New York and other cities is a wonderful triumph of dustrial conditions may yet be gravely modified by the engineering practice. The electric trolley road is, however, the most powerful of these factors in what we have alluded to as the work remedial of the ills of modern centralization. From the central stations it sends industries into small units, we are confronted on the its power lines in all directions through the suburbs of cities, and at almost nominal charge carries passengers for miles at a speed of ten to twenty miles an hour or tion of interests. Thus we have the car shops of Pullmore. The city worker is no longer obliged to live in closely built up streets. The cars escape to the region of green fields. The trolley may yet modify cities until they become centers of work and not of residence.

The trolley line with single overhead wire and rail and ground return is not a satisfactory thing. Much damage has been done by escape, or rather branching, of current from its rails. The underground trolley has been in use on a couple of roads, one in Ireland and one in Hungary, but only recently has it been introduced into America. The cities of Washington and New York have excellent examples of it. As it avoids the unsightly aerial wires, with attendant dangers, and as the underground system has two insulated conductors, avoiding destruction of pipes by electrolysis, the best wishes of civic engineers should be extended to it.

The self-contained motor car which can work independently of any central station is still in embryo. Many are in use, especially in Paris, but they are few in number compared to the central station car lines. A car motor needs such an exceptional reserve of power that the problem of devising an adequate motor for it a new exposition. After having been started as world's is far from easy. The storage battery, for which such fairs and exhibitions of the industry of all nations, they boundless fields of utility are open as soon as it shall have become differentiated and special exhibitions become lighter and more practical, has been tried on have been prepared, covering either special articles or street cars and operates a number to-day. The explosion oil engine may yet solve the problem. Hitherto the weight of the motor mechanism and the difficulty of establishing a sufficient reserve of power are the difficulties to be overcome.

We have already alluded to cold storage. Another domestic use to which the science of the day has been devoted is the production of ice. Ice formerly was harvested entirely from natural sources. Now it is made an exposition where a mingling of history and art led artificially in great quantities, and every first class to the erection of the most magnificent group of buildocean steamer or large steam yacht can make its own ings and architectural trophies that the world has ever ice and cool its own refrigerators. In southern regions this art makes itself most directly felt, for Florida need no longer import ice from Maine. It can be made by machinery in quantities required for daily consumption.

The business man and the litterateur, even the newspaper reader, share in the advance. Quick processes of illustration have changed the daily journal into an illustrated publication, and color printing is used in it, as well as for works of the highest art.

The typewriter, a product really of the last twenty years, has effected a perfect revolution in the old time great fair ended, far outdoing anything that the world secretary's art. There is no longer the striving after a legible hand of definite style, but the even work of the typewriter makes the handwriting of a secretary a | It is hard to be believed that it will soon be surpassed. thing of no importance. The typewriter brings the It seems to represent the proper ending of the nearly writer's art in close juxtaposition with that of the fifty years period during which such fairs have been held. printer, and, following out the analogy, we find the modern printer in possession of machines for composing.

It has long been a dream with inventors to do away with the hand composition. Early in the fifties William Mitchell's type-setting and distributing machines were experimented with at the Trow printing office, in a wonderful tribute to the inventive genius of the this city, and were used for some years there. Other inventors attacked the problem in other ways; some devoted their efforts to the production of a matrix, by means of which a stereotype or electrotype could be the far sighted liberality of the patent statutes, originproduced. At last the idea of a matrix-setting in contradistinction to a type-setting machine occurred, individual counted for far more than in the present day and a complicated and highly ingenious machine was of fierce competition and wealthy combinations of capiinvented for carrying out this idea. This machine, the Mergenthaler, so called Linotype machine (which might individual inventor required the fostering protection of more properly be written Lineotype), set, by means of a key-board, individual letter moulds or matrices. For justification, wedge-shaped spaces or quads were enrichment of others and for the good of the country at used. These were inserted between words, and when large. In the first days of the republic exceedingly few the line was nearly filled and a syllabic division or end patents were granted, but about 1845 the system was in of a word was reached, the line was completed by full operation and the American nation already began thrusting in the wedges. This accomplished the miss- to be noted for its inventive powers. The training of ing function of preceding machines—the machine did vears of privation and isolation which characterized its own justification. When a line of moulds were set life in the sparsely settled region had caused the Ameriup the casting of metal against their faces was auto- can people to be self-reliant. A farmer separated matically done, and a "slug" of one complete line of many miles perhaps from the blacksmith shop, with text resulted. Quantities of printer's work is now done absolutely no machine shop within reach, with carpenon machines of this class. It marks the solution of a ters and other tradesmen few and far between, learned problem of four centuries' standing. A very important line of work is in the field of the gas and oil explosion engines. In these we have a long ed a high order of constructive and mechanical skill range of temperature change acting to reduce the low and a quick adaptation to circumstances that have now economy due to the second law of thermodynamics. These machines are now made without ignition tube, flame or electric spark igniter, and, as they operate without boiler and require scarcely any attention, they go far to bring power within the use of all. Ericsson, Roper, and others have done well in a parallel line of work with hot air engines, and the entire subject of displacement of the steam engine is affected by them as well as by electric motors. These smaller motors, be cause they require so little plant, are now entering into standing geniuses-men who in their work exercise the the daily life of the individual. They are used in small undefinable quality of invention-the most difficult

possibility of economically producing small units of power with small investment of capital.

While this indicates the possibility of the division of other hand by immense industrial settlements, the tendency of the day having brought about consolidaman, Ill., supporting a city. We see the great Carnegie Iron Works, at Homestead, Pa., covering 110 acres of ground and employing 8,000 men, a veritable industrial army, beyond the imaginations of the past generation.

Formerly watches and clocks were individual creations, the tradesman turning out the finished product from his little shop. Now the great factory produces them, employing every refinement of automatic machinery and specialized labor, the principle of interchangeability affecting the product to the last degree. The foreign industry has been profoundly affected, and the New England timekeeper equals in quality the best hand-made product of an earlier day.

Our theme in this retrospect has been the wonder of it all, and in that wonder every few years an awakening is observed which finds expression in what has become an institution of the last fifty years-great expositions. Started in England by Prince Albert, the Consort of Queen Victoria, with the World's Fair of 1851, held in London, every few years have witnessed the inauguration of special countries, and lately these exhibitions have been very numerous. But the long series is punctuated throughout at intervals of a few years by real world's fairs, each one in splendor and completeness striving to outdo its predecessor, until, in 1893, at the great Western metropolis, all former efforts were eclipsed by the Columbian Exposition, designed to commemorate the discovery of America by the great Genoese. It was seen-where the water from the lake made easy the introduction of water into the scene, which water, circulating in beautiful lagoons, was traversed by the Venetian gondola, the relic of past centuries, and by the elec tric launch, the production of the very moment-where the most beautiful art products of the world were fairly rivaled in interest by the trophies of the mechanics and technologists' art-where in the reproduction of the features of life in foreign lands the human element was made to vie in interest with all the rest. The had ever seen. The destruction of its buildings by fire formed a fitting culmination of its necessarily short life.

**** THE PATENT SYSTEM.

Up to the end of the year 1845, 3,873 patents had been issued by the Patent Office of the United States. When the year 1895 closed its course, the number was 531,619, American people and more wonderful because out of this great number comparatively few were issued to foreigners. The largeness of the number is a tribute to ally established by our forefathers in the days when the talists. Even in those days, it was recognized that the the law, and it was known that the best possible policy for the country was to grant him this protection for the to do everything himself, and it was unquestionable that in these early days the farmers of America displayimprinted themselves upon the entire American people. To-day the farmer has complicated machinery to take care of, and he does it successfully; small repairs he executes himself, and in him is found the true material that inventors are made of. The American race seeming by the force of circumstances to be destined to be mechanical, have developed among themselves a special genus or race, that of inventors, men who have been termed by the courts of highest machine shops, small boats are driven by them, and in-statutory requirement which the courts ever have to

define; and it is this race of inventors who spend their lives far too often in perpetual striving and in poverty, while really working for the good of humanity, in the simple hope that their efforts will be appreciated by the cold business sense of mankind and that the selfish interest of the world will give them their reward. They and their work are the constant exponents of the theory of the patent statutes, a theory little understood, and one which it seems as if the very courts of law themselves sometimes fail to grasp, and for whose enlightened elucidation the decisions of old time judges, the ornaments of the American judicial bench, can be appealed to with the certainty that the inventor will there receive his due.

The theory of the patent law is simple. The country is enriched by inventions, and offers for them a small premium; this premium is a seventeen years' monopoly of their fruit-no more, no less. Having purchased the invention for this insignificant price, the purchase is consummated by the publication in the patent records of the details of the invention, so that he who runs may read. The whole thing is a strictly business transaction, and this character is emphasized by the fact that the inventor is required to pay for the clerical and expert labor required to put his invention into shape for issuing. His patent fees are designed to cover this expense, and do so, with a considerable margin to spare. Thus the people of the United States are perpetually being enriched by the work of inventors, at absolutely no cost to themselves.

The inventor does not work for love nor for glory alone, but in the hopes of a return for his labor. Glory, and love of his species, are elements actuating his work, and in many cases he invents because he cannot help himself, because his genius is a hard task master and keeps him at work. But none the less, the great incitement to invention is the hope of obtaining a valuable patent, and without this inducement inventions would be few and far between, and America would, without the patent system, be far in arrears of the rest of the world, instead of leading it, as it does to-day. The few pregnant sentences of the patent statutes, sentences the force of whose every word has been laboriously adjudicated by our highest tribunal, the Supreme Court of the United States, are responsible for America's most characteristic element of prosperity, the work of her inventors.

It would be idle to attempt to recapitulate here the great inventions of the last fifty years, for their name is legion. Morse's unequaled work in telegraphy, Reis' pathetic struggle to invent the telephone; the development of the dynamo by a host of ingenious inventors; the development of the compound and multiple expansion steam engine from the engine of fifty years ago, which was practically what was left by the great inventor Watt from the last century; the unequaled inventions in the world of steel, in bridge building and in naval engineering; the sewing machine; typewriters; these and myriad others will occur to the reader of our columns, and from the contemplation of it all but one moral can be drawn, one lesson deduced. We are indebted for most of this progress to the patent system. America's progress is a direct plea for the protection of the inventor.

Take away from the inventor the pecuniary reward of his invention, and what stimulus is there, especially if he be a poor man, for him to devote his time and energies to the development of his ideas? Those who read in these pages of the struggle against poverty of Morse and Howe and Wilson and a score of others while they were developing their inventions, will understand that finally these men received the reward for their unswerving devotion to their work. The sewing machine industry is a case in point ; while the patents remained in force, the business was enormously profitable, and these machines of American invention were introduced all over the world. Several of the large companies have taken up the manufacture of bicycles, while others have been forced into bankruptcy.

If the American patent system be changed in any way. the path of the inventor should be made an easier one and his rights should be more sedulously guarded than ever. The work of invention is going on in all lands, and any cessation in activity on the part of the American inventor will go to reduce America's rank in the world of nations. In the present epoch, a very short period will be required to leave us hopelessly distanced in the competition. Any blow at her inventors will be a blow at the very heart of America's industrial life and material and intellectual prosperity, and it is hard to believe that such a blow will ever be given. The following figures give an idea of the development of American inventions during the past fifty years :

				no pase me,	, ,
United St	ates patents	and reis	sues issue	d in 1845	508
66		66	**	1855	2.013
68	65	44	66		6.616
	64	44	*		14,837
	"	66			24,233
4	4	44	44		22,057
Greatest number issued in any year since 1845, 1890					
Smallest	44	66 ⁻ 16		1845	503
Patents issued for carriages and wagons					
56	sto	ves and	furnacea		18,972
64	™ ele	ctrical in	ventions		18.052
64	14 ch	Intel acru	tle and h	uttons	19,177
64	14 D.4	cking an	d storing	vessels	11 999
44	44 a 1		a sooring		10 94 7
44		ropatore	••• ••••	•••••	10,394
•					
Class for which smallest number of patents were issued :					
Silk					108
				••••••••••••	100