FISKE BRADLEY ALLEN

INVENTION: THE MASTER-KEY TO PROGRESS

Bradley Fiske

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Fiske B.

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Содержание

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PREFACE

To show that inventors have accomplished more than most persons realize, not only in bringing forth new mechanisms, but in doing creative work in many walks of life, is, in part, the object of this book. To suggest what they may do, if properly encouraged, is its main intention. For, since it is to inventors mainly that we owe all that civilization is, it is to inventors mainly that we must look for all that civilization can be made to be.

The mind of man cannot even conceive what wonders of beneficence inventors may accomplish: for *the resources of invention are infinite*.

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CHAPTER I
INVENTION IN PRIMEVAL TIMES

Our original ancestors dwelt in caves and wildernesses; had no sewed or fabricated clothing of any kind; subsisted on roots and nuts and berries; possessed no arts of any sort; were ignorant to a degree that we cannot imagine, and were little above the brutes in their mode of living. Today, a considerable fraction of the people who dwell upon the earth enjoy a civilization so fine that it seems to have no connection with the brutish conditions of primeval life. Yet, as these pages show, a perfectly plain series of inventions can be seen, starting from the old conditions and building up the new.

The progress of man during the countless ages of prehistoric times is hidden from our knowledge, except in so far as it has been revealed to us by ruins of ancient cities, by prehistoric utensils of many kinds, and by inscriptions carved on monuments and tablets. The sharp dividing line between prehistoric times and historic times, seems to be that made by the art of writing; for this epochal invention rendered possible the recording of events, and the consequent beginning of history.

Of prehistoric times we have, of course, no written record; and we have but the most general means of estimating how many millenniums ago man first had his being. Geological considerations indicate a beginning so indefinitely and exceedingly remote that the imagination may lose itself in speculations as to his mode of living during those forever-hidden centuries that dragged along, before man had advanced so far in his progress toward civilization as to make and use the rude utensils which the researches of antiquarians have revealed.

Inasmuch as the most important employment of man from his first breath until his last has always been the struggle to preserve his life; inasmuch as the endeavor of primeval man to defend himself against wild beasts must have been extremely bitter (for many were larger and stronger than he), and inasmuch as man eventually achieved the mastery over them, one seems forced to conclude that man overcame wild beasts by employing some means to assist his bodily strength, and that probably his first invention was a weapon.

The first evidences of man's achievements that we have are rude implements of stone and flint, evidently shaped by some force guided by some intelligence; – doubtless the force of human hands, guided by the intelligence of human minds. Many such have been found in caves and gravel-beds over all the world. They were rough and crude, and indicate a rough and crude but nevertheless actual stage of civilization. Some call this the Old Stone Age and others call it the Early Stone Age. Besides stone and flint, bones, horns and tusks were used. Among the implements made were daggers, fish-hooks, needles, awls and heads of arrows and harpoons. One of the most interesting revelations of those rude and immeasurably ancient implements is the fact that man, even in those times, possessed the artistic sense; for on some of them can be seen rough but clear engravings of natural objects, and even of wild animals.

Men naturally supported themselves mainly by hunting and fishing, as savages do now; and it was because they had invented suitable implements and weapons for practicing those necessary arts, that their efforts were successful. The first weapon was probably the fist-hatchet, a piece of sharpened flint about nine inches long, that he grasped in his hand. At some time during the centuries of the Old Stone Age, someone invented a much finer weapon, that continued to be one of the most important that was known, until the invention of the gun, and is used even now in savage lands – the bow and arrow. What a tremendous advantage this weapon was in fighting wild beasts (and also men not possessing it) it is not hard for us to see; for the arrow tipped with flint or bone, could be shot over distances far greater than the spear or javelin could be thrown, and with sufficient force to kill. The club and spear had probably been devised before, for they were simpler and more easily imagined and constructed.

How the bow and arrow came to be invented we have no intimation. The invention of the club and spear did not probably involve much creative effort, so simple were those instruments, and so like the branches that could be broken from the trees. Yet, to the untrained mind of the primeval savage, the idea of sharpening a straight branch of wood into a fine point at the end, in order that penetration through the skin might be facilitated, must have come as an inspiration. No such thing as a spear exists as a spear in nature, and therefore the making of a spear was a creative act. To us, the use of the spear as a projectile may not seem to have required the inventive faculty – unless the hurling of stones may also be supposed to have required it. It may be, however, that with the dull mind of primeval men, even the idea of using stones or javelins as projectiles was the result of a distinct, and perhaps startling inspiration.

The invention of the bow and arrow was one of the first order of brilliancy, and would be so even now. It is not easy to think of any simple accident as accounting for the invention; because the bow and arrow consists of three entirely independent parts – the straight bar of wood, the string, and the arrow; for the bow was not a bow until the string had been fastened to each end, and drawn so tight that the bar of wood was forced into a bent shape, and held there at great tension. When one realizes this, and realizes in addition the countless centuries during which the bow and arrow held its sway, the millions of men who have used it, and the important effect it has had in the overcoming of wild beasts, and the deciding of many of the critical battles of the world, he can hardly escape the conclusion that the invention of the bow and arrow was one of the most important occurrences in the history of mankind.

A still more important occurrence was the invention of making fire. Probably less inventive effort was needed for this than for the bow and arrow; for fire could be seen in the lightning and in trees struck by lightning, and in the sparks that came forth when two hard stones were struck together. The discovery of fire may have been made by accident; but this does not mean that no invention was needed for devising and producing the means whereby fire could be produced at will. To note the fact of a phenomenon, say the production of fire when stones are accidentally struck together, or the falling of an apple from a tree, requires no special effort, and of itself brings forth no benefit; but to reason from the appearance of the sparks to the production of an apparatus for making fire at will; or to reason from the falling of an apple to the enunciation of Newton's Law of Gravitation, is the kind of successful mental effort that has produced the effects which it is the endeavor of this humble book to indicate. These effects have combined as progress has advanced, to put civilized man in a position relatively to his natural surroundings very different from that held by primeval man, and very different from that held by the brutes, both in primeval days and now. Evidently, the effects have been made possible by some faculty possessed by man and not by brutes. This faculty is usually called reason, and is held to be a faculty by means of which man can infer cause from effect, and effect from cause, and can remember events and facts to a degree sufficient to enable him to hold them in his mind, while reasoning about them.

But it seems impossible to explain the advent of even the oldest and simplest inventions by the possession of reason only, using the word reason in its ordinary sense; for it is obvious that no matter how clearly a man could reason as between cause and effect, no matter how great a student of all phenomena he might be, no matter how good a memory he might have, he might nevertheless live for many years and never invent anything. In fact, we see men at the present day who possess great knowledge, splendid energy, keen powers of analysis, high courage, and even great administrative talent, and yet who are obviously deficient in originality, who seem to possess the constructive faculty in only a small degree, and who seem incapable of taking any step forward except on paths that have been plainly trod before.

Countless instances can be cited of the persistence of men, even in civilized lands, in following a certain practice for long periods, until someone possessing the inventive faculty has devised a better one. For the sake of brevity, only two cases, and those well known, will be mentioned as illustrative.

One was the invention of movable type, and the other that of pointing the wood screw. Man had continued for centuries to make blocks of wood or other material on which words and phrases were engraved or cut, and then to print from them. Suddenly a man in Germany (usually said to be John Guttenberg) made the change, so slight in appearance and yet so tremendous in results, of cutting only one letter on a block, and arranging and securing the blocks in such a way as to enable him to print any word or words desired. This did not occur until about the year 1434 A. D. Why had not someone done this in all the long centuries? Surely it was not because men of great reasoning faculties had not lived; for in the long interval the civilization of Egypt, Assyria, Babylon, Persia, Greece and Rome had flourished; and Plato, Aristotle, Cæsar and the great inventor Archimedes had lived! Similarly, men continued to use in wood the same flat pointed screw that they used in metals, boring the hole first in the wood with a gimlet, and then entering the flat point of the screw into the hole. Suddenly (but not until the nineteenth century A. D.) an inventor made and patented a screw which came to a sharp point like a gimlet, which could be forced into wood just as the gimlet was, and then screwed into the wood without further ado. How can we explain the curious fact that countless men of reason, intelligence and mechanical skill had continued century after century to bore into wood with gimlets, and then follow the gimlet with flat-pointed screws?

The explanation seems to be expressed in the phrase, "the idea had not occurred to them." Why had it not occurred to them? This question cannot, of course, be answered convincingly; but it may be pointed out that there is a small class of men to whom original ideas seem to come of their own accord. The inventor of mechanical appliances is in this class, and is perhaps its most conspicuous exemplar.

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It may be pointed out, however, that the inventors of mechanical appliances are not the only men to whom original conceptions come; for original conceptions evidently come to the poets, the novelists, the musical composers, the artists, the strategists, the explorers, the statesmen, the philosophers, the founders of religions and the initiators of all enterprises great and small. It may be pointed out also that their mental processes are similar, and that they are best described by the greatest of all poets in the lines —

"The poet's eye in a fine frenzy rolling,
Glances from heaven to earth, from earth to heaven;
And as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to shapes, and gives to airy nothing
A local habitation and a name."

These lines suggest that the first step in invention is made almost without effort; that a picture, confused and dim but actual, is made by the imagination on the mental retina; and that, after that, the constructive faculties arrange the elements of the picture in such wise as to produce a clear and definite entity.

Regarded in this way, the inventor of mechanical appliances suddenly sees a confused and dim picture of an instrument or a mechanism (or a part of it) that he has never seen with his bodily eyes; the musical composer hears imperfectly and vaguely a new musical composition; the sculptor sees a statue, the painter sees a new combination of objects and colors producing a new effect, and the poet feels the stirring in him of vague, but beautiful, or powerful or inspiring thoughts. If now the picture is allowed to fade, or if the constructive faculty is not able to make it into an actuality, or if the picture has not in itself the elements which the state of civilization then prevailing make it possible

to embody in an entity, no invention of a mechanical appliance is made, no plan of campaign, no musical composition, no statue, no painting, no poem is produced.

If, however, the constructive effort develops successfully the conception that the imagination made, and if the circumstances of time and place are all propitious, then the art of making fire at will is born, or Bonaparte's suggestion at Toulon is made, or the strains of Beethoven's music inspire the world, or the statue of Moses is carved, or the Immaculate Conception is pointed, or Hamlet is written, or the electric telegraph binds the peoples of the earth together.

The inventor in mechanics, the sculptor, the painter, the novelist and the poet embody their creations in material forms that are enduring and definite, and constitute evidences of their work, which sometimes endure throughout long periods. The architect and the constructing engineer are able similarly to produce lasting and useful monuments to their skill; but it can hardly be declared that their work is characterized by quite so much of originality and invention, because of the restrictions by which the practice of their arts is bound. It is, in fact, hard to conceive of a bridge very different in principle or design from bridges that had been built before; and while it is not difficult to conceive of an engine different in principle and design from previous ones, yet we realize that the points of novelty in such an engine would be attributable more to invention than to engineering. This is because the arts of engineering and architecture rest on principles that have long since been proved to be correct, and on practices that are the results of long experience; whereas one of the main characteristics of invention is novelty.

It is true that many of the most important inventions have been made by engineers; but this has been because some engineers, like Ericsson, have been inventors also. But it is also true that only a small proportion of the engineers have made original inventions; and it is equally true that many inventions have failed – or have been slow in achieving success – because of lack of engineering skill in construction or design. These facts show that the work of the inventor is very different from that of the engineer, and that the inventor and the engineer are very different people, though an engineer and an inventor sometimes live together inside of the same skin. In fact, it is by a combination of inventive genius and engineering talent in one man that the greatest results in invention have been achieved; though great results have often followed the intimate cooperation of an inventor and an engineer, the two being separate men.

It is in the latter way that important advances have usually been made; and it is somewhat analogous to the way in which authors and publishers, actors and managers, promoters and capitalists cooperate.

But while the individuals whose inventions have taken the form of new creations, such as novel machines and books and paintings, have received the clearest recognition as men of genius, may not the inventive faculty be needed in other fields and be required in other kinds of work? If an instrument is produced by the joint exercise of imagination and constructive talent, is not every puzzle worked out, and every problem solved, and every constructive work accomplished by the similar exercise of those same faculties?

It may seem obvious that this question should be answered in the negative, and so it unquestionably should be. But there always has been much cloudiness as to what constitutes invention in our own minds; and it must be admitted that the dividing line is not immediately obvious between invention and the art of meeting difficulties with resourcefulness, or between invention and the act of solving any of the perplexing riddles of our daily lives.

It may be declared with confidence, however, that the difference between invention and any one of these other acts is that, while invention ends in performing such acts, it begins with an exercise of the imagination. A man who designs an engine to fulfil a stated purpose, who solves any problem whatever that is presented to him from outside, simply accomplishes a task that is given to him to accomplish; whereas, while the inventor accomplishes a similar task, he does it as a second step in a task that was not given him to accomplish, but that he himself had pictured to himself. The act of

inventing consists of three separate acts – the act of conceiving, the act of developing, and the act of producing. Of these three acts, that of conceiving is obviously not only the first, but also the most important, distinctive and unusual.

For every real invention, there have been countless constructive acts. In the invention of the bow and arrow, the conception was probably instantaneous and unbidden. The subsequent work of developing the conception into material and practical shape was probably one of long duration, consisting of many acts, accompanied with many difficulties and disappointments, and accomplished finally in the face of much active and passive opposition.

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The Old Stone Age gradually developed into the New Stone Age at different times in different localities, as successive improvements in implements were made. The New Stone Age was distinguished from its predecessor mainly by the fact that the principal weapons and utensils were formed into regular shapes, polished into smoothness, and in many cases ground to sharp points and keen cutting edges. These improvements made the implements more effective both as weapons and as utensils, by facilitating not only cutting but penetration.

How much invention was needed to make these improvements, it is not easy to decide; but probably only a little was required, and that of an order not very original or high; for the improvements were rather in detail than principle. Perhaps their character can be best indicated by saying that they were improvements, rather than inventions of a basic kind.

It may here be pointed out that the act of improving upon an invention already existing may be almost wholly a constructive act, performed on a visible and tangible material object, and not on a picture made by the imagination on the mind. In such a case, the act of improving belongs rather in the category of engineering than of invention, for the reason that it involves only a slight use of the imagination. It may also be pointed out, however, that a mere improvement may be, and sometimes has been an invention of the highest order. As a rule, of course, basic inventions have been the most brilliant and also the most important.

But it was not only by polished instruments of stone and bone that the New Stone Age was characterized; for we find in the records which our ancestors unintentionally left us, many evidences that they had invented the arts of making pottery, of spinning and weaving, and of constructing houses of a simple kind. This Age was characterized by many improvements besides those relating to articles of stone, and was a period far in advance of its predecessor on the march to civilization. It was marked by the domestication of animals and plants, the tilling of the soil, and a gradual change from a purely savage and nomadic mode of life. This change was first to a pastoral life, in which men lived in fixed habitations and tended their flocks; thence to an agricultural life, in which men cultivated the ground over large areas and grew crops of cereals and vegetables; and then to a still more settled existence, in which men congregated in villages and towns. Certainly, the race had taken the first steps, and had started on the path which it has since pursued.

In order to make the start and to proceed afterwards in the line begun, many physical, mental and spiritual attributes were needed and employed, that mere brutes did not possess, and because of which the civilization of the Old Stone Age had been begun and gradually developed. Of these faculties, those principally characteristic seem to have been mental; and among those faculties, invention, reason, construction and memory seem to have been the most important. It would be unreasonable to declare any one of those faculties to have been more important than the others; but it can hardly be denied that the first steps in the march of progress should be credited to invention. Clearly, it was the weapons and utensils of the Old Stone Age that made possible the subduing and subsequent domestication of certain animals, such as the horse, the cow, the dog, the sheep and the goat.

It may be pointed out, in passing, that many animals have not been domesticated even at this late day – such as the tiger, the eagle and the bear. But, equally, certain tribes of men have not been domesticated. It may be that in both the undomesticated men and the undomesticated brutes, the mind is of such a character that it cannot assimilate even the first grains of knowledge, or make any effort whatever of an inventive character.

There was one invention that was probably made in the Old Stone Age, which must have needed considerable inventiveness to be developed as highly as it was developed during the Old and New Stone Ages, and that was language. The origin of language is, of course, hidden in the impenetrable mystery of the childhood of the race; and it may be that language was an original attribute of man. If we reason, however, that the development of language must have been a continuing act from the first, inferring it from the fact that it has been a continuing act from the dawn of recorded history until now, and if we suppose that it had a rise and a growth like those of other arts, we may reasonably conclude that some man invented the plan of making his wants known by the use of vocal sounds, uttered in accordance with a preconcerted code; that the invention was only partially successful at first, and that it was afterwards improved. That language was not a natural gift, but rather the result of an invention and subsequent development, is suggested by the fact that a child has to be taught to speak, but does not have to be taught to exercise his natural functions, such as breathing, eating, drinking, walking, etc.

Which was the first invention ever made by man, there is, of course, no means of ascertaining; but it seems obvious that that of language must have been among the first. The invention of weapons we may easily imagine to have been actually the first, called for by the necessity of defense against wild beasts and other men. Following the defense by individual men of their individual lives, it seems logical to suppose that a man and his wife, a man and his brother, and then groups of men, banded together in their common defense against common foes. To further their joint action, what would be more valuable than a language consisting of vocal sounds, arranged in accordance with a simple code, as a means of conveying information, issuing warnings, and giving signals in emergencies, to insure concerted action?

That language should later be used for manifold other purposes would be most natural; for many other arts have been invented primarily to further man's first aim, the preservation of his life, and have afterwards been employed for other purposes. The uses of clothing, houses, knives, guns and of nearly all weapons are cases in point.

The New Stone Age seems to have passed gradually into the Age of Copper, because doubtless of a more or less accidental discovery when native copper was seen upon the ground, or when some copper ore was subjected to fire. The metal, by reason of its great durability, ductility, elasticity and strength, came to be used for many purposes – the first use being probably in weapons; for weapons were the main dependence of the people in their struggle against beasts.

A great advance was made when bronze was discovered, with which weapons and tools of many kinds could be made that were harder than those of copper. Then the Age of Bronze succeeded the Age of Copper. One can hardly imagine that bronze was really invented; for it is difficult to see how, knowing the softness of copper and tin, any primeval man could have imagined a metal made from them much harder than either, and then proceeded to make it by mixing about seven parts of copper with one part of tin. The gradual improvement made in bronze implements, and the different kinds of bronze that later appeared (made by altering the proportions of tin and copper) were doubtless due more to constructive and engineering methods than to pure invention; but nevertheless a considerable amount of inventing must have been required; for one can rarely effect any important improvement in any weapon, instrument or tool, without first imagining the improvement, and then endeavoring to effect it.

In fact, an overwhelming majority of the "inventions" for which patents are issued by our Patent Office, are for mere improvements over existing apparatus; and the bald fact that the thing

accomplished is only such an improvement, instead of the creation of something different from everything else whatever, like the telephone or phonograph, does not debar the achievement from being classed as an invention. The pointed screw was merely an improvement over previous forms of screw, and yet it was an invention of high originality, novelty and importance. Obviously, improvements occupy various positions not only in importance and scope, but also in the relative degrees in which invention and construction were employed to bring them into being.

It is held by some that no purely human act can possibly create anything really new, that "there is nothing new under the sun," and that therefore every so-called invention made by a man must be merely a novel arrangement of already existing objects.

Of course, no man "creates" anything, in the sense that he makes anything whatever out of nothing; but it is a well-known fact that he has created many things in the sense that he has made many entities to exist that had not existed before as such entities; for instance, man made the speaking telephone to exist. The speaking telephone did not exist before Bell invented it, and it did exist after he invented it. To say that Bell did or did not create the telephone conveys a meaning dependent wholly on the meaning in which the word "create" is used. Men ordinarily use the word with such a meaning that it is correct to say that Bell created the speaking telephone; it being understood as a matter of common sense that Bell did not create the metals and other material parts which he put together to make the telephone.

Used in this sense, primeval man (or more correctly some primeval men, and probably a very few) created certain weapons, implements and utensils, that gave the men who used them such mastery over wild beasts and over men who did not use them, that the steps since taken toward civilization were made possible.

Our whole civilization can be traced back to those inventions, and can be shown to proceed from them and be based upon them. *No other basis that civilization could have proceeded from can even be imagined; for the actual progress of events was the outcome of the actual nature of man, and the actual nature of his environment.*

We seem forced to conclude, therefore, that we owe our civilization primarily to the invention of certain primeval implements and weapons, the art of making fire, etc., and therefore to the inventors who made the inventions. This does not mean that we do not owe it to other things besides inventions, and to other men besides inventors; for it is obvious that we owe it to all the facts of our history, and to such of our ancestors as did anything to advance it. We owe it in part, for instance, to the men who framed the laws that made living in villages and cities possible, to the men who executed the laws, and to all the men and women who observed the laws and gave examples of righteous living. For it is obvious that, no matter what inventions were made, the march of civilization could not have even started, unless there had been a sufficient number of good and intelligent men and women to keep the human procession in good order from the first.

It may be pointed out here that, although every human being has much of evil in his nature, yet even the most depraved person desires other people to be good. Even thieves see the advantage to themselves resulting from the fact that most men do not steal; murderers have no inclination toward being themselves murdered, and human beings as a class see the benefits of morality and good living throughout society as a whole. For this reason, and for the still more important reason that most individuals are not very different in their characteristics and abilities from the average of all individuals, the tendency of society is to reduce men to a common level; so that we see only a small fraction who are extremely good or extremely bad, extremely brilliant or extremely stupid, extremely large or extremely small, etc. Similarly, there is only a small fraction of the people who have done much good individually or much harm, or who have exercised individually any noticeable influence of any kind.

We may reasonably conclude, therefore, that there were only a few men in primeval days who performed any acts that entitle them to individual recognition; and as the only records that have come

down to us indicate that the most important acts were the inventing of certain implements, we seem forced to conclude that most of the recognition accorded to individuals of primeval days may be limited to a very small number, and they inventors.

Who they were, and where and when they lived, is not known and probably never will be. For countless centuries their names and personalities have been forgotten as wholly as those of many beasts. But maybe other achievements like those that have exposed the history of certain Oriental kings and wise men to our knowledge, will some day tell us who were the inventors who started the march of human progress, and pointed out the road that it should follow.

Yet, if we infer the probable conditions of the remote past from the conditions of the present and recent past, we shall have to conclude that, while the names and deeds of prehistoric rulers may some day become known to us, and even the names of authors, poets and song singers, the names of the original inventors will be forever hid. For inventors have ever been depreciated in their day; even at the present time, despite the known facts as to what inventions and inventors have done for every one of us, the inventor as an inventor is lightly regarded, and so are his inventions. So are his inventions until they have ceased to be regarded as inventions, and have been accepted as constituent parts of the machine of civilization. By that time the inventor has often been forgotten.

The Age of Iron succeeded the Age of Bronze in the countries from which we have inherited our civilization; but in Africa bronze does not seem to have been discovered until after iron was. Iron being an element like copper, and not an alloy of two metals like bronze, it seems probable that its discovery, like that of copper, followed the act of heating stones with fire. The coming of iron seems due therefore to discovery rather than to invention; but yet the mere discovery that a very hard substance had been accidentally produced would of itself have brought forth no fruit. One is almost forced to infer from probability that the fact must have become known to many men, but only as a plain and uninteresting fact. Finally, some man realized that that hard substance was superior to bronze for making weapons, and then set to work to ascertain exactly what kinds of stone it could be gotten from, and exactly what process gave the best results.

To us who have been carefully taught the facts known at the present day, and whose minds have been trained by logic and mathematics to reason from effect to cause, and to construct frameworks of cause wherefrom to gain effects, it seems that anyone who noted that the hard substance which we call iron came from heating certain stones, would immediately invent a process for making iron in quantities. But prehistoric man had no knowledge whatever save that coming from his own observation and the oral teachings of the wise men; mathematics and logic did not exist; and the only training given him was in those simple arts of hunting, fishing, field tilling, etc., by which he earned his livelihood. For a mind so untrained and ignorant to leap from the simple noting of the accidental production of the metal to a realization of its value, then to a correct inference as to the possibility of producing it at will, then to a correct inference as to the method of producing it, and then to devising the method and actually producing iron at will, suggests a reasoning intelligence of an order exceedingly high.

Nevertheless, the art of making iron may have originated not so much from effort as from inspiration; the process may have been less one of reasoning than one of imagination, less one of construction than one of invention. In fact, when we realize that imagination is almost wholly a pure gift (like beauty, or artistic genius or a singing voice) while the reasoning and constructive faculties require long education, we may reasonably conclude that the production of iron and of all the metals and processes in prehistoric times, was probably attributable mainly to invention.

The crowning invention of prehistoric man was that of writing; for it lifted him out of his dependence on oral teachings, with their liability to error and forgetfulness, into a condition in which the facts and experiences of life, and the reasons for failure or success, could be put into permanent form, and supply sure bases from which to start on any line of progress in the future.

The production of the art of writing seems to have been a pure invention, and it has always been so regarded. Nothing resembling writing is to be found in nature; *nowhere do we see in nature any effort to preserve any records of any kind*. How man, or a man, was led to invent writing we can only imagine, for we cannot ascertain. When we realize, however, how entirely novel an undertaking the production of writing was, and that there is no process of mere reasoning by which a man could arrive at a decision to produce it, we seem forced to conclude that it must have been caused by one of those inexplicable conceptions that imagination puts into the mind, and that constitute an inspiration, coming from the Great Outside and its ruler, the Almighty.

In fact, if one ponders the history and teachings of the Christian religion (in truth of all religions), and notes that the revelations on which they are believed to have been founded seem to have come unbidden to certain men as inspirations from On High, he must realize how similar are the conceptions that come to inventors in a field less spiritual, but yet actual. For in the case of each basic invention, an idea seems to have come unbidden to the mind, and grown and developed there.

The first writing was what we call picture writing, in which representations in outline of well-known objects were scratched with a hard point on some softer substance. This form of writing probably began in the Old Stone Age. It continued for different lengths of time among different peoples, as have all other characteristics of any stage of civilization; and it is practiced in some degree by some peoples even now. In fact, one might with reasonableness declare that many of the illustrations used in books and magazines and papers, many of the paintings and drawings that adorn our walls, and many of the moving pictures in our places of amusement convey messages by means of pictures, and are therefore forms of picture writing.

As the intelligence of man increased, and his consequent need for better means of expressing himself in writing increased, the idea occurred to someone to use conventional drawings to represent vocal sounds, instead of pictures of visible objects. The first writing of this kind, called phonetic writing, used characters that represented spoken words, and therefore required many characters and necessitated long and tedious study to master it. It was gradually replaced among most peoples by an improved phonetic system, in which each character represented a syllable instead of a word; though the Chinese have never wholly abandoned it. The syllabic system needed, of course, fewer characters, and was much more easily learned, much more flexible and generally satisfactory. The syllabic system was finally replaced among the more progressive peoples by the alphabetical system, in which each character represents a separate vocal sound. As the number of separate vocal sounds is few, only a few characters are needed. In most alphabets, the number of characters varies between twenty-two and thirty-six.

We of the present day plume ourselves greatly on our achievements in invention, and point to the tens of thousands of scientific appliances, books and works of art with which we have enriched our civilization. To most of us, prehistoric man was an uncouth creature, living in caves and uncleanly huts, and so far removed from us that in our hearts we class him as little higher than the beasts. Yet to prehistoric man we owe all that we are and all that we have. The gift of life itself came to us through him; and so did not only our physical faculties, but our mental, moral and spiritual faculties as well. It was prehistoric man who invented the appliances without which the wild beasts would not have been overcome, and the man, wilder than himself, been kept at bay; by means of which the soil was tilled, and boats were made to move upon the water, and villages and towns were built. It was prehistoric man who invented spoken language and the arts of drawing, painting, architecture, weaving and writing. It was prehistoric man who started the race on its forward march, and pointed it in the direction in which it has ever since advanced. It was prehistoric man who made the inventions on which all succeeding inventions have been based. The prehistoric inventor exercised an influence on progress greater than that of any other man.

CHAPTER II
INVENTION IN THE ORIENT

The first countries to pass into the stage of recorded history were Egypt and Babylonia. Excavations made near the sites of their ancient cities have brought to light many inscriptions which, being deciphered and translated, give us clear knowledge of the conditions under which they lived, and therefore of the degree of the civilization that they had attained.

As we note the progress that the inscriptions show us to have been made beyond the stage reached by prehistoric man, it becomes clear to us that much – if not most – of that progress could not have been made without the aid of writing. One cannot conceive of the invention and development of Astronomy, for instance, without some means of recording observations that had been made.

In developing the art of writing itself, much progress was effected in both countries, and many improvements were made in the art itself that must have been due to that lower order of invention which consists in improving on things already existing. In addition, invention was employed in devising and arranging means for preserving the writings in an enduring form. In Babylonia, this was done by making the writing on soft tablets of clay about an inch in thickness, that were afterwards baked to hardness. In the case of records of unusual importance, the precaution was sometimes taken of covering the baked inscription with a thin layer of clay, making a duplicate inscription on this layer, and then baking it also. If afterwards, from any cause, the outside inscription was defaced, it could be removed and the inside inscription exposed to view.

In Egypt, the writing was done on sheets of papyrus, made from a reed that grew in the marshes. To devise and make both the baked clay tablets and the papyrus, it is clear that invention had to be employed; for nothing exactly like them existed in nature. Thus the invention of the art of writing was supplemented by the invention of the art of preserving the records that writing made. The act of writing would have been useful, even if no means had been invented for preserving the things written; even if the things written had perished in a day. But the importance of the invention of writing was increased ten thousand fold by the invention of the means for preserving the things written; because without that means it would have been impossible by any process of continual copying of tablets to keep at hand for reference that library of records of the past on which all progress has been based, and from which every act of progress has started, since some inventor of Babylonia invented baked clay tablets and some inventor of Egypt invented papyrus.

It may be objected that there is no reason for assuming that any one man invented either; that each invention may have been the joint work of two men, or of several men. This of course, is true; but it does not minimize the importance of either invention, or the credit due to the inventors. It simply divides the credit of each invention among several men, instead of giving it all to one. It is a notable fact, however, that, although some inventions have been made by the joint work of two men, and although some books have been written, and some music has been composed by two men working in cooperation, yet such instances have been rare.

Many men combine to do constructive work of many kinds, and millions combine to work and fight together in armies; and it is an interesting fact that the working together of many men has been made possible by inventions, such as writing and printing. Yet there is hardly any other kind of work that is so wholly a "one man job" as inventing. The fact that only one man, as a rule, makes a certain invention, or writes a certain book, or composes a certain musical piece, or does any other inventional work, seems to spring naturally from the original fact that an invention begins with a picture made by imagination on a mind. Now a picture so made is an individual picture in an individual mind. If the picture is allowed to fade, or if from any cause the mind that received it does not form it into a definite entity, no invention is made. If, on the contrary, the mind develops the dim picture into a

definite entity of some kind, that mind alone has made that invention; even if other minds improve it later by super-posing other inventions on it.

It is true that sometimes a man who receives from his imagination a mental picture of some possible invention will communicate it to another man, and that other man will contribute some constructive work, and make the dim picture into a reality; so that the complete invention resulting will be the joint product of two men. It seems to be a fact, however, that these dim pictures have rarely been disclosed while in the formless period, and that almost every invention of which we know the history, was made by one man only.

It need hardly be interjected here that we are discussing inventions only, and not the acts of making inventions practicable in the sense of making them useful or commercially successful. At the present day, there are few inventions indeed, which even after having been completed as inventions, need no modification at the hands of the engineer and the manufacturer, before they are suitable to be put to practical use.

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That the Babylonians realized the importance of their invention is proved by the fact that their baked tablets were carefully preserved, and that in some cities large libraries were built in which they were kept, as books are kept in our libraries at the present day. When the expedition of the University of Pennsylvania made its excavations near the site of the ancient city of Nippur, in the southern part of Babylonia near the city of Babylon, a library was discovered that contained more than thirty thousand tablets.

The writing of the Babylonians, while phonetic, was a development of picture writing, each character expressing a syllable, and was made of wedge-shaped characters. From the shape of the characters the adjective *cuneiform* has been applied to the writing, the word coming from the Latin word, *cuneus*, a wedge. Syllabic writing was in use for probably three thousand years among the peoples of western Asia.

The Babylonians utilized their ingenuity and inventiveness in divers ways, and accomplished many things that help to form the basis of our civilization, without which we cannot imagine it to exist. Their creations were of a highly practical and useful kind, and illustrate the proverb that "necessity is the mother of invention." From the fact that their ships sailed the waters of the Persian Gulf, and had need of means to locate their positions and determine their courses from port to port, and from the fact easily noted by their navigators that the heavenly bodies held positions in the firmament depending on their direction from an observer, and on the month and season and the time of day, the study of the heavens was undertaken; with the result that the science of astronomy was conceived and brought into existence.

It may here be asked if this achievement can properly be called an invention. One must hesitate a little before answering this question either negatively or positively; because such an achievement is not usually called an invention, and yet it cannot truthfully be denied that there is nothing in Nature like the science of astronomy, and that therefore it must have been created by man. It cannot reasonably be denied, also, that after the science had at last been formulated, it was as clearly a distinct entity as a bow and arrow or a telephone. Furthermore, it does not seem unreasonable to suppose that, before any of the principles of astronomy were laid down, before anyone even attempted to lay them down, before anyone even attempted to ascertain the laws that seemed to govern the movements of the heavenly bodies, the idea must have occurred to someone that those heavenly bodies were all moving in obedience to some law; and a more or less confused and yet real image must have been made upon his mind of a great celestial machine. He must actually have imagined such a machine. This first act would be quite like that of the inventor of a mechanical device. The next act would be to observe and record all the phenomena observable in connection with the movements of the celestial

bodies, then to analyze and classify them. This series of acts would not, of course, be inventive or even constructive. They would rather be like those studies of any art, without which no man could be an inventor in that art.

The analysis having been completed, the positions of the heavenly bodies at various times having been ascertained and tabulated, the next step would seem to be to construct a supposititious machine of which each part would represent a heavenly body, and in which those various parts would move according to laws induced tentatively from the actual motions of certain heavenly bodies. If it were afterwards found that all positions of each part, predicted in advance by applying the laws tentatively induced, corresponded to the actual positions of the heavenly body that it represented, then the supposititious machine could be truthfully declared to be a correct imitation of the great celestial machine. That is, the machine could be declared to be successful.

The science of astronomy is, in effect, such a machine. Its parts are representations of the sun, moon and other heavenly bodies, that move according to laws that are illustrated in the diagrams, and expressed precisely in the formulas.

The first act of the originator of the science of astronomy being one of the imagination in conceiving a picture of a celestial machine, and being like that of the inventor in conceiving a picture of an earthly machine; and his second act being also like that of the inventor in developing the picture, a justification for speaking of the "invention" of the science of astronomy may perhaps be reasonably claimed.

(We must bear in mind, of course, that no invention is complete until the third act has been performed, and the thing invented has been actually produced.)

To speak of invention in connection with bringing forth novel creations is far from new, for the phrases "construct a theory," "invent a science," "invent a religion," etc., are in almost daily use; and it may seem unnecessary to some persons, therefore, to discuss it at such length. But most people seem to regard such phrases as merely figurative; while the author wishes to make it plain that they are not figurative but exact.

As this modest treatise does not pretend to be a learned one, and as the author is not a professional scholar, no further attempt will be made to claim the production of the science of astronomy as an invention. To pursue the subject further would be merely to enter a discussion as to the meaning, both original and derived, of the word invention. The author, however, cannot escape the conclusion that, no matter what may be the literally correct meaning of the word, the mental acts performed by the originators of the science of astronomy were like the mental acts performed by the inventors of mechanical appliances, and exerted a similar influence on history. That is, he believes that the men who brought into being the science of astronomy and the men who brought into being the bow and arrow, first saw pictures on the mental retina of some things actual yet vague and formless, and then constructed entities from them. He believes also that the creation of the bow and arrow, and the creation of the science of astronomy constituted actual and similar stepping-stones on which the race rose toward a higher civilization.

In default of any definition of the word invention, which precludes its application to the origination of a science, theory, religion or formulated school of thought, the author begs permission so to use it, in indicating the influence on history of the novel creations which, according to this meaning of the word, have been inventions.

The influence on history of the invention of the science of astronomy has been so great that we cannot estimate its greatness. On it the whole science of navigation rests. Without it, the science and the art of navigation could not exist, no ships could cross the ocean from one port to another, except by accident, and the lands that are separated by the ocean would still rest in complete ignorance of each other. This world would not be a world, but only a widely separated number of barbarian countries; most of them as ignorant of even the existence of the others as in the days before Columbus.

Following the invention of astronomy, or as it was first called, Astrology, the imaginative and practically constructive intellects of the Babylonians naturally led them to invent the sun-dial for indicating the time during the day, and the water-clock for indicating it during the night.

Another invention, doubtless brought into being by the study of the movements of the heavenly bodies, was the duodecimal system of notation, of which the base was twelve. In accordance with this system, the Babylonians divided the Zodiac into twelve equal parts or "signs"; divided the year into nearly equal months, that corresponded approximately to the length of a lunar month; divided a day and a night into twelve equal parts or hours; divided an hour in sixty (12 x 5) equal parts or minutes, and divided a minute into sixty (12 x 5) equal parts or seconds.

The duodecimal system of notation has been supplanted for many purposes by the more convenient decimal system, the invention of which is attributed by some to the Arabs; but the duodecimal divisions of time are still with us, and the duodecimal divisions of the circle are still used in most countries.

The duodecimal system of notation seems to have been the earliest system of notation invented; and it was an invention so important that we cannot imagine civilization without it and the decimal system, possibly its offspring. The influence of these two inventions on history has been so great that the mind is incapable of realizing its greatness, even approximately.

Who were the inventors, we do not know. It is almost certain that none of our generation ever will know, and it is far from probable that any one of any generation will ever know. If any knowledge on this subject is ever given to the world, it will be knowledge of names only – only names. Yet some human beings, forgotten now and probably obscure even in their lifetimes, invented those systems, and contributed more to the real progress of the race than many of the great statesmen and warriors of history.

The Babylonians invented measures of length, capacity and weight, also; and it is from those measures that all the later measures have been directly or indirectly derived. To have invented systems by which time, angle, distance, space, weight and volume were lifted out of the realm of the vague and formless into the realm of the definite and actual, was an achievement that almost suggests that noted in the first chapter of Genesis, in the words, "And God said 'Let there be light,' and there was light"; for what a clearing up of mental darkness followed, when the science of measurement turned its rays on the mysteries that beset the path of early man!

The Egyptians seem to have been inventors, though hardly to the same degree as were the Babylonians. The Egyptians studied the heavens and employed a science of astronomy; and it is possible that they, rather than the Babylonians, should be credited with its invention. But it is not the intention of this book to decide points in dispute in history, or even to discuss them. Its intention is merely to study the influence that inventions and inventors had. Whether the name of an inventor was John Smith or Archimedes, whether he lived in the year 1000 or 1100, or which one of two rival claimants should be credited with the honor of any invention, is often an interesting question; but it is not one that is especially important to us, unless it casts light on the main suggestion of our inquiry. The only reason for mentioning names and dates and countries in this book is to show the sequence of inventions as correctly as practicable. In order to show the influence of invention on history it seems best to give the treatment of the subject an historical character.

Possibly the most important invention of the Egyptians was papyrus, which was the precursor of the paper of today. The clay tablets of the Babylonians were clearly much less adapted to the making of many records than was papyrus. One cannot readily imagine an edition of 300,000 newspapers like the *New York Times*, made out of clay tablets an inch in thickness, and sold on the streets by newsboys. Clearly the invention of papyrus was one so important that we cannot declare any invention as more important, except on the basis that (other factors being equal) the earlier an invention was the more important it was. To assume such a basis would, of course, be eminently reasonable; because

the earlier invention must have supplied the basis in part for the making of the later. The invention of writing, for instance, was more important than the invention of papyrus.

A curious invention of the Egyptians was the art of embalming the bodies of the dead, an art still practiced in civilized countries. It was prompted by their belief that the preservation of the body was necessary, in order to secure the welfare of the soul in the future life. This belief resulted further in building sepulchres of elaborate design, filling them with multitudes of objects of many kinds, decorating the walls with paintings, sculptures and inscriptions, and placing important manuscripts in the coffins with the mummies or embalmed bodies. The sepulchres of the kings were, of course, the largest and most elaborate of all; and of these sepulchres the grandest were the pyramids. By reason of the great care and labor lavished on tombs and sepulchres and pyramids, and by reason also of the dryness of the air in Egypt, and the consequent durability of works of stone, it has been from the tombs that many of the clearest items of information have come to us about old Egyptian times.

The Egyptians excelled in architecture, and the greatest of their buildings were the pyramids. As to whether or not there was much invention devoted to those works, it is virtually impossible now to know. The probability seems to be that they could not have been produced without the promptings of the inventor, but that the progress was a slow and gradual march. It seems that there was a long series of many small inventions that made short steps, and not a few basic inventions that proceeded by great leaps.

The Egyptians seem to have been the inventors of arithmetic and geometry. What men in particular should most be credited with inventing them, we do not know; but that some men were the original inventors the probabilities seem to intimate. For these sciences were creations just as actual as the steam engine, and could hardly have been produced save by similar procedures.

The suggestion may here be made that whatever we do is the result (or ought to be) of a decision to do it, that follows a mental process not very different from that invented by the German General Staff for solving military problems. By this process one writes down —

1. The mission – the thing which it is desired to accomplish.
2. The difficulties in the way of accomplishing it.
3. The facilities available for accomplishing it.
4. The decision – that is, how to employ the facilities to overcome the difficulties and accomplish the mission.

In solving a military problem (or in solving many of the problems of daily life) it is often a matter of great difficulty to arrive at a clear understanding of what the mission actually is, what one really wishes to accomplish. In the majority of ordinary cases, however, the mission stands out as a clear picture in the mind. Such a case would be one in which an enemy were making a direct attack; for the mission would be simply to repel it. Another case would be one in which the mission was stated by the terms of a problem itself; for instance, to build a steam engine to develop 1000 horse power. In the case of the inventor, the mission seems to be sent to him as a mental picture; he suddenly sees a dim picture in his mind of something that he must make.

Perhaps, many centuries ago, some man who had been laying out plots of ground in Egypt, of different shapes and sizes, and making computations for each one, suddenly saw a phantom picture in which all the lines and figures appeared grouped in a few classes, and arranged in conformity to a few fixed rules. The mission was given to him free, but it devolved on him to formulate the rules. As soon as he had formulated and proved the rules, the science of Geometry existed.

It is interesting to note that the conception of the idea required no labor on the part of the conceiver. He was virtually a passive receiver. His labor came afterwards, when he had to do the constructive work of "giving to airy nothing a local habitation and a name."

The Egyptians seem to have learned the use of many drugs, though they can hardly be said to have invented a system or a science of medicine. They did, however, invent a system of characters for indicating the weights of drugs. Those characters are used by apothecaries still.

The first means of cure were incantations that evidently influenced the mind. It is interesting to note that modern systems tend to decrease the use of drugs and increase that of mental suggestion.

Both the Babylonians and the Egyptians held religious beliefs; but it is doubtful if the religious beliefs of either were so definite and formulated that they could be correctly called religions, according to our ideas of what constitutes a religion. An interesting fact is the wide difference between the beliefs of the two peoples, in view of the similarity of many of the other features of their civilizations. The beliefs of neither can be called highly spiritual; but of the two, the Egyptian seems to have been the more so. The Egyptians believed that the souls of those who had lived good lives would be rewarded; while the Babylonian belief did not include even a judgment of the dead.

One of the most important inventions made in Babylonia was that of a code of laws. It is usually ascribed to a king named Hammurabi; but whether he was the real inventor or not, we have no means of knowing. We do know, however, that the first code of laws of which there is any record was invented in his reign, and that it was the prototype of all that have followed since.

The influence on history of the invention and carrying into effect of a formulated code of laws, we cannot exactly gauge; but we may assert with confidence that modern civilization would not have been possible without codes of laws, and that the first code must have been more important than any code that followed, because it led the way.

Both the Babylonians and the Egyptians seem to have made most of their inventions in the period of their youth, and to have become conservative as they grew older. The Babylonians were a great people until about the year 1250 B. C., when a subject city, Assur, in the north, threw off its allegiance and formed an independent state, Assyria. The decline of Babylonia continued until the fall of Assyria and the destruction of Nineveh, its capital, about the year 606 B. C., when the new Babylonian, or Chaldean Empire, came into existence. It enjoyed a period of splendid but brief prosperity until it was captured by Cyrus, king of Persia, in the year 538 B. C.

Egypt's career continued until a later day; but it was never glorious in statesmanship, war or invention, after her youth had passed.

A nation possibly as old as the Babylonian or Egyptian was the Chinese; but of their history, less is known. It is well established, however, that they possessed a system of picture writing in which each word was represented by a symbol. The system was much more cumbrous, of course, than the syllabic or alphabetical; but its invention was a performance, nevertheless, of the utmost brilliancy and importance, viewed from the light of what the world was then. There is little doubt also that the Chinese were the original inventors of the magnetic compass and of printing from blocks, two of those essential inventions, without which civilization could not have been brought about. Another of China's inventions was gunpowder; though it is not clear that the Chinese ever used it to propel projectiles out of guns.

Achievements equally great, and maybe greater, were the creations of religions – Confucianism and Taoism, invented in China, and Buddhism, invented in India. These religions may seem to us very crude and commonplace and earthy; but we should not shut our eyes to the fact that they have probably influenced a greater number of human beings toward right living than any other three religions that we know of.

Like Babylonia and Egypt, China became conservative as she grew older. At the present day, her name stands almost as the symbol of everything non-progressive and non-inventive.

Assyria was able to capture Babylon about the year 1250 B. C., and to maintain the position of the dominant power in western Asia for about 600 years. A progressive and ambitious people, they accomplished an original and important step in the art of government by organizing conquered peoples into provinces under governors appointed by the king. It does not seem to be a great straining of the word to declare that this achievement was so novel, so concrete and so useful as to possess the essential features of an invention. For if we realize that during all the times that had gone by, conquered peoples had remained simply conquered peoples, paying tribute but not forming parts of

the conquering state, we can see that the idea of actually incorporating them into the state, thereby increasing the population of the state by the number of people incorporated, and making the state stronger in that proportion, we can hardly fail to realize that the conception of doing this was of the highest order of brilliancy. To work out afterwards the details of developing the conception in such a way as to render possible the production of an actual and workable machine of government was a constructive act. When the machine was actually produced a new thing had been created. In other words, the institution of this new scheme in government seems to have followed the same three stages as the invention of a mechanical device; that is, conception, development and production.

The likeness between this process and that of conception, gestation and birth is obvious.

The Assyrians were evidently a very practical and constructive people, somewhat such people as the Romans later were. They devoted themselves to the practical side of life, and to this end they developed the governmental and the military arts. They were great warriors. The period of their greatest greatness was in the seventh and eighth centuries B. C., when the conquerors Sargon II and Sennacherib were kings. The splendor of the empire afterwards was conspicuous but not long lived; for after unifying the great nations of the Orient under Assyrian rule, and carrying on wars marked with the utmost of cruelty and oppression, they finally entered on a rapid decline in morals, and consequently in national prosperity and strength. The end came in 606 B. C., when a combined force of Medes and Babylonians captured and sacked the hated Nineveh, the capital. The intensity of the hatred against the Assyrians may be gauged by the completion of the destruction visited on Nineveh. When Xenophon saw its ruins only two centuries afterwards, he could not even ascertain what city those ruins marked.

The Assyrians have left us clearer records of their achievements in the invention of weapons than has any other ancient nation. It is impossible to declare with certainty that all the seemingly novel weapons and armor which the ancient Assyrians possessed and used were invented by themselves, and not by the Egyptians or the Babylonians; but the mere facts that the Assyrians were the most military nation of the three, and that the specimens of those weapons which have come down to us have been mostly Assyrian, give probability to that supposition.

The Assyrian soldier was finely equipped and armed as far back as the thirteenth century B. C.; and Assyrian bas-reliefs show that they actually used war-chariots then, drawn by horses and operated by armed warriors. The infantry soldiers wore defensive armor consisting of helmets, corslets made of skin or some woven stuff on which plates of metal were sewn, and sometimes coats of steel mail; with leggings to protect the legs. They carried shields, and were armed with lances, swords, slings and bows and arrows. The Assyrians employed cavalry, the horsemen wearing mail armor, and carrying shields and swords and lances. They employed archers also; the archers being sometimes mounted.

The use of war-chariots, with all the mechanical equipment that was necessary, in order to make them operate effectively, shows a state of civilization much higher than many people realize. It shows also that a great deal of inventiveness and constructiveness must have been employed, and must have been skilfully directed; – for it is a very long road – a very long road indeed – from the bow and arrow to the war-chariot. In order to produce the war-chariot, several inventions must have previously been made. The most important of these was one of the most important inventions ever made, – the wheel.

Who invented the wheel, and when and where did he invent it?

This is one of the unanswered questions of history. The war-chariot suddenly appears on the stage, without any preliminary announcement, and without any knowledge on our part that even the wheel on which it moved had been invented.

It is true that the records of prehistoric man show us that in fashioning pottery he used a disc that he revolved on a spindle and applied to the surface of the urn or vase; and it is also true that a revolving disc is a kind of wheel. But a disc revolving on a stationary spindle is in its intent and use a

very different implement from a wheel placed on a chariot, and turned by the forward movement of the chariot itself, for the important purpose of reducing its resistance to being drawn along the ground.

It is true also that invention was needed to produce the revolving disc, the forerunner of all the polishing and turning machines on the earth today. But the wheel was a different invention, probably a later one, and certainly a more important one. There are things sometimes seen in nature that look a little like revolving discs; for instance, swirls of dust or water. In fact, almost anything put in rotation looks like one, if the rotation is rapid enough; for instance, the sling that a primeval slinger revolved around his head. But what do we know of in nature that looks like a wheel, or that is used for a similar purpose? Nothing. This being the case, the mind may lose itself in speculation as to what could have led to the conception of such an appliance in the mind of the original inventor of the wheel.

The suggestion may be hazarded that the invention was preceded by an accidental recognition of the fact that it was easier to drag something along the ground, if it rested on round logs, than if it did not so rest; and by noting also that the logs were passed over and left behind continually. From this point to the mental conception of a roller that would not be left behind, but would be secured to the thing dragged by a round shaft on which it revolved, there was probably a single mental jump. Someone saw such a contrivance with his mental eye. It looked dim and unreal – but he saw it. To make the picture clear, and then to develop the thing pictured, constructiveness was used. In other words, conception and development accomplished their successive but cooperating tasks. The invention was complete when a wheel was actually produced.

To realize the importance of the wheel, we have but to ask ourselves (or our neighbors) how history could possibly have been even approximately what it has been if the wheel had not been invented.

Another important invention probably made by the Assyrians was the catapult; another one, somewhat similar, was the balista. The catapult was used for hurling stones, balls, etc.; the balista for shooting arrows with greater force than an archer could exert. Another was the battering ram for making breaches in the walls of fortresses.

The Assyrians used these inventions in their wars against the contiguous nations of the East, and with their aid achieved the mastery, and unified the Orient. That the Assyrian rule was harsh and cruel should not be denied; but, on the principle that any kind of government is better than no government, it cannot reasonably be supposed that the central and efficient administration of Assyria was not better than the condition of continual petty wars and quarrels that had existed among the numerous tribes and nations, with their enormous possibilities for suffering of all kinds.

It may be pointed out here that the cruelties and injustices committed by any powerful government against great numbers of persons attract immeasurably more notice and condemnation by historians and others than do the numberless atrocities of all kinds that lie hidden in the darkness of anarchy, or the confusion of petty wars. In the endeavor to preserve order over widely separated and barbarous peoples, when means of transportation and communication were inadequate, stern measures seem always to have been required. That they have often been too stern, and that great cruelty has often been exercised, the wail of the ages testifies. But human nature is very imperfect; and no really good government, no government free from the faults of man, has ever been established. Yet every government has been better than anarchy.

The Assyrians, despite their cruel treatment of their conquered peoples, did a direct service to mankind and gave a powerful stimulus to the march of progress. For the great empire which they established, and the great cities which grew up, and the system of provinces which they instituted, formed a pattern for similar work by later nations; while the civilization which they spread throughout the more backward countries under their rule, especially in Greece, started the later culture which Greece developed, and which is the basis of all that is most beautiful in the civilization of today.

The influence of the weapons which the Assyrians invented was toward this end.

Between Egypt on the west and Babylonia and Assyria on the east lay Syria; a territory not very large, of which the part that played the most prominent part in history bordered the eastern coast of the Mediterranean Sea. Two important peoples dwelt in Syria, the Hebrews and the Phœnicians. Both belonged to the Semitic race, and neither was distinctly warlike; though the Hebrews during a brief period achieved considerable military strength and skill, under their great king David.

The main gift of the Hebrews to the world was the Jewish religion, a more spiritual religion than any that had preceded it, and based on a conception of one God, a holy God. The ideas held of immortality and of judgment after death for the deeds done in this life were not entirely new, but the conception of a holy and beneficent Deity was new; and it was so inspiring and stimulating a conception that it lifted the Jews at once to a moral and spiritual plane higher than any people had ever lived on before. It constituted a step also directly toward the Christian religion – which also was born in Syria; in Palestine.

That the conception and establishment of the Jewish religion was an invention may not be admitted by some; but the author respectfully asks attention to the sense in which he uses the word invention in this book, and points out that they constituted an invention in that sense.

That it was a beneficent invention, and that it helped the human race spiritually in a way analogous to that in which the invention of many mechanical devices helped it materially, does not seem hard to realize. For in both cases the race was transported away from savagery and toward high civilization; and in both cases there was first a conception of something desirable, then a constructive effort to develop it, and finally its production.

The Phœnicians lived just north of the Jews, and possessed a territory smaller than that of any other people who ever exercised an equal influence on history; for it embraced merely a little strip of land hardly longer than a hundred and twenty miles from north to south, or wider on the average than twelve miles from east to west. It bordered on the eastern edge of the Mediterranean Sea, and was shut off by the mountains of Lebanon from Syria, that lay due east.

The Phœnicians were a people of extraordinary enterprise and initiative. Inventors are men of extraordinary enterprise and initiative. How much the Phœnicians are to be credited with the invention of sailing vessels, we have no means of knowing; but we do know that (with the possible exception of the Egyptians) the Phœnicians were more identified with early navigation by sailing vessels and by vessels pulled by oars than any other people. It is even known that Phœnician vessels were navigating the Eastern Mediterranean, both under sails and under oars, as long ago as 1500 B. C. So, while we should not be justified in asserting positively that the Phœnicians were the inventors and developers of sailing vessels and of vessels pulled by banks of oars and steered by rudders, we may declare with ample reason that probably they were.

For the purposes of this book, however, the identity of the inventors is not important. What is important is the fact that the invention of those vessels had immediate fruit in a commerce by which the products of eastern civilization were taken westward to Greece and other countries, while tin and other raw material were brought east from Spain and even Britain; and that it had later fruit in gradually building up a western civilization. It had other fruit as well, in demonstrating the possibilities and the value of ocean commerce, and forming the basis of the world-wide navigation of today.

Few inventions have had a greater influence on history than that of the sailing ship. To some of us it may seem that no invention was involved; that to use sails was an obvious thing to think of and accomplish. But if any one of us will close his eyes a moment and imagine an absence of most of the great scientific and mechanical knowledge of today, and imagine also the absence of nearly all the present acquaintance with the laws of weather, flotation, resistance to propulsion, metacentric height, etc., he may realize what a feat was the invention of the sailing ship and even of the ship pulled with oars and steered with a rudder. It is true that we have no reason to assume that either vessel was conceived by one leap of the imagination and developed by one act, while we have many reasons to

think that each was the result of a series of short steps; but this does not invalidate the invention of the ships, or depreciate its influence.

By two other achievements, also, the Phœnicians showed the kinship between the inventor and the man of enterprise and initiative; the invention of the Tyrian dyes and of an alphabetical system of writing that forms the basis of the systems of today. Here again it is necessary to remind ourselves that possibly the Phœnicians were not the sole and original inventors of the alphabet, and that they may have merely improved upon a system invented by, say, the Cretans; and again it may be helpful to point out that the important fact is not the personality of the inventors but the birth of the invention, and the influence of the invention on history. Certain it is, however, that it was the Phœnicians who brought alphabetical writing to the practical stage and who not only used it themselves, but carried it in their ships all over the Mediterranean, where it bore abundant fruit. It bore fruit especially in Greece.

Phœnicia is an instructive illustration of the fact that a country (like a man) may make inventions of lasting usefulness to mankind, and yet not hold a position of power or splendor in the world. Phœnicia was nearly always a vassal, paying tribute to one great monarchy or another.

In striking contrast with Phœnicia was the empire of Persia, which, though it gave to the world of that day the best government it had ever known, contributed nothing in the nature of an actual new stepping-stone to civilization.

Persia conquered Lydia, which is credited with the important invention of coinage. The coins first issued by the Lydians were of electrum, an alloy of gold and silver. King Crœsus later issued coins of pure gold and pure silver.

Directly east of Syria was Phrygia. It was in Phrygia that the flute, the first real musical instrument, is supposed to have been invented, in about the sixteenth century B. C.

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The brief résumé just given of the inventions made in prehistoric times, and also in historic times in China, Egypt and western Asia, shows that before Greece had attained any civilization whatever the most important inventions for the betterment of mankind had been already made. These inventions were not only mechanical appliances and such arts as spinning, weaving, pottery making, etc., that were intended for safety and material benefit generally; for they included systems of government and codes of laws and even religions that aimed to elevate man, and that did elevate him mentally, morally and spiritually.

At the present day, when inventions follow each other with such rapidity that even students and experts cannot keep themselves informed about them, except in certain specialties, it is natural for us to feel that no inventing of any consequence was ever done before. In fact, the present age is called "The Age of Invention." Yet all the inventions of the last century added together have not had so great influence on mankind as the invention of writing, or of the bow and arrow, or the wheel – or almost any of the inventions we have noted. Not only are they not so important, – they were not so novel, they did not constitute steps so long, they did not mark such epochs, and probably resulted from less brilliant pictures on the mind. Can anyone think that the telephone was as novel or as important as the wheel? Can anyone suppose that the steam engine, or the electric telegraph, or the powder-gun took us as long a step upward to civilization as did papyrus? Will anyone declare that the railroad ushered in as great an epoch as the sailing ship? Is it probable that the first conception of the phonograph made quite so startling a picture on the accustomed brain of the habitual inventor as that of the art of making fire did on the virgin mentality of the savage?

The last contribution of western Asia to the betterment of the world was Christianity. It was not made until after Greece had reached the prime of her civilization and passed beyond it; and some may consider it a sacrilege to call it an invention. It was an inspiration from On High. But dare anyone assert that the wonderful conceptions that have come unbidden to the minds of the great inventors

were not, in their degree, also inspirations from On High? Whence did they come? That they came there can be no doubt. Whence did they come? Our religion teaches us that God directs our paths, that He puts good thoughts into our minds. It also teaches us that He inspired the men who wrote the Bible. In the ordinary meaning of the word "inspired," Some One inspired every noble and novel and beneficent achievement that was ever made. Who?

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Without insisting tediously on the meaning of the word invention, one may point out that the word is used continually to mean a mental act by which something heretofore non-existent is created. The expertest of all word users, in any language, cried:

"Oh, for a muse that would ascend the highest heaven of invention"; expressing almost exactly what the present author is trying to express, and indicating invention as the highest effort of the mind.

In this sense, may I reverently claim the Christian Religion as an invention, one of the greatest inventions ever made?

CHAPTER III
INVENTION IN GREECE

Our brief survey has thus far carried us over the lands of Egypt, China and western Asia; lands so far removed from us in distance, and inhabited by people so far removed from us in time and character, that they seem to belong almost to another world. But we now are coming to a country which, though its history goes back many centuries before the Christian era, was a country of Europe and inhabited by a people who seem near. The Greeks who overran what we now call Greece, probably about 1500 B. C., took possession of a civilization exceedingly high, which the inhabitants of the mainland and the Ægean Islands had received from the East, through the Phœnicians, who brought it in their ships. This civilization the Ægean islanders, especially the Cretans, had developed and improved, particularly in creations of beauty and works of art. The Greeks created a still higher civilization, and transmitted it to us. The influence of Greek civilization we see on every hand: – in our language, in our daily life, and especially in our ideas of art, literature and philosophy.

That a civilization so high and beautiful should have been attained, could hardly have been brought about without the presence of great imagination among the Greeks, and the exercise of considerable invention. The presence of both imagination and invention are evidenced in every page of the early history of Greece, in the stirring stories of her heroes, and in the conception and development of her government. Compared with the stories of ancient Greece, the stories of the childhood of every other country seem unimaginative and tame. The stories of early Greece still live and still have the power to charm. The Iliad and Odyssey are in the first rank of the great poems even now; and the story of Helen and the siege of Troy is as full of life and color as any that we know.

An interesting legend characteristic of the inventiveness of the ancient Greeks was that of the large wooden horse in which a hundred brave warriors concealed themselves, and were drawn within the walls of Troy by the Trojans themselves, who had been induced to do this by an ingenious story, invented to deceive them. Whether the legend is true or not does not affect the fact that invention was needed and employed to create the legend in the one case, or to cause the incident in the other case.

The prehistoric age of Greece was filled with myths of so much beauty, interest and originality, that the Greek mythology is more read, even now, than any other. It formed also the basis of the later mythology of the Romans.

It may be noted here that mere imagination is not a quality of very high importance, unless it be associated with constructiveness. In fact, imagination is evidenced more by savage and barbarous peoples than by the civilized; as it is also by children and women than by men. Imagination by itself, untrained and undirected, while it is unquestionably an attribute of the mind, is not one of reason, in the sense that it does not necessarily employ the reasoning faculties. In fact, the imagination, unless trained and well-directed, may lead us to the absurdest performances, in defiance of the suggestions of reason. Using the word imagination in this sense, Shakespeare said —

> "The lunatic, the lover and the poet
> Are of imagination all compact."

It is only when imagination has been assisted by reason, it is only when conception has been followed by construction, that practical inventions have resulted.

The myths invented by the Greeks in their prehistoric period were the products of not only imagination but construction. Each myth was a perfectly connected story, complete in all necessary detail, admirably put together, and told in charming language. The story of Jason's Argonautic Expedition in search of the Golden Fleece cannot be surpassed in any of the elements that make a

story good; Penelope is still the model of conjugal devotion, and Achilles the ideal warrior; Poseidon, or his Roman successor, Neptune, still rules the waves; Aphrodite, or Venus, calls up more vividly before our minds than any other name the vision of feminine beauty even to this day. Hercules exemplifies muscular strength, and Apollo still typifies that which is most beautiful in manliness.

The influence of the Grecian myths, "pure inventions" as they were, in the sense that they were fictitious and not true, has been explained and demonstrated at great length and with abundant enthusiasm by poets and scholars for many centuries. They have been generally regarded as inventions, but nevertheless as quite different from such inventions as the steam-engine or the printing press. The present author wishes to point out that the mental processes by which both myths and engines were created were alike, and that the inventions differed mainly in the uses to which they were put.

Even the uses to which they were put were similar in the end; for the use of the myths and of the steam engine was to improve the conditions of man's existence. There is only one way in which to do this, and that is by improving the impressions made on his mind. The myths did this by making beautiful pictures for his mind to gaze at, and by using them to induce him to follow a certain (good) line of conduct, rather than the contrary. The steam engine did it by making the conditions of living more comfortable, by rendering transportation more safe and rapid, and by rendering possible the procuring of many of the pleasant things of life from distant places.

The invention of a myth may be said to be the invention of an immaterial thing; the invention of a steam engine to be of a material thing. These two lines of effort, invention has followed since long before the dawn of history. Of the two, the invention of myths and stories probably succeeded the other.

Probably also it has been the more important in affecting our actual degree of happiness; affecting it beneficently in the main. For, while some myths and stories have filled men with dread and horror, a very large majority have had the opposite effect; and while many mechanical inventions have contributed to our material ease and comfort, it is not clear that they have much increased our actual happiness. Men accommodate themselves easily to changes in their material surroundings; what is a luxury today will be a necessity tomorrow; and very many of the material inventions have tended to artificial and unhealthful modes of living, with consequent physical deterioration and its accompanying loss of happiness.

As to influence on history, however, the influence of the material inventions has probably been the greater. Immaterial inventions might have been made in enormous numbers without of themselves affecting history greatly; but the material inventions have brought about most of the events that history describes; and without one material invention, that of writing, history could not exist at all. History is rather a narrative of men's deeds than of their thoughts; and their deeds have been directed largely by the implements which they had to do deeds with.

We must realize, of course, that the Greeks were much indebted to the Ægeans; for discoveries about the shores and islands of the Ægean Sea show that long before the advent of the Greeks they used tools and weapons of rough and then of polished stone, and later of copper and tin and bronze; that they lived on farms and in villages and cities, and were governed by monarchs who dwelt in palaces adorned with paintings and fine carvings, and filled with court gentlemen and ladies who wore jewelry and fine clothing. Exquisite pottery was used, decorated with taste and skill; ivory was carved and gems were engraved, and articles were made of silver and bronze and gold.

As early as the sixth century B. C., the Greeks made things more beautiful than had ever been made before. One almost feels like saying that the Greeks invented beauty. Such a declaration would be absurd of course: but it seems to be a fact that the Greeks had a conception of beauty that was wholly original with them, and that was not only finer than that which any other people had ever had before, but finer than any other people have had since. And not only did they have the conception, they had the ability to embody the conception in material forms that possessed a beauty higher than

had ever been produced before, and higher (at least on the average) than have ever been produced in any other country since.

Looked at in this way, the production of a new and beautiful statue, painting or temple, seems to be an act of invention much like the formulation of a myth or the writing of a poem. In this sense, the Greeks were inventors, inventors of works of beauty that have existed as concrete material creations for centuries, and have exercised an enduring influence on the minds of men.

The influence of paintings, statues and temples is not so clear as that of material inventions, but more clear than that of myths and poems. They may be said to form a class midway between inventions of material appliances and inventions of immaterial thoughts and fancies. A beautiful painting or statue is a material object in the same sense as that in which a steam engine is; but its office is to stimulate the mind, as a poem does.

The first inventor of mechanical appliances, mentioned by name as such, was Dædalus of Athens. He was probably a mythical person. He was reputed to be the son or the grandson of Erectheus, a probably mythical king. He is credited with the invention of the saw, the gimlet, the plumb-line, the axe, the wedge, the lever, masts and sails and even of flying; – for he is said to have escaped from Crete to Sicily with artificial wings. The story of Dædalus, like that of many other mythological personages, is both interesting and irritating from the mixture of the very probable, the highly improbable, and the entirely impossible, in a jumble. But the story of Dædalus seems to make it probable that all the things which he is reported to have invented (except flying) were in use in Greece in prehistoric times.

As no records show to us that the inventions just enumerated (except masts and sails) had been invented elsewhere, we may feel justified in inferring that they were invented in Greece by Dædalus, or by some other man bearing a different name, – or by some other men. The name borne by the man is not important to us now; but it is important to realize that such brilliant and original inventions were made so long ago by a primeval people; especially since they were of a character somewhat different from those invented in Egypt and Asia which we have already noted. The invention of the gimlet seems the most brilliant and original of those just spoken of; and one marvels that it should have been invented at such a time; for the action of the gimlet was a little more complicated than that of even the balista or the catapult. It is true that the number of parts was less, that in fact there was only one part. But that part turned around in one plane, and advanced in another; it was less like anything that existed before than the catapult was like the sling, or the balista was like the cross-bow. There was no immediate forerunner of the gimlet. In other words, the mental jump needed to invent the gimlet was from a base of nothing that we can exactly specify.

A possible suggestion for the gimlet was the succession of inclined planes by which one mounted to the top of an Assyrian or Chaldean palace; these planes rising gradually on each of the four sides, so as to form together what might be called a square spiral. It is possible that a circular spiral may have been traced later around some cylindrical shaft or column, and given the first suggestion for the screw or gimlet. Of course, a gimlet is a kind of screw. The Greeks do not seem to have applied their inventiveness after the time of Dædalus to mechanical appliances, but to works of art and systems of religion and philosophy. One of their most important inventions may be said to be mid-way between: it consisted in adding vowels to the Phœnician alphabet and producing the basis of the Latin and succeeding alphabets. The Greeks were not naturally of a warlike disposition, and their peculiarly jealous temperament prevented the various states and cities from combining and forming a great nation. Their energetic character and great intellectuality saved them, however, when Darius, King of Persia, invaded Greece in 490 B. C.

By that time the Greeks had raised and trained an army of great excellence. No especial inventiveness seems to have been exercised, but the equipments of the men, their organization, their armor, their weapons and their discipline had been brought to a standard exceedingly high. All these advantages were needed; for the Persians were a warlike people, their King Darius was an ambitious

and successful conqueror, and the number of Persians that invaded Greece was far greater than the number that Greece could raise to fight them.

Had the Greeks been destitute of invention they would have followed the most obvious course, that of shutting themselves up inside the protection of the walls of Athens. Had they done this, the Persians would have surrounded the city, shut them off from supplies from outside, and slowly but surely forced them to surrender.

But, on the insistent advice of Miltiades, the Greeks advanced to meet the Persians, leaving the shelter of their walls behind them. It may not seem to some that Miltiades made any invention in planning the campaign which he urged against much resistance, and which the Athenians finally carried out. Yet his mental action was one allied to that of making an invention; for his mind conceived a plan as a purely mental picture, then developed into a workable project, and then presented it as a concrete proposition. Later, when the hostile forces met on the low plain of Marathon, Miltiades rejected the obvious plan that an uninventive mind would have adopted. Instead of it, he invented the plan of weakening his center, strengthening his flanks, and departing from the usual custom of advancing slowly against the enemy, in favor of advancing on the run. The plan (invention) worked perfectly. The unsuspecting Persians broke through the center and pursued the fleeing Athenians to a rough ground; – only to be caught between the two flanks, like a nut in a nut-cracker, and crushed to pieces.

It can hardly be seriously questioned that in this plan Miltiades showed the abilities of the inventor, and in a highly brilliant and highly important way. Had he fought the battle in the obvious way, the great numerical superiority of the Persians could hardly have failed to gain the victory, despite a really considerable superiority of the Athenians in training and equipment. But the Persians were the victims of a new and unexpected kind of attack. A new weapon suddenly brought to bear on them would have had a similar effect.

This is the first illustration in recorded history of the influence of invention on the deciding of a war. Its influence was enormous in this case; for the battle of Marathon was one of the most decisive and one of the most important battles ever fought. If it had been decided contrariwise, Grecian civilization would have been stamped out, or so completely stifled that it would never have risen to the heights it afterwards attained; freedom of thought and government would have been smothered, and the world would be immeasurably different now from what it really is.

The defeat of the Persians was so decisive that they withdrew to their own country, but with the determination of returning, and in overwhelming force. By reason of a variety of circumstances, including the death of the king, the invasion did not take place until ten years later. Then, in the year 480 B. C., King Xerxes set out on a punitive expedition against Greece with an enormous military and naval force.

Again Greece was saved from Persia by pure brain power, that of Themistocles. Like Miltiades, he rejected the obvious. Discerning, as no one else discerned, that the weakest point in the Persian forces was the line of communication across the Ægean Sea, because the ships of those days were fragile, and an invading army needed to get supplies continually from Persia, he pointed out that although it was the Persian army that would do the actual damage in Greece, yet nevertheless, the major effort of the Athenians should not be spent on their army but on their navy.

The difficulties he met in making the Athenians see the truth may easily be imagined, from experiences in our own day. He succeeded at last, however; so that by the time the Persians reached Greece, Greece had a fleet that was very good, though not nearly so large as the Persian. The fleets came near to each other in the vicinity of Athens. The majority of the Athenian leaders advised that the Athenian fleet should retreat toward the south and west, to the isthmus of Corinth, and await the Persians there; because, if defeated, a safe retreat could be effected. But Themistocles opposed this plan with all the force and eloquence he could bring to bear; pointing out that the aim of the Athenians should not be to find a safe line of retreat, but to win a battle; and that the Bay of Salamis was the

best place, for two reasons. One reason was that the Persians would have to enter the bay in column, because the entrance was narrow, and the Persian ships, as they successively passed into the bay, would therefore be at a great disadvantage against the combined attack of the Athenian ships, waiting for them there; the other reason was that the bay was so small that the great numbers and size of the Persian ships would be a disadvantage, instead of an advantage. Themistocles (not without the use of considerable diplomacy and even subterfuge) finally secured the assent of the other Athenian leaders. The result was exactly what he predicted that it would be. The Persian fleet was wholly defeated, and Greece again was saved.

The great victory of the Greeks over the Persians wrought a powerful stimulation among all the people, especially in Athens, and was followed by the most extraordinary intellectual movement in the history of the world. It lasted about a century and a half; and in no other country, and at no other period, has so much intellectual achievement been accomplished by so few people in so short a time.

Before the Persian wars, the Greeks had already shown an extraordinary originality in art and literature; especially in architecture, sculpture and poetry. Naturally these peaceful arts languished during the wars; but after the Persian invaders had been finally ejected, they rose with renewed vigor, stimulated by the patriotic enthusiasm of the nation as a whole.

It was in Athens, and among the Athenians that most of the movement was carried on. The principal state in Greece besides Athens then was Sparta. The Spartans devoted themselves mainly to warlike and allied arts, while the Athenians devoted themselves mainly to the beautification of Athens; though they were careful to guard it adequately by maintaining an excellent navy, surrounding the city with high walls, and building two long parallel walls from Athens to Piræus, its seaport.

It would be out of place in a book like this to attempt any description or discussion of the various phases of the intellectual activities that rose with such startling quickness, and developed into such important movements, during the century and a half that followed the Persian wars; especially as this has already been done by many scholars, in many languages, and at many times. A very brief and elementary statement may, however, be made, for the purpose of illustrating the influence of invention on history.

The main characteristic of the movement as a whole and of every one of the various channels which it followed, was originality. No such perception of beauty had ever been evidenced before; no such conceptions of logic, philosophy or science.

Accompanying these was a conception of free government equally original. Whether the government of Athens was the cause of the intellectual rise, or the intellectual rise was the cause of the government, may safely be left to scholars to debate; for the purposes of the present discussion, it seems sufficient that they co-existed and had together a powerful influence on history.

The greatest genius that guided the intellectual forces of the Athenians in the matter of government was that of Pericles, who ruled their minds by pure force of argument and persuasion, from about 445 to 431 B. C. Athens and her subject cities formed a virtual empire, small in extent, but powerful in influence; though in form it was a democracy. In some ways it was the most perfect democracy that ever has existed even to this day; for not only was every citizen available for office, but he was expected to take active part in deciding public measures, and to be really qualified to hold office.

This idea was put into practical operation by a careful system of payment for every public service; to the end that even the poorest citizen should be enabled to hold office, and a wealthy office-holding caste prevented from existing. To so great an extent was this carried out that, by the time that the Age of Pericles ceased and the Peloponnesian War began, almost every citizen was in the pay of the state. The perfect equality of all the citizens, and their community of interests and privileges, was recognized by supplying them at times with free tickets to places of amusement, and by banqueting the people on great occasions at the expense of the state. To distribute widely the powers and duties of citizenship, exceedingly large juries were established for the trials of all cases. There was no king or

president or prime minister. The source of authority was the Assembly which included every citizen over eighteen years of age, and held forty meetings a year. Cooperating, as a sort of committee, was a Council of Five Hundred, whose members were chosen by lot each year from citizens over thirty years of age.

The success of the Athenian democracy has had a powerful influence ever since on history; because it has supplied not only a precedent but an encouragement to every people to try to escape from the individual restrictions that monarchies and all "strong governments" tend to impose. But it had another though less powerful influence also, which continued for a long while, but now has ceased, in supplying a precedent for slavery. For while the citizens of Athens were free, only the sons of Athenian fathers and Athenian mothers could be citizens; many thousand workers and merchants of all kinds could take no part in the government, and there were besides an enormous number of slaves. It was to a great degree the fact of slavery that made possible the success of the so-called Athenian democracy; for it liberated the citizens in very great measure from the drudgery of life, and gave them leisure to devote themselves to the study of government and the arts.

In addition, Athens acquired great wealth from the spoils of its wars and the tribute of its subject states. This wealth was expended largely in the beautifying of Athens, and in the consequent encouragement and opportunity to artists of all kinds. Naturally, the art most immediately encouraged was that of architecture; and that the encouragement met with ready and great success the most beautiful ruins in the world superbly testify. The directing genius in this work and in all the others was Pericles, who stimulated the Athenians with his conception and description of a city worthy to symbolize the power and glory of the empire. The twin arts of architecture and sculpture worked together and in harmony; and a city more beautiful than ever known before, or ever known since, testified to the soundness and brilliancy of the conception and to the constructive ability of the Athenians to embody it in material form.

The poets and scholars kept pace with the statesmen and the architects and the sculptors; but the philosophers surpassed them all. For, while the successful democracy of Athens is a model still, and while the Parthenon and the statue of Apollo are models still, yet an integral part of the system of government (slavery) has been abjured by the civilized world, and the temples and the statues have been for the pleasure of but a few; while the teachings of the philosophers have been the basis on which has rested ever since much of the intellectual progress of mankind.

It may be noted here that, as men have progressed up the steep road to civilization, the only guides they have had have been men who have not themselves passed over the road before, and whose only qualification as guides has lain in some attribute of the mind that enabled them to survey the road a little farther ahead than the others could, and to point out the paths to take, and the obstructions to avoid. Man's physical instincts guide him considerably as to the methods to preserve his physical existence; but they help him not at all to lift himself above his physical self, and in many ways they hinder him. It seems to be the office of the mind both to discern the upward paths and to stimulate the will to overcome the difficulties and dangers in the way.

Of the great pointers of the way, Socrates, Plato, Aristotle and others, it might be deemed presumptuous of the present author to do more than speak; and of the great stimulators, Æschuylus, Sophocles, Euripedes, Herodotus, Thucydides, Xenophon, and, above all, Demosthenes as well. But because it is pertinent to our subject it is instructive for us to note that the main distinctive feature of the work of each was originality. It is true that it is the completed work in the case of each that meets our gaze; it is true that the superficial impression would be the same, even if each work had been a copy of some work that had gone before; in the same way that, superficially, many a copy of an oil painting is as good as the original. But from the standpoint of influence on the future, it is the originator rather than the copyist who wields the influence; just as it is the basic inventor of a mechanical appliance rather than the man who improves upon it.

The Athenians and Spartans became involved in the Peloponnesian War, that lasted from 431 to 404 B. C., and ended with the capture of Athens. The Spartans thereupon became dominant in Greece, but only to be mastered by the Thebans in 371 B. C. The little jealous states of Greece were never able to agree together long, and no one state was ever able to unite them. But the half-barbarian people of Macedonia, under Philip their king, after developing their army, according to a novel system invented by him, overcame and then united under their sway the highly cultured but now military weak states that had despised them.

Possibly, it would somewhat strain the meaning of the word invention, to declare that Philip made a radically new invention, when he improved on the Theban phalanx, and devised his system of military training; for kings and other leaders had trained armies long before Philip lived, and Philip departed only in what some might call detail from the methods that had been used before. But, at the same time, it was an act, or a series of acts, betokening great initiative and originality, for a man ruling a weak collection of tribes such as dwelt in Macedon, to create out of such crude material as he began with, such an extraordinary army as he ultimately was able to lead to battle. To accomplish this it was necessary for him to conceive the idea of doing it, then to embody his conception in a formulated plan, and then bring forth the finished product. The thought of doing it must have come to him: – how else could he get it? An idea comes from outside through the mental eye to the mind; as a ray of light comes from outside through the physical eye to the retina.

The picture made on Philip's mind must have impressed him profoundly, for he spent the rest of his life in giving it "a local habitation and a name." To accomplish it cost him years of continual effort of many kinds, but he did accomplish it. He did, as a result, produce a machine, as truly a machine as Stephenson ever produced, but made up of many more parts; each part independent of any other, and yet dependent on every other, and all working together, for a common purpose.

Let us remind ourselves again that a machine composed of inanimate parts only is only one kind of machine; for a machine may be composed of animate parts, or inanimate parts, or of parts of which some are animate and some inanimate. Clearly, it makes no difference, so far as the act of invention goes, whether a man uses animate or inanimate parts; the essential of invention is the creation of a new thing. If a man merely puts two pieces of wood and a piece of string into a pile, or if he merely collects a number of men together, no invention is made and nothing is created. But if he so combines the two pieces of wood and the string as to make a bow and arrow; or if he combines a modified Theban phalanx with masses of cavalry and catapults in a novel and effective way as Philip did, invention is exercised and something is created.

Before Philip's time a phalanx was used to bear the brunt of the battle, and to overwhelm the enemy by mere strength and force; as the Thebans did at Leuctra and Mantinea. But Philip conceived the idea of merely holding the enemy with his phalanx assisted by the catapults, and hurling his cavalry against their flanks. Philip's army, as Philip used it, was a machine and a very powerful one: – each part independent of every other, yet dependent on every other – all the parts working together for a common purpose. Philip conceived the idea of making this machine, and afterwards made it; just as Ericsson more than two thousand years later conceived the idea of making a "*Monitor*" and afterwards made it.

By means of his machine Philip defeated the Greeks at Cheronea in the year 338 B. C., just as Ericsson by means of his machine defeated the *Merrimac* at Newport News in the year 1862 A. D., exactly twenty-two centuries later. The two machines differed, it is true. Yet they did not differ so much as one might unthinkingly suppose; for each machine was made up of parts, of which some were animate and some were not; and in each machine every part, animate or inanimate, cooperated with all the others; and all cooperated together, to carry out the inventor's purpose, the destruction of the enemy.

The influence of Philip's invention began before Philip died, and it continues to this day. For after Philip's death, his son Alexander put it to work at once on the task of subduing thoroughly all of Greece, and then subduing Asia.

The influence of the machine in subduing even Greece alone must not be regarded lightly; not so much because Greece was subdued, as because the various little states were by that means brought together; and because it illustrates the fact that without a machine, no great number of people can work together. It *was because of the absence of any machine* that the Grecian states acted separately and antagonistically, instead of in cooperation.

After subduing Greece, Alexander took his machine across the Hellespont, in the year 334 B. C., to try it on the Persian troops in Asia Minor. The machine worked so successfully at a battle on the Granicus that Alexander took it south, and with its aid was able to conquer all of Asia Minor in about a year.

It may be objected that it is not correct to attribute all of Alexander's success to the excellence of his machine; and this objection would have great force and receive the approval of most people, for the reason that, in most histories, the main credit is given to the energy of Alexander and the courage of his troops; – though the excellence of the training and organization bequeathed by Philip is admitted.

To this hypothetical objection the answer may be made that the ultimate result was due to both the machine and the excellence with which it was operated; that is, to the product of what the machine could do if it were used with perfect skill and the percentage of skill with which it was actually used. This statement is, of course, true of all machines and instruments, as the author has often pointed out, in articles and addresses.

In the case of Alexander and his army, the percentage of skill, of course, was high; but Alexander and each one of his soldiers was only a part of the machine; and even their skill was part of the machine in the sense that it was a characteristic included in the original design of Philip. In other words, we should not fall into the error of dissociating the skill of Alexander and his soldiers from the machine itself; because it was part of Philip's invention that the training should produce that skill. The system of training was part of the invention.

It is true, however, and exceedingly important, that the degree of skill which Alexander brought to bear personally was far in excess of what any system of training could possibly produce. When we read of the amazing victories that Alexander made over superior forces of highly trained warriors, we see that Philip of Macedon should not be given all the credit; that the genius of Philip of Macedon was not the only genius contributing to the result. We see that genius of some kind directed the decisions of Alexander. What were the characteristics of that genius?

Courage? Yes; history tells of no one possessing higher courage, both physical and moral, than Alexander. Not only was he physically brave, not only did he dare physical danger of many kinds, and on many occasions, but he was morally brave; he did not shirk responsibility; he did not fear to take enormous risks; he did not hesitate to reject advice, even the advice of his most experienced and able generals; he was willing to stake everything, sometimes, on the success of some wholly untried expedient of his own devising.

But does mere courage, even of so many kinds – and even if it be added to trained skill and the possession of an admirable machine – do they all together explain the amazing successes of Alexander? No. What does explain them?

Genius? Yes, but the word genius is only a word, and explains nothing; for the reason that no one knows what the word genius means. It is merely a label that we attach to a man who is able to do things that other men cannot do. But granting that the possession of "genius" is an explanation of Alexander's being able to accomplish what he did, in what way did that genius operate? in what way did it help him to win so many victories and extricate himself from so many perilous situations?

By inventing methods and devising schemes and improvising plans that an uninventive man would not have thought of. The story of the Gordian knot may or may not be true; but it seems credible, because it was exactly the kind of a thing that Alexander might have been expected to do in such an emergency. Posing as a great conqueror, he was (according to the legend) suddenly confronted with the untying of a knot, the successful accomplishment of which would make him master of Asia. He realized that he could not untie it. Any man but a man like Alexander would have tried it and acknowledged failure, or have declined to try it: placing himself in a defensive position in either case. But Alexander draws his sword and cuts the knot in two, thereby accomplishing whatever the untying of the knot would have accomplished, but in an unexpected way. Alexander's victories and escapes from perilous positions were largely accomplished by unexpected measures.

But Alexander showed his inventive ability before he invaded Persia; in his very first campaign undertaken to subdue a revolt in Thessaly immediately after he ascended to the throne. The Thessalians opposed him in a narrow defile. An ordinary man would have thought, as the Thessalians did, that he was checkmated. But Alexander conceived and executed the ingenious scheme of cutting a new road up the steep side of the mountain, leading his army along that road, and suddenly threatening the Thessalians in their helpless rear. Shortly afterward in Thrace he reached a defile in the mountains which it was necessary for him to pass, but which he found defended by a force that had stationed a number of war-chariots at the top, to be rolled down on the Macedonians. Alexander immediately ordered his infantry to advance up the path and to open their ranks whenever possible to let the chariots rush through; but when that could not be done to fall on their knees and hold their shields together as a sort of roof on which the chariots would slide, and from which they would roll off. This amazing story is supposed to be true; and it is said to have succeeded perfectly.

Not long afterward Alexander had to cross the Danube with his army and all their equipments and attack a force of barbarians on the farther bank. This he saw he could not do by the use of any means available of an ordinary kind. Nothing daunted, he conceived and executed the scheme of floating his equipments across at night in floats made of tent skins, filled with hay.

The next clear example that we find of Alexander's inventiveness was when he undertook the siege of Tyre. Tyre stood on an island of Phœnicia in the extreme eastern end of the Mediterranean Sea. It was surrounded with a wall, very thick and very high, and was separated from the shore by half a mile of deep water. To capture such a place was no small undertaking for a man who had no ships. But Alexander conceived and executed a scheme that worked successfully. In accordance with that scheme, he built a causeway that extended from the shore out toward the island on which Tyre stood. Naturally, the Tyrians obstructed his efforts by sending fireships against him and firing projectiles; and these tactics became more and more effective as the causeway approached the city. Then Alexander visited some of the jealous neighbors of Tyre that had submitted to him, and secured a fleet of some eighty ships; and these he led, as the admiral commanding, against the Tyrian harbor.

By this time, the causeway was well protected with catapults and war-engines of various kinds, and had been carried close up to the island. Yet little actual damage could be done to Tyre, because of the height and thickness of the walls, and because Alexander's galleys that he had equipped with war-engines could not get close enough, by reason of large boulders under water. Alexander then equipped certain galleys with windlasses to root up the boulders, the galleys being fitted with chain cables to prevent divers from cutting them. Tyre was soon afterwards reduced to a purely passive defense and consequent surrender.

The story of the siege of Tyre, if read in the light of the conditions of the comparative barbarism of the world in those days, is a record of inventiveness, on the part of Alexander, so convincing and complete, as to entitle Alexander to a place in the first rank among the inventors of our race.

Shortly afterward Alexander reached the town of Gaza, the great stronghold of the Philistines. It stood on high ground, and was more than two miles from the sea. Alexander's engineers reported to him that, as the fleet could not assist them, and as the walls were themselves very high and stood

on a high hill, the walls could never be stormed. Things looked serious. They were serious; and failure would then have come to any man, except a man like Alexander. He cut the Gordian knot by ordering that ramparts be thrown up as high as the top of the walls, and war engines placed on the ramparts. This was done, and the city was taken.

Alexander's campaigns in Egypt, and afterward in western Asia, were characterized by the same quickness and daring, both in conception and in execution, that had marked his opening campaigns in Greece. Later, when advancing toward Persia, he encountered a tribe of hillsmen in the Uxian Pass, who, like the Thessalians and the Thracians, thought they had blocked his passage by opposing him in so narrow a defile. Alexander literally "circumvented" them by making a night march over a difficult mountain pass, and astonishing them by an attack on their rear the following morning. Shortly afterward a like situation presented itself, when an army opposed him in a narrow defile called the Persian Gates, that was fortified with a wall. Alexander soon realized that the position of his enemy was impregnable. He learned, however, that there was a path that led around the pass, though it was exceedingly dangerous, particularly to men in armor and to horses, and especially at that time, when snow and ice were on the ground. He again utilized his former invention (circumvention) and with his former success; though the conditions under which it was accomplished were much more difficult.

The four examples just given of literally circumventing an uninventive enemy illustrate in the simplest form the influence of invention on military history.

After it became clear to Alexander that his invasion of Asia would be successful from a military point of view, his active imagination presented to his mind a picture of a grand and noble empire, embracing the whole world, but dominated and inspired by the spirit of the civilization of Greece. To develop this conception into an actual reality, became at once the object of his efforts. To develop it, he decided to adopt in some measure the characteristics and dress of the people in whatever province he might be, and to take such steps in organizing provinces, founding cities and establishing systems, as to weld all into one empire, under himself, as ruler. One can hardly credit the authoritative account he reads of Alexander's bewildering success. He seems not only to have won battles, and built cities, and organized provinces, but actually to have super-posed Greek civilization on Persian civilization!

In one of his most important later battles, Alexander again utilized his inventiveness. If he had not done so, he would assuredly have lost the battle. It was against King Porus in northwestern India. Alexander found the forces of Porus encamped on the opposite side of the Hydaspes River, with the evident intention of preventing him from crossing. As the army of Porus in men alone was evidently equal to his own, and as it was reinforced with a multitude of elephants, Alexander was apparently confronted with a problem impossible of solution. It would have been impossible to anyone but a man like Alexander. He, however, by means of various feints and ingenious stratagems, managed to get across at night about sixteen miles up the river, using boats that he had constructed, and floats of skin stuffed with straw. Porus took up a position on the opposite shore and made ready to receive attack, his front preceded by war chariots and elephants. Alexander had neither; but he did have brains and originality. So he simply held the enemy with his infantry, and then made a determined attack with cavalry and archers on the enemy's left flank, and especially on the elephants. The elephants soon got beyond control; and the rest of the battle was a fight between a highly trained Macedonian phalanx, assisted by cavalry, and an Oriental mob.

Alexander died in Babylon when not quite thirty-three years old. In actual and immediate achievement he surpassed perhaps every other man who has ever lived. He founded an empire which he himself had conceived and developed, which covered nearly all the then known world, and which, though it was composed mainly of barbarous and semi-barbarous people, was dominated by Greek thought. It is true that the empire fell apart almost immediately after Alexander died. But it did not fall into anarchy, or revert to its previous state: it was divided into four parts, each of which was distinct, self-governing and well organized. The two larger parts, the kingdom of the Seleucidæ,

which occupied approximately the territory of Persia, and the kingdom of the Ptolomies, or Egypt, continued as torch-bearers to civilization for many centuries thereafter.

Of the two, the former was the larger and was probably the better, from an administrative point of view; but Egypt represented the finer civilization; for Alexandria, with its library and its wonderful museum, became the seat of learning and the resort of the scholars of the world, and the centre of the Hellenistic civilization that followed that of Greece.

This Hellenistic civilization, it may here be pointed out, was in some respects as fine as that of Greece, and in some respects was finer, because it was more mature. But (perhaps for the reason that it was more mature) it lacked much of the element that was the highest in the Greek, the element that gave Greek civilization greater influence on history than any other civilization ever had – the creative element. The creative period of Greece ceased when her political liberty was lost. Furthermore, the immense amount of wealth that poured into the Grecian cities and the Græco-Oriental world, by reason of the putting into circulation of gold that had been stored away in Oriental palaces, as well as by the commercial exploitation of the riches of the East, brought about a general effeminizing of all classes of society, and the consequent dulling of their minds.

Nevertheless, there was great intellectual activity in the Græco-Oriental world, and a certain measure of invention, though little was of a basic kind. Euclid improved the science of geometry, and put it in virtually the same shape as that in which it has been taught since, even to this day. Aristarchus, the astronomer, announced the doctrine that the earth revolves around the sun and rotates on its own axis; and Hipparchus invented the plan of fixing the positions of places on the earth by their latitudes north and south of the Equator and their longitude east or west of a designated meridian. Hippocrates and Galen conceived and developed the foundations of the science of medicine of the present day. Eratosthenes estimated with extraordinary accuracy the circumference of the earth, and founded the science of geography.

But the greatest of all of the original workers of that time was Archimedes, who lived at Syracuse in Sicily, and was killed by mistake when Syracuse was captured in the year 212 B. C., while engaged in drawing a geometrical figure on the sand. His principal fame is as a mathematician; but as a great inventor of mechanical appliances, he is the first man recognized as such in history. The invention with which his name is most frequently linked is that of the Archimedean screw. This consisted of a tube, wound spirally around an inclined axle, and so disposed that when the lower end of the tube was dipped into water and the axle was rotated water would rise in the tube – as shavings do when a screw is screwed down into wood. It constituted a very convenient pump and was so used. This was, of course, a mechanical invention of the utmost originality and value, and forms one of the clearly defined stepping-stones to civilization.

There seems to be a belief in the minds of some that Archimedes was the inventor of the lever. The lever was, of course, invented long before he lived; but the laws of its operation and the principle that the weight on each side of the fulcrum, multiplied by its distance from the fulcrum, is equal to the weight on the other side, multiplied by its distance (when the lever is in equilibrium), seems to have been established by him.

Many stories are told of his exploits when Syracuse was besieged by the Romans, but they are rather vague. The best known story is that he arranged a great many mirrors in such a way that he concentrated so many rays of sunlight on some Roman ships that they took fire. Whether this is true or not is not definitely known; but many centuries later Buffon, the French scientist, made an arrangement of plane mirrors with which he set fire to wood 200 feet away.

The greatest single exploit of Archimedes was his discovery and demonstration of the hydrostatic principle that the weight of liquid displaced by a body floating in it is equal to that of the body. The story is that the king gave him the apparently impossible task of determining the quantity of gold and the quantity of silver in a certain gold coin, in making which the king suspected the workmen of stealing part of the gold and substituting silver. Pondering this subject later while lying

in his bath, Archimedes suddenly realized that his body displaced a bulk of water equal to that part of his body that was immersed, and conceived the consequent law; and the conception was so startling and so vivid that he rushed unclad out into the street crying, "I have found it, I have found it."

The story as a story may not be exactly true; but if Archimedes had realized the full purport and the never-ending result of his conception, he would probably have done something even more eccentric than he did.

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Archimedes esteemed mechanical inventions as greatly inferior in value to those speculations and demonstrations that convince the mind, and considered that his chief single work was discovering the mathematical relation between a sphere and a cylinder just containing it.

Whether this discovery and the discovery of the hydrostatic principle just mentioned were inventions or not, depends, of course, on the meaning of the word invention. Within the meaning of the word as employed heretofore in this book, both seem to have been inventions. Each made a definite creation and each caused something to exist, the like of which had never existed before. Furthermore, the mental processes followed resemble very closely the conception and formulation of a religion or a theory, the conception and composing of a new piece of music, story or poem, the conception and developing of any new plan or scheme; the conception and embodying in material form of any mechanical device.

It is not asserted, of course, that all inventions are on a dead level of equality, simply because they are inventions. Evidently there are degrees of excellence among inventions as among all other things.

CHAPTER IV
INVENTION IN ROME: ITS RISE AND FALL

We have noted, up to a time approximately that of Archimedes, a continual succession of inventions of many kinds, that formed stepping-stones to civilization so large and plain, that we can see them even from this distance.

We now come to a period lasting more than a thousand years, in the first half of which there was a gradually decreasing lack of inventiveness shown, and in the latter half a cessation almost complete.

The nation that followed Greece as the dominant nation of the world was Rome. She became more truly a dominant nation than Greece ever was; but her civilization was built on that of Greece, and her success even in war and government was due largely to following where Greece had led. That Rome in her early days should have followed the methods of Greece was natural of course; for the two countries were close together, and the methods of Greece had brought success. The early religion of Rome was so like that of Greece that even to this day the conceptions of most of us regarding Zeus and Jupiter, Poseidon and Neptune, Aphrodite and Venus are apt to become confused.

Like the Greeks, the Romans first were gathered in city-states that were governed by kings; and as with the Greeks, more republican forms were adopted later. In one important particular, the Roman practice diverged from the Greek, and that was in incorporating conquered states into the parent state, and granting their inhabitants the privileges of citizenship; instead of keeping them in the condition of mere subject states. The Roman system was somewhat like the system of provinces established by the Assyrians. It forms the basis of the "municipal system" of the free states of the present day, in which local self-government is carried on, under the paramount authority of the state.

It may be pointed out here that the conception of such an idea and its successful development into an effective machine of government by the Romans constituted an invention; though in view of what had been done before by Assyria and Greece, it cannot be called a basic invention.

The early Romans were very different in their mental characteristics from the Greeks; for they were stern, warlike, intensely practical, and possessed of an extraordinary talent for what we now call "team work." As a nation they were not so inventive as the Greeks; but the Roman, Cæsar, was the greatest military inventor who ever lived.

As might be expected, their early endeavors pertained to war, and their first improvements were in warlike things. One improvement that was marked by considerable inventiveness was in changing the phalanx into the legion. The phalanx, the historian Botsford tells us, was "invented by the Spartans, probably in the eighth century B. C.," and consisted of an unbroken line of warriors, several ranks deep. The Thebans improved on this; and from the Theban, Philip developed the Macedonian phalanx with which Alexander fought his way through Asia. The Romans under Servius Tullius developed this into the Roman phalanx, which was different only in detail. The essential characteristic of the phalanx was strength. This was gained by the close support given by each man to his neighbor, the personal strength of each man and the trained co-operation of all. A tremendous blow was given to an enemy's line when a phalanx struck it.

In the early wars among the hills of Italy, the Romans found the phalanx too rigid for such uneven country; and it was in endeavoring to invent a substitute that they finally developed the legion. This machine was much more flexible, the individual soldiers had more room for their movements, and yet the machine seemed to possess the necessary rigidity when the shock of impact came. The heavy infantry was in three lines, and each line was divided into ten companies, or "maniples." The burden of the first attack was borne by the first line. If unsuccessful, the first line withdrew through gaps in the second line, and the second line took up the task; – and then the third, composed of the

most seasoned troops. The attack usually began with the hurling of javelins, and was followed at once by an assault with the Roman strong short swords.

Now the legion was just as truly an invented machine as a steam engine is; and it had a greater influence on history than the steam engine has ever had thus far. It was by means of their legions that the Romans passed outside of the walls of Rome, and conquered all of Italy. It was by means of their legions that the Romans conquered all the coast peoples that bordered the Mediterranean Sea, subdued Gaul, Europe and Egypt and Asia, and became the greatest masters of the world that the world has ever seen.

The first war of the Romans that history calls great was their war against the splendid and wealthy city of Carthage, situated on the opposite side of the Mediterranean, inhabited by descendants of the Phœnicians. They were an aggressive and energetic people, but only commercially. They were not of the warlike cast, and delegated the work of national defense to hired soldiers and sailors. They had one great advantage over the Romans in the possession of an excellent navy.

The Romans resolved to create a navy. With characteristic energy and practical ability, they devoted themselves at once to both the acquisition of the personnel and the material, and the adequate training of the crews. It is stated that within two months from the time of starting, Rome possessed a hundred quinqueremes, the largest galleys of those days, having five tiers of rowers; though they had had none when the war broke out. The first naval battle took place near the promontory of Mylæ. Naturally, the Romans were at a great disadvantage as compared with the experienced officers and sailors in the Carthaginian fleet; for though the Roman soldier was far better than the Carthaginian, the Roman sailor was inexperienced and unskilful. To remedy the difficulty, the Romans made a simple but brilliant invention. They provided each quinquereme with a "corvus," that consisted essentially of a drawbridge that could be lowered quickly, and that carried a sharp spike at its outer end; and then arranged a plan whereby each quinquereme should get alongside of a Carthaginian, drop the drawbridge at such a time that the spike would hold the outer end of the drawbridge in place on the Carthaginian deck, and Roman soldiers should then rush across the drawbridge and attack the inferior Carthaginian soldiers.

Few more brilliant inventions have ever been made; few have been more successful and effective. The battle ended in a perfect victory for the Romans, and constituted the initial step in the subjugation of Carthage by Rome.

There were three wars in all, called Punic Wars. The great Carthaginian General, Hannibal, invaded Italy by land in the Second War, and after a campaign marked with a high order of daring and ability, threatened Rome herself after a brilliant victory near Lake Trasimene. Another victory followed at Cannæ, but a decisive disaster later on the Metaurus River. So the Second War was won by Rome. But Carthage still existed, and menaced the commercial, naval and military dominance of Rome. Therefore war was brought about at last by Rome, and Carthage destroyed completely.

The conduct of Rome toward Carthage cannot be justified on any grounds of any system of morality accepted at the present day; and yet it cannot reasonably be denied that it was better for human progress that Rome should prevail than Carthage. The Romans, harsh and ruthless as they were, were less so than the Carthaginians; and they had an element of strong manliness and a comprehensive grasp of things beyond mere commerce and money-getting and ease and comfort that the Semitic Carthaginians wholly lacked. The effect of the conquest of Carthage by Rome was a little like that of the conquest of Persia by Alexander.

During the same year (146 B. C.) when Rome destroyed Carthage, she also destroyed Corinth in Greece, and brought Greece and Macedonia under her sway. She had previously (190 B. C.) defeated Antiochus the Great, and taken from him nearly all his territory in Asia Minor.

By the year 58 B. C., Rome had become the most powerful nation in the world and still preserved a republican form of government. In that year, 58 B. C., the man who probably is the most

generally regarded as the greatest man who has ever lived, appeared upon the stage of history. His name was Julius Cæsar.

He appeared in that year, because he went then from Rome to Gaul, and started on those brilliant and in many respects unprecedented campaigns which have had so profound an effect on history, and which for originality in conception and execution have had no rivals since.

At this time, Italy and the lands of Africa and Asia on which Alexander had impressed the civilization of Greece, were prosperous and well-governed; but beyond those countries only barbarous customs prevailed, and only a primitive civilization reigned. The lands that lay north and northwest of Italy, throughout all Gaul, were inhabited by savage tribes that were in a state of continual war with each other. In the southern and middle parts the effects of Roman civilization might be dimly seen; but in the southwestern part, and in the north, especially among the German tribes on the Rhine, and the Belgæ near the North Sea, a condition of virtually pure savagery prevailed.

Конец ознакомительного фрагмента.