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. McClellan, 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 instrument, 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 exerts 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.