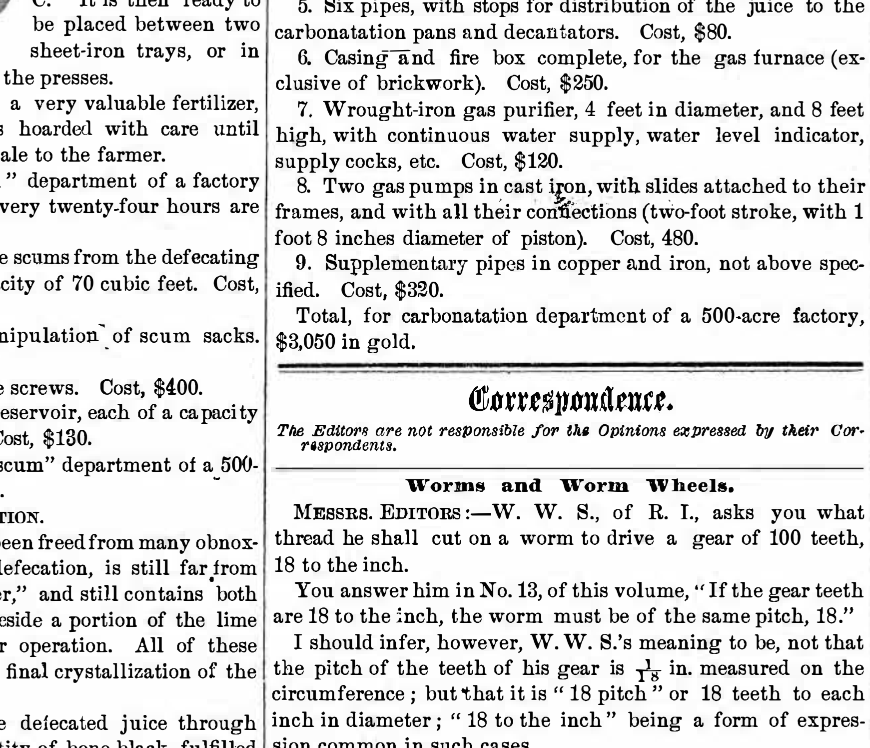
By the old methods, passing the defecated juice through filters charged with a large quantity of bone-black, fulfilled the desired result, but the loss in sugar and the waste in bone-black were considerable; so much so indeed, that the new process of carbonatation (by which an economy of 50 per cent of bone-black was effected) was no sooner discovered, than it was adopted without delay, by every sugar manufacturer in Europe.

Carbonatation consists in the saturation of the defecated beet root juice by means of carbonic acid gas.

The cheap production of this gas is effected in many different ways, one of which we shall here describe as the simplest and easiest to put in practice.

A furnace, of which the figure annexed is a section, fulfills our purpose:

The cover, B, on the top of the furnace, is for the introduction of charcoal, which falls on the grate, A, and spreads itself in the neighboring empty space. Air is admitted through A, which, after favoring the combustion of the coal, and having been partly transformed into carbonic acid gas, penetrates into the chamber, C, which is filled with fragments of limestone. The gas is here partially cooled by coming in contact with the water pans, E E, through which a continuous stream of cold water is allowed to flow. From C the gas next passes into the receiver, D, where it is washed and purified by being passed through pure water or through water in which a small amount of soda has been dissolved. R is a pipe through which a double-acting air pump draws the gas out of the receiver, D, and forces it into the liquid to be charged. The same suction causes the necessary draft for sustaining the combustion of the charcoal at A.



During the combustion of charcoal, 6 lbs. of pure carbon, combine with 16 lbs. of oxygen to form 22 lbs. of carbonic acid gas, and each 22 lbs. of this gas are sufficient for the precipitation and elimination of 28 lbs. of the lime retained in the juice. This furnishes all necessary data for the calculation of the quantity needed in any case.

The carbonatation pans, into which the combined defecated and scum juices have been conveyed, are furnished at their bottom with a pipe pierced with three parallel rows of small holes, one-eighth of an inch in diameter, through which the carbonic acid is forced through the liquid. They are also furnished with coil pipes or double bottoms for heating by steam while the process of carbonatation is going on.

After a certain period of time, which is indicated by the cessation of "foaming," the carbonatated juice is run into large receivers, or decantators, where it is allowed to settle, after which the juice is ready for the filters, unless, as is often done, it is submitted to a double carbonatation. In many works the carbonic gas is obtained by the calcination of limestone instead of the combustion of charcoal. In places where this rock is abundant and of good quality this method has its advantages.

The deposit formed during carbonatation is a good manure, which must not be lost or wasted.

The specifications and valuations in gold for the carbonatation department of a factory for working, per diem, 150,000 lbs. of beet root, are as follows:

1. Three sheet-iron carbonatation pans, 6 feet in diameter, and 40 inches high, with copper coil pipe and full complement of valves and cocks for admitting steam, for the emptying of the pans, for introducing steam into the gas blowers in case of obstruction, etc. Cost, $660.

2. Three decantators, each of a capacity of 70 cubic feet, with three bronze cocks to each for drawing off the liquid at various hights. Cost, $240.

3. Three carbonatating pans, same as the first, for second operation. Cost, $660.

4. Three decantators, same as the first, for second operation. Cost, $240.

5. Six pipes, with stops for distribution of the juice to the carbonatation pans and decantators. Cost, $80.

6. Casing and fire box complete, for the gas furnace (exclusive of brickwork). Cost, $250.

7. Wrought-iron gas purifier, 4 feet in diameter, and 8 feet high, with continuous water supply, water level indicator, supply cocks, etc. Cost, $120.

8. Two gas pumps in cast iron, with slides attached to their frames, and with all their connections (two-foot stroke, with 1 foot 8 inches diameter of piston). Cost, 480.

9. Supplementary pipes in copper and iron, not above specified. Cost, $320.

Total, for carbonatation department of a 500-acre factory, $3,050 in gold.

Correspondence.

The Editors are not responsible for the Opinions expressed by their Correspondents.

Worms and Worm Wheels.

MESSRS. EDITORS:—W. W. S., of R. I., asks you what thread he shall cut on a worm to drive a gear of 100 teeth, 18 to the inch.

You answer him in No. 13, of this volume, "If the gear teeth are 18 to the inch, the worm must be of the same pitch, 18."

I should infer, however, W. W. S.'s meaning to be, not that the pitch of the teeth of his gear is $\frac{1}{18}$ in. measured on the circumference; but that it is "18 pitch" or 18 teeth to each inch in diameter; "18 to the inch" being a form of expression common in such cases.

If this is the case, and his gear is correctly constructed, its pitch diameter will be $5\frac{5}{9}$ in., and its external diameter $5\frac{2}{3}$ in., and the correct pitch of a worm to drive it will be $3{\cdot}1416 \div 18 = {\cdot}1745$ in. He will not probably find a lathe which will produce a thread more nearly accurate than (to put it in practical workshop form) 40 threads in 7 inches.

In this connection, a few words relating to worms and worm wheels in general may, perhaps, not be deemed intrusive. Technical propriety might perhaps demand that I should say "endless screw," and "tangent wheel;" but I adopt the former terms, justified by custom, almost universal in this country.

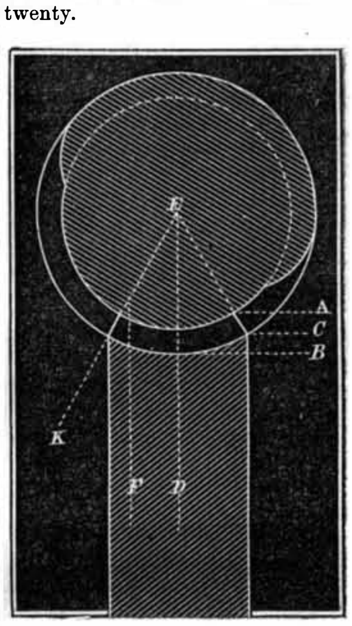
A well-constructed movement of this kind meets completely mechanical wants which could, otherwise, with difficulty be provided for. Its general proportions admit of considerable variation, but the range of proportions within which the best results are reached, is not so great as might be supposed.

It is not advisable to use the "diametral pitch" in calculating the diameter and number of teeth of the wheel, as inconvenient fractions are thereby introduced into the pitch of the worm, and the threads required cannot be accurately cut. But a simple fraction of an inch should be adopted as the pitch of the worm, and all well-equipped lathes will furnish sufficient variety between $\frac{1}{8}$ in. and 2 in. And from the given pitch the diameter and number of teeth of the wheel can be readily determined by the well-known rules, No. teeth $\times$ pitch $\div 3{\cdot}1416 =$ diameter, and Diameter $\times 3{\cdot}1416 \div$ pitch $=$ No. teeth.

The pitch circle of the wheel, on which to calculate the foregoing, cannot be correctly located until the other principal dimensions are fixed. Of these, the diameter of the worm should never be less than three times the pitch; the best proportion being from five to eight times, avoiding undue obliquity of strain on the one hand, and unnecessary movement of the surfaces under friction on the other.

The width of face of the wheel should be one-half the diameter of the worm; no particular advantage is gained, in general, by making it greater.

Now, make the depth of the teeth $\frac{3}{5}$ the pitch, and their ends to coincide with the radius of the worm (as by the line *e k*, in the figure), and a simple, easily-constructed form thus far is obtained, entirely suitable for nineteen cases out of twenty.



Extend horizontal lines, as A and B, from the extreme upper and lower points of the tooth thus described, and bisecting A B we have C, a point in the pitch circle. No allowance need be made for clearance, unless the work is to be cast, or is of very heavy character.

The form of the teeth and its execution now remain to be considered.

Most treatises on mechanical construction treat of this movement as simply a rack and pinion, which is well enough as far as it goes, but is very far from covering the subject. Not only must the tooth in its general form coincide with the helical curve described by the thread of the worm, but to each different point in the length of the tooth the thread presents itself in a different position, requiring each section of the tooth, from the one made by the central plane of revolution, to the end of the tooth, to be of constantly varying form. For example, in the figure a section of the thread by the central plane at A will evidently be different from a section made by another parallel plane at F, and the same may be said of any two points on one side the central plane.

A little consideration will show that none of the ordinary expedients for cutting teeth will give these such a form as they require; but there is a very simple means of giving them their proper form with accuracy, certainty, and economy. It consists in finishing them (after they have had most of the metal removed in the ordinary cutting engine) by means of a cutter or hob, made in the same form as the worm, and caused to revolve in contact with the wheel in the same precise relation to it that the worm is afterward to occupy. The hob should be a trifle greater in diameter than the worm, and should be grooved spirally, and rather finely; a hob of 2 inches diameter, having perhaps 8 grooves. In other respects it should be a careful counterpart of the worm. It may be mounted in the cutting engine in place of the ordinary cutter, and such arrangements made as will allow the wheel to revolve by its action easily, yet steadily. Or it may be applied by other methods; probably no average mechanic, having a lathe of any kind, would be at a loss how to execute this simple but beautiful process.

In work requiring accuracy, proper gearing is sometimes so applied as to give the wheel a positive revolution at a velocity exactly proportionate to that of the hob and its pitch. By this means a piece of work may be produced well nigh perfect.

Since the means for nicely adapting the teeth of the wheel to the thread of the worm are so ready and efficient, we shall retain great practical simplicity in the whole construction if we give that thread as simple a form as possible. And a thread whose sides are bounded in section by two straight lines making an angle with each other of 30°, having a depth, as before mentioned, of $\frac{3}{5}$ the pitch, with all its angles slightly rounded, will be found to meet almost every possible case satisfactorily, and is certainly as simple as need be.

These brief notes are very far from exhausting the subject, but seem to me to touch the principal points necessary to the proper construction of a screw and tangent wheel in any ordinary case. CALLIPERS.

Worcester, Mass.

The Wheels of all Vehicles, Dynamical Levers.

MESSRS. EDITORS:—Mr. R. Desbonne, on page 230, current volume, in criticising my theory of the economy of short-