Scientific American.

ESTABLISHED 1845.

MUNN & COMPANY, Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

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THE EFFECT OF INVENTIONS ON THE PEOPLE'S LIFE.

The material world has advanced so rapidly during the last half century, and with a pace so accelerated, that mankind has almost lost one of its most important faculties, and one essential to happiness—that of surprise. The nil admirari faculty is attaining a wide spread. The most marvelous developments are taken as a matter of course—the condition of things fifty years ago is seldom pictured to the mind—and all the material blessings which we now enjoy are used as conveniences of daily life, and no more. Formerly there was an idea prevalent that surprise and astonishment were emotions of the ignorant. To-day they are rather emotions of the scientist. The educated engineer cannot without such emotions contemplate the insignificant feed wire of a trolley road carrying silently hundreds of horse power to points all along the line—he cannot without these feelings contemplate the electric motors, drawing power in proportion to the work they have to do, all regulated by the automatic government of counter-electromotive force—he cannot see the unstable though gigantic ocean liner filled with every refinement of electrical and mechanical art, all working perfectly on their never quiet, never level platforms—he cannot follow the construction of a cantilever bridge with the ensuing changes from compressive to tensile stress and the reverse, as the span is completed—these things all excite in him such emotions that he cannot observe them and know them without a feeling of true astonishment at the achievements of mankind.

Our other columns at once, in their fullness and necessary and inevitable inadequacy, bear testimony to the status of our age. They are filled with most interesting matter from the pens of specialists. Yet in spite of the special competency of their authors, all acknowledged authorities—notwithstanding the pages of matter and quantities of illustrations—we feel that the task of telling about the progress of a lifetime can at the least be only inadequately performed—so much has been done.

The temptation is to consider the greater things, to contemplate the 600 foot steamer crossing the Atlantic through storm and sunshine—the open hearth furnace with its tons of steel, fluid as water and resembling molten silver—the immense steam engine and great hydraulic power plant. But we may usefully leave for the moment the monumental works of the last half century and see what changes have been effected in our daily life by the movement of progress.

The steam engine has been greatly improved, and in the articles on naval progress and the locomotive much will be found on its development. The Corliss valve motion and the compounding of cylinders, leading to more perfect expansion and a longer range of working temperature limits, have brought about great economy so that one-tenth the fuel will do the same work as compared with many engines of the middle of the century. In details, such as the supply of water to the boilers by injectors and inspirators, doing away with the feed pump, the machine stoker for supplying fuel, and the feeding of oil drop by drop to the cylinder, the drops passing through a glass tube so as to give sight feed lubrication, the steam power plant has had many and great developments.

The machine shop has not been neglected, and America can boast of the finest machine tools, for wood and metal, such as automatic lathes, milling machines and shapers, that the world can show. The development of abrasives, emery and carborundum, has made the emery grinder a necessary tool in every machine shop. The miner even shares in the advance, special machinery for extraction of ore, for undercutting and drilling being invented, while modern explosives of graduated power and quickness make the work of placing shots much safer. Compressed air has been used in some classes of underground work, but electricity is making its presence felt there also, and electric machinery for tunneling and mining is in extensive use.

The work of St. Clair Deville in the days of the last Napoleon have borne fruit, and now aluminum has a recognized place among commercial metals. In its reduction the electric furnace and the electrolysis of fused salts have been tried, and the cheapened production of sodium has had its effect on the cost of production.

The lightness of the metal led to hopes that it might lead to the construction of a flying machine. The development of the laws of moving aeroplanes have given a better basis perhaps in this direction than any preceding work, and the theory of the internal energy of the atmosphere gives a possibility of the solution of the problem of soaring flight. Yet very little has been really accomplished, although more has been done during the last five years to raise the rational hopes for true mechanical flight than during the fifty years that preceded.

Food for the family is now procurable in endless variety, independent of the season of the year. The enormous development of the canned goods industry, of cold storage and of cheap transportation makes the salmon of Oregon, the delicate fruits of California, and the vegetables of the West familiar to the residents of the most distant cities. The winter kitchen can have every summer vegetable, and the feats of the Romans in supplying the tables of its emperors are daily surpassed, only it is now done for the benefit of the poor. Even in the treatment of food, notably of the cereals, there is great advancement, and the roller mill turns out flour of greatly improved quality, and with larger yield from the grain than was done by the old grist mills.

In the matter of the transportation of water the most impressive achievements of engineering are executed in order that at the turning of a kitchen faucet water may flow into the kettle of the cook. The contrast between old and new methods is nowhere more forcibly presented than in the two Croton aqueducts—one of the year 1842, following approximately a contour line from the Croton Lake to the Central Park, New York, its path being traceable from the surface over nearly all its extent—the new one of 1890 driven deep underground wherever possible, as a matter of preference, and built without surface disturbance except at the shafts and in one or two difficult places. To supply cities with water through such aqueducts, great dams are built or natural lakes are utilized. The fact that the lake or dam is to be fifty or more miles distant plays no part.

Perhaps the manufacture of shoes supplies as good an illustration as any of the substitution of factory for hand work in supplying domestic wants. The American shoe factory with its workshops filled with machinery and with trained operatives, each practiced in performing one single operation, using ingenious sewing machines, producing welt shoes or shoes without welt, sends its products to all parts of the world, and the hand made shoe is used less and less.

Foremost among the developments of the last half century is the India rubber industry. The discovery of the vulcanization of India rubber at once brought into the realm of practical uses a unique material, India rubber. At first it had been unsatisfactory, subject to change of qualities and uncertain in every way and affected by variations in temperature. But Goodyear's great invention of vulcanization produced a new and wonderful material, which has affected every department of modern life, and which, as not the least of its achievements, has created the modern pneumatic bicycle. It is hard to believe that this invention only goes back a little over fifty years.

In the march of progress the farmer has participated. Reaping, mowing, raking, harvesting, plowing, and cultivating, form but an incomplete statement of work now executed for him by machinery. Steam has long been used to do his work—now electricity is stepping in to his assistance, and we find an electric plow under trial. Patent churns, centrifugal and deep pan cream separators make his dairy work easy, and it is further simplified by the creamery to which he delivers his milk for butter and cheese making by machinery. To-day America exports cheese in enormous quantities, and many a tourist has eaten in foreign lands, under foreign titles, cheese from cheese factories of the Empire State.

The stock farmer who raises cattle for market to supply meat is not neglected. His market has expanded enormously, until the "roast beef of old England" has to be supplied by countries thousands of miles away from London. Cattle ships, which in all their appointments represent the finest marine engineering, receive them and they are dispatched across the ocean with as little concern or uncertainty as if it were a ferry which was to be crossed. The docks on the Thames receive steamer load after steamer load of cattle for the supply of the great metropolis and of the country at large. It really seems as if, without modern improvements, the world would have to go unfed. It would be fairer to say that it is the concentration of population in such centers as London and New York which has made it necessary to provide food supply by such methods. Under the conditions of former days, in a society more in accord with Mr. Ruskin's ideas, we might find the cattle ranges dotted with little villages, and London as yet not unified and consolidated, its constituent settlements still having independent existence. At present it is the other way, and there are in the West, deserted cities whose inhabitants were unable to resist the tendencies of the day. The cattle trade and food supply systems indicate the tendency of the world toward life in great centers of population. The deserted farms of New England, like the deserted cities of the West, tell the same story.

There is often a companionship in disease and its remedy. Cities grow large, and dwellers in the suburbs identify themselves with the metropolis. For their benefit special rapid transit methods are developed. It is very few years since the horse car was welcomed by the American city as an improvement on the old rattling omnibus. The writer recollects the day when there were many omnibus lines in New York and when the horse railroads of Philadelphia were an object of pride and rejoicing. Now all is changed. The horse railroad is archaic, and with a few exceptions in the way of compressed air, steam and electric motors, transit within city limits is done by central station methods. The city resident who desires to see the finest example of steam engineering has but to visit the power plant of his municipal railroad. The maintenance day after day and month after month of the great cable roads of

New York and other cities is a wonderful triumph of 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 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 more. 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 is far from easy. The storage battery, for which such boundless fields of utility are open as soon as it shall become lighter and more practical, has been tried on 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 artificially in great quantities, and every first class ocean steamer or large steam yacht can make its own 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 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 thing of no importance. The typewriter brings the writer's art in close juxtaposition with that of the 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 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 produced. At last the idea of a matrix-setting in contradistinction to a type-setting machine occurred, and a complicated and highly ingenious machine was invented for carrying out this idea. This machine, the Mergenthaler, so called Linotype machine (which might 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 used. These were inserted between words, and when the line was nearly filled and a syllabic division or end of a word was reached, the line was completed by thrusting in the wedges. This accomplished the missing function of preceding machines—the machine did its own justification. When a line of moulds were set up the casting of metal against their faces was automatically done, and a "slug" of one complete line of text resulted. Quantities of printer's work is now done on machines of this class. It marks the solution of a 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 range of temperature change acting to reduce the low 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, because they require so little plant, are now entering into the daily life of the individual. They are used in small machine shops, small boats are driven by them, and industrial conditions may yet be gravely modified by the possibility of economically producing small units of power with small investment of capital.

While this indicates the possibility of the division of industries into small units, we are confronted on the other hand by immense industrial settlements, the tendency of the day having brought about consolidation of interests. Thus we have the car shops of Pullman, 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 a new exposition. After having been started as world's fairs and exhibitions of the industry of all nations, they have become differentiated and special exhibitions have been prepared, covering either special articles or 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 an exposition where a mingling of history and art led to the erection of the most magnificent group of buildings and architectural trophies that the world has ever 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 electric 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 great fair ended, far outdoing anything that the world had ever seen. The destruction of its buildings by fire formed a fitting culmination of its necessarily short life. It is hard to be believed that it will soon be surpassed. It seems to represent the proper ending of the nearly fifty years period during which such fairs have been held.

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, a wonderful tribute to the inventive genius of the 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 the far sighted liberality of the patent statutes, originally established by our forefathers in the days when the individual counted for far more than in the present day of fierce competition and wealthy combinations of capitalists. Even in those days, it was recognized that the individual inventor required the fostering protection of the law, and it was known that the best possible policy for the country was to grant him this protection for the enrichment of others and for the good of the country at large. In the first days of the republic exceedingly few patents were granted, but about 1845 the system was in full operation and the American nation already began to be noted for its inventive powers. The training of years of privation and isolation which characterized life in the sparsely settled region had caused the American people to be self-reliant. A farmer separated many miles perhaps from the blacksmith shop, with absolutely no machine shop within reach, with carpenters and other tradesmen few and far between, learned to do everything himself, and it was unquestionable that in these early days the farmers of America displayed a high order of constructive and mechanical skill and a quick adaptation to circumstances that have now imprinted 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 standing geniuses—men who in their work exercise the undefinable quality of invention—the most difficult 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:

United States patents and reissues issued in				1845	503
"	"	"	"	1855	2,013
"	"	"	"	1865	6,616
"	"	"	"	1875	14,837
"	"	"	"	1885	24,233
"	"	"	"	1895	22,057
Greatest number issued in any year since 1845, 1890					26,292
Smallest "	"	"	"	1845	503
Patents issued for carriages and wagons					20,821
"	"	stoves and furnaces			18,972
"	"	electrical inventions			18,052
"	"	clasps, buckle and buttons			12,177
"	"	packing and storing vessels			11,323
"	"	plows			10,342
"	"	harvesters			10,334
"	"	mills			10,048
Class for which smallest number of patents were issued:					
Silk					108