of the comet where the lines cross, and can thus follow its track.

The comet will rapidly diminish in luster after perihelion, when it will be about 71,000,000 miles from the sun. It will probably be visible in this latitude until the last of February. Its luster at perihelion will be four times greater than it was at its appearance in 1812.

An interesting incident conected with the comet was announced at a recent meeting of the Boston Scientific Society. The plane of the earth's orbit and that of the comet coincided on the 6th of December. Mr. Chandler, of the Harvard College Observatory, had suggested previously that when the earth reached that position in space, meteors would be seen moving in the comet's orbit. The prophecy was fulfilled. On the night of the 6th of December three members of the Society discovered twelve or more meteors radiating from this very point, in space.

It is confidently expected that the Pons-Brooks comet will grow much brighter, and project its tail farther into space before reaching perihelion. But there is always a fascinating uncertainty about comets. Our present visitor has had one or two sudden outbursts and has as suddenly grown dim. No one can tell what will come next; neither can any one understand why the comet that looks down upon us this year should be four times as bright as upon its former visit, seventy-one years ago! We must expect changes as the fleet footed visitor approaches the sun. A noteworthy change is now going on. A second tail is being developed while the original one is rapidly extending, and observers of the present generation may behold the long wished for sight of a comet with two tails, unless the second tail vanish as suddenly as it appeared.

DRILLING AND BORING GUN BARRELS.

To the unmechanical eye, and to some mechanics, the true drilling of a gun barrel or a rifle barrel appears to be an almost impossible job, but in reality it is as simple as many other processes that awaken no surprise. Some gun barrels are made hollow at the beginning of their formation. Those which are rolled from "skelps," and have a welded seam along their entire length, are rolled on a rod that is the rudimentary bore. So, also, the damascened, or "stub and twist" barrels are hand-welded in a spiral of about three-quarters of an inch wide—technically, a pitch of three-quarters—on a rod that leaves the beginning of the bore. Neither of these sorts of barrels is drilled—they are only bored or rimmed. But the best rifle barrels and pistol barrels are drilled bars of solid steel, and the drilling is a more exact job than the boring. The bars, cut to proper lengths and annealed, are placed upright in a drilling machine, each bar resting on a revolving disk or chuck, and held in place by a guide at the top. The drills are fed down by an adjustable weight. Usually the drills are twist drills, but even when they are used they must be removed for every two or three inches of drilling and the barrels emptied of chips. Some manufacturers prefer a half-round drill with a single projecting cutting lip on its end. In either case the rotation of the barrel and its upright position are expected to insure a true hole from end to end.

All barrels, whether formed hollow or drilled from the solid, must be bored to size. This is effected by means of a bar of cast steel, round except for from twelve to fifteen inches from the end, which is forged square and ground perfectly true to gauge, which is slightly smaller than the intended diameter of the bore. On one of the faces of this squared portion is placed a segmental slip of soft pine wood, the cross section of which corresponds nearly to that of a "half-round" file. This piece of wood goes in with the rimmer, and secures a perfectly round hole, and prevents chattering. If the bore requires enlarging, one or more slips of paper are placed between the wood and steel. This boring is the final finish of the barrel before rifling.

Improved Testing Machines.

At a recent meeting of the American Society of Civil Engineers in this city, a paper by Mr. A. V. Abbott, on "Some Improvements in Testing Machines," was read by the author, and illustrated by a stereopticon. A 200,000 pound testing machine was first described, its general construction providing for weighing the forces applied by means of platforms and levers somewhat similar to those used in ordinary scale work with special arrangements to reduce friction. To secure the direction of the pressure upon the test pieces in the axis of the machine, both ends of the piece are connected with segments of spheres moving freely in spherical sockets which take the proper position upon the first application of the stress.

Arrangements are also made by means of wedges to grip, and hold uniformly the ends of the test pieces. The machine is arranged to test in tension, compression, for transverse stress, for shearing, bulging, and torsion. In the machine exhibited the action of applying stress is automatic, and at the same time the same power gives an autographic record of the stress applied, and of any variations which may occur during the continuance of the stress, and with an instantaneous autographic record of the result at the conclusion of the test. The stresses are applied by means of weights which slide upon two parallel lever beams, the one registering up to 10,000 pounds, and the other up to 200,000. By means of a remarkably ingenious electrical attachment, connected with clock work, the movement of these weights is continuous and automatic, and the registering apparatus is also controlled by the same electric current.

It is impossible in this abstract, and without the aid of a diagram, to fully describe the details of these movements, but they seem to be very complete and accurate. Diagrams automatically made by the machine were exhibited and described.

A number of broken pieces of steel were exhibited, and also specimens of woods which had been tested in various ways. Machines of smaller powers were also described, and a number of briquettes of cement were broken upon a small automatic machine, which was exhibited.

Boston's Sewerage Experiment.

The public will follow with interest Boston's experiment of leading its sewage into deep tide water. This morning the pumps will be set in motion at Old Harbor Point, the final discharge being at Moon Island. The entire cost has been $4,544,272, and the building of the sewerage is spoken of as "one of the greatest engineering feats of the age." It may seem a little hypercritical to express a regret on this inaugural day of great enterprise that Boston did not see fit to include in its plans all the possibilities in the case. London has taught the world that a nuisance can be turned into a profitable product available for agriculture. The market gardeners about the city eagerly take up all the sewage fertilizers turned out at the London works, and find them even better than what they buy in the market.

At Pullman, the infant city of Illinois, also, the revenue derived from the sale of the manipulated sewage is a good and fair interest upon the money invested in the works, to say nothing of the incalculable benefit to the community in the solution of a serious difficulty. A glance at the North Cambridge and Arlington meadows, and, in fact, the market gardening section of Middlesex County, ought to satisfy any one as to the extravagance of the policy which dumps the refuse of a great city into the sea. It is an open question, moreover, whether the "deep tide" will take and hold this sewage. Nantasket and the contiguous beaches may have occasion hereafter to thank Boston heartily for perfuming the surf and giving a new value to their bathing privileges. Of course the present works need not be abandoned, even if they prove to be a nuisance. The pumping station can be turned into a fertilizing factory, but the roundabout way of getting at it will certainly be very expensive.—*Springfield Republican, January* 1.

The Planet Jupiter.

We never look upon Jupiter at opposition without rejoicing that, when the vast nebulous mass that once filled and extended far beyond the limits of the solar system quickened into life and threw off the concentric rings of which the planets were formed, the largest rings condensed into the planet Jupiter. Thus, the lesser members of the brotherhood may behold the magnificent spectacle of a planet second only to the great sun himself, a miniature solar system with a quartet of revolving satellites, a telescopic wonder on which the eye rests with ever new delight. The huge planet has not yet cooled down; his primeval fires still blaze, and he gives out light and heat to the moons that surround him, and as readily yield to his sovereign power as their mighty lord bows to the sun's resistless sway. Observers on the earth, nearly five hundred million miles away, may watch the process of world making on this distant sphere. In the belts that diversify his disk, in the huge spots that from time to time agitate his mass, in the immense cloud atmosphere that conceals his fiery nucleus, we behold, on a grand scale, the progress of the cooling process that millions of years ago stirred to the depths the earth's lesser bulk, before it developed to the perfection of its present condition as an abode for animate life. Just as surely will the prince of planets reach, latest of all the sun's family, the same perfection of development, when millions of years hence the earth, like the moon, has arrived at the period of inevitable decay, and, preceded on the list by Mercury, Mars, and perhaps Venus, will be floating through space as a dead world. Viewed in this light, every changing belt, every new spot, and every sudden rift are a revelation in Jovian language of the tremendous commotion that will eventually bring order out of chaos.—*Providence Journal.*

The Importance of the Mechanic.

Each ensuing day makes more prominent the fact that we have come upon the time when the mechanic is master. We have crowded professions and ill-filled trades. A chance to fill the position of sub-assistant clerk in a wholesale house is eagerly grasped at by a hundred applicants, though the wages received be scarcely more than "a chance to learn the business." Let a master workman try to obtain an apprentice at three times the salary offered the clerk and his applicants will be poor alike in quantity and quality. A skilled workman in any trade need never want for hire; he is eagerly sought after by a hundred employers; he is independent of the condition of the market; the skill and cunning of his hand and eye are too valuable to lose, and must be paid whether the products are slowly or rapidly consumed. If business ceases, the master hand is eagerly seized by some rival house, which knows and values the product of his skill. He who would crush down the obstacles to success in our own days must have, as well as the wit to see the crevice, the strength to deal the blow. This is an age of the steam engine, and it is the engineer, not the conductor, who is master.—*Boston Commercial Bulletin.*

Patent Office Affairs.

WASHINGTON, Dec. 31, 1883.

That Congress not only made no increase in the clerical force of the Patent Office last year, but actually reduced their number by twenty, is being prominently brought to the attention of Congressmen. It is undeniably a strong argument for ample force in the Patent Office that there is now a surplus of $2,500,000 in the National Treasury belonging to the Patent Department. A system of lessening the cost of patents by a graduated scale of fees has been proposed, but excessive cost is not so often complained of as the sometimes inevitable delays, many of which might be avoided by a more generous use of the money of patentees in paying for help in the Patent Office.

The Commissioner of Patents is required by law to make a report to Congress at the close of each calendar year, and I have made some inquiries as to the statistics it will embrace. There has been an increase in nearly every branch of the office over last year, and the receipts for moneys paid in during 1883 over 1882 is, in round numbers, $135,000. This, however, does not equal the increase of 1882 over 1881, which was $155,556.66. The increase in correspondence has been about ten per cent, and in applications of every kind nearly twenty per cent. The number of patents forfeited during the year is about 2,000. These figures are not exact, for in none of the divisions have any steps been taken toward furnishing the data for the Commissioner's report, which must be presented to Congress within the next month, but they are sufficiently close to show that the patent business throughout the country is not retrograding; it is rather constantly increasing in importance and demanding more rigid attention of the lawmakers and those who administer the laws.

The Civil Service Committee has completed its rules for the examination of applicants for positions in the Patent Office, and they will be published on Thursday of this week. For the position of assistant examiner the applicant will be required to show a knowledge of arithmetic, of algebra to equations of the second degree, of geometry and trigonometry, of chemistry and physics. For draughtsmen, drawing from mechanical models and explanations of certain rules for mechanical drawing will be required. For the position of assistant librarian, which is now vacant, a knowledge of French and German, and the ability to properly translate those languages into idiomatic English, is required, as well as explanations of methods of cataloguing, and the proper arrangement of books by classification of subjects. This knowledge of German is also made desirable in those seeking positions as assistant examiners.

The controversy respecting the electric railway is now fairly inaugurated in the Patent Office. The proceedings have been somewhat delayed by the taking of testimony abroad under a commission in support of the claims of the celebrated German scientist, Dr. Werner Siemens, of Berlin. Counsel were heard in argument upon the merits of the case last week, before the Examiner of Interferences. The point is to construct a commercially practicable railway, which can compete with the existing modes of transportation.

A small section of road was built and operated by Siemens, at the exposition at Berlin, in 1879, and there are now several short lines in operation in various parts of Europe, and notably one at the Giant's Causeway, in Ireland, familiar to travelers. Edison has a line two miles and a half long, at Menlo Park, N. J., fully equipped and in daily operation, for the benefit of visitors and pilgrims to the shrine. There is also an experimental road at Saratoga Springs, and another claimant is Stephen D. Field, of New York, a nephew of Cyrus W. Field.

The Commissioner, on Friday, gave a decision in a case which has been long pending, the application having been filed January 6, 1883, wherein it was claimed that John T. Berchers had discovered a method to effectually and fully preserve fish in cans. His method he described as cutting the fish longitudinally and in thin slices, instead of transversely and in thick lumps or chunks. Both the examiner who had the case in the first instance and the Board of Examiners-in-Chief decided that there was nothing patentable in the application, and the Commissioner, after fully setting forth the facts in the application, sustains the opinion of the examiners.

The new classification of subjects of invention, which is the official guide of the office in the distribution of applications for official action, when ready, will be published as a supplement to the *Gazette.*

The House Committee on Patents, as announced by Speaker Carlisle, is as follows: R. B. Vance, N. C.; O. R. Singleton, Miss.; C. S. Mitchell, Conn.; J. E. Haskell, Ky.; George W. Dargan, S. C.; J. Winans, Wis.; W. P. Hepburn, Iowa; H. L. Morey, Ohio; L. E. Alkin, Pa.; and W. W Rice, Mass. This is considered a good committee, some of the members having had experience in the committee heretofore.

The Senate Patent Committee is as follows: Orville H. Platt, Mass., chairman; George F. Hoar, Mass.; John I. Mitchell, Penn.; Elbridge G. Lapham, N. Y.; Richard Coke, Texas; Wilkinson Call, Florida; and J. N. Camden, W. Va.

Already a number of applications for extension of patents, which can only be done by Act of Congress, have been filed and they will all be carefully considered before action.

FRANKLIN.

Nature of Electricity.

Prof. Thompson has shown how a series of floating magnet poles of like name, repelling one another, tend to produce equal distribution of the poles. Prof. Thompson, arguing from the second law of electrostatics (inverse squares), sought to explain the first law in a rational manner, on the hypothesis of self-repelling molecules, which tend to uniform distribution. When there is a surplus in one part and a deficit in another, the molecules are urged toward each other, *i. e.*, attract. This was shown by putting a surplus of floating magnets at one part of the basin. By the movements of these magnets, when confined in barriers and with surplus and deficit purposely made, the author imitated the effects of a Leyden jar, induction, a battery current, etc., the motions and arrangement of the poles illustrating the hypothetical behavior of electricity. The author was led by the hypothesis to infer that either the ether is electricity, or that the ether is electrified, and the former seemed the simpler conclusion.

GRINDING MILLS.

High grinding, low grinding, and gradual reduction, or a system which will more or less completely embody the elements of any two systems, have engaged the attention of millers to a remarkable degree for some years past. With the efforts made for the advancement of this industry there have come remarkable improvements in all kinds of grinding mills. The dressing of burr millstones and the attention given to their running have also directed inventors to the making of improved forms of other grinding mills, where various designs of grinding and cutting disks of metal have been introduced for a greater variety of work, and for its performance in a much better way than was formerly possible.

We herewith illustrate some points of mills now being

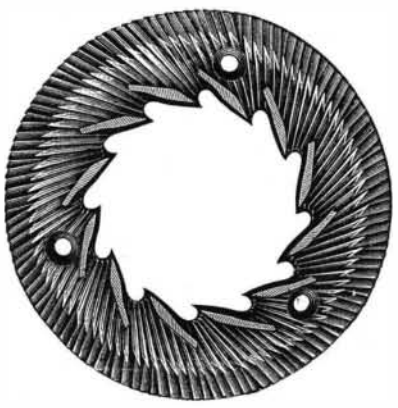


Fig. 1.

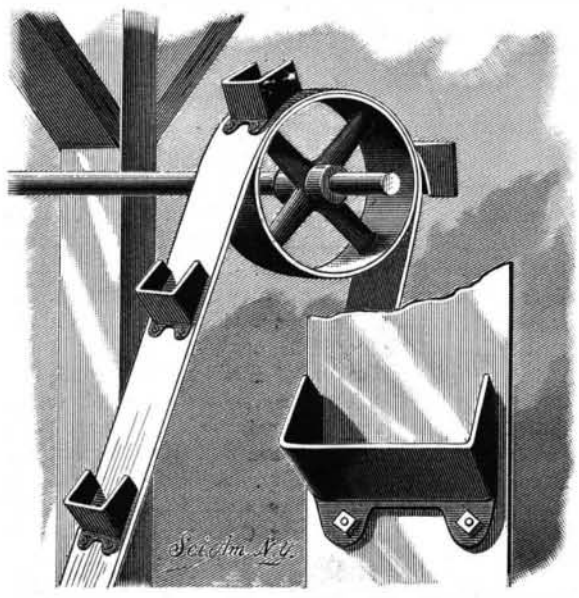
made, which are guaranteed to do a wide variety of work—to be fully equal to any pair of French burr millstones or any roller mill for the reduction of wheat to flour, either for the first breaks or regrinding the middlings and bran, also for fine corn to table meal, or corn and cobs to feed meal, as well as drugs, spices, and calcined bones to powder.

Fig. 1 represents the front side of the grinding disk, and Fig. 2 is an enlarged view of the same. The first reduction is produced in the bosomed part of the disk, where the furrows run sharp cutting edge front, to cut the grain fine with the least power possible. The second reduction is upon the flat outer circle of furrows running their inclined sides front, to mash and mellow the meal already cut fine. The saw toothed inner edge of the disks forms a natural crusher, to reduce pieces sheared from the cob, so they will pass through the mill by the aid of the conveyer flights arranged around the eye of the disks. These conveyer flights are arranged to act like a fan to draw cool air and grain into the mill at a low speed. The grain, first cut fine, is then rolled, mashed, and mellowed so perfectly that it enlarges in bulk. The grinding disks are cheaply renewed and easily interchangeable. A spring extending from the bridge tree down to the base gives sufficient elasticity to allow of nails and spikes passing through the mill without injury, while not crowding during the grinding.

These mills are made in several varieties, adapted for either animal power or steam or water power, the "Scientific grain mill" and "Quaker City grinding mill" especially having acquired an enviable degree of popularity. Their special construction is covered by several patents, and the makers, Messrs. A. W. Straub & Co., of 2,227 to 2,231 Wood Street, Philadelphia, endeavor to make them the best mills in the market.

ELEVATOR BUCKET.

The buckets shown in the accompanying engraving may be constructed of either wrought, malleable, or cast iron, or other suitable material. Each bucket is made with a back and sides but without any bottom, the belt on the outside of which the bucket is arranged serving that purpose. The outer edges of the sides are so shaped as to conform, or nearly so, to the circular travel of the belt around the drums.



HOLMES' ELEVATOR BUCKET.

The buckets are secured to the exterior of the belt by short bolts passing through flanges on the back, whereby they may be readily attached to or removed from the belt. By making them without an attached bottom and arranging them on the outside of the belt they will readily and quickly empty themselves as they pass over the upper drum of the belt, as the flexing of the belt will work the contents away from the open bottoms of the buckets, relieving the mass within and giving it a quick and free discharge. The construction effectually prevents the clogging or sticking of the mass to the interior. As the buckets have but three sides, the belt answering for the fourth, they can be more easily made than those having four sides. The elevator can also be arranged vertically or nearly so, and its buckets will empty freely, thus saving a large amount of space in mills having several stories. This form of bucket is cheap, simple, and durable.

This invention has been patented by Mr. Joseph A. Holmes, of Greenland, N. H.

Demagnetizing of Watches.

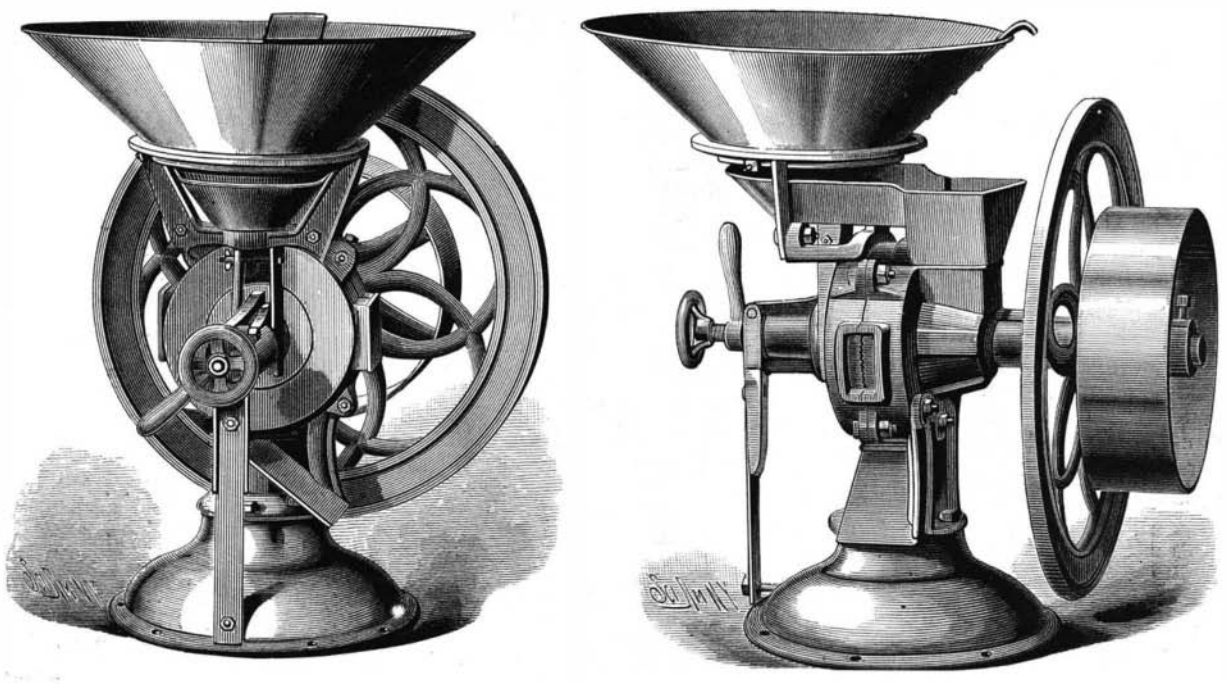
One of our contemporaries, in noticing the "queer freaks of watches" from having become magnetized by being brought too near dynamos or swift running belts, is led to refer to the Maxim machine for demagnetizing them as one whose "mechanism is a secret." Readers of the SCIENTIFIC AMERICAN will doubtless remember that we gave illustrations and description of this machine in August, 1881. The theory on which it works is that the different parts of the watch—the plates, arbors, mainspring, balance wheel, etc., all being magnetized, though with different degrees of strength, are brought within the influence of a powerful magnet, and then rapidly rotated, so that the watch is subjected to rapid reversals of polarity, while at the same time it is being steadily withdrawn from the field of influence of the magnet. The opposite poles, of course, destroy the magnetism of each other, and the recharging of each separate piece in the watch is prevented, or rather is successively weakened by the gradual withdrawal under the compound motion the machine gives the watch. An interesting paper explaining early experiments in this ine, with full illustrations, will be found in SUPPLEMENT Nos. 206 and 207. It was written by Prof. Alfred M. Mayer, of the Stevens Technological Institute.

Another Possible Cause of Boiler Explosions.

M. Vignes, in the *Journal la France*, draws attention to experiments made as long ago as 1846, by Professor Donny, of Ghent, and intended to show the influence which air exercises on the boiling point of water and on the character of its ebullition. In this experiment, ordinary water is placed in a clean glass tube, open at one end, and boiled long enough to drive away not only the air above the surface of the water, but all the air dissolved in the water. Then when the upper part of the tube is full of pure steam, the mouth is hermetically sealed and the tube is left to cool. When cool, it is about half full of water, above which is vapor of water at a very low pressure. The tube being thus prepared, its lower end is plunged into a bath of glycerine or oil, which is gradually heated. No ebullition is visible in the tube when the temperature reaches 234 degrees Fah. At 240 degrees Fah., however, the column of water bursts, as it were, in two, with a sudden explosion, and part of it is flung against the sealed end with such force as often to break it open. Now in industrial works, it often happens that a boiler, having been filled with water, works for three or four hours without receiving a further supply. It may then be cooled down, and the next time it is wanted it may very probably be fired up again without starting the feed pump, the water level being judged sufficiently high; but the water in such a boiler will be in the same condition as

Fig. 2.

that in the test tube; that is, it will be deprived of all air, and consist of water below and vapor above, the latter, however, being probably at a much higher pressure than that of the water in the tube. This water has no free surfaces in its interior due to the presence of bubbles of air, from which evaporation can take place. Consequently, as in the test tube, there will be delay in vaporizing—at least, until the expansion becomes great enough to overcome the pressure of the superincumbent vapor, and a sudden flashing into steam, which will be of the nature of an explosion, and may easily overcome the resistance of the boiler. The pressure thus attained may be very great. In the test tube, the pressure of the temperature of explosion—240 degrees Fah.—will be eighty-six times what may be taken as the pressure of the superincumbent vapor in the boiler, as already observed. That pressure will probably be much higher, and the pressure of the explosion will probably be much higher also. To avoid this source of danger, it will be sufficient, as M. Vignes points out, to make it a rule always to feed a boiler when it is fired up after standing. This will have the double effect of lowering the pressure and of facilitating evaporation, by distributing the mass of water in the boiler, and charging it to some extent with bubbles of air. Meanwhile, the facts he has adduced are certainly sufficient to warrant a belief that we have here a key to many cases of boiler explosions which have hitherto been wrapped in mystery, and it seems very desirable that careful and precise experiments should be undertaken to prove or disprove the production, on a large scale, of the phenomena thus shown to exist in laboratory experiments.



STRAUB & CO.'S GRINDING MILL.