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## Contents:

(Illustrated articles are marked with an asterisk.)



## TOO MUCH GAS; NOT ENOUGH LIGHT.

The various companies who furnish illuminating gas to the citizens of New York appear to think that it is gas that we want, and not light. We have plenty of the former, at any rate we pay for enough, but somehow, in cold weather, the light becomes "small by degrees and beautifully less." If there ever was an absurdity, it is paying for gas by the cubic foot instead of by the volume of light it affords. What we want is light, and that is the article we ought to pay for, and the only correct measure is the photometer, not the gas meter. In every other country but this, there is an inspector appointed whose duty it is to report upon the candle power of the gas furnished by the companies; and, if it is found to be below the prescribed standard, the delinquent company is compelled to pay a heavy fine. In London, the gas inspector is a thoroughly competent man, appointed by the Government, and beyond the reach of the companies. He takes hold of the work fearlessly, and the consequence is that in that city the candle power of the gas is very much higher than with us. Some of the London companies take pride in keeping their gas up to fifteen candles, which is the maximum required of them. It is possible to make a gas of twenty-one candle power, but we could not consume it in an ordinary burner or under the usual pressure; it would be apt to smoke. The more dilute the gas is, the more readily it will pass through any given aperture; hence a gas of a very low specific gravity will rapidly run up a high score on the meter without affording any compensation in the amount of light.

If gas is to be sold by the cubic foot, then the company may pump in a quantity of atmospheric air, or let it consist of fifty per cent hydrogen, or make it of a low grade on purpose. As long as they contract to furnish gas and not light, they are at liberty to speculate as much as they please; the lapse is largely our own for not agreeing with them to give us light, and not gas.

Now that there is every prospect of a reform in many things, we propose that this question be also submitted for discussion. All we want is to have a gas of a fixed and known candle power, to have an inspector appointed to control the manufacture, and heavy penalties attached for any breach of the law; precisely as it is in London, where the whole business has long since been reduced to a system, and frauds have rarely been detected. There are certain circumstances under which the companies ought to have some indulgence shown them, for example: sudden changes in the temperature cannot be anticipated, and they affect the illuminating power of the gas in a very marked ratio.

It has been found that the amount of light emitted at 32° Fahr., is 25 per cent less than at 65° Fahr., and at 4° above zero, it is 70 per cent. less than at 65° Fahr. On the other hand, increased heat is not accompanied by a corresponding amount of light, since the temperature of boiling water causes an increase of 4 per cent over the standard, and that of 320°, only 18 per cent. The loss of illuminating power is due to the condensation of hydrocarbons, which are gaseous at ordinary temperatures, but become solid in the cold. When the companies anticipate a cold snap, they manufacture a richer gas, which will bear this condensation without too great a loss in illuminating power.

The gas companies always have competent chemists, either directly in their employ, or retained for consultation; and they know how to furnish light with gas, instead of gas without light, as soon as it is made their interest to do so. As the law now stands, there would appear to be no remedy but to quietly submit, or take it out in grumbling; in the meantime, it would be well to revive the excellent bill drawn up last winter under the auspices of the Board of Health, and put it on its passage as soon as the Legislature comes together. If that bill did not contain a proviso for the inspection of gas meters, it would be well to have it inserted, as the companies furnish their own meters, and the consumer cannot know that they give correct tally until he is so assured by the authorized inspector. It is a common observation at the present time, that persons who are compelled to work at night soon complain of weak eyes and defective vision.

Many students are disabled and obliged to abandon their studies, while others have substituted kerosene oil for gas. There is no doubt that poor gas has much influence in this increasing infirmity, and this fact affords another argument in favor of a change. According to the *American Gas Light Journal*, more than one hundred million cubic feet of gas are made every month in the city of New York. As the quality of coal used is manifestly very poor, the yield does not probably exceed six or seven thousand cubic feet; but even this inferior coal involves the distillation of about 17,000 tuns a month, or over 200,000 tuns a year. It is probable that, under proper legislation, the companies will be compelled to manufacture a gas practically worth one quarter more than they now furnish to consumers; and, as the annual amount paid to all of the gas companies in New York cannot vary very much from five million dollars, it follows that the community is at least one million dollars short in this transaction. It seems hardly credible that these figures can be correct, and yet they are based on the best information that we can obtain. They are so large that, even with a discount of fifty per cent, they show how imperative is the necessity for reform in a matter in which the whole population is interested. We repeat what we said in the outset, that we have too much gas and not enough light.

## PROGRESS OF THE UNDERGROUND RAILWAY SYSTEM.

While the people of New York city have been threatened with the complete disfiguration of their beautiful city by a viaduct railway of unparalleled costliness and repulsive appearance, the inhabitants of Paris are promised a most convenient mode of transit along the main thoroughfares, which will unite all the railway *termini* to one central depot, and also make two connections with the Belt Railway (*Chemin de Fer de Ceinture*). The tunnel or underground system will be adopted in the work.

There is no need to say much more in favor of this mode of construction. The subject has been exhausted in the public journals, as well as by the more convincing arguments of actual experiment on the largest scale, in London, Detroit, Chicago and other cities. The Metropolitan Railway of London affords the best illustration of what is wanted in New York, and points out the most ready and economical means for its achievement.

By making a tunnel along the public highways, the cost of the land and the more expensive item of compensation to occupants is reduced to a minimum. Add to these most important considerations, the fact that the traffic already lies in the very direction your subterranean road will take, and you need say little more to convince the public of the merits of the underground system. The large majority of the opponents of the tunnel railways will be found to consist of real estate speculators, jobbers, men with axes to grind to the detriment of the public grindstone, and the large class of local politicians whose interests lie in the total abnegation of economy and convenience. The proposed railway in Paris, as will be seen in an article on another page, will follow the course of the great thoroughfare of Paris, the Champs Elysées and the Rue de Rivoli. By it, not only will rapid transit from one end of the city to the other be obtainable, but a complete union of all the depots of the main railway lines of France will be accomplished.

There is now some hope for New Yorkers that the viaduct railway, the largest and most hideous job of the almost demolished Ring, will not be constructed. More millions of dollars than we can now reckon will be saved to the people if this imminent calamity can be averted. The Parisian company comes before the public with no other demand than the recognition of the merits of the project, and disdains to ask for pecuniary aid, either from the government, the department, or the city authorities. As all works of such vital social importance should, the Metropolitan Railway of Paris stands solely on its merits as a much needed convenience to the business world, and relies, for a dividend on its capital, on the patronage of the traveling public. And the precedent of London indicates that this is not a chimerical or visionary support to which to trust. The wants of all classes concerned are surely satisfied when a thousand trains a day run in each direction, when people are conveyed four miles in fifteen minutes, with convenient stoppages, for two cents a head, and an average dividend of six per cent is returned to the stock holders.

The citizens of New York have just broken the political power of one of the most powerful combinations against liberty and private rights that ever existed in the world. Surely the same people can throw off such burdens as the viaduct railway, with its monstrous bridges, its destruction of buildings, and its trains running in full view of the horses in the thoroughfares, and substitute a cheap, convenient, and accessible road, made for the use of the public, and trusting to its usefulness and efficiency for a profit to its proprietors.

## AN EXACT METHOD OF DETERMINING THE EVAPORATIVE EFFICIENCY OF STEAMBOILERS.

At the late Fair of the American Institute in this city, there were entered for competition the Allen, the Phlegel, the Low, and the Root steam boilers, and a smaller boiler of the Blanchard design.

The Committee of Judges on steam engines and boilers being very desirous of making a trustworthy test, the Board of Managers, with commendable liberality, authorized the considerable expenditure of Institute funds which the proposed method of trial necessitated, and the series of tests has, during the last week, been concluded.

The usual method of testing steam boilers has been simply to determine the quantity of water passing through the boiler and the amount of fuel consumed during a given time, and to state the ratio of these quantities as the evaporative efficiency of the boiler. It is, however, evident that, unless the steam leaves the boiler unmistakably superheated, there is no certainty that a part, and a large proportion, perhaps, of the water may not have been carried over unevaporated, and we know how frequently ignorant or dishonest steam boiler vendors have imposed, upon uninformed purchasers, stories of fourteen, fifteen, or even more pounds of water evaporated by the pound of fuel in their very economical (!) boilers.

With a view to ascertaining accurately the relative performance of the boilers offered for trial, and at the same time giving honest and intelligent builders a weapon with which to meet such competitors as are above referred to, the Committee of Judges, Messrs. Thurston, Sloan, and Weir, caused to be built a large surface condenser of about 1,100 square feet of condensing surface, and with meters attached to measure the amount of condensing water.

The steam was delivered into this condenser from the boiler, where the pressure was, as nearly as possible, seventy-five pounds per square inch.

The trial of each boiler was twelve hours long. Steam was raised with wood to a pressure of seventy-five pounds, when the exhibitor was allowed to use coal and the trial was formally begun. The feed was measured by a meter, the water of condensation was weighed on a carefully adjusted platform scale, and the temperatures of feed, steam, water of condensation, injection and discharge of condensing water, and of the temperature of flues were all carefully recorded by selected students of the Stevens Institute of Technology, under the direction of Professor Thurston, chairman of the committee.

The quantity of heat carried off by the condensing water being known, and the quantity of water of condensation, it becomes an easy matter to determine the quantity of heat transferred to the tank by each pound of the latter, and thus to determine precisely its condition, and if wet, the amount of water brought over unevaporated.

The publication of the report will be anticipated with great interest by engineers. It is only known that the results are quite creditable to the exhibitors, and indicate that persons claiming an economy much superior to about ten pounds evaporated from 212° Fahr. by the pound of combustible may be looked upon by purchasers with great suspicion.

## CONCRETE BUILDING.

The recent fire in Chicago has called forth a general discussion on the subject of fireproof building and building in general, and although we have said much at different times on the subject of concrete building, the present seems a favorable opportunity for calling our reader's attention again to this important subject.

Slowly but surely, in spite of many failures on the part of experimenters, is the truth becoming established that artificial stone can be made as durable as most natural stones. There have been many humbugs practiced, but these, though they have hindered progress, have not totally checked it. The artificial stones made by the Sorel, Frear, and Ransome processes, and those made with Portland cement, are all good, reliable stones. Of these, however, only the latter can be used *in situ* for concrete walls, and it is of the latter that we propose to speak more particularly in this article.

The erection of concrete buildings, or at least partially concrete buildings, promises, we think, a complete solution of the problem of cheap building for working men. Of all materials we know of, none compares with good Portland cement for this purpose. It has proved its value in extensive works in Europe, where, in addition to the usual effects of weather, it has had to endure the constant action of sea water. It hardens perfectly in a few hours, and forms with sand a concrete rivaling, in hardness and compactness, the best building stones in use. It can, by the addition of coloring matters, be given tints resembling brown sandstone or Nova Scotia stone, while it is far more durable than either. It is much cheaper than bricks and mortar, and can be easily molded in ornamental forms. It possesses far greater strength than ordinary brick work, and looks better when finished. It is as well adapted to inside as outside work, and may be wrought into floors and partitions. It is incombustible and as impervious to water as any stone in use.

With all these advantages, it is steadily making progress against prejudice, and we have not the slightest doubt that it is destined to a far greater popularity in the future than it enjoys at present.

This cement unites readily with sharp clear sand, gravel, broken bricks, pebbles, cinders, etc.; and hydraulic limes may, in some climates, be economically used in connection with it.

To erect buildings of this concrete requires only the skilled labor necessary to place properly the frames, in which the concrete is molded, and the frames of doors and windows. For warehouses, it admits of the use of iron for pillars and braces, while everything else, floors, partitions, ceilings, etc., may be of concrete. It is estimated by an expert of this city that 100 cubic feet of Portland cement concrete wall can be constructed for $22·75.

If plastering is used on interior walls, only one coat is required, so that this item of cost is considerably lessened.

For sidewalks this cement also furnishes a cheap and beautiful material, which can be formed in blocks on the spot, presenting a perfectly uniform surface, rivaled only by cut stone.

The rebuilding of Chicago furnishes an admirable field for the employment of concrete; and we trust that, as economy must be perforce consulted, our Western friends will be induced to turn their attention to the system, as it offers advantages possessed, as we believe, by no other.

## DR. DRAPER'S EXPERIMENTS WITH BRICK AND STONE.

We desire to call special attention to an article, published in our last, which is followed by a second, in our present issue, from the pen of Dr. John C. Draper, on the absorption of moisture by brick and stone. His experiments will show that bricks, properly compounded and burned, are really superior to many kinds of natural stone for building purposes.

A brick is an artificial stone, homogeneous and without cleavage. It may be made so as to absorb less moisture than many varieties of stone in popular use.

The experiments conducted by Dr. Draper were made with brown stone, Nova Scotia stone, fine red Philadelphia bricks, and a white, or rather cream colored, brick, made by A. Hall & Sons, of Perth Amboy, N. J. A specimen of the latter now lies on our table, and is undoubtedly one of the best building bricks ever produced in this country.

In color it is soft, yet brilliant, its tint being very agreeable to the eye. In texture it is dense and hard, ringing with a clear bell-like sound when struck, and chipping more like dense, hard stone than like the ordinary bricks in market. With granite or blue stone trimmings, these bricks would produce a beautiful architectural effect for fronts, in our opinion far superior to the somber appearance of the brown stone, now so much in vogue, and which is undoubtedly one of the least durable of building stones in use.

Even ordinary bricks will endure our climate better than brown stone, as will appear upon an examination of buildings constructed of bricks with brown stone fronts. In such buildings, that have been erected for a considerable time, it will be found that the fronts are the first parts to become dilapidated, the surface becoming disintegrated and peeling off.

Nova Scotia stone is, perhaps, not much better, in this respect, than brown stone.

The senior member of the firm of Hall & Sons has, perhaps, as extensive theoretical and practical knowledge of brickmaking as any one in the country, and this journal has been enriched by his contributions upon this important subject. The result of the application of this knowledge, and the use of a very excellent article of clay, has enabled his firm to produce the bricks alluded to.

In conclusion, we would say that any who have any doubt as to the superiority of brick over the brown stone and Nova Scotia stone, as building material, will do well to peruse Dr. Draper's articles with attention.

## THE STUDY OF SCIENCE IN SCHOOLS.

There is not an inventor or mechanic who does not suffer for want of a good elementary training in mathematics and the sciences; and yet, notwithstanding this notorious fact, it seems impossible to introduce such a reform in our school education as will successfully remedy the evil. The chief difficulty in the way of reform is in the supply of teachers. Our training schools have raised up teachers whose minds run in the same groove, and who have no mental switch by which they can turn off on to a new track. The custom of learning everything by rote, and reciting like a parrot, has become so embedded in our system of education, that it seems almost impossible to find any explosive sufficiently active to blow it up, and no jack screw or hydraulic ram is powerful enough to move our Boards of Education from their firm foundations. But as the continued dropping of water may wear away a stone, we propose to keep adding here a little and there a little, until some impression has been made and some good has been accomplished. It is probable that we must look to the West for our chief support in the war that it is proposed to wage against the relics of monastic education. They have a practical way of viewing things in that section of the country, and common sense is allowed to have due weight in questions of all kinds. We are, therefore, not at all astonished to learn that, at the University of Iowa, instead of teaching physics, chemistry, geology, and astronomy, by oral recitations and unillustrated lectures, they have established laboratories and workshops, where practical things can be practically learned, and theoretical ones can have all of the weight that properly belongs to them. The trustees of the Iowa State University have resolved that the only way in which instruction in science can become thorough is by placing the elements of physical science *at the very beginning of the course*. They do not propose to wait until the pupil, by droning over dry facts and abstract principles, has acquired a disgust for every branch of knowledge, but they think it wiser to pursue the natural method, and begin when the mind is anxiously inquiring into the cause of things, and the boy takes his watch apart to see what makes it go. The old-fashioned way was to give the boy a sound flogging, to take the watch away, and make him learn by rote the principle of compensating balance wheels.

"My dear boy," says the teacher, "the duration of an oscillation depends on the radius of the wheel, the mass of its rim, and the strength of the spring," which, of course, is very intelligible to the lad, and would enable him at once to construct a new watch.

Common sense would dictate the propriety of showing up the parts of the watch, and by degrees expounding the principles upon which the construction is based. Theory and practice is what we want, and not either of them alone. Technical instruction alone will not result in the advancement of science, but that, together with a thorough training in the phenomena of Nature, will lead to great progress.

For the purpose of aiding in the introduction of experimental science in our schools, Professor Gustavus Hinrichs, of Iowa, has published "The Elements of Physical Science," and "The School Laboratory of Physical Science," books which are intended to serve as guides to teachers and pupils.

The author says that, under his system, the result is "a marvel of studious industry." The students enjoy measuring, weighing, testing, demonstrating, and recording facts which, in former times, were pored over in a maze of bewilderment in the driest text books, to be afterwards bolted in sections without question. He proposes that the course shall be divided into three parts, rudiments, elements, and general principles—all of which should be completed in the high school course, and be conducted with facilities as good as have so long been afforded in other departments. By securing in this way a sound elementary training, two very important advantages are gained: First, if, as often happens, the boy is unable to pursue his studies beyond the high school, he will not be compelled to grope about in utter darkness in his subsequent career, but will be so far grounded in principle and practice as to be able to avoid the errors which now pervade society, and give aid and comfort to believers in perpetual motions and mysterious agencies. Second, the advantages, to those who have the means of pursuing their studies beyond the confines of the high school, will be very great. Having surmounted the elements of knowledge, they are in condition to prosecute their studies to a higher point than was hitherto possible, and the advantages to themselves and to society would be very great.

In the first part of his book, Professor Hinrichs takes the pupil through a course of simple and easy experiments relating to magnitude, weight, machines, properties of matter, light, electricity, and magnetism. The metrical system is taught by means of actual measurements performed by the scholars themselves, and the pupil constructs his own measures of weight and length, makes numerous determinations, and puts down results in his journal. There are blank pages at the end of the volume for independent observations and experiments.

This strikes us as the only sensible way in which to impart instruction in science, and after it has been practiced for one generation, the condition of society will be found to be vastly improved. The best interests of education demand that we should begin at the bottom of the ladder and not at the top. The top can take care of itself, but if the foundation be weak and rotten, the bottom and the top will topple down to a common ruin.

[Special Correspondence of the Scientific American.]

## A NUMBER OF EXTENSIONS.--TEDIOUS SEWING MACHINE CASE.

WASHINGTON, D. C., Nov. 18, 1871.

Among the extensions recently granted is the patent to J. W. White for a cotton seed planter. It consists of a frame with a seed wheel mounted within, a furrow opener attached to the forward part of the frame, and an adjustible seed coverer suspended from the rear. It is said to save fifty per cent in labor, and do much better work than hand labor. The civil war prevented the patentee from securing a suitable reward for his invention.

Also the patent of George S. Butterfield is extended. It is a grinding and polishing machine, designed especially to improve the manufacture of knives for planing machines, in which a perfectly plane and true surface is a great *desideratum*, the grinding by hand being very defective in this respect, as well as laborious. The result is secured by causing the article to be ground to reciprocate, vertically and horizontally, in a plan tangential to the face of the grinder. The mechanism for giving the vertical movement is very ingenious and elaborate. This particular compound movement, however, was not new, the same having been provided for in a patent issued to William Harvey as early as 1847, and in other patents antecedent to Butterfield's. The invention reduces the cost of the knives at least ten per cent. The machine is a valuable one and substantial profits have already been realized.

Also an extension is granted to E. H. Smith for a sewing machine shuttle. The invention is pronounced by the Examiner to be a very meritorious one, and as yet not suitably rewarded.

Willard & Ross' improvement on harvesters. This patent was reissued in 1864, in seven divisions, and in four of these, extensions have been granted. The patent is an improvement on what is known as the Ball machine or Ohio Mower. In that machine the double hinged coupling arm is used, giving a flexible connection to the finger bar, and rendering it capable of freely conforming to an uneven surface. The improvement consists in projecting the inner end of the finger bar beyond the lower joint, to form a knuckle, and in pivoting to the coupling arm a lever to act in connection with it, by which the lower joint is made rigid; so that, when the heel of the finger bar is raised to pass obstructions, the outer end can be lifted also. This locking and lifting device constitutes the leading feature of the invention, and in the original patent there were but two claims, though the reissues embrace fourteen claims. The devices are simple but useful.

John Griffin's pile for wrought iron beams and girders. This improved pile closely resembles, on a cross section, a finished beam, and the rolling is therefore effected without any great reduction of its different parts, and consequently without any very unequal tensions of the fiber of the metal. In the case of other piles, the tension during the process of rolling is so unequal as, more or less, to tear the metal and separate the flanges from the web, thereby checking the edges of the flanges. Griffin's pile has thus far been used exclusively by the Phœnix Iron Company, of Phœnixville, Pa., and by Palmer & Co., at Buffalo, N. Y.; and these companies have manufactured more than two thirds of the beams and girders made in this country since the patent was issued, amounting to 37,758 tons. The advantages arising from the invention are, first: that cheaper iron may be used. Second: lighter and cheaper machinery may be used in rolling it. Third: the beams are much superior to those made of the ordinary rectangular pile. Fourth: larger beams can be rolled, the size being limited only by the size of the roll trains and the capacity of the furnace. The royalties to the patentee have already amounted to a large sum, but in consideration of the value of the invention, the Office does not consider that he has been suitably rewarded. To the public, the saving has been from one to one and a half cents per pound, amounting already to the sum of $700,000. The use of wrought iron beams in public and private buildings has greatly increased of late years, and in 1857 the manufacture was exceedingly limited. Since 1861, the Government has procured from the companies referred to, not less than 4,000 tons of fifteen inch *chassis* rails, for fortification ordnance; and the saving arising from this invention is not less than $120,000. It is patented in England, France, and Belgium.

William Pratt, for an improvement in safety lamps. This is a protection against the explosion of vessels containing a volatile inflammable liquid; and consists of a volute of ribbed metal wound together, forming a series of regular tubes, inserted in the main orifice. The parts are so arranged that the wick cap cannot be removed until the cap of the feeder tube has been removed. The invention does not appear to have gone into general use, but it is claimed to be one of great utility.

William Sellers' improved machine for threading bolts the object being to avoid the necessity of reversing the motion of the cutting dies or stopping the machine to change the bolts, and to facilitate the change of the dies. It is claimed that the machine does twice the work of an ordinary machine. If the 402 machines, manufactured and sold, had been in constant use during the fourteen years since the patent was granted, it is calculated, and the estimate is supported by practical machinist, so that the saving to the public would have amounted to the sum of $1,081,500. The profits to all the parties interested are estimated at about $50,000.

W. H. Nettleton's machine for turning pillars for clock movements. Nearly all the clock pillars made in the country are manufactured on this machine. In the town of Bristol, Conn., there are nine clock making companies; and one of these manufactured last year 40,000 clocks.

Pierpont Seymour's machine for spreading lime and other fertilizers. The invention is a mechanism for operating a hopper with an inclined bottom provided with reciprocating bars.

Richard M. Hoe's printing apparatus consists in locating the cam shafts for driving the fly frames close up to the frames, greatly reducing the jar and wear of those parts. A simple invention, but one which saves annually, to each press on which it is used, the sum of $150. Patented in England.

Alexander S. Newton's machine for turning wooden boxes. An arrangement of devices by which round wooden boxes can be made from a square stick, thereby saving the expense of rounding the timber before it is placed in the lathe.

The following applicants have been refused:

Nicholas Whitehill, for a cultivator. The machine is a straddle row cultivator, the middle being elevated to pass over the row of corn, and provided with a compound evener suspended on three points. Remonstrants claimed that the patent was anticipated by the patent to Stahl and Hiffenbacher, as early as 1835, and also by five other patents of later date.

W. N. Clark, for an elastic door guard, being a rubber buffer, confined by an escutcheon ring, to receive the force of the door knob and protect the wall. In this case, the original application as well as the application for re issue was refused by the Examiner, but finally allowed on appeal. The Commissioner decides that "applicant has monopolized more than his invention in his re-issue, and is not entitled to further monopoly of even what he did invent."

It is not uncommon in the regular routine of the Patent Office for an application to become somewhat snarled and tangled, and generally off the track. In January, 1869, William Duchemin, of Boston, applied for a patent for an improved sewing machine for manufacturing shoes, and its history in brief is this: February, 1869, letter from office rejecting some claims, showing needed corrections in specifications, and calling for an additional drawing. May, 1869, applicant informed that a certain clause of his claim must be limited if he wishes to avoid an interference with a subsequent application. May 20, 1869, interference declared. June 9, 1869, interference dissolved. New interference declared between applicant and three other applicants. September, 1866, decision in favor of Duchemin. Case appealed to Examiners-in-Chief, who, in January, 1870, decided against