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THE PRIZE ESSAY OF OUR SEMI-CENTENNIAL ANNIVERSARY NUMBER.

We take much pleasure in announcing that the winning essay in our prize competition on the subject of the progress of invention during the past fifty years was written by Mr. Edward W. Byrn, of Washington, D. C.

The names of the writers of the five next best essays, to be published in subsequent issues of the SCIENTIFIC AMERICAN SUPPLEMENT, are as follows: Edmund Becker, Washington, D. C.; George M. Hopkins, Brooklyn, N. Y.; Gardner D. Hiscox, New York City; Frederic de Garis, Patchogue, Long Island, and A. M. Farlow, Barlow, Ohio.

When our readers learn that the successful essay was closely pressed for first place by many of its competitors, they will understand that the competition, taken as a whole, was of an exceptionally high order. As compared with the half dozen essays which head the list, the balance of the manuscripts are rated by the judges at a high standard, and we may say that there are few that lapse into mere mediocrity.

This result is particularly creditable to the competitors, and especially so, when we bear in mind the great breadth of the subject and the amount of careful research that was necessary to its ample but discriminating treatment. We were guided in our selection of this subject as much by the fact that to handle it successfully would involve many hours of careful preliminary reading, as by the fact that it was specially appropriate to a semi-centennial number. The result has fully justified our expectations, and our readers will find that the winning essay, which we publish in the adjoining columns, and those which will follow in consecutive numbers of the SCIENTIFIC AMERICAN SUPPLEMENT, bear the internal evidence of careful and systematic research.

The presence of college students among the competitors calls for mention of the fact that the proximity of the summer examinations has shut out many college men from this competition; and the efforts of those who did send in their essays call for a word of special recognition.

It is an interesting fact, worthy of record here, that the interest in the competition was not confined to America, but that it brought some excellent MSS. to this office from different quarters of the globe. Any further discussion of the merits of the essays can best be given in the words of Judge A. P. Greeley, of the Patent Office, Washington, who, in forwarding his report, says: "Many of those which I have placed somewhat low on the list are of decided merit, and only fail of higher rating because of failure to cover the broad field of invention. Some of them show a remarkably full and accurate knowledge on particular lines, without the broad grasp of the whole field.

"I have been much interested in these essays. They evidence a widespread knowledge and appreciation of the progress that has been made in the last fifty years. It has been by no means easy to determine the best one of the half dozen or more at the top of the list; but the selection I have made is the result of careful consideration, and is my best judgment in the matter."

The result of the vote on the question as to what invention introduced during the past fifty years has conferred the greatest benefit upon mankind places Bessemer Steel in the place of honor. Then come the Telephone and the Telegraph—though we think the relative order of these two should more justly be inverted. Following these come the Sewing Machine, the Reaper, the Electric Light, the Electric Motor, the Bicycle, the Grain Binder and the Westinghouse Air Brake. There were several miscellaneous votes, which we cannot give in detail; but our readers will pardon our mentioning with all modesty that not a few correspondents wrote that the SCIENTIFIC AMERICAN has conferred the greatest benefit upon mankind. While we cannot agree with this opinion, we appreciate highly the kind feeling which prompts the sentiment.

In the course of the past fifty years expressions of good will like this have been by no means infrequent; and we enter upon the second half century of our journalistic life with the confidence that these cordial relations between ourselves and our subscribers will strengthen as the years go by.

Our cordial thanks are due to Judge A. P. Greeley, of the Patent Office, Washington; Prof. R. H. Thurston, of Cornell University; and Prof. R. S. Woodward, of Columbia University, for the valuable service they have rendered in acting as a jury in the above competition. It would be difficult to find three gentlemen whose time is more fully occupied; and that they should have taken in hand just now a matter involving so much careful attention places both ourselves and our readers under a debt of obligation which we take this opportunity to acknowledge.

$250 PRIZE ESSAY COMPETITION.

THE AWARD.

Editor SCIENTIFIC AMERICAN:

Dear Sir: Having completed our examination of the essays on the subject of "The Progress of Invention During the Past Fifty Years," we beg to announce that the essay receiving the highest average rating was written by "Beta," who, on opening the sealed envelope accompanying the manuscript, was found to be Mr. Edward W. Byrn, of Washington, D. C. To him, therefore, the prize of $250 should be awarded. The names and addresses of the five authors receiving the next highest average ratings are given in order below. It remains only to add that each member of the committee examined the essays independently, marking them on a scale of 100, and that the average of the three independent ratings was taken in each case for the final rating of an essay.

"Liberty," Edmund Becker, office of Lighthouse Board, Treasury Department, Washington, D. C.
"Investigator," George M. Hopkins, Brooklyn, N. Y.
"Semper Fidelis," Gardner D. Hiscox, N. Y. City.
"Verbum Sap. III," Frederic de Garis, Patchogue, Long Island, N. Y.
"A. Malcom," A. M. Farlow, Barlow, O.

Very truly yours,
R. H. THURSTON, Cornell University.
A. P. GREELEY, U. S. Patent Office.
R. S. WOODWARD, Columbia Univ.
Committee.

THE PROGRESS OF INVENTION DURING THE PAST FIFTY YEARS.

PRIZE ESSAY BY "BETA" (EDWARD W. BYRN, A.M.)

If the life of man be threescore years and ten, fifty years will about mark the span of ripe manhood's busy labor, and the sage of to-day, turning back the pages of memory, may, as the times pass in review, enjoy the rare privilege of personal observation of, direct contact with, and positive knowledge concerning the events of this prolific period. To him what a vista it must present; what a convergence of the perspective; for the past fifty years represents an epoch of invention and progress unique in the history of the world. It is something more than a merely normal growth or natural development. It has been a gigantic tidal wave of human ingenuity and resource, so stupendous in its magnitude, so complex in its diversity, so profound in its thought, so fruitful in its wealth, so beneficent in its results, that the mind is strained and embarrassed in its effort to expand to a full appreciation of it. Indeed, the period seems a grand climax of discovery, rather than an increment of growth. It has been a splendid, brilliant campaign of brains and energy, rising to the highest achievement amid the most fertile resources, and conducted by the strongest and best equipment of modern thought and modern strength.

The great works of the ancients are in the main mere monuments of the patient manual labor of myriads of workers, and can only rank with the buildings of the diatom and coral insect. Not so with modern achievement. This last half century has been peculiarly an age of ideas and conservation of energy, materialized in practical embodiment as labor-saving inventions, often the product of a single mind, and partaking of the sacred quality of creation.

The old word of creation is, that God breathed into the clay the breath of life. In the new world of invention mind has breathed into matter, and a new and expanding creation unfolds itself. The speculative philosophy of the past is but a too empty consolation for short-lived, busy man, and, seeing with the eye of science the possibilities of matter, he has touched it with the divine breath of thought and made a new world.

It is so easy to lose sight of the wonderful, when once familiar with it, that we usually fail to give the full measure of positive appreciation to the great things of this great age. They burst upon our vision at first like flashing meteors; we marvel at them for a little while, and then we accept them as facts, which soon become so commonplace and so fused into the common life as to be only noticed by their omission.

Perhaps, then, it will serve a better purpose to contrast the present conditions with those existing fifty years ago. Reverse the engine of progress, and let us run fifty years into the past, and practically we have taken from us the telegraph, the sewing machine, the bicycle, the reaper and vulcanized rubber goods. We see no telephone, no cable nor electric railways, no electric light, no photo-engraving, no photo-lithographing nor snapshot camera, no gas engine, no web perfecting printing press, no practical woodworking machinery nor great furniture stores, no passenger elevator, no asphalt pavement, no steam fire engine, no triple expansion steam engine, no Giffard injector, no celluloid, no barbed wire fence, no time lock for safes, no self-binding harvester, no oil nor gas wells, no ice machines nor cold storage. We lose the phonograph and graphophone, air engines, stem winding watches, cash registers and cash carriers, the great suspension bridges, iron frame buildings, monitors and heavy ironclads, revolvers, torpedoes, magazine guns and Gatling guns, linotype machines, all practical typewriters, all pasteurizing, knowledge of microbes or disease germs, and sanitary plumbing, water gas, soda water fountains, air brakes, coal tar dyes and medicines, nitro-glycerine, dynamite and guncotton, dynamo electric machines, aluminum ware, electric locomotives, Bessemer steel, with its wonderful developments, ocean cables, etc. The negative conditions of that period extend into such an appalling void that we stop short, shrinking from the thought of what it would mean to modern civilization to eliminate from its life these potent factors of its existence.

As the issue of patents in this country is based upon novelty, it will aid us in the effort to appreciate this great movement to note the increase of United States patents in the past fifty years. Beginning in 1846, and dividing the time into periods of five years, the increase is shown most graphically in the scaled diagram No. 1.

If the growth of United States patents and the progress of the last half century can be taken as fairly correlated, what an insignificant thing is the little attenuated triangle back of 1846 compared with the swelling curves of the later period! It is probably safe to say that fully nine-tenths of all the material riches and physical comforts of to-day have grown into existence in the past fifty years.

It is interesting to observe how closely the grant of patents and the prosperity of the country are related. Referring to scaled diagram No. 2, the zigzag line marks the increase or decrease in the patents issued from year to year. We note the depression of the civil war, followed by the rapid reaction and growth of reconstruction. Again, the depression caused by the financial panic of 1873, and again in 1876, the unsettled and dangerous condition of politics incident to the contested presidential election. This was followed by another wave of prosperity, indented with depressions in the presidential election years, while the stringency of the times from 1890 to 1894 shows a marked influence in the corresponding depression in the line, all of which indicates a most sympathetic relation.

Passing now to the chronological development of the period, Morse had just harnessed the most elusive steed of all Nature's forces, and put it in the permanent service of man; when nitro-glycerine, discovered by Sobrero, in 1846, for the first time lent its terrible emphasis, and seemed to bring an awakening of the dormant genius of man.

Within the first decade (1846-1856) came the sewing machine, Bain's chemical telegraph, the Suez Canal, the House printing telegraph, the McCormick reaper, the discovery of the planet Neptune, the Corliss engine, the collodion and dry plate processes in photography, the Ruhmkorff coil, the Bass time lock for safes, the electric fire alarm of Channing & Farmer, Gintle's duplex telegraph, the sleeping car of Woodruff, Wilson's four-motioned feed for the sewing machine, Ericsson's hot air engine, the Niagara suspension bridge, and the building of the Great Eastern.

The next decade (1856-1866) brought with it the Atlantic cable, the discovery of the aniline dyes by Perkin, the making of paper pulp from wood, the discovery of coal oil in the United States, the invention of the circular knitting machine, the Giffard injector, for supplying feed water to steam boilers; the discovery of caesium, rubidium, indium and thallium; the McKay shoe sewing machine, Ericsson's ironclad monitor, Nobel's explosive gelatine, the Whitehead torpedo, and the first embodiment of the fundamental principles of the dynamo electric generator by Hjorth, of Denmark.

The next decade (1866-1876) marks the beginning of the most remarkable period of activity and development in the history of the world. The perfection of the dynamo, and its twin brother the electric motor, by Wilde, Siemens, Wheatstone, Varley, Farmer, Granime, Brush, Weston, Edison, Thomson, and others, soon brought the great development of the electric light and electric railways. Then appeared the Bessemer process of making steel; dynamite; the St. Louis bridge; the Westinghouse air brake; and the middlings purifying and roller processes in milling. That great chemist and probably greatest public benefactor, Louis Pasteur, added his work to this period; the Gatling gun appeared; great developments were made in ice machines and cold storage equipments; machines for making barbed wire fences; compressed air rock drills and the Mont Cenis tunnel; pressed glassware; Stearns duplex telegraph, and Edison's quadruplex; the cable car system of Hallidie, and the Janney car coupler; the self-binding reaper and harvester; the tempering of steel wire and springs by electricity; the Lowe process for making water gas; cash carriers for stores; and machines for making tin cans.

With the next decade (1876-1886) there arose a star of the first magnitude in the constellation of inventions. The railway and telegraph had already made all people near neighbors, but it remained for the Bell telephone to establish the close kinship of one great talkative family, in constant intercourse, the tiny wire, sentient and responsive to the familiar voice, transmitting the message with tone and accent unchanged by the thousands of miles of distance between. Then come in order the hydraulic dredges, and Mississippi jetties of Eads; the Jablochkoff electric candle; photography by electric light; the cigarette machine; the Otto gas en-

gine; the great improvement and development of the typewriter; the casting of chilled car wheels; the Birkenhead and Rabbeth spinning spindles; and enameled sheet iron ware for the kitchen. Next the phonograph of Edison appears, literally speaking for itself, and reproducing human speech and all sounds with startling fidelity. Who can tell what stores of interesting and instructive knowledge would be in our possession if the phonograph had appeared in the ages of the past, and its records had been preserved.

The voices of our dead ancestors, of Demosthenes and Cicero, and even of Christ himself speaking as he spake unto the multitude, would be an enduring reality and a precious legacy. In this decade we also find the first electric railway operated in Berlin; the development of the storage battery; welding metals by electricity; passenger elevators; the construction of the Brooklyn bridge; the synthetic production of many useful medicines, dyes, and antiseptics, from the coal-tar products; and the Cowles process for manufacturing aluminum.

In the last decade (1886-1896) inventions in such great numbers and yet of such importance have appeared that selection seems impossible without doing injustice to the others. The graphophone; the Pullman and Wagner railway cars and vestibuled trains; the Harvey process of annealing armor plates; artificial silk from pyroxyline; automobile or horseless carriages; the Zalinski dynamite gun; the Mergenthaler linotype machine, moulding and setting its own type, a whole line at a time, and doing the work of four compositors; the Welsbach gas burner; the Krag-Jorgensen rifle; Prof. Langley's aerodrome; the manufacture of acetylene gas from calcium carbide; the discovery of argon; the application of the cathode rays in photography by Roentgen; Edison's fluoroscope for seeing with the cathode rays; Tesla's discoveries in electricity, and the kinetoscope, are some of the modern inventions which still interest and engage the attention of the world, while the great development in photography, and of the web perfecting printing press, the typewriter, the modern bicycle, and the cash register is beyond enumeration or adequate comment.

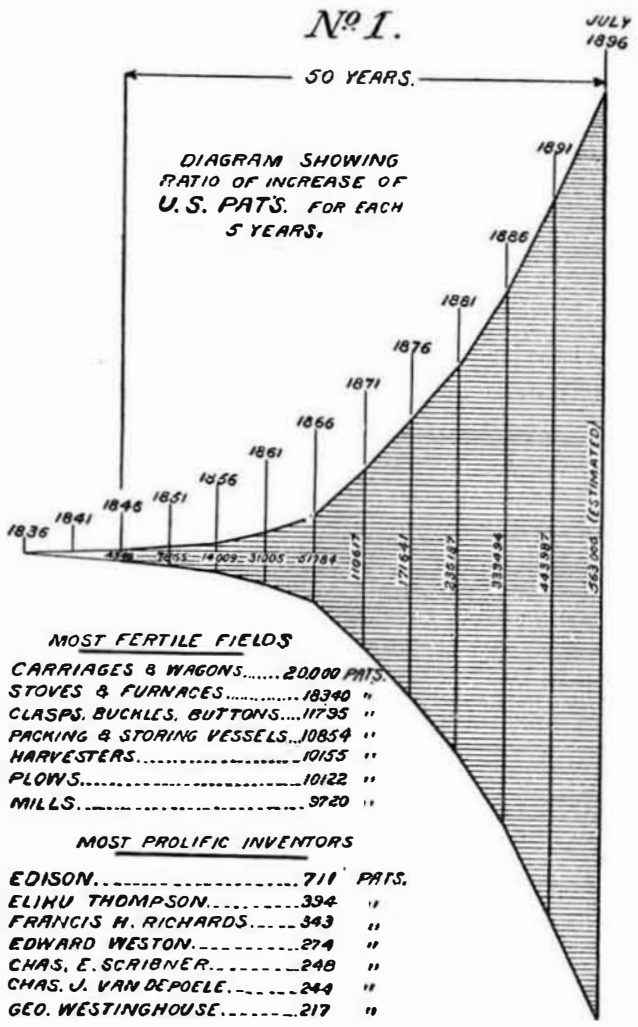
Looking at this campaign of progress from an anthropological and geographical standpoint, it is interesting to note who are its agents and what its scene of action. It will be found that almost entirely the field lies in a little belt of the civilized world between the 30th and 50th parallels of latitude of the western hemisphere and between the 40th and 60th parallels of the western part of the eastern hemisphere, and the work of a relatively small number of the Caucasian race under the benign influences of a Christian civilization.

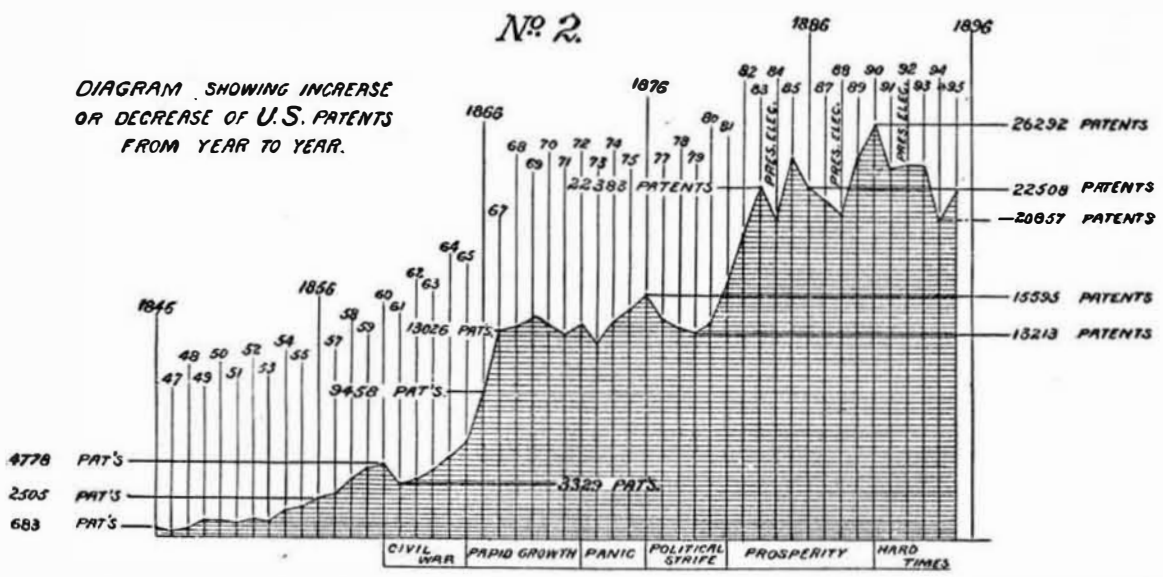
Remembering, furthermore, that most of this great development is of American authorship, does it not appear plain that all this marvelous growth has some correlation that teaches an important lesson? Why should this mighty wave of civilization set in at such a recent period, and more notably in our own land, when there have been so many nations far in advance of us in point of age? The answer is to be found in the beneficent institutions of our comparatively new and free country, whose laws have been made to justly regard the inventor as a public benefactor, and the wisdom of which policy is demonstrated by the growth of this period, amply proving that invention and civilization stand correlated—invention the cause and civilization the effect.

This retrospect, necessarily cursory and superficial, brings to view sufficient of the great inventions as milestones on the great roadway of progress to inspire us with emotions of wonder and admiration at the resourceful and dominant spirit of man. Delving into the secret recesses of the earth, he has tapped the hidden supplies of Nature's fuel, has invaded her treasure house of gold and silver, robbed Mother Earth of her hoarded stores, and possessed himself of her family record, finding on the pages of geology sixty millions of years existence. Peering into the invisible little world, the infinite secrets of microcosm have yielded their fruitful and potent knowledge of bacteria and cell growth. With telescope and spectroscope he has climbed into limitless space above, and defined the size, distance and constitution of a star millions of miles away. The lightning is made his swift messenger, and thought flashes in submarine depths around the world, the voice travels faster than the wind, dead matter is made to speak, the invisible has been revealed, the powers of Niagara are harnessed to do his will, and all of Nature's forces have been made his constant servants in attendance. We witness a new heaven and a new earth, contemplation of which becomes oppressive with the magnitude and grandeur of the spectacle, and involuntarily we find ourselves asking the question, "Is it all done? Is the work finished? Is the field of invention exhausted?" It does seem that it is quite impossible to again equal the great inventions of this wonderfully prolific epoch; but as these great inventions, which now seem commonplace to us, would have seemed quite impossible to our ancestors, we may indulge the hope of future possibilities beyond any present conception, but onward and upward in the great evolution of human destiny.

Rejoicing in our strength and capabilities, the new light of man's power and destiny breaks more clearly over us, and content with the infinite quality of mind and matter, the teachings of philosophy, and the facts of evolution, we rest in the assurance of positive knowledge that all that has been done in the past is merely preliminary, that human ingenuity knows no limit, and so long as man himself remains hedged about with the limitations of mortality and the conditions of growth, so long will his strivings and attainments be infinite.

BETA.





STEEL.

The term steel signifies iron containing a small percentage of carbon, and in modern times the term has become extended so as to indicate iron containing an almost infinitesimal amount of carbon, provided the metal is produced by the open hearth or Bessemer process. In the early ages of the world meteoric iron, a close representative of modern nickel steel, was used by the ancients. The art of producing iron in the primitive fining hearth, analogous to a blacksmith's forge, goes back to an early date. Then the blast furnace was invented, and cast iron, containing a larger percentage of carbon than steel contains, was produced. In the intense heat of the blast furnace, with its prolonged contact with the fuel and gases of combustion, the iron absorbed over two per cent of carbon. Such iron is termed cast iron.

With the exception of some special processes, the majority of steel in early days was produced from wrought iron. The latter was made from cast iron by the puddling process. The cast iron in the form of pigs was melted on the hearth of a reverberatory furnace in contact with iron cinder and iron ore, accompanied by constant stirring of the melted metal. The carbon was gradually oxidized, and wrought iron quite free from carbon was produced. This, after being worked down into shape by hammers and rolls, was inclosed in cases with shavings of horn and similar material and heated to a high heat for many hours. The metal absorbed carbon for the second time, and when removed from the boxes showed a blistered surface, and was termed blister steel. It was worked over to produce spring steel and shear steel, or was broken into pieces and melted in crucibles to produce cast steel, the crucibles holding from thirty to fifty pounds of steel.

Puddling involved a constant stirring and working of the metal with a pokerlike tool termed a rabble. This seemed to involve much labor, and many attempts were made to get rid of it. Various forms of mechanical puddling machines were manufactured, and about 1870 a great deal of attention was attracted by the American Danks rotary puddling furnace, the proof of which is given in the fact that it was elaborately examined in 1871 by a committee of English iron masters, who actually imported 40 tons of pig iron from England to test it with. This is cited to show the importance attached at so late a period to the old puddling process. It seemed obvious that, by puddling cast iron to a point when a portion of the carbon only was removed, steel might be directly produced; and the iron and steel world of the later sixties was intensely interested in the production of puddled steel, which then offered the only prospect of producing steel in large units. Many minor inventions were made in the production of steel until the world was ready to receive the monumental one, termed the "Bessemer process."

Sir Henry Bessemer early began his experiments on the production of steel from pig iron by the use of an air blast. His work was done principally in the fifties, and as evolved and developed by constant experiment, it took the shape of the following steps: Cast iron was melted in a cupola or a reverberatory furnace, and then was run into a vessel near whose bottom or in whose bottom were a number of blow holes, and through which, before the introduction of the metal, a blast under heavy pressure was maintained. The hot iron was run in, and as the blast was forced through it, its carbon and silicon were burned out and its temperature rose enormously, the carbon and silicon of the