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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 690.

For the Week Ending March 23, 1889.

Price 10 cents. For sale by all newsdealers.

SATISFACTORY PROSPECTS FOR THE WAR VESSELS.

The recent achievements of the dynamite cruiser Vesuvius and the gunboat Yorktown, on their respective government trial trips, demonstrate something more than the mere certainty of acceptance of these vessels. To the William Cramp & Sons, it is sufficient to know that the vessels have proved a success, and to the government board, that the vessels have passed a satisfactory test. But to the public at large, to the ship builders of this country, and to builders abroad, the success of these two modern war vessels demonstrates the ability of American ship and engine builders to not only equal, but surpass those of foreign countries. When it is taken into consideration that the estimated speed of the Vesuvius and the estimated horse power of the Yorktown was placed as high in each case as it was supposed by the government officials possible for the contractors to attain, the wonderment is expressed that in each instance the contract requirements were exceeded far beyond the most sanguine expectations.

The Vesuvius was required by the government contract to make 20 knots per hour. On her official trial trip she made a mean of 21·646 knots per hour.

The contract requirements of the Yorktown called for a development of 3,000 horse power, with a provision that for every extra unit of horse power obtained, the contractors should receive a bonus of $100. On her official trial trip the Yorktown developed, as an approximate mean for a four hours' continual run in a seaway, not less than 3,650 horse power, though the designer of her engines, Mr. Horace Lee, is inclined to place the figure as high as 3,700, the findings of the official board being not yet made public.

The ability of the Cramps to turn out such successful vessels as the Vesuvius and Yorktown shows for itself that the American shipbuilders of the past have worthy representatives at the present day, for it is well known that the name which the famous clipper ships in the forties and fifties won for American builders placed the latter ahead of all other ship designers in the world. The breaking out of the civil war found the American navy consisting of a great number of unserviceable craft. Before one year had passed, every ship yard on the Atlantic coast north of the Delaware capes was taxed to its very utmost, gunboats were turned out complete and with their batteries in place in 90 days after the first laying of their keels, while Monitors were rushed through in six months' time.

As a result the close of the civil war found the navy of the United States possessing more ships than that of any other navy in the world; while the muster rolls bore on their faces the names of some 100,000 seamen, ready for service and duty afloat. It must also be remembered that the civil war developed a type of vessels entirely new to warfare. This was the Monitor type, which immediately after became so popular among the naval establishments of foreign governments. Russia especially seized hold eagerly of the new idea, and was followed in quick order by France, Germany, Spain, and Italy. Although the Monitor type in its original design is fast becoming obsolete, there are features of it, however, which promise to become permanent fixtures in the armaments of naval vessels. The turret, revolving or fixed, is a purely Monitor idea, and at the present day it is safe to say that one-fifth of the heavy armored war ships of Europe carry a steel or iron turret on the spar deck. The 100-ton guns on the majority of the Italian vessels are mounted in turrets; the guns of the Thunderer type of the British navy are likewise; while in the German navy the Friedrich der Grosse and Preussen, sister ships, each of 6,660 tons displacement, carry their respective four 22-ton Krupps in turrets, the thickness of metal ranging from 9 to 10 inches on different parts.

With the appearance of the dynamite cruiser Vesuvius among the vessels of this country's naval establishment, it is not at all unlikely that, before two years will have elapsed, several of the European governments will possess vessels of similar design, and intended for the same mode of warfare.

As it is now, the Cramps have received offers from foreign emissaries to build cruisers of the Vesuvius type, and it is understood that the firm has been offered as high as $500,000 for the original vessel itself. This latter offer could not, of course, be taken up by the Cramps, inasmuch as over two-thirds of the vessel's contract price has been paid down by this government. The Italians are especially anxious to obtain the Vesuvius. They have also conferred with the officials of the Pneumatic Dynamite Gun Company, with the express view of purchasing guns for use aboard their own ships, even if they be unable to buy the Vesuvius, or manage to have built vessels of similar type.

There has been evinced a tendency on the part of some persons to deny the Vesuvius the name she is so justly entitled to, that of "the fastest vessel in the world of her tonnage class and over." The only vessel afloat which has attained in speed anything like that made by the Vesuvius in her speed attainments is the Tripoli, of the Italian navy. This vessel displaced, on trial, 831 tons; the Vesuvius displaced 810 tons. The speed of the Tripoli was 20·1 knots over the measured mile, and less than 20 knots for the mean of a four hours' continual run. The El Destructor, of the Spanish navy, made a mean of 22·6 knots on a four hours' continuous run, but the El Destructor is less than 500 tons displacement, and carries little or no armament. The Vesuvius, on trial, was weighted down with 140 tons of armament.

Throwing the El Destructor out of comparison, which is only just and right, the Vesuvius presents herself to the world as an American-built ship, and one whose speed for her tonnage and over has never been exceeded. As for high horse power development per ton of machinery, boilers, and the like, the Vesuvius likewise attained to higher than ever got by any other vessel abroad having the same type of marine engines. She obtained an average mean of 16·9 horse power per ton of machinery, boilers, coal, and water in boilers. The best ever obtained abroad is placed at 12 horse power per ton, and an average of the best at 10 horse power. The Tripoli and El Destructor, however, carry engines of the locomotive type, and as for weight abroad, it is all in the machinery. It must be remembered, too, that no comparison is being made in relative attainments with torpedo boats of the Ariete type—boats built by Thornycroft. Such craft have no claim to comparison with sea-going cruisers of the Vesuvius type.

It now looks as if all the new ships of the navy are going to exceed the expectations of the Navy Department. The Petrel is likely to make 250 horse power over and above her contract requirements. This will give the contractors a bonus of $25,000. The Bennington and Concord vessels, of the Yorktown type, are designed for 3,400 horse power, and their contractors expect to attain from the engines a development of 250 to 300 horse power over and above the stipulated number.

The four last years have done much to stimulate and encourage ship builders, and the success with which the latter are meeting promises to assure to them not only the confidence of the American people, but to serve also as an inducement for foreign purchasers to buy vessels of American build.

PROGRESS OF ELECTRIC ILLUMINATION.

For proof of the innate conservatism of the human family we have only to glance at the history of any great invention. Any innovation calculated to change old established manners and customs is sure to meet, at first, with opposition, and unless by actual trial it is shown to be desirable and advantageous, it dies and passes out of sight.

Every important invention passes through this ordeal. It is surprising, on taking a retrospective view of inventions that have proved of the greatest benefit to mankind, to note what struggles they have passed through before receiving anything like adequate acknowledgment from the public. On the other hand, when an invention has passed its period of probation, and is found desirable, its progress is rapid, and nothing can impede it. Several applications of electricity have reached this stage, and are progressing in a manner little dreamed of ten years ago by the most sanguine, and even now, very few, unless connected in some way with the industry, realize the extent of the adoption of the electric light and of electricity as a means of distributing motive power.

So far as we know, every city in the United States is provided with arc and incandescent illumination, and the introduction of electric lighting is rapidly extending to the smaller towns. Already hundreds of villages of only a few thousand inhabitants have their electric light plant. In many instances the electric light has been placed in competition with gas light, while in other cases it has been introduced to advantage where gas light was impracticable. In all these applications the economical distribution of power for small uses by means of the electric motor is a very attractive and important feature.

In addition to the general plants adopted by cities and villages, there are thousands of isolated plants for single buildings or groups of buildings, and electric lighting has been largely adopted by steamboat and railway lines. For isolated plants the storage battery is coming largely into use, the batteries being connected by day for charging with the arc lines, and used at night for incandescent lighting.

In addition to these applications of electricity, we find it largely employed in the mining districts, the generators being located upon the surface and the motors in the depths of the earth. Electric tramways are also of great utility in transporting ore and other materials, but a larger use is that of driving cars upon the street railways. Electric cars are now regularly manufactured, and they are in use not only in the cities, but in the small towns and villages. The extent to which this method of propelling cars has been adopted, and the rapidity with which it is progressing, is notable.

With all the perfection that has already been attained in electrical machinery, improvements are constantly being made, and there is doubtless still great room for further improvements.

Storage batteries for stationary lighting and power have reached great perfection, but there seems to be opportunity for improvements looking toward decrease of weight and greater durability under constant jarring and agitation.

A well known street railway magnate said to a representative of the *Electric World*, the other day, "What we are looking for is a good, serviceable, commercially practical, storage battery. We have numerous storage batteries, some good, others indifferent, but all of great value in the laboratory. Now, give us something cheap and practical. There is nothing the matter with the overhead and underground systems of street railways, but what is wanted is a system in which we can convert our present cars into electric tramways, and go on running without all this fuss about overhead wires, underground cables, and a hundred annoying details. We have all the practical motors that can be desired, but what is needed is a storage battery that has a good life, high efficiency, light weight, convenient form for handling, and that will be guaranteed. Then will come the era of swift, sure, safe, and pleasant surface traffic."

PRESENT ASPECT OF INVENTION.

A correspondent has written to us asking whether the realm of invention is not exhausted—whether there is still any chance for one of an inventive mind to devise improvements on existing devices or machines. The doubt implied in the above question seems very natural in view of the record of the patent offices of different countries. Every year sees an increase of patents. Besides these there are numberless inventions that are unregistered and that do not find a place on the records. Notwithstanding all this, the field is so large, and is so imperfectly cultivated, that the work has only commenced. Man's energies now, after so many years of waiting, are bent on the subjugation of the material world. More than half a million patents are the written history of what has been done, but the unwritten portion is the largest. Yet the conquest is far from complete.

If we consider the great inventions that are waited for, perhaps the subject of a prime motor would be the first occurring to the mind. From every point of view the steam engine is unsatisfactory. It is hampered by the condition of a narrow range of temperature, so that with steam of any manageable degree of heat, not more than fifteen or twenty per cent of the heat of the fuel can possibly be utilized. There is only one way in a heat engine to avoid this restriction. It is to use a very high temperature in the motor. If steam is greatly superheated, it attacks the metal of which a machine is built, it destroys lubricators and packings, and is quite impracticable. Steam cannot overcome the ill effects of the second law of thermodynamics. In the gas engine, in which the combustion of gas is directly used, a higher temperature is obtained, and an engine far more economical in the calorific sense is obtained. But its fuel is expensive, and has to be first manufactured. The cylinder becomes heated, and, to prevent this from going too far, water is caused to circulate around it. This is a concession to the practical, for theoretically the use of water in this place is wrong. Neither the steam engine nor gas engine fills the bill. A prime motor that will convert eighty or ninety per cent of the heat energy of coal into mechanical energy has yet to be invented.

Another conversion of energy should be the subject of invention. Mechanical energy can be converted into electrical energy with little loss; the problem of a successful conversion of heat energy into the electric form has yet to be solved. The ordinary thermo-electric battery is exceedingly uneconomical, on account of the small difference of temperatures that it can utilize, and, in all of its present forms, must have a low coefficient of restitution. Of all the heat energy which it absorbs, it cannot restore as much even as the steam engine does. A prime motor and a direct converter of heat into electricity, with efficiencies of eighty per cent or more, and using common fuel, have yet to be invented. In the ordinary cycle, coal is burned under a boiler, and the steam thus generated actuates an engine, in its turn driving a dynamo. In the second conversion of mechanical into electric energy, there is a loss of not over ten or fifteen per cent. But in the first step eighty-five to ninety per cent of heat energy is lost. In overcoming this loss, by going directly from heat to electricity, without the wasteful intermediation of steam, there is ample room for invention.

A primary battery that would be economically available for heavy work has yet to be invented. Almost all are characterized by high resistance, expensive depolarizer, or a negative plate of high initial cost. In the Upward battery there was a genuinely new departure, but it has not been extensively introduced. The use of zinc for the positive element is a weak point, owing to the expense of such fuel. The storage battery has met with success, in great measure, on account of its low resistance. In the approved arrangement of primary batteries, one-half the energy is expended uselessly in overcoming the resistance of the battery itself. Several attempts have been made in the direction of advance in primary generator construction, in some cases carbon or some of its compounds being utilized as positive element. In a primary battery of cheap construction, of low resistance, comparable to that of a storage cell, and consuming a cheap positive element, there is a chance for invention of the highest order and economic value.

Even the storage battery is defective. The spurious voltage represents a loss of ten per cent, and its excessive weight and deterioration tell heavily against its more extensive introduction. No one can pretend to say that the climax has been reached in it. The future must have a battery in reserve whose active portions shall bear a more favorable ratio to the weight of the inactive portions.

The field of greater achievements could be gone over and many other wants suggested. The sun's radiant heat should be utilized; tidal force and the movements of the wind should be harnessed and made to do their part in the labors of the world. In considering the great advance of natural science as regards definition only, remembering how accurately the extent of achievement is stated, it is impossible to resist the conclusion that the world is on the verge of the revealment of some of the greatest inventions. To know just what we have done and what are the limits of our power in any given direction, is half the battle, and that half has been won.

In inventions of minor or less fundamental character the field is widening rather than narrowing. Since the days of Faust and Gutenberg, all books have been set up, letter by letter, in the most laborious and primitive way. At last a fairly successful type moulding machine that replaces the compositor has appeared. But no one can pretend to say that it marks the limit of achievement in this particular art. In the most numerous classes of inventions, such as car couplers or lock nuts, there is evidently ample region for work, as certainly the perfect coupler or nut has not yet been invented.

About 1812 Robert Fulton is said to have invented means for bringing the double-ended ferryboats which he had designed to their pontoon docks without a jar. As the ferryboat of the present day reaches her pier, the ends of two cables brought from the dock are hooked to eyebolts on her deck, and the cables are then tightened by a species of windlass so as to hold the boat in place. The whole operation is executed by hand, while several hundred people patiently await its completion. In this exceedingly crude contrivance it would seem that a relic of Robert Fulton's invention has been preserved. The ingenuity of the constructors of steamships and railways ought to be adequate to the production of an automatic coupling that would hold the boat in place as she touches the dock.

A good instance of a genuine improvement in a field apparently barren has been afforded during the last few months. The channel eye was one of the first improvements in the needle. By placing the eye near its point, the sewing machine became a possibility. Except for these changes, the latter for a specific purpose, the little pointed piece of steel has remained the same for many generations, and has served as a trial of patience to many of the weaker-sighted mortals who have attempted to thread it. It seemed a hopeless thing to expend ingenuity on. Needle threaders were invented, but proved of little use, and it is within a few months only that a self-threading needle has been placed upon the market.

We think it is evident that the horizon of the inventor's world is widening. Every great change or invention opens a new region, and a fundamental patent is often the basis for numerous and profitable improvements and additions.

THE PRATT INSTITUTE OF BROOKLYN.

In our issue of October 6, 1888, we described the Pratt Institute in detail and fully illustrated its various departments, devoting nearly an entire issue to the subject. We have since then watched the progress of this school with much interest, as we believe this and similar institutions are to play an important part in the future of our industries, and further than this they are to disseminate technical knowledge among all classes.

An inspection of the Institute during a recent reception revealed the fact that a great deal had been done in the organization of the various departments and getting them in thorough working order. The exhibits of objects produced by the students in the several classes indicated a marked advance over those shown last year. The cooking school was in full operation, and judging from the cleanly and orderly appearance of everything in the kitchen, the deft manner in which the cooking operations were carried on, we would suppose that a graduate from this department might be able to satisfy an epicure.

In the art department a number of creditable exhibits were shown, and the same may be said of the department of mechanical drawing. Wood carving is a new branch recently introduced; a number of fine specimens of carving were on view. The department of millinery and dressmaking showed specimens of handiwork which would do credit to some of our fashionable establishments. Type writing and stenography were being taught to bright-eyed lads and misses. The wood-working and machine department are in thoroughly good order, and various kinds of wood and iron work were being carried on. The blacksmith's shop and the foundry were in full blast. In the trade schools were to be seen students laying brick, plastering walls, cutting and carving stone, plumbing, etc.

In the hall of the new Ryerson Street entrance were to be seen samples of work done by the students in the School of Mechanic Arts. Among these were specimens of plumbing, blacksmithing, pattern making, cabinet work, etc.

The Technical Museum is one of the very interesting features of the Institute. Here are to be found the crude materials and the manufactured articles in various stages, arranged in the order in which the processes are carried on. There are also specimens of rocks and minerals. A set containing specimens of all known elements.

Among the new additions are to be found an exhibit of zylonite; an interesting exhibition of the Edison lamp in the various stages of manufacture; a fine set illustrating the manufacture of American faience; another set of textile fabrics, laces, and embroideries. The museum is open on certain afternoons and evenings of the week, and is free to all who wish to visit it.

We cannot pass through this great institution and examine the various departments critically without feeling that its founder has conferred a great benefit upon the city of Brooklyn and vicinity.

Meteorites.

Professor Darwin recently delivered, at the Royal Institution of Great Britain, a lecture on "Meteorites and the History of Stellar Systems." The lecturer, referring first to the advantages now enjoyed by astronomers from the application of photography, said that we might reasonably hope to obtain some information as to the process of development of the stars and planets. He then explained the nebular hypothesis of Laplace, who supposed the solar system to have originally consisted of a mass of gas in rotation. As the gas cooled it contracted and rotated more rapidly, until at length it became so much flattened that it could no longer subsist in a single shape. A ring was then shed, and the contraction of the central portion continued until a second crisis arrived, when another ring was detached. A succession of rings was formed, and these coalesced subsequently into planets, while the central portion formed the sun.

A recent photograph of a nebula in Andromeda, by Mr. Roberts, was then exhibited. In it could be seen the central condensation, the successive rings, and planetary nebulæ already formed. The speculation of Laplace appeared thus to be actually proved. The truth of this hypothesis involves the gaseous constitution of the nebulæ, but the recent researches of Mr. Lockyer and other considerations now render it almost certain that the immediately antecedent condition of the sun and planets was not a gas, but that they consisted of a swarm of loose stones or meteorites. There is thus apparently an absolute contradiction between the nebular hypothesis and the meteoric theory. The object of the lecture was, however, to point out that these two views may be reconciled with one another. The lecturer then suggested that in a celestial nebula the collisions of meteoric stones may play the same part as the collisions of gaseous molecules in ordinary air, and that in this manner a gaseous character may be imparted to a celestial nebula, although it may not consist of gas at all.

Proceeding to examine the details of this hypothesis, Professor Darwin arrived at the conclusion that the collisions of meteoric stones would be sufficiently like those of molecules to satisfy the conditions of the hypothesis. He maintained, therefore, that we are justified in believing in the substantial truths of the nebular hypothesis while still holding that stellar nebulæ consist of a swarm of loose stones in frequent collisions with one another. In conclusion, he spoke on the zodiacal light, on comets, and on shooting stars as evidence of the continued existence of meteorites in the solar system. These stones may be characterized as the dregs and sawdust of the system, the great majority of stones having been absorbed in the formation of the sun and planets.

SOME people are disposed to sneer at inventors and patents. Don't do it! Nine-tenths of the material prosperity of this American Union is due to inventors and their patents. A volume would not suffice to relate the many obligations we owe to the men whose patient investigation and ingenuity have cheapened processes and lessened labor for this prosperous people. Rather let us remove our hats before the man who has devised a machine by which we may get bread with less sweat. —*Safety Valve.*