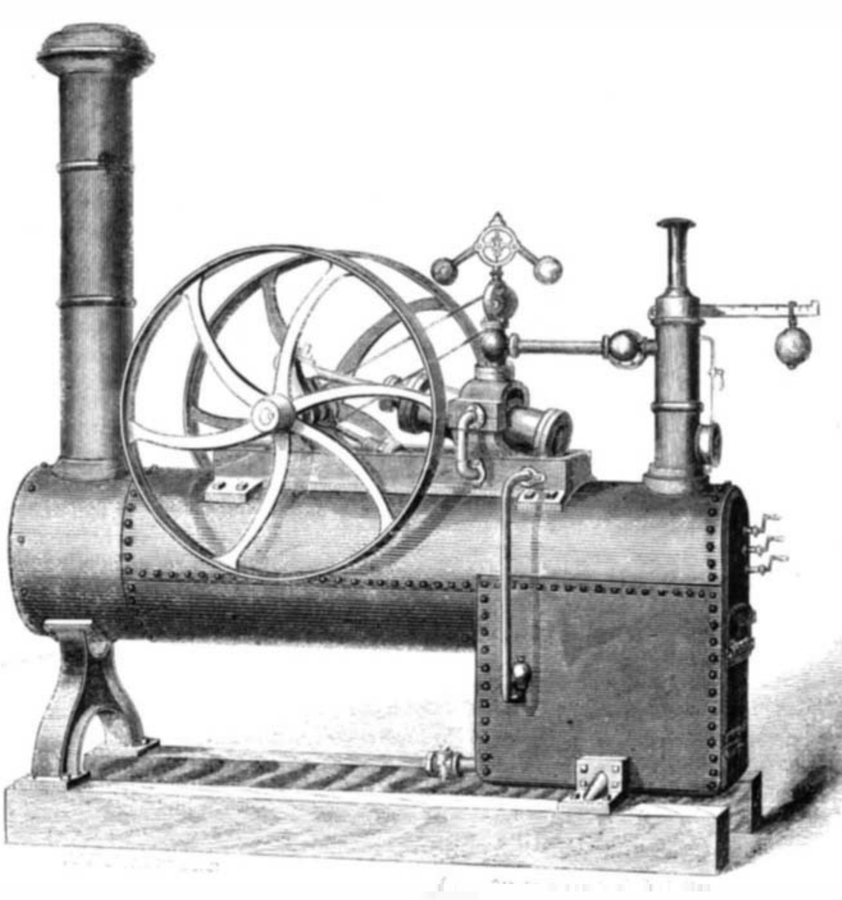
Improved Portable Engine.

This engine is the invention of Mr. Henry T. Carter, and was pateneed through the Scientific American Agency on the 25th of July, 1865. The advantages consist in obviating the leakage of steam from the trunnion, and the simplicity and durability of its working parts. Most of the oscillating engines that have been presented to the public have been constructed so as to take the steam by means of a friction joint on the trunnion or elsewhere. The cylinder, or plate, is kept in its position by means of powerful set screws and springs. These agents are inefficient, and the engine, after a short time wearing, leaks steam. This engine has a tight steam chest and slide valve, so there is no more possibility of its leaking than any slide valve engine. The valve is moved by means of a link and the oscillation of the cylinder. For further particulars of the valve gear we would refer the reader to No. 9 of the present volume of the SCIENTIFIC AMERICAN.

The boiler is made of the best material, and the workmanship of the engine is unsurpassed. These engines are made to reverse, when ordered, and are put upon wheels at a little advance of the regular prices.

The strength of the working parts and the lightness of the engine, insures that point which is so desirable in portable engines—safety in transportation.

The prices are very reasonable, and will no doubt attract the attention of parties wishing a good engine. These engines, as well as stationary ones of the same patent, are manufactured by the Winslow Machine Works, Portland, Maine.



CARTER'S PORTABLE ENGINE.

HOW AMERICAN LOCOMOTIVES ARE MADE.

In the SCIENTIFIC AMERICAN, page 259 of the current volume, we gave an article from an English contemporary, which treated at some length on the great locomotive manufactory at Crewe, England, and the processes, or, rather, methods, by which the designs and details are carried out. It must have struck the American mechanic that some of the plans therein set forth were "melancholy and slow," or, in other words, not what we should have expected from a great factory where three thousand men are employed, and where millions of dollars must be invested. It may be pardoned in a small machine shop, where there is a lack of capital, if the proprietor thereof sees fit to plod on in the old and not good way, when there are tools and methods in existence far ahead of those rude ones he sees fit to make use of, but it is not a sign of progress that machines are built to square bolt holes in flanges, or to straighten copper bolts for fire-box stays. All this is just so much time wasted, and attention might better have been directed how to dispense with the square holes, and, consequently, the machine to make them, or the substitution of some other material than copper, which would be equally as good.

The great competition in locomotive building in this country has made a resort to system, or fixed plan of procedure, a matter of necessity. There are no less than twenty noted establishments where quantities of engines are turned out, to say nothing of lesser ones, and repair shops, which do a great deal toward renovating and rebuilding engines. In the best of these large shops the same principle is pursued as in the manufacture of Colt's pistol, or a Springfield rifled musket; that is to say, every engine of its class is exactly like its predecessor, and a cylinder could be made and fitted to a locomotive any where with the certainty that it would be right as to its center from the frame, right as to its position on the frame, and of the same dimensions in other respects to insure its proper working.

One of our locomotive shop superintendents, on reading the article on the English locomotive works referred to, said "we could not do much here building engines in that way."

The Jersey City Locomotive Works is a representative shop, and we shall proceed to give some account of the manner in which the principal details are there executed, such as the cylinders, the frames, the drivers and connections. Other parts we are not able to allude to.

THE FRAMES.

These are in two parts for convenience of handling; that is to say, the section which carries the cylinders is bolted to the section on which the pedestals of the driving-wheel boxes are forged. The frames are laid on the planer and faced off, and two sets are thus going on at the same time; the cross-head of the planer being wide enough to carry two tool stocks. The frames are all planed to hardened steel gages, so that the distances and dimensions prescribed by the draftsman are arbitrarily preserved. The pedestal sections are laid one on top of the other on a slotting machine, where the jaws are slotted out together, so that the dimensions and lengths are correct beyond cavil. The two parts, the cylinder sections and that just named, are also bolted together at a fixed distance, so that when the frames are set up they are identical—the bolt holes for the cylinders, brackets, etc., having all been drilled on a press beforehand. On the frame there is a shoulder which the back end of the cylinder flange is fitted against; this shoulder is faced accurately on the planing machine a set distance from the center of the pedestal, and when the cylinder is bolted in place a key is driven in behind it on the forward side, so that it is fast between two solid wrought-iron shoulders, on a solid forging, and can never be displaced or be out of truth.

THE CYLINDERS.

The cylinders are not bored in pairs as in the English works, nothing being gained by that operation as locomotives are here made. They are bored singly, on a machine constructed purposely by Hewes & Philips, of Newark, N. J. The machine consists of a cast-iron bed with a platen laid on top of it. On each end of the bed are two vertical columns which carry shafts, to which boring bars or heads are attached. The cylinder can thus be set on its own bottom as it was planed, and moved any where by means of screws, to be bored accurately. The boring heads are also adjustable by moving a handle, so that in a very few minutes the cylinder can be put in the machine, secured and set; this also by any ordinary workman. The cylinders are faced on the flanges, and turned outside of the same before they are moved from the boring mill.

The cylinders, when on the engine, are bolted to the saddle piece on which the fore end of the boiler rests; they have, therefore, a vertical flange which must be faced off true with the bore. To do this the planing machine is fitted with coned centers—the cones being the diameter of the bore—16 or 18 inches, as the case may be. The cone centers, having been once set, any number of cylinders can be put in and planed off without loss of time in adjusting them.

Moreover, the vertical flange that rests against the saddle, and the valve face, are both planed at one operation, and the cuts are not mincing ones, but the tool takes a good solid chip at first, so that the work is well and speedily done. When the cylinders are bolted to the saddle they are correct, and there is no heavy handling to be done. Formerly, when the cylinders were bolted to the sides of a square smoke box, they were frequently out of center; that is to say, the cylinder had to be made to suit the smoke box of the boiler, and, as it was obviously impossible to rivet that on within a hair's-breadth, much delay ensued. The crank pins could not be turned until it was known where the cylinders were. They were sometimes a sixteenth of an inch in or out, and the shoulders of the pins had to be faced accordingly. All this delay is obviated by the simple means alluded to.

THE DRIVING WHEELS.

The lathe in which the driving wheels are turned is a remarkable machine, and is built by Messrs. Bement & Dougherty, of Philadelphia, Pa., with some additions by Mr. Davis, the efficient superintendent of the Jersey City Locomotive Works.

The wheels are of cast iron, and are mainly completed at one operation; that is to say, at one setting in the lathe, all except the crank pin holes, which are bored in a special machine. The outside or tread of the wheel, the hole for the axle and facing off the hub, are all going forward at the same time. Two wheels a day are turned out complete. Before the wheel is taken off the lathe, the key seat is cut in it by a special attachment. A seat one and an eighth inches wide, and half an inch deep and in length—the depth of the hub—is cut in ten minutes, on an average. In no instance do the cranks exceed one-sixteenth of an inch deviation from being at right angles. The axles are also cut as to their key seats, and when the two parts come together they stay there; there is no fitting and filing, no backing the wheel off, no key seats to be chipped and filed, as in some works. All this is an immense saving of time, while in point of workmanship the quality is unsurpassed.

DETAILS.

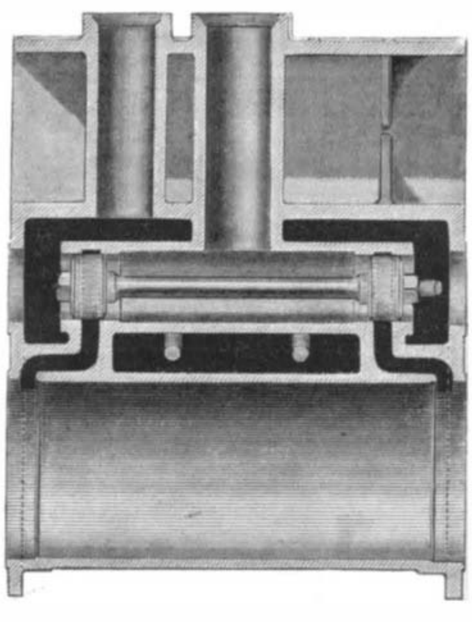
In no department of the machine shop can skillful management be shown to better advantage than in the details—in the picking up of the loose ends, so to speak, and the small processes which waste time and add, in no respect, to the value of the work.

In days bygone it was a distinction, coveted by many workmen, to fit up the connecting rods, and all such details as had gibs and keys and brasses. There was much inspection of joints, much criticism as to the fit of gibs in the jaws, and a nicety of discrimination in regard to the flanges of the brasses where they embraced the strap, that was highly praiseworthy. The long, laborious filing of key ways is a thing of the past; filing and scraping of brasses is also done away with, and when the rods come from the machine the key ways are very nearly perfect, and require little alteration. The brasses fit like a kid glove to the hand, if the workman follows his gage, and the consequence is that where dollars were expended, cents are sufficient.

Messrs. Bement & Dougherty, of Philadelphia, Pa., are the makers of the machine for cutting out key ways in connecting rods, and a more useful tool of its class has not been produced in this century. It is an original conception, carried out in a workmanlike manner. A slotting machine is by no means reliable to make straight key ways. Sometimes the tool springs sideways, and cuts under the center punch marks. In spite of squares and straight edges, the workman is in a measure working in the dark, for one side of his job is always hidden from him. Smoking lamps or stinking gas jets are of no avail to disclose the mysteries of that nether side, and, to his mortification, the skillful artisan sometimes finds that the slotting machine is a delusion and a snare, that fails in time of need. Not so with the machine of Messrs. Bement & Dougherty. The rod, once planed, is put in centers like those of a lathe, and two cutters, in form like drills, but peculiar in shape, on the cutting ends, are set revolving at right angles with the center on the place where the keyhole is to be cut. After these cutters are started, and the machine properly set, they go forward and backward, and work out the keyhole complete without any further attention, except that which all tools working on iron require—that is, to see that no accident occurs to the edges.

used. Some of the engines of our vessels of war have valves, which, besides being ballanced by a number of extra traps, have an extra engine to each cylinder, large enough to drive a good-sized vessel, solely for the purpose of reversing the engines, and it is a long job, and requires a number of men to do

FIG.1.



it, at that. These engines are necessarily very expensive, and the cost of maintaining them in a serviceable condition is very great; where a pair of such engines are used in one vessel, the liability to accident is so imminent, as to make the movements nec-

owners for some reason preferring in all cases to pay a certain specified sum of money for the work done.

Engines to which these valves have been applied may be found in great numbers in the tug boats of New York and Philadelphia and in the Hudson River, at Albany and Troy, and also in larger vessels running from New York to other ports; some of them have been entirely unmanageable, but are now brought into the dock with the greatest ease and celerity.

Fig. 1 is a section of a 12-inch locomotive cylinder, showing the steam-chest ports, exhaust pipes, and method of applying the valves. In this case the cylinder and valve chest are one and the same casting. The cylinders of marine engines are made in a similar manner, much simplifying and lessening the first cost of the engine. The cost of fitting up these cylinders is very slight, the boring bar does the whole of it—simply boring out the short bearings for the valves and squaring up the sides of the ports, all easily and quickly done. The steam enters the outer chest, from the boiler, and almost entirely surrounds the case in which the valve moves, thus insuring an equal expansion of all parts and preventing the sticking of the valves; the full pressure of the steam is exerted upon the outside ends of both valves, and it is exhausted between them—consequently balancing them. This arrangement makes the only truly balanced valve now made; a child can move them without difficulty when they are properly adjusted and cared for. As they are incompressible by the steam, relief valves are inserted to relieve the excessive back pressure when reversing suddenly. This is absolutely necessary on a locomotive cylinder, but is not so necessary on any other kind of an engine.

Fig. 2 is a section of the same cylinder through the center of the exhaust pipe, and shows the arrangement of the ports, valve case and relief valves. The pressure of the steam in the exterior of the case keeps the latter closed. They are placed over each port and have a small spring over them to insure their closing.

When the back pressure in the cylinder becomes greater than the pressure in the chest, the valves open, and the steam or water, or both, are discharged

FIG.2

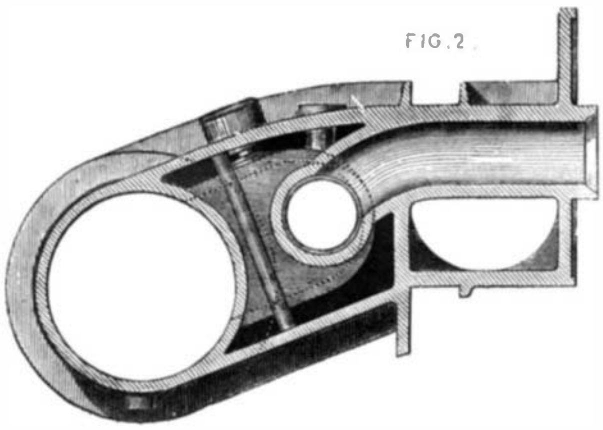


FIG 3

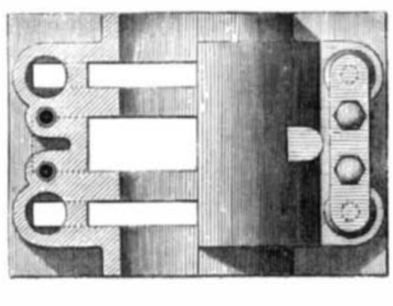
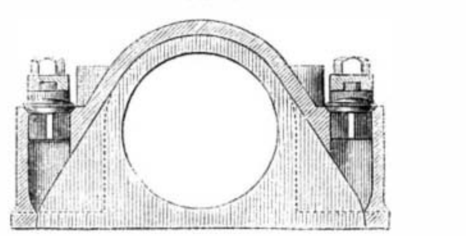


FIG.4



The cutters are two in number, and work from each side; they start in solid metal, and no holes are to be drilled previously. They meet in the center when the key way is finished, and they work down and then return, repeating this operation until the job is completed. We regard this machine as one of the most novel, ingenious and useful ever produced for the engineering profession.

In various other details of our locomotive shops a great many changes and improvements have been made of late years, but to dilate upon them at length is more than we can afford space at present. The work of erection—at one time a slow and costly part of the job—is much expedited and rendered cheaper, for no part waits on the other, and when the several details are to be put together they require but little adjustment.

The number of engines turned out in the Jersey City Works is six in a month. This is accomplished with a force of 600 men. It is the calculation to make one engine per month with 100 men, and we are informed that the Company does this.

DAVIS'S PISTON VALVE.

We alluded to the superintendent, Mr. Thomas S. Davis, previously, and we here append illustrations of a new piston valve of his design, which he has applied to locomotives and many other engines on land and sea.

Persons at all conversant with marine or steamboat engines, know what an enormous amount of power is consumed in reversing some of them, paricularly those in which the ordinary slide valve is

essary to be gone through with, in an action at sea or in entering a port, any thing but agreeable.

By using the valves and case here shown, the inventor is confident he can, and will guarantee, to so improve any engine of this kind, that one man can work the vessel into any position necessary without the help of tugs, and with no more risk than is usual to easily managed boats; the engines shall be entirely under the control of the engineer, and can be handled easily, and reversed instantly, without the

FIG. 6.

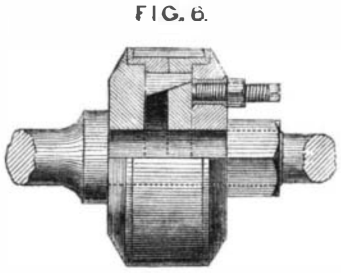
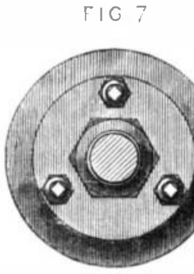


FIG 7



loss of time necessary to shut off, or throttle the steam.

The great desideratum of a reduction in the quantity of coal consumed is also accomplished. This is a positive fact, and can be testified to by numbers of owners of vessels. There is no instance on record, where these valves have been applied to old engines, that the consumption of coal has not been greatly reduced. The inventor has never been able to get an engine to alter for the saving in coal for one year, the

into the steam chest. The water falls to the bottom and is discharged by cocks inserted for that purpose.

Fig. 3 represents a partial section and top view of the valve case as made and applied to the valve face of the ordinary slide-valve cylinders. This one was made for a locomotive, but those for marine engines are made in the same manner, except that they have no relief valves. In some cases, where the valves removed have approximated in size to barn doors, two or more valves have been used, placed side by side and worked by one valve stem. The inventor has found this manner of using them better than to make the valves very large in diameter; they take less room and give all the area requisite.

Fig. 4 is a section through the center of the port of the same valve case.

Figs. 6 and 7 represent the valves, showing the manner of placing the rings together, one inside of the other; they are all cut in one place, and so put together as to break joints, with dowel pins to prevent their getting out of place. The cheeks or followers are held together by the shoulder upon the valve spindle and the nut; they are fitted to the spindle, and also to the shoulder or recess in the rings, and are made to fit the bore of the valve chest as nearly as possible, leaving the extreme periphery as thin as it will stand. Through one of the followers are screwed set screws of any number desired—three are generally used. In very small valves the set screws are left out entirely, and the cone is forced into the rings by placing a thin piece of metal or other material, between the cone and the follower, and screwing the nut up until the follower comes to a bearing upon the recess and edge of the rings; this answers all practical purposes, and is some cheaper. The conical plug is solid, and is fitted to the valve spindle and also into a ring which is made conical upon its inside periphery; outside of this ring are placed two rings, alike, but reversed; they are recessed on their outside edges to give a bearing for the followers; the outside ring is made a little wider than the port, otherwise it might spring out and catch when passing it; its edges are slightly bevelled, being a little wider upon its interior periphery to allow the two-joint breaking rings to grasp and retain it. The action of the arrangement is this:—By screwing up the set screws or nut, the solid conical plug is driven into its surrounding conical ring, which, being cut, is expanded, and through it the surrounding rings are also expanded, at the same time the distances from the center of the valve to any point or points of its exterior periphery are all equal, or the outside of the valve is true to the center, and the valve has all the advantages of a solid block, without the disadvantage of being obliged to insert new valves when they begin to leak.

These valves have been in successful use for the last four years, and the inventor has yet to hear of a case where they have not accomplished their object thoroughly. There are great numbers of vessels now running about, and from our harbors, which are wasting money for their owners almost as fast as they can earn it, and to all who own such vessels, the inventors wishes to say if they will call upon him he will satisfactorily demonstrate that they are wasting money, and will show them what he has done and can do to save it for them. Address Thomas S. Davis, Jersey City Locomotive Works.

Correspondence

Award of Premiums at the American Institute Fair.

MESSRS. EDITORS:—When we put our machinery on exhibition at the late Fair of the American Institute, and thereby contributed a share to make it interesting, we did it in the simple belief that, according to the programme by which they solicited our contribution, entire impartiality would be shown in the distribution of prizes; and that, as they explicitly stated, no premiums would be given, directly or indirectly, to any member of the Board of Managers of the Fair, or any Committee or officer of the Institute. It has, therefore, surprised us not a little to find that, in direct contradiction to their public announcement, two of the managers have received—if not directly, at least indirectly—the first premiums, that on steam pumps was awarded to the Woodward Steam-pump Company, of which, we suppose, Mr. Geo. M. Woodward is the principal; and on oscillating engines to Messrs. Wm. D. Andrews & Bro., whose superintendent or partner is Mr. David G. Starkey, who, together with Mr. Woodward, was a prominent member of the machinery department.

You, Messrs. Editors, as impartial judges, must acknowledge with us that this thing looks dubious, to say the least, and ought to be inquired into, in order that exhibitors, and the public in general, may know in the future how much value they can attach to the judgment of the American Institute, which they pretend to express through their premiums and awards. A. & F. BROWN & Co.

Progress Machine Works, New York, Oct. 25, 1865.

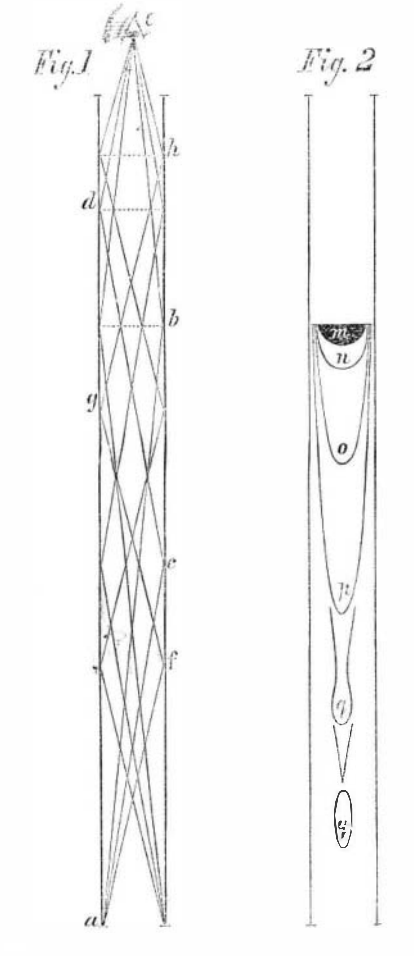
The Way to Zinc Cast Iron.

MESSRS. EDITORS:—For the information of E. D., and others, I place at your disposal some experiments made by myself in galvanizing small cast-iron articles, such as gears and other small parts of machinery. I heated the castings to be galvanized to a red heat; I then plunged them into a bath of clear muriatic acid, to detach the scales and to thoroughly clean them; they are then immersed in a bath of melted zinc. As soon as the iron has attained the melting heat of the zinc they are removed. In this way I have made some beautiful galvanized castings. Great care should be taken, or in plunging the articles into the zinc, while wet, the zinc will be thrown in the face of the operator. The zinc should be covered with sand, and the casting must be immersed very slowly. E. H. HILL.

Worcester, Mass., Oct. 14, 1865.

Straightening Gun Barrels Illustrated.

MESSRS. EDITORS:—In your issue of 9th Sept. last, a correspondent asks for a statement of "the theory of the process of straightening gun barrels by looking through them at the light." The process referred to is, no doubt, that which is called by the workmen "straightening by the shade." This art is based upon a beautiful group of scientific facts or principles, and is, therefore, one of much scientific interest. It is also an art of great practical value, because it affords the means of straightening the barrels of fire-arms with a far greater degree of precision than is attainable, or even approachable, by any other process. The theory of the art, if I mistake not, is little understood even by those who practice it successfully; and, so far as I know, it has never been satisfactorily set forth, and explained in any work. I therefore offer, for the SCIENTIFIC AMERICAN, a brief exposition of the process, and of the scientific principles involved in it.



When the eye looks into a gun barrel, as shown at *e*, Fig. 1, the interior surface appears to be spread out into a plain circular disk, as far from the eye as the other end of the barrel. Through the center of this disk is a circular orifice, and surrounding this, at equal distances from it and from each other, respectively, are four or more well-defined concentric circles, dividing the disk into as many bright concentric rings, each of an apparent breadth, precisely equal to the diameter of the central orifice. The central orifice is the other end of the caliber as seen by direct vision. The several concentric circles are so many images of the end of the caliber reflected to the eye from different points along its length. The first of these circles, or that nearest the central orifice, is an image formed by light once reflected. The second, third, fourth, fifth, etc., respectively, are images formed by light reflected twice, three times, four times, five times, etc. In order to see how these images are formed, and to find their respective loci in the caliber, consider that a ray of light from each point in the end of the caliber, as *a*, may pass to some point, *b*, on the other side of the caliber, and be thence reflected to the eye, thus forming, at *b*, an image of the end of the caliber by one reflection. Another ray from the same point may pursue the route, *a c d e*, forming an image at *d*, by two reflections. Another ray may take the route, *a f g h e*, forming an image, at *h*, by three reflections—and so on for the other images. Now, since, in the formation of each of these images, respectively, the angles of incidence and reflection are equal, it follows that the locus of the image, *b*, formed by one reflection of light, is at one-third of the distance from the eye to the further end of the caliber; that formed by two reflections, *d*, is at one-fifth; that by three reflections at one-seventh, and the succeeding ones one-ninth, one-eleventh, etc., of the same distance.

Hence we see that all three images are located within the third part of the length of the caliber nearest to the eye. Consequently there are two-thirds of the entire length of the caliber in which none of these images appear. It is to this part of the caliber only that the workman directs his attention, for it is here only that he can cause the "shade" to appear which discloses the crooks in the caliber, if any exist. When this part is straightened he inverts the barrel and works from the other end.

When we would examine a plain mirror for the purpose of ascertaining whether its reflecting surface is a true plane, we cause objects to be reflected from it to the eye at small angles of incidence. If, under these circumstances, every part of the mirror gives an image true to nature, we pronounce it perfect; for the slightest deviation from a true plane, would cause a manifest distortion of the image. In the process of straightening gun barrels by the shade, crooks in the caliber are detected upon the same principle. The internal surface of the barrel is a mirror, and whatever objects are reflected to the eye from that portion of it that lies beyond *b*, will be reflected under very small angles of incidence. It is not a *plain* mirror, to be sure, and therefore the reflected image will not be true to nature. But if the caliber be straight, the image will have no other than that normal distortion which is due to the transverse or cylindrical curvature of the mirror; while, if there be longitudinal flexures also, there will be an abnormal distortion of the image which will reveal the defect.

Having thus presented the theory of the process in a general form, we will look for a moment at its practical application.

The workman fastens a piece of board horizontally across a window at a distance of 10 or 12 feet from his working stand point, the lower edge of the board being straight and six or eight feet above the floor. This we will call the shade board. He fastens another strip of board to an upright post or other object near his stand point, having, in its upper edge a notch in which he may rest one end of the barrel while he looks into the other. He places one end of the barrel on the rest and directs it at the window a few inches below the shade board; then looking into the caliber, and directing his eye to the lower side of it and to the point just beyond the image, *b*, he gradually depresses the end which he holds in his hand, bringing the direction nearer and nearer to the shade board. Soon he sees a dark shade, as shown at *m*, Fig. 2. This is the reflected image of the shade board; the curved part of its outline being the image of the straight edge of the board. As he depresses the end more and more the shade lengthens to *n o p*, etc. If the caliber be perfectly straight, the shade will always maintain a true and symmetrical parabolic form, growing more and more pointed at its apex, until it reaches the further end of the caliber. But if there be the slightest flexure in the caliber, the barabolic figure of the shade will be distorted. As soon as the workman discovers a distortion of the figure, he slowly revolves the barrel about its axis with his fingers, at the same time alternately elevating and depressing it slightly, until the shade assumes a form in which the two sides near the apex are equally drawn in toward each other, as shown at *q*; (or if the crook be considerable, the two sides may be drawn quite together, cutting off a portion of the shade at the apex, as at *r*). He now knows not only that there is a crook at *q*, but also that the caliber is concave downward at that point. If he is an experienced workman he will be able to judge correctly how far that point is from his eye; and he will reach