Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year, postage included.....$3 20
One copy, six months, postage included..... 1 60

Club Rates.

Ten copies, one year, each $2 70, postage included.....$27 00
Over ten copies, same rate each, postage included..... 2 70

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VOLUME XXXIII., No. 12. [NEW SERIES.] *Thirtieth Year.*

NEW YORK, SATURDAY, SEPTEMBER 18, 1875.

Contents.

(Illustrated articles are marked with an asterisk.)

THE WOODBURY PATENT.

In our number for January 9, 1875, we gave an account of the strange proceedings before the Patent Office, conducted under the immediate auspices of the then Commissioner of Patents, Leggett, by which that officer granted a patent for an old device that had been in common use for about a generation. This is now known as the Woodbury planing machine patent: the particular claim allowed by Leggett being for a device to press down or hold the lumber while passing through the machine. The patent as granted by Leggett is so drawn as to render every form of planing machine or lumber-dressing machine an infringement of the patent; consequently, if the patent can be sustained, it will be a "Big Bonanza" for its owners; every person who builds a house, or puts up a picket fence, or walks upon a wooden floor, must pay tribute to this patent. A large amount of money was spent in obtaining the patent; and as soon as it was granted, a still larger sum was subscribed, and a joint stock company was organized to endeavor to sustain it. Leading lawyers were retained, and intimations circulated expressive of the determination of the company to exhaust every possible resource which money could command to enforce the patent. Users of planing machines were given to understand that their interests would lie in supporting, not in opposing the patent. By quietly submitting, they were promised the enjoyment of licenses under the patent for a small sum; but in case of opposition, they were liable to loss both of business and property. Some of the users succumbed to this pressure, and took licenses. But the great mass of lumber dealers resisted, and joined in a united effort to test the validity of the patent, in a legal manner, before the courts, forming, for this purpose, a National Committee of Defense. It is now alleged that certain members of the executive committee of this association have turned traitors, have accepted bribes from the Woodbury Company, and are now working, not to defeat, but to uphold the patent.

The following letter, published in the *Northwestern Lumberman*, gives a *resumé* of the situation:

THE CASE OF WOODBURY VERSUS THE PLANING-MILL MEN.

BOSTON, July 26, 1875.

This case, one of the greatest in the whole annals of patent litigation, is still undecided, and, as the months roll on, even gains in interest.

In 1874, Joseph Page Woodbury invented, or claimed to have done so, a flexible pressure bar as an attachment to planing machines, to supersede the heretofore commonly used roller. The advantages claimed for it were that, owing to the close proximity in which it could be placed to the rotary cutter, it prevented any tendency in the board to split or crack, and, from its ready and varied adjustment, admitted of the speedy insertion of any thickness of board or plank.

On April 29, 1873, some twenty-five or more years after his invention, Mr Woodbury secured a patent in which he claims for his invention four points embodying the principles set forth above. Since the time of securing this patent the Woodbury Patent Planing Machine Company (Mr. Woodbury himself died some months since) have demanded from all users of the aforesaid pressure bars the following royalty:

"The company has determined to charge a preliminary fee of $10 on each machine using said invention, and that all planing, tongueing, and grooving machines, and all molding machines, which cost $300 and upwards, using said invention, shall be considered first class machines, and to pay a royalty of $200 per annum, payable quarterly; and if said quarterly license fees are paid within the first fifteen days from and after the first day of January, April, July, and October, respectively, a discount of twenty per cent shall be made. All other planing machines and molding machines to be considered second class machines, and to pay a royalty of $100 per annum, payable quarterly, subject to the same terms of discount as the machines of the first class; and the company has determined to grant no licenses until the damages and royalty from the date of patent, April 29, 1873, to March 2, 1874, have been fully settled and paid."—*Extract from pamphlet of Woodbury Patent Planing Machine Company.*

"So much for Buckingham!" Immediately on the issue of the Woodbury demands, the leading lumbermen, who were users of these pressure bars, and which they had been using unquestioned for the past twenty-five years (and they claim that similar bars had been in use before the invention of said Woodbury), formed themselves into a National Executive Committee of Defense, with W. N. Greene, of Bronsons, Weston & Greene, Burlington, Vt., as chairman, N. M. Jewett, of Jewett & Pitcher, Boston, Mass., as treasurer, and W. W. Crapo, of Crapo & Co., Flint, Mich., these being the general officers. This association, to defend the manufacturers and users of planing machines against the claims to royalty demanded by the Woodbury Company, soon grew to vast proportions, and now includes the leading lumber and planing mill men in all the principal lumber cities of the Union, numbering in all some six hundred and fifty firms. Then the Woodbury Company endeavored to compromise with the executive committee, hoping thereby to get injunctions against all other users of planing and molding machines, as they would not be strong enough to make a defence; whereat the manufacturers of planing and molding machines, foreseeing the danger and loss to their customers, pledged themselves to support the association, and urged its continuance in the courts. All of which Mr. H. B. Smith, of Smithville, N. J., treasurer of the Manufacturers' Defense Association, most concisely sets forth and ably advocates in his journal, *The New Jersey Mechanic*, of July 1, 1855.

The association have secured for their counsel the Hon. Caleb Cushing, Hon. Wm. M. Evarts, Hon. E. Pierrepont, Hon. B. K. Curtis, and John T. Drew, Esq. The Woodbury Company have Benj. F. Butler, with some others of note.

The association have published pamphlets and papers pithily presenting their position in the case, one of the most witty and concise of which is quoted: "If a man can file a claim to an invention in 1848, have it rejected in 1849, and withdraw his fee and papers in 1852, and then obtain a patent in 1873 under one clause of a law, while he violates another clause, and enlarges his claims and increases his combinations, we certainly think Noah might, through some descendant, get a patent on steamships on a claim of having been the inventor of the ark."

So the case now stands, having developed itself into a very pretty controversy, in which we must confess our sympathies are wholly with the manufacturers and users of planing machines. "But with the strong rests the victory."

One of the later developments of the case here is the withdrawal of two of the prominent lumber firms from the association, to form a combination with Almy and some other inventor of a bar similar to Woodbury's, they to work in unison against the association of which they were former members, in consideration, it is reported, of receiving a liberal share of the stock. W. F. S

It appears, further, that the Attorney General of the United States has issued an order for *scire facias* proceedings against the Woodbury Patent Planing Machine Company on account of fraud in its procurement. It is suspended until October 15, 1875, to enable the Woodbury Company to file rebutting evidence.

The Woodbury Company has brought suit against several parties using machines. The first case is that of Hancock & Greeley, Cambridgeport, Mass., the trial of which is likely to come on in the course of a year.

SHALL WE EAT THE HORSE?

We have spoken from time to time of the progress of hippophagy in Paris, regarding the same as an experiment which there was no particular need of putting into practice here. It may nevertheless be demonstrated that, in not utilizing horse flesh as food, we are throwing away a valuable and palatable meat, of which there is sufficient quantity largely to augment our existing aggregate food supply. Supposing that the horse came into use here as food, it can be easily shown that the absolute wealth in the country would thereby be materially increased. In France the average price for horse meat, as compared with similar cuts from the steer, is about two fifths less. A horse is there sold to the slaughterer for from $10 to $15.

Estimating from this that $10 is the gross value of every horse in the United States, over and above his worth for working purposes, it remains to be seen how much of that sum may be set apart as to be derived from his utilization for food alone. As will be seen further on, the French butchers derive a revenue from hide, hoofs, hair, etc., and, as is well known, the same portions of the animal find industrial uses here. Placing the value of these parts of the carcass at $7, we find that $3 is the net value of each horse for alimentary purposes. In round numbers there are about ten million horses in the country. According to the above showing, we must add three dollars to the value of each horse, since, in addition to his value as a worker or as a raw material for manufacturing, he now has a new one as food. Consequently the aggregate value of all the horses is increased by $30,000,600. But this accretion to the wealth in the country is of course not convertible into actual money, for, so long as the working value exists, the food value as well as the manufacturing value are practically at zero; neither could be realized without great loss, and hence both are negatived. But there is a certain easily ascertained annual proportion of the horses of which the working value becomes less than the sum of their food and manufacturing values, and this proportion includes the class of which the working value is more than their manufacturing value, but less than the above sum. We may estimate roughly that one tenth of all the horses reach this condition yearly. Then, on this million animals, the food value is directly realizable, and therefore the wealth of the country may be considered as actually increased by the $30,000,000 derivable therefrom.

Moreover, in order that the horses should be available to the butcher, they must not be diseased or worn out. By this the owners are directly benefited, since, while on one hand they are obliged to sell their horses in fair condition, they are saved the expense of keeping the animals when the latter become used up and are unable to do but light work, though requiring more attention and more feed. So also with colts, which, whether they become good or bad horses, cost about the same to raise. If the animal bids fair to turn out poorly, he can be disposed of at once and at a remunerative price. The result of this weeding out in youth and destroying when old, coupled with the facilities which the former affords of selection of the best types, will naturally conduce to the improvement of breeds and a general benefit to the entire equine population of the country.

We can adduce no more striking example of the art of utilization than the mode in which the French deal with their superannuated chargers. On the 1st of January last, France contained fifty horse abattoirs, and during last year consumed 2,850.144 lbs. of horse, mule, and ass meat. The flesh of each horse weighs about 350 lbs. The skin is sold to the tanner for $2.50. The hair of the mane and tail fetches three cents. The hoofs are bought by comb, or toy, or sal ammoniac, or Prussian blue, makers. The tendons are taken to glue factories. There are about ninety pounds of bone, worth sixty cents. The intestines, for purposes of manure, or as food for dogs, cats, and pigs, bring five cents. The blood is purchased principally by the sugar refiners, but also by fatteners of poultry and fertilizer manufacturers. Twenty pounds of dried blood, which is the average, are worth forty-five cents. The fat goes to the soap kettle, or is transformed into genuine "bear's grease," which, delicately perfumed and elegantly put up, fetches some exorbitant prices in the apothecary stores of the United States; or else it is used as harness grease or as lamp oil. The yield is from twelve to eight pounds, at a value of ten cents a pound. Finally, it is said that even the waste flesh is allowed to decompose, and the maggots gathered as pheasant food, but this seems rather apocryphal. These utilizations are of course entirely outside the food supply.

MR. DAWSON'S IDEA OF EVOLUTION.

According to the reporters, the mantle of Agassiz has fallen upon Principal Dawson of Montreal: Agassiz dead, Dawson remains the great American opponent of Darwinism. The honor may be thrust upon him unsought; nevertheless it is not wholly undeserved. At least, in his zealous opposition to the drift of the scientific thought of the day, he has no American rival—that is, in the scientific field.

We do not think the less of him for that. Next to the man who suggests a new and better way of interpreting the facts and phenomena of Nature, the most useful man is he who most intelligently opposes it. It is through such opposition that errors are weeded out, and exact truth ultimately prevails. Occasionally the victory of a good theory, like the undulatory theory of light, may be delayed, and a bad theory kept in power by too strong an opposition: but the damage done thereby is more than offset by the good effected through the criticisms which innovating theories meet at the hands of those who stand by the old. It is for this reason that we rate the opposition of a man like Agassiz next in usefulness to the constructive work of men like Spencer and Darwin. When such opposition fails to shake a new theory, we may rest assured that it is not based upon a delusion.

But the opposition must be genuine to be useful. It must not call something else by the name, and expect the crown of victory for demolishing the substitute. That is a trick of theologians, rarely resorted to by men of Science; but, we fear, it is precisely what Principal Dawson has, consciously or unconsciously, been indulging in. We may be wrong, but to our mind his faculty for misapprehending the position and arguments of intelligent evolutionists is something marvelous in a man of his acknowledged scientific ability. In Dr. McCosh it would not be so surprising.

We refer to his address at Detroit, in which he reviews at great length the geological record of life's origin, and insists that the facts are overwhelmingly against the theory of specific evolution through natural causes. What he understands by evolution is nowhere distinctly affirmed, though it is clearly indicated in numerous passages. That it is very different from the understanding of the living disciples of evolution is plain enough from assertions like the following:

Discussing the insufficiency of evolutionary hypotheses, he says: "We have all no doubt read those ingenious, not to say amusing, speculations in which some entomologists and botanists have indulged with reference to the mutual relations of flowers and haustellate insects. Geologically, the facts oblige us to begin with cryptogamous plants and mandibulate insects; and out of the desire of insects for non-existent honey and the adaptations of plants to the requirements of non-existent suctorial apparatus, we have to evolve the marvelous complexity of floral form and coloring, and the exquisitely delicate apparatus of the mouths of haustellate insects."

Believing Dr. Dawson to be an honest man, the only inference we can draw from a sentence like the last is that he utterly misapprehends the views of modern evolutionists. Certainly nothing in the writings of Wallace, or Darwin, or Lubbock, or Gray can be found to sustain such an ultra Lamarckian method of development. To be guilty of such a mis-statement of the position of another is to forfeit one's claim to any respect as a scientific critic. Even Agassiz' mantle will fail to cover errors so gross and obtrusive.

THE NEW DEPARTMENT OF AESTHETICS.

Professors of the humanities have ever been inclined to look down upon the pursuits of naturalists as little becoming the refinement and dignity of gentlemen and scholars. They have delighted to picture such as turn their attention to the inferior world as eccentric fellows, chiefly employed, like the unfortunate spouse of Lady Jane in the "Ingoldsby Legends," in bug-chasing and poking into all sorts of dirty places for the ugly things that squirm in filth and darkness, solving the infinite (unlike the Breitmann) as one eternal—evolution!

We fancy that the cultivators of polite literature will therefore be taken somewhat aghast by the address of the retiring President of the American Science Association, especially by that part in which he serenely asserts that the chief requirement of the modern naturalist is an inborn and highly developed æsthetic faculty.

In the physical sciences everything depends on accurate observation, with strict logical consequences derived therefrom. In biology, on the contrary, while the basis of knowledge equally depends on accurate and trained observation, the logic is not formal but perceptive. Consequently the first requisite for excellence in this crown of the sciences is æsthetic perception.

Savages are usually keen observers, but they would not make good biologists: they lack artistic tact. The native Australians furnish an illustration. In them the absence of this faculty is complete. Oldfield relates that when one of them was shown his own portrait he called it a ship, another said it was a kangaroo, not one in a dozen identifying a portrait as having any connection with himself. Professor Le Conte gives a higher illustration of the same incapacity in a well known class of travelers. Having penetrated to the inmost chamber of the temple of Art, even the Hall of the Tribune at Florence, they stand in the presence of the most perfect works of art, and gaze upon them with the same indifference that they would show to the conceptions of the mediocre artists exhibited in our shops. Perhaps they even wonder what one can find to admire in the unrivaled collection there assembled. They may be highly educated, and good and useful members of the social organism; but they lack the æsthetic sense which enables one to enter into spiritual harmony with the great artists whose creations are before them.

Such unæsthetic and unappreciative persons would not delight a Ruskin, as students of Art; nor would a professor of rhetoric be hopeful of making poets of them. Professor Le Conte maintains that they would make no better students of biology. The æsthetic character of natural history makes it for ever beyond them, just as it prevents the results of its cultivation from being worked out with logical precision.

This view of the fundamental difference between biological and physical science claims accord with the views of such masters of biology as Helmholtz and Huxley. To the genius of the artistic interpreter more than the patience of the collector its future progress will be due. A rising giant has invaded the domain of polite literature, and the humanities must make room!

LIGHTNING RODS.

We published, in our last number, a very interesting communication from Mr. George B. Prescott, the electrician of the Western Union Telegraph Company, concerning an alleged electrical phenomenon, observed during a thunderstorm, within a private dwelling, and described by a correspondent in our paper of August 14, 1875.

The phenomenon in question consisted of electrical discharges from the water and gas pipes of the dwelling, which was furnished with a lightning rod. The question was as to the cause of the electrical manifestation. Mr. Prescott believed that it was due to the defective connection of the lightning rod with the earth; but in order to satisfy himself fully in the matter, he took the trouble to send an assistant to the locality, and subject the premises, pipes, and rod to actual electrical tests with the galvanometer.

The result was that the lightning rod was found to be so sadly defective in its ground connection that it could not conduct the electricity into the earth, except feebly; and whenever a thunderstorm occurred, the house became charged with electricity, and the current, being unable to pass down the rod, made its way through the building to the water pipe, and escaped through it into the ground. The details given by Mr. Prescott are quite interesting. He advised the immediate connection of the rod with the water pipe, which would thus to serve as an extensive conducting terminal for the rod, ensure the safety of the building, and put an end to the electrical manifestations among the pipes before mentioned.

This case is a representative one, as the rod was put up in the same defective manner as are the majority of rods, that is, the bottom of the rod was simply stuck down a few feet into the ground or rock, and thus practically insulated.

We have repeatedly advised our readers that a lightning rod, in order to serve as a protection for a building, must have a large conducting terminal in the earth. This terminal may consist of an iron water pipe, as in the present case, or a very considerable extension of the rod itself into wet or damp earth; or a trench, filled with iron ore or charcoal, may be made available.

The aggregate annual losses of life and property in this country, by the striking of buildings by lightning, is immense, but might be almost wholly prevented if properly arranged conductors were generally employed. But it is evident that a more intelligent class of lightning rod men are needed in their erection; and it is probable that electrical instruction must also be given in our common schools before much improvement can be expected.

If a man, employed to put up a tin pipe to conduct the rain water from the roof to the cistern, were to solder up the bottom of the pipe, thus preventing any flow, his work would be rejected, and he would be stigmatized as a fool. But this is substantially what our lightning rod men are doing every day. They put up rods for the alleged purpose of conducting the electric fluid, but seal or insulate the bottoms of the rods so that the fluid cannot flow into the ground; and the majority of employers are so ignorant of the subject that they are unable to detect the fraud.

The known laws that govern the flow of electricity are almost as simple as those relating to water. If a proper connection exists between the rod and the earth, the building will be protected, for electricity will flow through the rod with the same certainty that water will pass through an open leader from roof to ground. But if the bottom of the pipe be sealed, the water cannot run; and if the bottom of a lightning rod be sealed or insulated, the electricity cannot flow.

Tests of lightning rods with the galvanometer, as directed by Mr. Prescott, will always show whether they are safe or not. But it may be taken for granted, without a test, that a rod is unsafe which merely has its bottom stuck down a few feet into dry earth. We repeat, the golden rule for safety is to have the bottom of the rod placed in connection with a large mass of conducting material in the ground.

ANOTHER VIEW OF MR. CROOKES' LAST DISCOVERY.

In a recent issue we gave a summary of Mr. Crookes' recent observations on the behavior of delicately suspended pith balls when acted on by a beam of light. In a vacuum the pith balls, and disks of cork similarly suspended, seemed to be repulsed by the light under conditions which demonstrated, Mr. Crookes asserts, a hitherto unrecognized power of light.

Similar observations with substantially the same apparatus were made fifty years ago, so that the discovery is not new if true; it simply reasserts what was generally believed when the Newtonian theory of light prevailed, namely, that luminous radiations are capable of exerting a direct push upon matter. It is strikingly inconsistent, however, with the now dominant theory of light; and according to some careful observers, it is equally inconsistent with fact. Professor Osborne Reynolds suggests that the action of the pith balls or disks is due to the evaporation of some fluid on the surface of the disks, the recoil of the evaporating particles, as they leave the disk, driving it back.

A better explanation, because better sustained by experimental evidence, is that given by Professor Dewar, of Edinburgh, who claims that the heating of the disks is the efficient cause of the action observed. In his investigation Professor Dewar used substantially the same apparatus that Mr. Crookes employed, simply changing the composition of the disks and interposing certain substances having well known effects upon the radiations.

Placing a candle before the apparatus so as to cause a large deflection, he first interposed a vessel of ordinary glass, and the deflection was diminished. On filling the vessel with water, the disks ceased to be deflected. Now it is well known that water, though transparent to light, is almost opaque to heat.

The experiment was then reversed. A smoked piece of rock salt was interposed, shutting off the light but allowing the heat to pass through. The disk remained deflected: so likewise when a solution of iodine in carbon bisulphide was used, a substance opaque to light but transparent to heat. These experiments show that it is not the luminous radiations which have power to move the pith balls, but the obscure radiations commonly known as heat rays.

The next question was: How do the heat rays produce the motion? To test this, disks of rock salt (transparent to heat) and glass (transparent to light) were substituted for those of pith or cork. When a beam of light was thrown upon the clear salt no motion ensued, the radiations passing through unabsorbed. When the light was received on the glass, part was arrested, the glass was heated, and the disk was deflected. The effect was reversed when the back of the rock salt disk was coated with lampblack. The radiations were absorbed by the lampblack at the surface of contact; the lampblack was heated and, by conduction, heated the salt, and the result was (at first) repulsion. Were the lampblack a good conductor, it would heat through first, and then there would be repulsion from that side, or apparent attraction. This in a vacuum: at ordinary pressure the motion is always forward from the side of the disk most heated.

Other experiments were made with disks of sulphur, clear and ordinary; and with transparent disks coated on one side with white phosphorus, which is opaque to the ultra-violet rays. In the latter case, when the disks were acted on by light, chemical action ensued with disengagement of heat, resulting in a motion of the disks away from the side heated. The reverse was demonstrated by bringing ether near a disk; and doubtless the same effect would have been produced by a piece of ice. The chilling substances caused a radiation of heat from the side of the disk toward it; the distant side became the heated one, and apparent attraction was the result.

Professor Dewar's explanation of these phenomena is simple, and does not involve any new or inexplicable power in radiations. The apparent attraction of the disks by light under ordinary pressure is caused, he says, by convection currents. The air or gas in front of the disk is heated, and, rising, tends to cause a vacuum; the disk consequently advances, pushed forward by the power that drove the ship of the "Ancient Mariner":

> "The air is cut away before
> And closes from behind!"

In a vacuum the effect is different: the disk is repulsed instead of attracted—repulsed by the recoil of the residual molecules of the gas, which leave the heated side of the disk at an increased velocity after impinging upon it in the course of their travels.

"What takes place is this: The particles of the gas are flying about in all directions, with a velocity which depends on the temperature. When they impinge on the heated disk, they go off with a greater velocity than those which go off from the colder side, and hence there is a recoil of the disk. When the gas is at all dense the particles get a very short way before they are met by another and sent back, and so the velocity gets to be a common velocity before any visible action takes place. When the gas is rare, the particles may get a long way off before they meet others, and so the action becomes perceptible."

The vacua employed by Professor Dewar were formed by the charcoal method, the density of residual gas being reduced to one four-millionth of its density at ordinary pressure. In such a vacuum, the average path between two collisions is about 1 foot against an average of one four millionth of a foot at ordinary pressure. It will be seen, therefore, that the particles may have relatively a very long way to travel after leaving a disk.

For the benefit of those who have dreamed of securing a profitable direct motive power derived from solar radiations, it may be added that the total work done by the radiations in these experiments did not amount to the five-millionth part of the available energy received by the movable surfaces.

EXPLOSIONS IN GUNPOWDER MILLS BY ELECTRICITY.

A correspondent remarked, some time since, that the mysterious explosions of some powder mills may probably be due to an electric spark given off by persons dressed in woolen clothing, who, when the air is dry, may (by friction of their clothing or feet) produce from their finger ends a spark of electricity sufficient to ignite a gas jet. He submitted the question whether it would not be possible that men at work in powder mills may create so much electricity in their bodies that, when their hands come in contact with metallic conductors, it may be, if not sufficient to ignite powder, enough to ignite some inflammable gas generated from the chemicals.

This letter has drawn the attention of the London *Chemical Review*, which states that in England they have often seen in American journals the statement that an electric spark, sufficient to ignite gas, may be given off by the human hand; but the editor says that he never heard of such cases on his side of the water. We know that the air in England and all the countries of Western Europe is very damp, owing to the prevailing west winds and the absence of extensive areas of dry land, blowing over which the wind would become very dry, as are our west winds, coming over our prairies.

It is asked what inflammable gas may be generated in the manufacture of gunpowder? To this, it may be answered that, in the manufacture of fulminates for percussion caps, inflammable vapors, as nitrous ether, etc., are given off, while the dust of gunpowder and even of charcoal, when floating in the air in a proper quantity, may form an explosive mixture. Even the dust from the mineral grahamite, which in its character is very similar to gunpowder charcoal, has repeatedly exploded in the mines in Western Virginia, when mixed with air in the right quantity. It is well known among electricians that a weak electric spark will more easily explode gunpowder than a strong, intense spark; the latter will scatter a heap of gunpowder without igniting it, but, when the spark is weakened by substituting for a part of the conducting metal a less conducting material, such as water or a moistened thread, then ignition will readily take place.

We acknowledge that we have no positive evidence that powder mills have actually been exploded by electricity; but the possibility of such a cause was only suggested in our paper, and it must be admitted that this suggestion is not unworthy of serious attention.

Resignation of Commissioner of Patents.

The daily papers announce the resignation of Mr. J. M. Thacher, the present Commissioner of Patents, to take effect October 1. His successor has not yet been announced by the President, but the name of R. H. Duell, of Courtlandt county, N. Y., is mentioned as the probable appointee. Mr. Duell is reputed to be a lawyer of considerable ability as well as a first class politician. He was formerly a member of Congress.

NEW RUSSIAN GUN.—A great cannon, lately built at the works at Oboukowsky, has cost $65,000, and weighs 40 tons. It is a breech loader, entirely in crucible steel, 20 feet 6 inches long; its largest ring is 57½ inches in diameter, and the tube has thirty-six grooves.