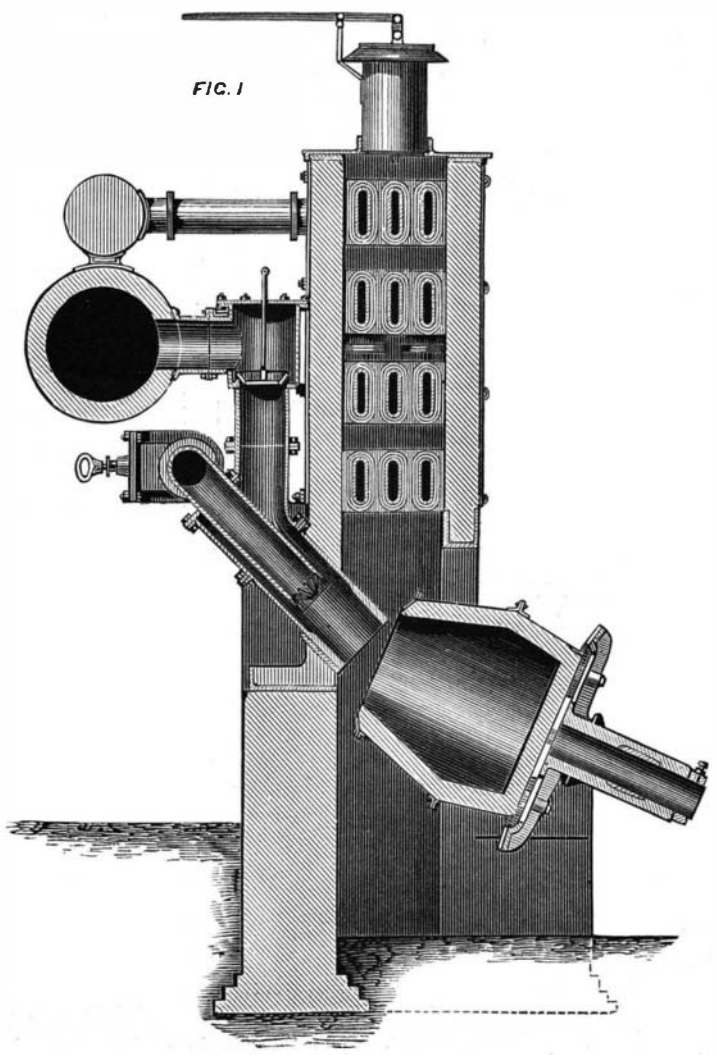
THE GODFREY AND HOWSON PUDDLING FURNACE.

Mr. R. Howson lately described the Godfrey and Howson puddling furnace before the Iron and steel Institute of Great Britain. The acting part of the machine consists of a pan-shaped vessel, Figs. 1 and 2, mounted on an axis. This axis is inserted into a long bearing bored out in a framing situated immediately below the pan, a bevel wheel, driven by a pinion, being keyed on the axis between the bottom of the pan and the frame. The frame itself is mounted on trunnions, which allow of a tilting motion at right angles to its bearings. The shaft of the pinion, which causes the revolution of the pan, passes centrally through one trunnion, while on the other trunnion a worm wheel is keyed, worked by a worm, through which the tilting motion is effected. It will thus be seen that the pan can be revolved at an angle; its position can be changed through an arc of a circle, so as to bring its opening at one time in front of the source of heat, and at another to tilt out the finished ball. The center of motion is situated a little above the bottom of the pan, and the weight of the trunnion frame is adjusted so as to balance the weight of the pan and its contents. The source of heat consists simply of an enlarged gas blowpipe, the jet from which enters the mouth of the pan centrally or nearly so, while the products of combustion escape concentrically outside the tuyere and inside of the edge of the pan. The gas enters from the main into an annular space just above the tuyere, and the air is forced through a nozzle placed centrally and perforated with holes. The nose of the center tuyere is protected from the heat by means of a coil, after the manner of a blast furnace, but instead of water it is sufficient to allow a small jet of steam to circulate through it, this alternative being designed to obviate the consequences of a leak, which might result in a chance explosion in the pan. The air nozzle itself requires no protection.

The pipe which conducts the gas from the main to the tuyere is fitted with a simple valve for shutting off the gas and regulating its supply. There is also a valve attached to the air pipe for a similar purpose. The pressure of air which appears to be most suitable so far, may be stated to be about 12 inches of water. The burnt gases, whether incandescent or not, after issuing from the pan, have a high temperature. This waste heat is conveniently utilized by allowing it to pass on its way to the atmosphere by a vertical chamber traversed by a series of heating pipes through which the air is forced on its way to tuyere.

The apparatus for generating the gas is that of Messrs. Brook and Wilson. This (Figs. 3, 4, and 5) consists of a combustion chamber having a solid hearth and no fire bars. The coal is fed from the top, the combustion takes place at the bottom, and the gas escapes intermediately between the two, through lateral openings into a channel which passes round the chamber, and from which channel it is conducted into a main communicating with the furnace, or with a number of furnaces. The air required for combustion is supplied by means of the steam jet, blowing into a bell-mouthed pipe placed outside, but mounted on a box-shaped casting which traverses the middle of the chamber. On each side of this box, in the interior, there are openings through which the mingled air and steam find their way into the charge. The object of placing these openings in a central position is to prevent any currents from passing up the sides of the chamber in an undecomposed state, and contaminating the gas, as they are liable to do unless the proper precautions are taken. The steam jet prevents an obvious advantage, as it gives command of pressure at the tuyere to assist the blowpipe action, affording at the same time a ready means of adjustment so as to regulate the rate of combustion and the formation of gas according to requirement. We take our illustrations from the *Engineer*.

FIG. 1



THE GODFREY & HOWSON PUDDLING FURNACE.

FIG. 3

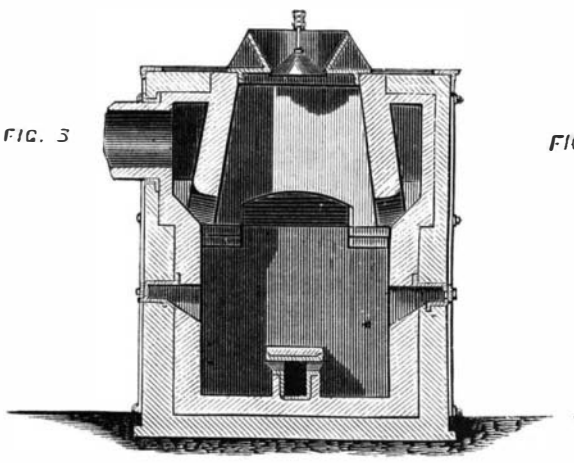


FIG. 4

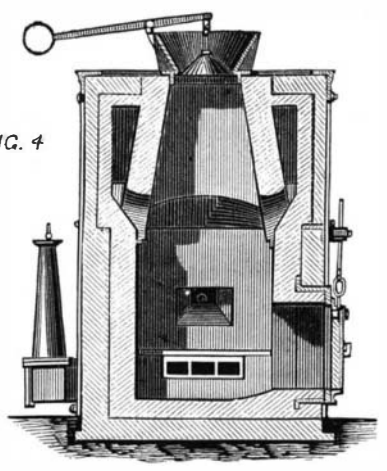


FIG. 2

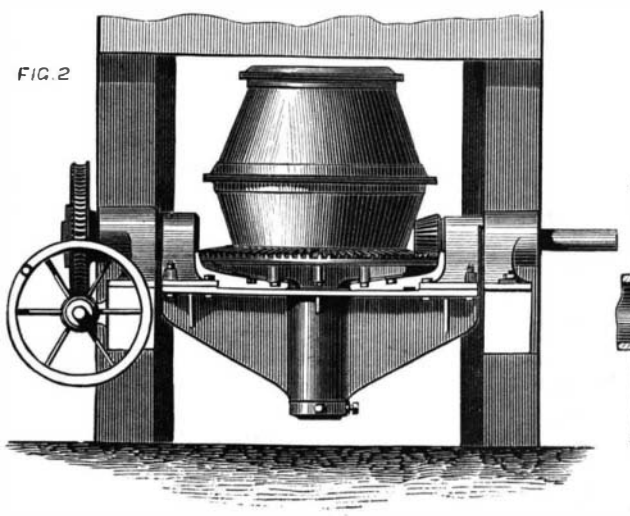
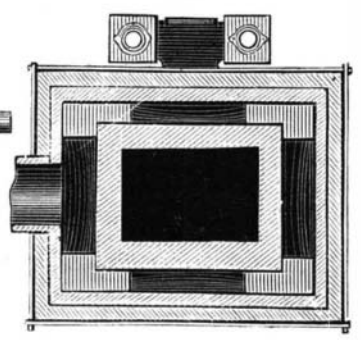


FIG. 5



THE GODFREY & HOWSON PUDDLING FURNACE.

New Inventions.

An Ornamental Chain patented by D. D. Nevins, of Attleborough Falls, Mass., consists of short pieces of wire, having loops in their middle parts and having their ends bend outward, rearward, and inward to form rings or loops. It is neat and ornamental, and suitable for watch chains or necklaces.

In washbasins the stopper is usually suspended on a chain suspended outside the basin. Herbert W. Carnes, of Brookline, Mass., has patented a Stopper which works without a chain. It is suspended by lugs and a pin to a lever, one end of which is hinged to the strainer pipe and the other provided with a handle, by which the stopper may be taken out of or inserted into the strainer pipe.

William R. Young, of Healdsburg, Cal., has patented a Combination Padlock which is an improvement in the class of keyless or permutation padlocks. It consists in providing the screwthreaded plate which closes the open end of the padlock with holes to receive the reduced ends of the U-shaped staple for the purpose of preventing access to the interior locking mechanism. The plate renders the padlock stronger and more capable of resisting force.

Robert Brass, of Brooklyn, N. Y., has patented a Feed Bag with two wire ventilators in the front. The flanges are attached in such a manner that the ventilator is prevented from tearing out of the bag.

George F. Shaver, of Mooheadville, Penn., has patented a Device for taking Mail Bags upon and delivering them from a Railroad Mail Car while in Motion. A rod on the car seizes a bag suspended from the roadside crane, while another rod on the latter, at the same time, takes a bag suspended from a frame attached to the car. The bag entering the car slides inward and strikes a curtain, so that it is subjected to no injurious shock.

Charles W. Helden, of Florence, Ala., has patented a Vehicle Wheel which is designed to secure greater strength and durability and to obviate the welding of the axle. It consists in the peculiar construction and arrangement of the hub and its connections, in which the extremity of axle is tapered squarely to the end and a flanged non-rotating hub fitted over the same with a square perforation, while the box is provided with a flange and revolves upon the fixed hub, its flange being bolted to a collar upon the opposite side of the spokes, so as to hold the latter in place.

Thomas A. McDonald, of Durham, N. S., Canada, has patented a Shoelace Fastening. It consists of a single spring finger made in a continuous piece with and bent around parallel to a perforated base plate which is affixed to one of the flaps by clips and an eyelet, the said base plate and spring finger being each perforated, so that, when the cord is passed through the perforations in the base plate and the finger, and is then wrapped around the finger, a tension upon the cord from the straining movement of the foot presses the spring finger tighter against the base plate and cramps and binds the folds of the cord wrapped around the same, thus increasing the security of the fastening in proportion to the increased strain upon the cord.

Benjamin E. Atwood, of Newville, Cal., has patented a Brake Shoe Holder for Wagons. It is an improvement in the class of clamps for the shoes of wagon brakes, which have an adjustable jaw to enable the shoe to be inserted or detached and another substituted, when required, with convenience and dispatch.

Calvin S. Powers, of Fountain, Minn., has patented an Electro-Vapor Bath. The novel features consist in the arrangement of a hammock with enclosing boards, doors, and head rest, whereby the current may be applied to the patient in either a sitting or reclining position; and in forming the foot rest in the shape of steps with a foot bath in the lower one and a metal covering to their surfaces to constitute one of the electrodes. Revolving and adjustable electrodes are used for applying the current to the back and loins, and there is an arrangement of sectional doors whereby the legs and arms may be treated independently of the rest of the body.

A Sash Holder patented by D. O. Hink, of Maryville, Mo., consists of a plate, to which is pivoted a lever upon which a curved cam is formed, which has two working surfaces, on its side and on its edge. When the cam lever is employed in locking a window it is let into the stile, and is used in connection with a sliding piece which is carried by a lip. A wedge-shaped recess is formed in this piece, in which the cam turns, so that when the cam lever is turned the window is clamped between the pulley stiles and also between the stops.

Louis Prahar, of New York city, has invented an improvement on his Pocketbook Clasp, patented May 23, 1876. A hook is formed upon the rear end of the lower plate and a loop or keeper upon the tail of the top plate. The forward end of the spring is secured to the lower side of the plate by a stud. The free end passes back and rests against the end of the tail of the top plate and holds it in position.

A novel Office Chair has been patented by Martin Schrenkeisen, of New York city. The side posts of the back of the chair project a little below the seat, and to them are attached the rear end of bars, whose forward ends are pivoted to brackets fastened to the pedestal of the chair. Springs are coiled around arms of the bracket. By this construction the back of the chair is held upward and forward, so as to fully support the sitter when leaning back, and bear against his back when sitting erect and leaning forward.

A Horseshoe invented by H.L. Homan and George W. Homan, of Easton, Mo., consists in two calks, having formed on them screw-threaded shanks, which are fitted to corresponding holes in the shoe, and are prevented from turning by a key fitted to notches formed in the side of the calks. They will resist all strains and are readily replaced when worn.

In a Harness Saddle patented by S. E. Tompkins, of Sing Sing, N. Y., the strengthening rib of the seat has a projection underneath through which is an eye. Upon the upper side of the rear edge of the saddletree is a pin projecting to the rearward and through the

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eye of the seat projection. The seat and saddletree are thus simply and firmly connected together.

Ole H. Larson, of Fort Dodge, Iowa, has patented a Ventilating Beer Faucet. A flexible tube with split bulb, and connected with the outside air, forms part of the faucet, and is forced into the liquid where the bulb floats on the surface, thus admitting of a free passage of air. It is an ingenious and good device.

Mr. William A. Cates, of Union, Oregon, has devised an ingenious clock, the dial of which is so subdivided as to indicate the 24 hours of the day. It is arranged with a revolving face plate having a map of the earth on a polar projection, the face plate being placed on the hub of the hour hand. A loosely moving and graduated index hand is placed on the hub of the hour wheel, for indicating the time and geographical position of any place on the earth.

Mr. Daniel G. Beers, of Sandy Hook, Conn., is the inventor of an improved clothes wringer so constructed as to allow the rollers to spread while operating upon large or thick fabrics without throwing the gear wheels out of engagement.

Zelotes McKinler & Virgil True, of Laclede, Mo., have patented a Gas Stove, which is designed to provide an economicalform of cooking stove especially adapted to small families and for summer use. It generates its own gas from a burner, without the use of a wick, by volatilizing, through the heat of the burner, a limited quantity of the volatile oil admitted to the burner from a reservoir placed above the same. The improvements consist in the particular construction and arrangement of the pipes with respect to the reservoir and the supports or stoves for the cooking utensils.

John Miller, of Petersburgh, Pa., and William B. Miller, of Altoona, Pa., have patented a Shaft Tug, an improvement upon that form of shaft tug which is provided with an internal protector to receive the wear of the shaft; and it consists in the peculiar construction and arrangement of the parts whereby the protector may be taken out and replaced, when worn, without deranging or destroying the tug strap.

A Pill Machine invented by Dr. John Hill of South Norwalk, Conn., consists of a series of blades fixed to a vibrating bar, and adapted for dividing the rolls of pill mass upon a tablet, in combination with pivoted clearers which separate the mass from the cutters. The bits of pill mass are then rolled into pills in the ordinary way.

John W. Drake of Tolono, Ill., has invented an improved lamp shade and reflector, which by an efficient arrangement of conical sections and reflectors throws a strong light through the opening of the shade.

On the base of a buckle patented by T. L. Wiswell, of Olathe, Kan., is formed a hook. The end of the strap passes through the buckle, enters the hook and rests upon the ring it holds, so that it is impossible to detach the hook without loosening the strap. It is strong and the buckle does not need to be sewed on.

An air feeder for stoves has been invented by G. C. Palm, of Andersonburg, Penn., which supplies the air for combustion from outside the house. An air trough beneath the floor leading out to the outer air is connected with an air box under the stove. This box is provided with partitions, dampers, doors and two outlet pipes. One outlet pipe is connected with a sunken air chamber under the stove and the other with the bottom of the hearth. The former supplies heated air to a heater above the stove and the latter furnishes the draft.

Communications.

The Law of the Pressure of Saturated Steam with Relation to Temperature.

To the Editor of the Scientific American:

The exact law of the connection between the pressure and temperature of saturated steam has hitherto eluded discovery, notwithstanding the numerous and admirable investigations and experiments instituted on the important subject; and the respective values relied upon for practical purposes have been derived from empirical formulæ more or less simple or complex in proportion as less or greater exactness is required. I think that I have discovered the true nature of the relation in question, a result which I have obtained with the aid and on the ground of the views and conclusions set forth in my recently published pamphlet, "Nature of the Physical Forces" (Rosnan & Co., San Francisco, Cal.). The following is a brief statement of the principal facts involved.

The unit of weight of a given volume of a gas is, according to my deductions, and in conformity with the kinetic theory, equal to the square root of the weight of volume. Multiples of volume, as 2...3...4, etc., therefore involve an increase of the unit of weight at the rate of the square roots of the numbers, respectively by 1·4142....1·732....2, etc. If the number of volumes is increased, while the space occupied by them remains that of one volume, the force of expansion, which is equivalent to pressure, will increase in proportion to the weight of the number of volumes; the units of weight increasing only at the rate of the square roots of these numbers. The increase of volumes of steam in a steam boiler, consequent on the continued application of heat, is of this nature; and the pressure being at 100° C., that of 1 volume, whose weight is equal to that of a column of mercury 760 mm. high and = 1 atmosphere, is at 120° C. = 1491 mm., or nearly 2 atmospheres, at 135° C. = 3 atmospheres, etc., the units of weight being $\sqrt{760} = 27{\cdot}568$ for 1 atmosphere; $\sqrt{2 \times 760}$, or $1{\cdot}41 \times 27{\cdot}568$ for 2 atmospheres; $\sqrt{3 \times 760}$, or $1{\cdot}73 \times 27{\cdot}568$ for 3 atmospheres, etc.

The power by which additional volumes are constantly forced into the same space is increase of temperature, and it remains to be shown that the units of heat actually increase at the same rate as the units of weight of the volumes of steam, and thus to illustrate in the most striking manner the truth of the mechanical equivalence of heat.

The temperatures really increase at the rate indicated; in order to render this manifest, it is only necessary to divide the squares of temperature expressed in degrees of the centigrade scale, by 10,000. In the following, the quotients thus obtained are compared with the square roots of the units of the pressure corresponding to the temperature according to Regnault. The first column contains the temperatures; the second the units of pressure in atmospheres; the third the squares of temperature divided by 10,000; the fourth the roots of units of pressure.

100° C.	1·000	1·0000	1·0000	195° C.	13·84	3·8025	3·7198
120° C.	1·962	1·44	1·4000	200° C.	15·38	4·0000	3·9211
135° C.	3·097	1·8225	1·7579	205° C.	17·00	4·2025	4·1231
145° C	4·11	2·1025	2·0259	210° C.	18·85	4·4100	4·3414
160° C.	6·12	2·5600	2·4729	215° C.	20·8	4·6225	4·5604
165° C.	6·94	2·7225	2·6339	220° C.	22·88	4·8400	4·7831
170° C.	7·844	2·89	2·7998	225° C.	25·00	5·0625	5·0000
175° C.	8·83	3·0625	2·9708	230° C.	27·5	5·2900	5·2438
185° C.	11·12	3·4225	3·3343				

The values of the units of temperatures corresponding to the square roots of the units of pressure are slightly but uniformly in excess of the values of the latter, which discrepancy will be accounted for presently; of the existence of the exact relation there can be no doubt; and this very simple relation expressed in general terms is as follows:

The temperatures are as the square roots of the number of units of pressure; the pressure is proportional to the total weight of volumes, which is equal to the square of the square root of the number of volumes multiplied by the unit of weight; and the square of the temperature (t) divided by 10000, is the square root of the number of compressed volumes, or $p = \left(\frac{t^2}{10000}\right)^2 \times 760$; and inversely, the square root of the number (n) of units of pressure, multiplied by 10000, is the square whose root represents the temperature at the pressure of n units, or $t = \sqrt{\sqrt{n} \times 10000}$.

A comparison of the values of t and p calculated from these formulæ, with the values actually found by experiment, will show if and to what degree the theory is in agreement with facts.

The first column of the following table exhibits the temperatures, from which the pressures of the second column have been calculated, and *vice versa*; the figures of the third column are the actual pressures, according to Regnault; the fourth shows the difference:

100° C.	760	mm.	760	mm.	
120° C.	1530	mm.	1491·28	mm.	38·72
135° C.	2523·2	mm.	2353·73	mm.	169·47
145° C.	3359·2	mm.	3125·55	mm.	233·65
160° C.	4980·73	mm.	4651·62	mm.	329·11
165° C.	5633·12	mm.	5274·54	mm.	358·58
170° C.	6347·59	mm.	5961·66	mm.	386
175° C.	7127·96	mm.	6717·43	mm.	410·53
185° C.	8899·66	mm.	8453·23	mm.	446·43
195° C.	10988·84	mm.	10519·63	mm.	469·2
200° C.	13160	mm.	11688·96	mm.	471
205° C.	13421·45	mm.	12955·66	mm.	465·79
210° C.	14780·546	mm.	14324·80	mm.	455·75
215° C.	16239·3	mm.	15801·33	mm.	438
220° C.	17803·156	mm.	17390·36	mm.	413
225° C.	19477·87	mm.	19097·04	mm.	380·83
230° C.	21267·916	mm.	20926·4	mm.	341·516

The figures show, as already stated, that the actual pressures are lower than those calculated from the temperatures; there has been a loss of temperature which has to be accounted for, if the doctrine of the mechanical equivalence of heat is to be rigorously true. The loss seems to be strongly confirmatory of the correctness of the law, as above enunciated; for when the pressure of the steam is indicated by the gauge, a certain amount of the expansive energy has already been consumed in the heating and expansion of the boiler, and the work thus performed is not included in the registered tension. The discrepancies, therefore, enter as a necessary factor for the determination of the values. The loss, as will be seen, increases gradually till at about 14 atmospheres it reaches a maximum, and, after remaining nearly stationary between 14 and 17 atmospheres, gradually diminishes. This seems to be in perfect agreement with the behavior of metals under strain, their power of resistance increasing gradually up to a maximum with the increase of the straining forces. Special investigations, however, are necessary to show that the discrepancies are solely due to this cause.

San Francisco, Cal., December, 1877. E. VOGEL.

The Telephone's Freaks Again.

To the Editor of the Scientific American:

We have just completed a line eleven miles long, from this place to Cape Girardeau, through a hilly, heavily timbered country, and are using the Bell telephone. At Cape Girardeau our wire passes in on the north side of a window and the wire of the Western Union Telegraph Company passes through the window on the south side, and that is as near as they come together any place on the line. If we listen in the telephone at Jackson we can hear every click made by the W. U. instrument, which is in the same room with the telephone, but in no way connected by wires. The telegraph instrument is secured to a small table and the telephone is fastened on a railing two feet distant.

Jackson, Mo. T. F. WHEELER.

Trueing a Crank Pin.

To the Editor of the Scientific American:

A quicker way of doing the job than that described by J. R., in issue of December 16, is this:

Set the crank shaft perfectly level; place the crank in a horizontal position, and apply a good level to the crank pin bearing. If you have no short level, true up parallel the edges of a strip of wood or metal, a trifle shorter than the crank pin bearing, and wide enough to clear the outside collar of the same; hollow out one of the edges, so that on placing the strip upon the bearing only the ends will touch; put the level on top, file away the high end of the pin till the parallel strip rests level, and by aid of a straight edge carefully file a flat place across the pin. This operation is repeated with the crank in vertical position, and, if you choose, with the same standing at an angle of 45°, both forward and back. With a pair of callipers find the smallest diameter across the flat places, and file the pin opposite to them to that diameter. Use the brasses or a template, the brasses being too large, in filing between the flat places to indicate the high spots, until you have the pin true and round.

I have followed this practice for a good many years with good success, both as to time required to do the work and the truth of it. JAMES LOCHER.

Two Brilliant Meteors.

To the Editor of the Scientific American:

After reading Dr. James' communication to your valuable paper of the 29th inst., I think it very probable that the meteorites in question were distinct, and the dates of observation correct. Within an hour of the time of falling I made a note of the occurrence, from which I wrote my communication to you. Besides, the meteor observed by Dr. James had "a slight deviation to the East," while the one seen by myself had an inclination of 65° to the West.

In regard to the cause of the green color, it may be proper to state that the fact that Dr. Smith, Pugh, Forchhammer, Bergemann and others have observed a fraction of 1 per cent (from 0·03 per cent to 0·45 per cent) of Cu and P, in various meteorites, may lead us to ascribe the phenomenon in question to those elements, although the amount observed be not sufficient to cause the appearance.

Racine, Wis. R. C. HINDLEY.

PRACTICAL MECHANISM.

BY JOSHUA ROSE, M.E.

NEW SERIES—No. XXXVI.

GEAR WHEEL TEETH.

The designations of the various parts of a gear tooth may be understood from Fig. 256, in which A represents the face of a tooth, B the flank, C the point, D the root, E the depth, length, or height, F the breadth, G the thickness, and P P the pitch circle or pitch line, these last two terms being synonymous. When, however, this line is spoken of in connection with a tooth it is termed the pitch line, but with the whole wheel, the pitch circle. The thickness of the tooth is always measured along the pitch line. The distance from the center of one tooth to the center of the next, measured along the pitch line, is termed the pitch, either of the wheel or of the teeth, as the case may be. The distance between one tooth and the next one measured on the pitch line, as at H, is called a space, and is equal to the thickness of the tooth and whatever clearance is allowed. (Clearance will be explained hereafter.)

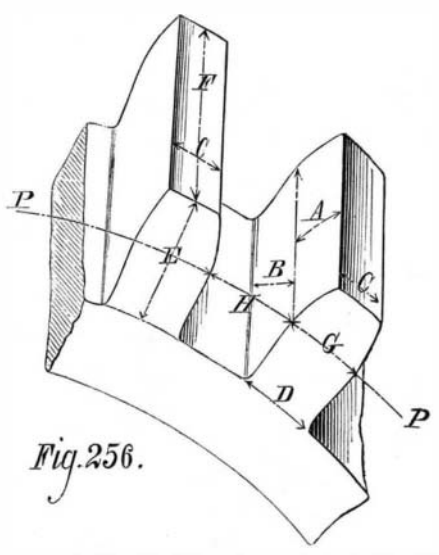

Fig. 256.

The pitch of the teeth may be measured in two ways, one around the circumference of the pitch circle and the other straight across. It is evident that the first is an arc and the other a chord, hence the designations arc pitch and chordial pitch. Suppose that in Fig. 257 P P represents a portion of a pitch circle, and A, B, C, D the centers of teeth, then the distance between two of these centers, measured across E, is the chordial pitch, while that measured around the curvature of P P is the arc pitch. In a wheel having teeth it would be somewhat difficult to practically measure the arc pitch; hence when in the workshop the simple term "pitch" is used, it is understood to imply the chordial pitch, which can

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