Transcribers' Note: Greek transliterations were added by the transcribers and enclosed in {curly braces.}

# GREAT FACTS.

**THE "GREAT EASTERN" STEAMSHIP, LAUNCHED 1858.**

GREAT FACTS: A POPULAR HISTORY AND DESCRIPTION OF THE MOST REMARKABLE INVENTIONS DURING THE PRESENT CENTURY.

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ILLUSTRATED WITH NUMEROUS ENGRAVINGS.

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## PREFACE.

The conveniences, the comforts, and luxuries conferred on Society by the many important Inventions of the present century, must naturally excite a desire to know the origin and progress of the application of scientific principles, by which such advantages have been gained.

Practically considered, those Inventions are of much greater value than the discoveries of Science on which most of them depend; and the scientific inquirer who confines his views to abstract principles, without looking beyond them to the varied methods of their application to useful purposes, may be compared to a traveller who, having toiled arduously to gain the top of a mountain, then shuts his eyes on the prospect that lies before him.



To the inquiring youth, more particularly, it is desirable that he should be enabled to satisfy his wish to know by what means such wonders as Steam Navigation, Locomotion on Railways, the Electric Telegraph, and Photography have been gradually developed; and in becoming acquainted with the successive steps by which they have advanced towards their present perfection, he will at the same time learn a useful lesson of perseverance under difficulties, and will have his mind impressed with many valuable scientific truths. The knowledge to be gained by such inquiry is eminently practical, and of a kind which those engaged in any of the pursuits of life can scarcely fail to require.

A History of Inventions almost necessarily implies a description of the mechanisms and processes by which they are effected; so far, at least, as to render the principles on which their actions depend understood. It would be impossible, however, in a work of this limited size to enter minutely into explanations of mechanisms, and into the applications of scientific discoveries, which would require a separate treatise for each; but it has been the Author's endeavour to give a succinct, intelligible account, free from technicalities, of the manner in which they operate, so as to be comprehensible to all classes of readers.

By thus giving a popular character to the work, to make it acceptable to the young, it is hoped that it will not be found less worthy, on that account, the perusal of those more advanced in life.

When Beckman wrote his History of Inventions, towards the close of last century, scarcely any of the wonderful discoveries and contrivances that now form parts of our social system were known; and the table of contents of his two large volumes affords a curious insight to the nature and limited extent of such contrivances as were then considered most important. The introduction into his history of such subjects as canary birds, carp, the adulteration of wine, apothecaries, cock-fighting, and juggling, lead us to infer that the Historian of Inventions at that time must have had some difficulty to find appropriate matter wherewith to fill his volumes. The opposite difficulty now presents itself. The numerous important, wonderful, and curious accomplishments of human skill and ingenuity during the present century render preference perplexing, where so many deserve description. From among the number that press for notice, the Author has endeavoured to select those that are either the most important, the most remarkable, or that seem to possess the germs of future progress;



and he trusts that the selection he has made, and the mode in which the subjects have been treated, will render this volume interesting and instructive.

F. C. B.

*6 Haverstock Terrace, Hampstead, November, 1858.*



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## THE PROGRESS OF INVENTION.

The inventive faculty of man tends more directly than any other intellectual power he possesses to raise him in the scale of creation above the brutes. Nearly every advance he makes beyond the exercise of his natural instincts is caused by invention—by that power of the mind which combines known properties in different ways to obtain new results.

When an Indian clothes himself with the skins of animals, and when he collects the dried leaves of the forest for his bed, he is either an original inventor, or he is profiting by the inventions of others. Those simple contrivances—the first steps in the progress of invention—are succeeded by the more labored efforts of inventive genius, such as contriving means of shelter from rain, or

from the heat of the sun, when caves cannot be found to creep into, or the overhanging foliage fails to afford sufficient covering. The construction

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of places of shelter is an imitation of the protection formed by Nature; and the rudest hut and the most magnificent palaces have their prototypes in caverns and in the interlacing branches of trees.

Nature also supplies knowledge of the means by which inventors are enabled to work. The savage who seizes hold of a broken bough is in possession of the *lever*, the uses of which he learns by the facility it affords in moving other objects. He ascends to the top of a precipice by walking up the sloping hill behind, and he thus becomes practically acquainted with the principle of the *inclined plane*. The elements of all the mechanical powers are then at his command, to be applied by degrees in administering to his wants, as his inventive faculties, guided by observation and experience, suggest. An accidental kick against a loose stone shows the action of propulsive force; and the stone that he has struck with his foot, he learns to throw with his hand. The bending of the boughs of trees to and fro by the wind teaches the action of springs; and in the course of time the bow is bent by a strip of hide, and the relaxation of the spring, after farther bending, propels the arrow. Observation and imitation thus lead to invention, and every new invention forms the foundation of further progress.

It has been so with every invention at present known, and must so continue to the end of time:—"There is nothing new under the sun." Gas lighting, Steam locomotion, and the Electric Telegraph have each sprung from some source "old as the hills,"

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though so modified by gradually progressive changes, that the giant we now see bears no resemblance to the infant of ages past.

The observation that light particles floating in the air are attracted by amber when rubbed, which was made known six centuries before the Christian era, was the origin of the invention

by which communications are now transmitted, with the rapidity of lightning, from one part of the world to another. There is no apparent relation between effects so dissimilar; yet the steps of progress can be distinctly traced, from the attraction of a feather to the development of the electric telegraph.

Whenever the history of an invention can be thus tracked backward to its source, it will be found to have advanced to its present state by progressive steps, each additional advance having been dependent on the help given by the progress before made. Sometimes these onward movements are greater and more remarkable than others, and the persons who made them have become distinguished for their inventive genius, and are considered the benefactors of mankind; yet they were but the followers of those who had gone before and shown the way.

Many of the most remarkable inventions are attributable to accidents noted by observing and inventive minds. Not unfrequently also have important discoveries of truth been made in endeavouring to establish error; and new light is being constantly thrown on the path of invention by unsuccessful experiments.

This view of the means by which inventions



originate and are brought to perfection may appear to detract from the merit of inventors, since it regards them as founding their conceptions altogether on the works of others, or on chance. But instead of diminishing their claims to approbation and reward, it places those claims on a more substantial foundation than that of abstract original ideas. The man who has the faculty to perceive that by a different application of well-known principles he can produce useful effects before unknown, directly benefits mankind far more than the discoverer of the principles which had till then lain dormant; and the numerous difficulties which ever arise before an invention can be practically operative, frequently afford exercise for reasoning powers of the highest kind, which may develop new arrangements, that exhibit as much originality and

research as were displayed by the discoverers of the principles on which the invention depends.

The dependence of every invention on preceding ones produces very frequently conflicting claims among inventors, who, forgetting how much they were indebted to others, do not hesitate to charge those, who make still further improvements, with imitation and piracy. It is, indeed, sometimes difficult to determine whether the alterations made in well-known contrivances are, or are not, of sufficient importance to constitute inventions; and there can be no doubt that there is too great facility afforded, by the indiscriminate grant of letters patent, for the establishment of monopolies that often serve to obstruct further improvements. At the same time, it must be observed



that a very trifling addition or change occasionally gives practical value to an invention, which had been useless without it. In such cases, though the individual merit of the inventor is small, the benefit conferred may be important, and may operate influentially in promoting the progress of civilization.

Scientific discovery goes hand in hand with invention, and they mutually assist each other's progress. Every discovery in science may be applicable to some new purpose, or give greater efficiency to what is old. Those new and improved instruments and processes provide science with the means of extending its researches into other fields of discovery; and thus, as every truth revealed, supplies inventive genius with fresh matter to mould into new forms, those creations become in their turn agents in promoting further discoveries.

The action and reaction thus constantly at work, tend to give accelerating impulse to invention, and are continually enlarging its sphere of operations. Instead, therefore, of supposing, as some do, that invention and discovery have nearly reached their limits, there is more reason to infer that they are only at the commencement of their careers; and that, great as have been the wonders

accomplished by the applications of science during the first half of the present century, they will be at least equalled, if not surpassed, by those to be achieved before its close.

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# STEAM NAVIGATION.

Ships, propelled by some mysterious power against wind and against tide, cutting their ways through the water without apparent impulse and like things of life, were not unfrequently seen gliding along in the regions of fancy, ages before the realization of such objects on geographical seas and rivers was looked upon as in the slightest degree possible. Even at the beginning of the present century, it seemed to be more probable that man would be able to navigate the air at will, than that he should be able, without wind or current, and in opposition to both, to propel and steer large ships over the waves; yet, within twenty years afterwards, Steam Navigation had ceased to be a wonder.

If we look back into the records of past ages, we find that inventive genius was active in the earliest times, in endeavouring to find other means of propelling boats than by manual labour and the uncertain wind, some of which contrivances point to the method subsequently adopted by the constructors of steam-vessels.

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To enable us to appreciate properly the gradual advances that have been made in perfecting any invention, it is necessary to consider its distinguishing features, and the difficulties which inventors have had successively to contend against. On taking this view of the progress of Steam Navigation, it will be found that the amount of novelty to which each inventor has a claim is very small, and that his principal merit consists in the application of

other inventions to accomplish his special object. The same remark will indeed apply to most other inventions; for the utmost that inventive genius can accomplish, is to put together in new forms, and with different applications, preceding contrivances and discoveries, which were also the results of antecedent knowledge, labour, and skill.

When, for instance, we look upon an ordinary steam-boat, the most remarkable and the most important feature is the paddle-wheel, by the action of which against the water the boat is propelled. Yet that method of propelling boats was practised by the Egyptians hundreds of years before steam power was thought of; and the ancient Romans made use of similar wheels, worked by hand, as substitutes for oars. It would seem, therefore, to be only a small step in inventive progress, after the discovery of the steam engine, to apply that motive power to turn the paddle-wheels which had been previously used; and now that we see the perfected invention, it may surprise those who are unacquainted with the difficulties which attend any new appliance, that Steam Navigation did not sooner become an accomplished fact.



In a book called "Inventions and Devices," by William Bourne, published in 1578, it was proposed to make a boat go by paddle-wheels, "to be turned by some provision." The Marquis of Worcester, in his "Century of Inventions," also speaks vaguely of a mode of propelling ships. But Capt. Savery, the inventor of the earliest working steam engine, was the first to suggest the application of steam to navigation; and Dr. Papin, who contended with Savery for priority of the invention, also suggested about the same time the application of the elastic force of steam to that purpose.

These crude notions, however, do not deserve to be considered as inventions, though they probably assisted in suggesting the idea of the plan proposed by Mr. Jonathan Hulls, who in 1736 took out a patent for a steam-boat, and in the following year published a description of his invention, illustrated by a drawing, entitled, "A

description and draught of a new-invented machine for carrying vessels or ships out of or into any harbour, port, or river, against wind or tide, or in a calm."

The greater part of this publication is occupied with answers to objections that he supposed might be raised to the scheme, and in the preface he makes the following observations on the treatment inventors were exposed to in his day, which we fear will apply equally at the present time. "There is," he says, "one great hardship lies too commonly on those who purpose to advance some new though useful scheme for the public benefit. The world abounding more in rash censure than in candid and unprejudiced estimation of



things, if a person does not answer their expectations in every point, instead of friendly treatment for his good intentions, he too often meets with ridicule and contempt."

At the time of Mr. Hulls' invention, Watt had not made his improvements in the steam engine, and the kind of engine Hulls employed was similar to Newcomen's, in which the steam was condensed in the cylinder, and the piston, after being forced down by the direct pressure of the atmosphere, was drawn upwards again by a weight. The paddle, or "vanes," as he called them, were placed at the stern, between two wheels, which were turned by ropes passing over their peripheries. The alternate motion of the piston was ingeniously converted into a continuous rotary movement, by connection with other ropes attached to the piston and to the weight, the backward movement being prevented by a catch or click.

The woodcut which lays before you is a reduced



copy of Hulls' "draught" of his steam-boat, as given in his book, a copy of which is preserved in the British Museum.

The utmost application of steam power to navigation contemplated by Hulls was to tow large vessels into or out of

harbour, in calm weather, by means of a separate steam tug-boat, as he considered the cumbersome mechanism would be found objectionable on board the ships to be thus propelled. It does not appear that this plan was effectually tried, nor was the arrangement of the mechanism, nor the imperfect condition of the steam engine at that period, calculated to make the effort successful.

For some years after Mr. Hulls' plan had been published, and had proved abortive, no further attempt seems to have been made, until the improvements in the steam engine, by Watt, rendered it more applicable for the purpose of navigation. The French claim for the Marquis de Jouffroy the honour of having been the first who successfully applied steam power to propel boats, in 1782; though another French nobleman, the Comte d'Auxiron, and M. Perier, had eight years previously made some experiments with steam-boats on the Seine. The Marquis de Jouffroy's steam-boat, which was 145 feet long, was tried on the Soane, near Lyons, with good promise of success. The marquis was, however, obliged to leave France by the fury of the Revolution, and when he returned in 1796, he found that a patent had been granted to M. le Blanc, for building steam-boats in France. He protested against the monopoly, but the patent



remained in force, and the plan received no further development, either from the Marquis de Jouffroy, or the patentee.

About five years later, Mr. Patrick Miller, of Dalswinton, in Scotland, directed his attention to the propulsion of boats by mechanical means, and contrived different kinds of paddles, and other propellers to be worked by hand, which were tried on boats on Dalswinton Lake. The great labour required to work these machines induced Mr. James Taylor, a tutor in Mr. Miller's family, to suggest the use of steam power to turn them, and he recommended Mr. Miller to obtain the assistance of William Symington, an engineer, who was at that time endeavouring to make a steam locomotive carriage. Among the first difficulties that

suggested themselves, was the danger of setting fire to the boat by the engine furnace. This difficulty was overcome by Mr. Taylor, and the arrangements were completed, and the experiment was tried in 1788. The steam engine and mechanism were applied to a double pleasure-boat; the engine being placed on one side, the boiler on the other, and the paddle-wheel in the centre. The cylinders of the steam engine were only four inches in diameter; but with this engine the boat was propelled across Dalswinton Lake at a speed of five miles an hour.

The success of this experiment induced Mr. Miller to have a larger boat built, expressly adapted for the introduction of a steam engine. It was constructed under the superintendence of Symington, and was tried successfully on the Forth and Clyde Canal in



1789, when it was propelled at the rate of seven miles an hour.

In the arrangement of the mechanism of this boat, the cylinder was placed horizontally, for the purpose of making connection between the paddle-wheel and the piston, without the working beam. The piston was supported in its position by friction wheels, and communicated motion to the paddles by a crank. The paddles were placed in the middle of the boat, near the stern; and there was a double rudder, connected together by rods which were moved by a winch at the head of the vessel.

It is not very clear why Mr. Miller did not follow up this success. Objection, indeed, was made by the proprietors of the canal on account of the agitation of the water, which it was feared would injure the banks. It would appear also that a misunderstanding took place between Miller and Symington, which gave the former a distaste to the undertaking; and having shown that such a plan was practicable, he left others to carry it into practical effect.

Several methods of propelling boats, otherwise than by paddles, had some years previously been suggested; among which

were two that have been again and again tried by succeeding inventors, down to the present day.

One of these is an imitation of the duck's foot, which expands when it strikes the water, and collapses when it is withdrawn. The other is the ejection of a stream of water at the stern, or on both sides of the boat, so as to produce a forward movement by reaction.

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Both these plans of propulsion seem feasible in design; but they have hitherto failed in practice. A pastor at Berne, named J. A. Genevois, has the credit of having invented the duck-feet propeller in 1755; and in 1795, six years after Mr. Miller's successful experiments, Earl Stanhope had a steam-boat built on that principle. It was so far a failure, that it was not propelled faster than three miles an hour. The other method of propulsion, though of older date, was patented in 1800 by Mr. Linnaker, who proposed to draw the water in at the head of the vessel, and eject it at the stern, and thus to obtain a double action on the water for propelling; but the plan was not found to answer.

In 1801, Lord Dundas revived Mr. Miller's project, and availed himself of Mr. Symington's increased experience and the further improvements in the steam engine, to construct a much more perfect steam-boat than any that had been made. He spent £3,000 in the experiments, and in March, 1802, his vessel, called the "Charlotte Dundas," was tried on the same scene of action, the Forth and Clyde Canal. This boat, according to Symington's report, towed two vessels, each of seventy tons burthen, a distance of nineteen miles and a half in six hours, against a strong wind. The threatened injury to the banks of the canal by the great agitation of the water prevented the use of this boat, which was consequently laid aside; for the views of the inventors of steam-boats in the first instance were limited to their employment to drag boats along canals.

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We now approach a period when more decided advances and

more rapid progress were made towards realizing steam navigation as a practical fact. Mr. Fulton, an American, residing in France, after making a number of experiments, under the sanction and with the assistance of Mr. Livingstone, the American Ambassador, launched a small steam-boat on the Seine in 1803, but the weight of the engine proved too great for the strength of the boat, which broke in the middle, and immediately went to the bottom.

Not disheartened by this failure he built another one, longer and stronger, and this he succeeded in propelling by steam power, though very slowly. It was, indeed, a much less successful effort than the attempts of Mr. Miller and Lord Dundas. Having been threatened with opposition by M. le Blanc, the patentee of steam-boats in France, Fulton determined to return to his native country, where the large navigable rivers and lakes offered ample scope for the development of steam navigation. Having heard of the success of Symington's boats, he visited Scotland for the purpose of profiting by his experience; and he induced Symington, by promises of great advantages if the invention succeeded in America, to show him the "Charlotte Dundas" at work, and to enter into full explanations of every part. Thus primed with the facts, and with the further suggestions of Symington, Fulton repaired to New York. Mr. Livingstone, who had assisted Fulton in his experiments, was himself an inventor of several plans of propelling vessels by steam, and in 1798 he obtained a patent in



the State of New York, for twenty years, on condition that he should produce a steam-boat by the 7th of March, 1799, that would go at the rate of *four* miles an hour. Having failed to fulfil that condition, the patent privilege was left open, and was promised to the first inventor who succeeded in propelling a boat by steam power at the proposed speed of four miles an hour. Fulton, who had entered into partnership with Mr. Livingstone, possessed advantages in the construction of the vessel he built in America, far greater than any previous inventor. He had not only gained knowledge by his former failures, but he was able to profit by the

experience of others, and he had secured a superior steam engine, manufactured by Boulton and Watt, of twenty-horse power. This was a much more powerful engine than any that had been used in any former experiment; the one employed by Mr. Livingstone having had only five-horse power. This steam-vessel was launched at New York in 1807, and was called the "Clermont," the name of Mr. Livingstone's residence on the banks of the Hudson. Its length was 133 feet, depth 7 feet, and breadth 18 feet. The boiler was 20 feet long, 7 feet deep, and 8 feet broad. There was only one steam cylinder, which was 2 feet in diameter, with a length of stroke of 4 feet. The paddle-wheels were 15 feet in diameter, and 5 feet broad; and the burthen of the vessel was 160 tons. Crowds of spectators assembled to see the boat start on its first experimental voyage. The general impression, even of those who were friendly to Fulton, was that it would fail, and an accident which occurred



when the vessel was under way confirmed this opinion. The foreboders of evil exclaimed immediately that they had "foreseen something of the kind;" and observed "it was a pity so much expense had been incurred for nothing!" The required repairs were, however, soon made. The vessel when again tried cut her way bravely through the water, to the astonishment of all, and the doubts, and fears, and lamentations were quickly changed into congratulations.

As the "Clermont" urged its way up the Hudson, its chimney emitting innumerable sparks from the dried pine wood used as fuel, it excited great alarm among those who were not prepared for such an apparition. An American paper of that day thus described the effect produced on the crews of other ships in the river:— "Notwithstanding the wind and tide were adverse to its approach, they saw with astonishment that it was rapidly coming towards them; and when it came so near that the noise of the machinery and paddles was heard, the crews, in some instances, shrunk beneath their decks from the terrific sight, or left their vessels to go on shore; whilst others prostrated themselves and besought

Providence to protect them from the approach of the horrible monster which was marching on the waves, and lighting its path by the fires which it vomited."

During the time that Fulton was building his steam-boat Mr. R. L. Stevens, of Hoboken, in the State of New Jersey, was also engaged in a similar undertaking. Though his name is comparatively little heard of in the history of Steam Navigation, his



efforts were more successful than any that had been made previously, and but for the fortunate chance to Fulton that he was able to launch and put his boat in action a few days before Stevens had completed his, all, and more than all, the merit that is now ascribed to the former would have been attributed to Stevens. The previous successful experiment of Fulton having fulfilled the conditions imposed by the State of New York, he obtained the exclusive right of steam navigation on the rivers and along the coast of that State; therefore, after Stevens had launched his boat on the Hudson, he was unable to employ it there. In this predicament he ventured on the hazardous experiment of taking his steam-vessel by sea, and successfully accomplished his voyage from New York to Delaware. This was the first attempt to put to sea in a steam-boat.

Mr. Stevens introduced many important improvements. He increased the length of stroke of the engines; he applied upright guides for the piston-rod, to supply the place of the parallel motion; and he divided the paddle-wheel by boards, by which means a more uniform motion was obtained. By these improvements he succeeded in raising the speed of steam-vessels to thirteen miles an hour.

Whilst Steam Navigation was making such progress in America, it was not neglected in this country. Mr. Henry Bell, of Glasgow, a man of great ingenuity, had for some time directed his attention to the subject, and had given some useful hints to Fulton.