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Contents:

(Illustrated articles are marked with an asterisk.)

PAINE'S ELECTRO-MOTOR.

In recent numbers of the SCIENTIFIC AMERICAN, we have given accounts of the extraordinary claims put forth by Henry M. Paine and friends, concerning his improvements in electro-magnetic machinery. They assert that his engine, now running at Newark, N. J., develops two horses' power by the use of a battery of only four ordinary telegraph cups; and, further, that any desired degree of power may be obtained with the same four cups, simply by multiplying the number of magnets.

In other words, Mr. Paine has discovered the perpetual motion, and found the long sought philosopher's stone.

This absurd proposition has been received, yea, swallowed whole, by persons who have heretofore enjoyed reputation for common sense, if not sagacity, in things scientific. But this easy credulity in the present case, shows that they have been over-rated. They belong to that large class of individuals, intelligent and sound in ordinary matters, but in whose minds there runs a vein of lunacy upon the perpetual motion question; the result of careless and deficient training in scientific principles. From this class, Mr. Paine will draw followers and money; in fact, he has already done so, with much success, unless we are misinformed.

The exhibition of the original machine, which, for a time, was open to a favored few who had money to invest, is now closed, for the purpose, it is stated, of perfecting preparations to show the improvements on a more grand scale.

Mr. Paine's patents have been assigned to a joint stock company, capital three millions of dollars, called the Paine Electromagnetic Engine Company; and they are now busy, at Newark, in building a new machine, by which they expect to convert all such doubters as the SCIENTIFIC AMERICAN, and bring the world in general to a realizing sense of the astounding nature of their discoveries.

The company is said to be composed, for the most part, of gentlemen of wealth, who are abundantly able to lose any amount of money that they choose to subscribe. It is to be hoped that they will be liberal in their estimates, and give us an example of the mechanism on a scale sufficiently large and brilliant to attract the attention of the world. It is only by the exhibition of the most striking examples of absurdity and failure, that the malady to which we have alluded can be reached or suppressed.

We understand that the new machine is to be of five hundred horse power, and is to run, as before stated, with only four cups, at a cost of about twenty cents a day, and is to be ready for operation about the 4th of July next; after which date, unless the company should be disappointed, steam boilers will be no longer wanted, horses may be turned out to grass, and workmen may take things easy. Their places will be supplied by electric engines, electric horses, and magnetic laborers.

During the brief interval that remains before the inauguration of this great electromagnetic revolution, we have thought it best to prepare and enlighten the minds of our readers concerning the nature of the mechanism by which the Paine Company expect to accomplish so much. We have, accordingly, provided a series of engravings, representing the salient points of Mr. Paine's improvements, which we print on another page, together with his own explanations of them, as presented in his patents.

These patents embody several apparently good improvements in electro-dynamics; but we are unable to detect in them anything that is likely to turn the world upside down, in the astonishing manner that Mr. Paine and his worthy coadjutors so confidently predict.

THE NEW SYSTEM OF PIERS FOR NEW YORK.

It seems at last that the Dock Commissioners have resolved upon definite action in the matter of the improvement of the docks and piers. Many plans have been submitted to them, but it is finally announced that the one adopted will be that of a magnificent street, completely surrounding the water front, to be in width not less than 150 feet in any part. The river front is to present a solid wall of granite masonry, in combination with *béton*, which has proved its value for this purpose in many European harbors.

The plan is a very expensive one. Its cost is estimated at about two and one half millions of dollars per mile. The building of docks and piers is, however, essentially a costly undertaking, and we are inclined to believe that the plan proposed could hardly be replaced by another, embracing greater durability and convenience at less cost.

In any system of public works, durability is an element that should be considered of primary importance; especially in structures where frequent repairs entail interruption to business.

The depth of water along the frontage is to be not less than twenty feet. From the granite wall will project piers, from three hundred to five hundred feet in length, and from sixty to one hundred feet wide, according to situation. The superstructures will be, for the most part, of timber, supported on iron, stone, or timber pillars, but having at the head of each pier a column of solid granite masonry the full width. It is stated that some of the piers will be constructed wholly of iron, and a limited number entirely of stone.

The iron columns are to be hollow and six feet in diameter, so that men may enter them to work, while sinking them to their permanent foundation. Each pier will have three rows of these columns, which, when sunk to bed rock, will be filled with a concrete of stone and cement. The spaces between the piers will be two hundred feet in width. The sewers are to be carried through under, and made to discharge their contents at the outer ends of the piers, so as not to fill up the slips.

The completion of this work is not intended to be accomplished at present, but it is designed to at once carry out the system from Grand street to East Fourteenth street, on the East River, which, it is stated, will give a pier length of twenty-one and one half miles, and will for a long time to come amply accommodate the commerce of the port.

It seems to be the general opinion among those qualified to judge of the merits of this plan, that it is one of the best that could have been adopted, and it is estimated that the additional rents will pay the interest on the bonds to be issued, without advancing the rates at present demanded.

The completion of this great work, and that of the East River suspension bridge, together with the removal of the Hell Gate obstructions, will render the East River famous for the engineering skill devoted to its improvement.

There is, however, one point which the system proposed does not cover. It makes, so far as we can see, no provision even in anticipation of any disposal of sewage, other than its discharge into the river as now practiced. The results attained by several processes, particularly that known as the "A. B. C. process," in which sewage is treated by the use of alum, blood, and clay, indicate that the time is coming when the discharged filth of cities will be used to restore fertility to impoverished lands instead of being allowed to poison the water about docks and piers. In constructing a work of such permanence as the one under consideration, it would have been wise to have anticipated the future employment of improved methods of treatment in such a way that their application would not entail expensive alterations. This could be done without increase of first cost to any noticeable extent.

DOCTORING IRON.

The attempts made, from time to time, to obviate the process of puddling, in the manufacture of iron by doctoring, are, while they have some warrant in chemistry, still entirely empirical. The two principal substances sought to be removed—carbon and phosphorus—possess strong affinities, and form combinations in the metal, very difficult to break up. Their presence in undue quantity produces qualities in iron which unfit it for many purposes; and, practically, only oxygen, administered in large doses, has, as yet, been able to remove these undesirable elements. The introduction of oxygen mixed with nitrogen, as in atmospheric air, is the essential feature of puddling and of the more recent Bessemer process. In the Heaton process, which has now ceased to attract much attention, the oxygen was introduced in the nitrate of soda employed, the salt, being decomposed by the heat, yielding its oxygen to the crudities contained in the metal, and forming with them gases which passed off. In the Ellershausen process, oxygen is introduced in the oxide of iron employed in making the pig blooms. The Peters process, which, we understand, is soon to be put into practical operation in Rhode Island, is a new way of introducing and controlling the admission of oxygen.

Thus we find that oxygen is the giant of the chemistry of iron. This fact, however, is not, and should not alone be, a bar to experiments with other materials, although the uniform failure which has attended dosing with chemicals, is, to say the least, discouraging. There would be more hope in this direction were our knowledge of iron more complete than it is. There is scarcely a field of industry more beset with difficulties and perplexities, than that of the iron manufacture. So manifold have the varieties of iron and steel become, that no one knows where to draw the line of distinction between them, and the terms have become entirely too indefinite. There are so many things called steel, that no one knows where to say iron leaves off and steel begins.

There are also mysterious reactions and physical changes, in the condition of these metals, yet unexplained, upon which more light must be shed before the use of chemicals, salts, etc., can be intelligently applied.

To attempt to doctor iron is, then, to grope in the dark The attempts may add to our stock of knowledge, but there is little prospect of their revolutionizing the processes now employed. For this reason we accept with much allowance the glowing statements indulged in by some English journals, in regard to the Sherman process, and also that of a central New York paper, which now lies on our table, containing an enthusiastic encomium of what it calls the "Bendell" iron, which, it states, is produced by dosing, the drugs and medicines employed being exceedingly cheap, but the names of which are not given. The sanguine author of the article in question regards the process as destined to revolutionize iron working throughout this country. We hope it may—but for the reasons above assigned, we doubt it.

MENTAL EMACIATION.

A strange title, do you say? What new disease is this? Not by any means a new disease, dear reader, but one astonishingly prevalent. The number of men whose minds are weaker and smaller at forty or fifty than when they were were twenty-five, is legion. Their bodies are sleek and plump, their purses, many of them, are fat; both have been well nourished; but their minds are in a feeble, emaciated condition, unable to cope with the great questions of this pre eminently advancing age.

Engage them in conversation upon any topic involving much grasp of thought; propound to them any one of the great problems of vital importance to the human race; you shall see how their minds shrink from effort they are incapable of performing; and how they fall back upon the supports of old superstition and prejudice, and there find rest from the labor such questions involve. This general mental emaciation is one reason reforms move so slowly. The best and strongest minds are tugging at the mysteries of nature, and expending their energies in physical researches. Some intellectual giants are also grappling with problems of social construction, political economy, and morals, but, as their teachings are directed mainly to the mentally emaciated, they make but little headway in correcting existing evils. Men, in the hot pursuit of wealth, which is the most absorbing of present human aims, neglect systematic thought, feed their minds upon little else than the sloppy pabulum of sensational daily papers, and become mentally starved. How few there are that can safely think for themselves upon any subject not immediately related to their profession or calling! What millions might be counted, who might far better shut their eyes and accept without thought the conclusions of such men as Mill and Spencer than even to attempt to reach a conclusion or form a definite opinion from their own thinking!

Talk with men engaged in professions which imply greater breadth of thought than ordinary business occupations, and how often you will hear the admission, that their habits of thought have unfitted them for correct thinking upon topics which require systematic thought, and strictly logical method! Ask nine out of any ten, selected at random, what is their religious belief? and you will find that they either have none, or that they accept a creed they cannot comprehend or explain. If they vote at general elections, they are guided by hastily formed opinions, for which they have never sought good and sufficient reason. Somebody's plausible speech, or some half conceived principle of right or wrong, is enough to influence their action; and so they give their minds the rest they crave, and trust to luck that it will all come right in the end. Many are going on through life, similarly trusting that their future will all come out right—hoping that it will—which they call having faith; and when they suppose themselves to be trusting in God, they are simply trusting in luck.

Hence it follows that sects and creeds multiply, charlatans prosper in politics, religion and medicine, and false teachers only find it necessary to assert, with show of authority and with simulation of knowledge, to win numerous disciples.

The majority of men prefer to have other people think—or pretend to think for them. Glittering generalities that either mean nothing, or mean falsehood, are accepted as formulas of action, and repeated as maxims for the guidance of individual conduct. If such a formula be attacked by some bold critic who sees its hollowness, the masses who have accustomed themselves to blindly follow, cling to it, refusing to give up that which has saved them the labor of forming an independent opinion, and dreading the mental effort which the formation of new opinions, or the selection of another formula, would entail.

So the world moves slowly in some respects, but it moves. There remains an immense amount of superstition, but day begins to dawn. People are not so easily led blindfold as they were a century ago, and the rights of individual conscience begin to assert themselves.

STEAM ON THE ERIE CANAL--ANSWERS TO QUERIES.

We call attention to an able paper read by George Edward Harding, C. E., before the Society of Arts, in London, May 10, of the present year. The paper is entitled "The Application of Steam to Canals," and gives a great deal of practical information, useful to inventors at the present time. We shall publish it in parts.

We also take the present occasion to answer a large number of queries relative to the dimensions and models of canal boats. The largest boats are 96 feet long, 17 feet 8 inches in width, and 9 feet in depth over all. Their greatest draft is 6 feet, as prescribed by law, and they will carry 240 tuns of freight.

The bridges are 11 feet from the water; that is, this is the least distance allowed. The mean depth of the canal between the bottom of the banks, is 7 feet.

The model of the boats may be described as an oblong box with vertical sides, and having all the corners slightly rounded. To propel such a boat, when loaded, at a rate of three miles per hour, would require not less than sixteen horse-power, taking as a basis for the estimate, the fact that two horses now scarcely make more than a mile and one half per hour when the boats are loaded to full capacity, and that the resistance of fluids increases as the cubes of the velocities of bodies moving through them.

From this it will be seen how visionary it is to suppose that any boat of this model can be propelled, when loaded, at five or six miles per hour, without reducing its freight carrying capacity more than can be allowed. To propel such a boat at five miles per hour would require a power of nearly seventy-five horses, not making the least allowance for waste of power, which always takes place in any method of steam propulsion. To propel it at six miles per hour, would require one hundred and twenty-eight horse-power.

Another query, in which many are interested, is: what does the law, offering the prize, mean by the "Belgian system" of propulsion? We will give an engraving of this plan in our next issue. Meanwhile we will say, that the plan is the invention of Baron Oscar de Mesnil and Max Eyeth, who patented their inventions in the United States, Feb. 9, 1866.

It consists essentially of a rope, laid on the bottom of a canal, which is simultaneously wound on and off a drum, attached to the boat and turned by steam or other power.

In answer to other inquiries, we give it as our opinion that the meaning of the last clause of the first section of the act authorizing the prize, excludes all use whatever of the banks, and confines the means of propulsion to the boat itself, and the propeller must be made to act either upon the water or the canal bottom.

The commissioners have not held their first meeting, and have as yet no office in this city. As soon as they take action of any kind, our readers will be informed. The chairman of the Commission is General George B. McClel an, and his office is at the Department of Docks, 348 Broadway, New York.

PLOWING AND CULTIVATING BY STEAM.

Horace Greeley, editor of the New York *Tribune*, is now on a tour in the South, and, in a recent letter to the above paper, describes a visit to a plantation fifty miles below New Orleans, where the manufacture of sugar is a specialty. The plantation, Magnolia Grove, is 3,000 acres in extent, and the owner, Mr. Effingham Lawrence, conducts all the operations on a large scale, and in an enterprising manner. One thousand acres are actually cultivated. Fowler's plowing machinery is used, imported from England. The plows are drawn across the field by two thirty horse steam engines, provided with drums, on which the wire ropes that operate the plows are wound. One engine is placed on each side of the field, and the drums alternately wind and unwind the rope, drawing the plows back and forth between the engines.

"The ground," writes Mr. Greeley, "was cane stubble, heavily ridged or hilled to counteract excess of moisture, with the 'trash' of last year's crop lying between the rows, and constantly clogging and choking the plows, often requiring the machinery to be stopped in order to clear them. The subsoil—never disturbed till now—was a glutinous clay loam, compacted by sixty years treading of heavy mule teams, so wet that it came up unbroken, as if it were glue, and about as easy to pulverize as so much sole leather. So obstinate is it that Mr. Lawrence had reduced each gang of plows to two, lest his engines should be stalled, or his wire ropes broken. These two each cut a furrow sixteen inches wide, and fully two feet in average depth; had the surface been level, they would have averag d twenty-six inches. They were drawn across the field (576 feet) faster than most men would like to walk. Three men were required to keep them in place, and clear them of the choking 'trash,' which I would have burned out of the way though I had I been planter, would have preferred to have it buried, as they buried it. Against all these impediments, each set of machinery was plowing from five to six acres per day—plowing them two feet deep, remember, and thus relieving them of the generally superabundant moisture, as shallow plowing, or even ordinary subsoiling, never did and never can. Mr. Lawrence, upon land thus plowed, makes an average of 2,000 pounds per acre of sugar, where he formerly made but 800 pounds. And he regards himself as yet on the threshold of steam cultivation.

"And even this was not the best he had to show us. In other fields, perhaps half a mile distant, other machines were cultivating cane by steam. I believe the like of this has not yet been done elsewhere on earth. The rows of cane are fully seven feet apart; the plants now fully a foot in average hight. A locomotive engine stands at either end of the field, moving forward or backward by a touch of the hand of the negro boy standing upon it and looking out for signals. The cultivator is composed of five or six ordinary horse cultivators, enlarged and fixed in a frame, whereof the half that that has just stirred the earth to a depth of two and a width of five feet is lifted clear of the ground on reaching the engine which drawsit, while its counterpart is brought down to its work by the plow guider stepping upon it. At a signal, the boy at the other end of the field, or 'land,' starts his engine, and begins to unwind his wire rope, and uncoil or pay out that of the drum beneath the opposite engine, pulling the cultivators through the earth as they are guided nearer the row that they were kept further from as they passed in the opposite direction. Having thus thoroughly pulverized the space between two rows, by traversing it twice, the engines move forward to the next space and repeat the operation; and so on till nightfall. Mr. Lawrence assured me that one such thorough working answers for the season; whereas, while tilled by mule power, every cane field required working six times per season, at intervals of fifteen days. A set of machinery and hands tills about twelve acres per day. I judge the cost of this day's work, including fuel and wear of machinery, ranges from $25 to $30. This is far below the cost of repeated workings by mule power, while it is far more efficacious. The land plowed and tilled by steam is far dryer than the rest. Mr. Lawrence considers his thousand acres under tillage worth $100 per acre more than they would be but for steam culture. He will keep his two sets of plowing machinery at work, not only throughout each day, when the earth is not too sodden, but (by relay of hands) throughout each night also, when the moon serves. Steam tillage of growing crops, being a nicer, more critical operation, will be confined to daylight.

"I close with an avowal of my confident belief, that Mr. Effingham Lawrence has rendered an immense service to American agriculture, especially that of the Prairie States, by demonstrating the benefits not merely of steam plowing, but of subsequent steam tillage, and that the day is not remote wherein the barrens' of Long Island and New Jersey, the rich intervales of the Connecticut and the Susquehanna, will be profitably plowed and tilled, to a depth of 24 to 30 inches, by steam power, and that far larger and surer crops than those of the past will therefrom be realized."

The Birmingham Gunmakers', and Inventors' Club.

At the first general meeting of the Birmingham (England), Gunmakers' and Inventors' Club, the President, Mr. A. Wyley, delivered an address in which he reviewed the position held by gunmakers and other mechanics; noted the difficulties which beset the trade, and suggested means by which these might be alleviated or overcome. He said that "the manufacture of firearms at the present day, involves a wider range, if not a greater amount, of knowledge than any mechanical pursuit, if we except the more scientific manufactures, such as those of optical, geodetical, and astronomical instruments." Referring to the drawbacks of the manufacture of firearms, Mr. Wyley said that, "First of all, the trade, especially the military branch of it, is, in its nature, exceedingly spasmodic and irregular; at one time utterly stagnant, at another in a perfect fever of activity. During the period of slackness, men take to other branches, sometimes to totally different pursuits. When the trade suddenly revives (and the transition is always sudden) these men return to their former posts, but, of course, not so efficient as if they had remained in it all along. This is one cause of the indifferent work that is always turned out when any sudden demand arises." The gunmaking trade had not taken the position in public estimation that it might occupy, and its leading men were ranked far below civil and mechanical engineers. Many causes have contributed to this, but clearly one of the foremost is the utter want of unity or cohesion in the trade. In almost every case, the individual interests of its members seem the only motives of action (and even these interests are poorly understood), while those of the trade and of the public are totally disregarded. These causes have kept the masters in the gun trade at arms length from each other, and they naturally endeavor to to keep all those in any way dep ndent on them in the same state of isolation; and so it happens that no one knows or cares what his next neighbor is doing. Hence it is that blunders innumerable are made, costly experiments repeated over and over again, although the question, to solve which the experiments were made, may have been settled years before. From this source arise endless multiplication of patterns, all sorts of useless bores of barrels, all sorts of rifling, and that inability to judge of the cost of manufacture of anything out of the usual course of their own experience which often leads masters to give unduly low estimates, there necessarily ending in screwed down prices and inferior work. If those engaged in the gun manufacture, were animated with a spirit of brotherhood—if they were to unite and co-operate, many great improvements would be effected by systematising the details of the trade To bring about a closer union among the active members of the the trade, is the principal object of the Gunmakers' and Inventor's Club.

The Wreck of the Saginaw---Mechanical Ingenuity of a Shipwrecked Washingtonian.

The following is from the Washington *Morning Chronicle:*

When the Saginaw was wrecked on Ocean Island, last October, a boat saved from the wreck was started for Honolulu to seek aid to rescue the crew from that island. The boat foundered in the surf when near her destination and all of the crew perished save one, who told the tale of the Saginaw's fate, and had relief sent to the shipwrecked crew. The length of time which elapsed before succor came, caused such apprehension in the minds of the sufferers on the Pacific Island, that they fitted out another boat to tempt the perilous navigation of nearly 1500 miles. This work on the boat went on well; but they had no sextant, the only one saved from the wreck having been taken in the other boat. Second Assistant Engineer Herschel Main, U. S. N., of this city, who was among the shipwrecked, collected from the *débris* of the wreck cast ashore, a variety of materials, from which he constructed a sextant with such tools as he could improvise, and which has been tested and found accurate.

Mr. Main exhibited considerable ingenuity in constructing an instrument so delicate and intricate under such disadvantageous circumstances, and has given an additional proof by his achievement of the truth of the old adage that necessity is the mother of invention.

The material used in the construction of the sextant consists of a piece of a steam gage, a piece of zinc, some small pieces of brass filed to suit the different portions of the in trument, rivets made from any material found, and the mirrors necessary, from such pieces of looking glass as were washed from the wreck. These last were set in frames of brass desk locks, and all the work was principally done with a pocket knife and rough tools made for the occasion.

This instrument is now in the possession of Mr. King, chief of the Bureau of Steam Engineering in the Navy Department, and can be seen by all who take an interest in a curiosity which exhibits such skill and mechanical ingenuity as is rarely found under such difficulties.

There happened to be no necessity for a practical test of the instrument, for by the time it was completed and second boat ready to start, relief arrived and the shipwrecked men were rescued from the island and conveyed to Honolulu. The instrument, however, as above stated, has been tested by navy officers and found accurate.

The Decomposition of White Light.

Mr. Lewis Rutherford, of New York, so well known for his magnificent stellar, lunar, and solar photographs, was in London a few weeks ago, and brought with him a prepared piece of glass which would produce a diffraction spectrum. A diffraction spectrum is produced, without the use of prisms, simply by the aid of a glass plate, which contains a great number of fine parallel lines ruled with a diamond upon one of its surfaces. These lines should be $\frac{1}{1500}$th of an inch apart, and extend over a surface about two inches square There is a great degradation of the light when it is drawn out in this way into a spectrum, but the spectrum is a very pure one.

The ruled glass plate is technically called "a grating," and a number of spectra are produced on each side of the glass plate, any one of which spectra may be viewed by a telescope of low power placed in the right position. By means of the grating prepared by Mr. Rutherford, about eight spectra could be seen, and the whole arrangement was exhibited at the last *soiree* given by General Sabine to the Royal Society.

The great difficulty in preparing these gratings consists in ruling the lines with sufficient accuracy, it having been found that an error of $\frac{1}{250000}$ is sufficient to render them inapplicable for purposes of scientific research. The spectrum is exceedingly faint as compared with that obtained by the use of prisms; but in scientific researches it presents the great advantage that any spectrum obtained by the diffraction plate will bear direct comparison with another spectrum produced by any other diffraction plate, even though the plates may have been made of different glass, prepared in a different manner, and the number of spaces between the lines on the glass of different widths.

There are other advantages appertaining to this little-known method of producing a spectrum. It is not liable to the difficulties produced by what is known as the "irrationality" of the ordinary spectrum. This irrationality, as it is called, is caused by the property, possessed by different kinds of glass, of acting specially on different rays of light. For instance, the very densest flint glass, when compared with crown glass, draws out the blue and violet rays of the spectrum more than the red. A bisulphide of carbon prism ex erts a still more marked influence of the same kind. In consequence of the impartiality (for so it may be called) of the glass gratings upon the rays, a remarkable spectrum is produced, very unlike the one with which the public are familiar; for in the diffraction spectrum, the yellow rays are in the middle of the spectrum, instead of near one end. They are midway between the extreme red and blue — *William H. Harrison, in the British Journal of Photography.*

IRON telegraph poles are being introduced into Switzerland with great success. They have also been placed on 350 miles of Swiss railways. It is predicted that in Germany, where iron is cheap, that it will be substituted for wooden poles on all the lines. We would suggest that iron poles be substituted, in our cities, for the cumbrous and unsightly ones which meet the eye in every direction. They may be made light and artistic, and besides they will endure so much longer than wood as to render them economical in the end. President Orton, of the Western Union Telegraph Company, will, we trust, take the matter into consideration.