stantly 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 meet 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.*