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Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 868.

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PSYCHOLOGY OF INVENTION.

In all that has been written on how to invent, methods of invention, suggestions to inventors, etc., the advice usually given when condensed to the fewest words has been, "Keep on thinking." This is good as far as it goes, but thinking, unless it has a basis of knowledge, is valueless. The inventor must deal with existing materials, whether they be thoughts or matter, in various forms. He is no more able to create thoughts than matter. The mind cannot be coerced, new thoughts will not come at command.

If a conception of any subject be carefully investigated, it will be found to have some relation to a former experience. Possibly such experience may have been of such a nature as to produce a mental impression so slight as to be received unconsciously, and still sufficiently strong to develop into a well-defined thought or idea under proper mental conditions.

Invention being practically synonymous with new thoughts, and thoughts being the outgrowth of knowledge, the value of knowledge to the inventor is apparent, even though it may be in the nature of obscure impressions of the memory, vague suggestions from men and things, or broad yet accurate and practical information on any subject.

It is a fact that the mind, when occupied on a given subject, and forced to consider correlated subjects, acquires the penetrating quality which is vital to the success of the inventor.

It is while knowledge is being acquired in any direction that inventions in that line become possible, and conceived under such conditions they possess greater value, because the work is done intelligently and in the light of fundamental knowledge.

The works of such an inventor are ascribed to genius, while they really represent persistent effort supported by knowledge.

The term invention is here applied with its broader meaning, which includes the idea of calling into existence anything based on or originating in a new thought, whether in the realm of science, abstract or applied, or art or letters.

After all, invention is little more than an excursion beyond the boundaries of present knowledge, rendered possible by the accumulated experience of ages past. Progress is hindered by the fact that men re-enact the same things generation after generation, instead of acquiring a knowledge of what has already been accomplished, and, with such knowledge as a basis, pushing forward to new fields.

Inventors who have followed the plan here outlined have achieved both distinction and pecuniary reward, and if the general standard of invention could be raised to this level, results could be accomplished which would overshadow everything done in the past.

There is certainly no limit to the amount of material available. It is only necessary for the inventor to place himself in the proper relation to existing materials to enable him to reach out and take the reward.

THE EARTH AND THE INNER MOON OF MARS.

The scrutiny of the planet Mars by astronomers during the summer of 1892, with the aid of more powerful telescopes and better equipped observatories than have existed at former favorable periods of observation, and the sensational articles concerning this planet and its two little moons that have appeared in the daily papers, have aroused great popular interest in the affairs of the earth's next door neighbor of the solar system.

The satellites are peculiar as being the smallest heavenly bodies whose orbits and sizes have been even approximately determined.

Phobos, the inner moon, having a diameter of about eight miles, is of a size easily comparable with the earth and objects upon the earth's surface, its diameter and circumference being respectively almost exactly one one-thousandth of the earth's diameter and circumference.

Let us suppose everything on the surface of the earth to be reproduced on the surface of Phobos, as men, trees, ships, mountains, rivers, etc., all reduced in size proportionally. It would be only necessary to divide by one thousand the dimensions of any earthly object to ascertain its dimensions as modeled on a Phobian scale.

A man six feet high would, on this scale, stand 0·072 inch of our measure on Phobos, and looking down with our human eyes to find him, we should have to look for an oval object about 0·022 inch diameter in its longest dimension, as we should see only the head and shoulders. A good magnifying glass would be needed to determine the real character of the mere speck that would be visible to an unaided human eye at a distance of two or three feet from the surface, on which it would be seen to crawl with a painfully slow motion.

A few species of our larger birds could be seen in flight without a magnifying glass; only a few, the ostrich, the condor, the swan, could thus be discerned when their wings were not extended.

The altitude of the highest mountains would not exceed thirty, and the profoundest depths of earthly seas yet sounded would be represented by twenty-six of our feet.

A ship of the size of the Great Eastern sailing on a Phobian ocean would be less than 7½ inches long. A right whale of average size reduced to our Phobian scale would be less than five-eighths of an inch long.

A railway train of ten vestibule cars with locomotive and tender would have a length of less than six of our inches and its breadth would be represented by a line less than 0·02 of an inch in thickness.

An earthly river, two miles in breadth and one hundred feet deep, would be represented on Phobos by a stream a little more than ten and one-half of our feet in breadth, and one and one-fifth inches in depth. Let this river be frozen over with a sheet of ice four Phobian feet thick, and the ice would be only as thick as a sheet of drawing paper.

A square two and one-half of our inches on each side would represent a Phobian acre of land. A United States postage stamp would cover a space of nearly three Phobian city lots. A city like New York built to the Phobian scale would have streets ranging from four-tenths to one and two-tenths inches wide, and these would pass between buildings ranging from six-tenths of an inch to two and four-tenths inches in height.

Having thus constructed an earth to the scale of Phobos, in which, to unaided human eyes, only the largest quadrupeds and fishes would be visible, wherein we should have to look for all but the largest birds with microscopes, and in which all insect life would be undiscernible by any means at present known to us, Let us suppose an ordinary sized man transferred to its surface.

If a good pedestrian, he could walk over the Phobian equator, circumnavigating the globe, in six of our hours, making strides of three thousand Phobian feet. The soles of his walking boots would be thirty Phobian feet thick. Each hair of his head would be ten Phobian inches in diameter. His feet would be over nine hundred Phobian feet long and about three hundred Phobian feet in breadth. In walking he would raise the toes of his feet above the heads of the Phobians to a height of five hundred feet. If his stature in earthly measurement be taken as five feet ten inches, he would tower into the Phobian sky to a height over one and one-tenth miles.

Enormous giant as such a man would be to our imaginary Phobian, he is, as compared with our globe, no larger than such an inhabitant of that satellite would be as compared with his little world. The truth is, there is no absolute standard of large or small. Size is strictly relative, and the physical man, considered in relation to the universe, is nothing but a material point—a center of vital mental and moral forces, whose effects reach as far beyond the limit of his ken as the universe extends beyond the power of his vision. The life of man is a brief and narrow strip of imperfect light, bordered on either side by impenetrable mystery.

Memorial Fair Coins.

Congress has appropriated two and a half millions of dollars to help the World's Fair, to consist of memorial half dollars, or "Columbian half dollars." The designs of the coin have been selected. The reverse will show the main building of the exposition, and the obverse the head of Columbus. The plaster cast of Columbus was made by A. S. J. Dunbar, sculptor, of Washington, from a portrait which is recognized by experts as being as nearly authentic as any that exists, and is believed to have been painted for Domenico Malipiero, a Venetian senator and historian, in 1501. This portrait, with a well-traced history approving its antiquity, was recently purchased by the United States Consul-General at Frankfort, Germany, for Mr. James V. Ellsworth, of Chicago. The work of coining the souvenir "Columbian half dollars" will occupy a month or six weeks.

The bill also provides for the striking of 50,000 bronze medals, with appropriate devices and emblems, at a cost of $60,000, and 50,000 vellum impressions for diplomas at a cost of $43,000.

A Water Weight Railroad.

A novel form of inclined railway has been built at Bridgenorth, England. It connects the upper and lower parts of the town, communication between which was formerly provided by means of steps cut in the solid rock. The length of the track is rock 201 feet, but its vertical rise is 111 feet. There are two cars, on separate lines of rail, and they are connected by a steel cable passing round a wheel at the top. They are thus balanced, and a preponderating weight is given, whichever one is at the top, by pumping a supply of water into a tank placed in the frame of the car. The steel rails are secured to ties which are bolted to the solid rock and also embedded in concrete. The brakes are normally on the wheels, and motion is only possible while the brakesman turns his handle. The track is cut out of the solid rock, so that it shall not spoil the beauties of the landscape.

Four Hundred Years.

The approaching celebration of Columbus Day is in honor of a historical event which, among the events whose centennials the world has arranged to celebrate, is without a parallel in world-wide importance, exact dating, and remoteness in time.

With the exception of a few battles, whose dates are fixed by their historical connections with ancient eclipses, there are no events of great importance, earlier than the destruction of Jerusalem, whose dates are not in dispute. The time of Christ's birth is in almost hopeless obscurity, and the date of the crucifixion is variously assigned. From the rapidly accumulating evidence for this latter date, the writer is confident, however, that the twentieth century will witness, after nineteen centuries through which the true date has remained unknown, the grand celebration of a centennial Easter day by the whole Christian world.

The days that have passed since the discovery of America by Columbus have been counted with undoubted accuracy, but the number that are needed to make four hundred years is a question that admits of debate and that has divided opinion concerning the true date for Columbus Day. It is not a question that is simply solved by adding 400 to the year of the discovery and assuming that four centuries are comprised between October 12, 1492, and October 12, 1892. The first ninety years in this interval was measured by a calendar in which the average length of the year was exactly 365¼ days, and the remainder is being measured in a calendar that omits three continual leap years in four centuries, and thus makes the average length of the year 10 minutes 48 seconds shorter. When the change was made from the old to the present calendar ten days were omitted, so that the year 1582 contained but 355 days.

Because of this irregular keeping of the calendar, October 12, in the year as it is now observed, marks a point nine days earlier in the autumn season than it did in the century when Columbus made his discovery. This error has been recognized by resolutions in Congress, and President Harrison, in conformity therewith, has proclaimed October 21, instead of October 12, as the day on which to "express honor to the discoverer and appreciation of the great achievements of the four completed centuries of American life."

The impression is current in many minds that a year is the period of time that the earth requires to make the circuit of the sun. This period is known as the sidereal year, but it is not the year to which the calendar that we now use is adjusted, and which has the length that is best adapted to human affairs. For this purpose a period of time known as the tropical year, which is 20 minutes 24 seconds shorter than the sidereal year, is employed. This is the period to which the alternations of summer and winter, of long days and long nights, most nearly conform. Exactly stated, it is 365 days 5 hours 48 minutes 45½ seconds in length. Our present calendar is adjusted to this year with great precision, and by it the anniversary dates for all modern historical celebrations are determined.

This period will, therefore, probably be regarded for all time to come as *the* year. From the standpoint of astronomy it may be most concisely defined as the period in which the earth nods to and from the sun. This nodding movement is the resultant of two motions which the earth has with reference to fixed space.

In an article published in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 778, two years ago, the writer first pointed out the mistake that had been made in selecting October 12 for the Columbian celebration. In that article it was shown that 146,097 days intervened between October 12, 1492, and October 21, 1892. Four hundred of our modern calendar years contain this number of days, as was there calculated, and four hundred tropical years are but three hours short of the same interval. For these reasons the 21st of next October will be the appropriate quadri-centennial day. Then the sun will return again for the four hundredth time to the same position in the heavens, and pursue nearly the same course that it did on the New World's natal day.

As the period between successive nods of the earth to the sun has come to be recognized as the year to which human affairs are adjusted, it is well that October 21 has been finally selected, since it points off four hundred of these periods as the span of four hundred years.

The four hundredth sidereal year, or true revolution of the earth around the sun, also has a certain claim to consideration as an appropriate anniversary date. This point of time will be reached on the evening of October 26 in this country and on the morning of October 27 in Europe. Then for the four hundredth time since the sighting at daybreak of Watling's Island the relation between earth, sun, and stars will be such that there will again be on watch the constellations that looked down upon that auspicious occasion.

The anomalistic year is yet another cycle of a still different length that is made by the earth in its course about the sun. The earth travels in an elliptical orbit with the sun at one of the foci of the ellipse. This ellipse, or track of the earth, does not remain in a fixed position, but shifts slowly around in the same direction that the earth is traveling, as though it were laid out on a gigantic turntable.

The real shape of the earth's orbit cannot be well illustrated, in perspective, and if pictured in plain view its appearance would be so like a circle that the fact that it was not would hardly be revealed except by measurement. On the second of January the earth passes the part of the orbit which is nearest the sun, and in July it passes the point that is farthest away. The time between two passages of either of these points is 4 minutes 39 seconds longer than the sidereal year. After the earth has completed its circuit about the sun, it must therefore continue on for this length of time before it will be again at the same part of the elliptical orbit. Four hundred anomalistic years, or the four hundredth return to the same point on its orbit that it occupied at the time Columbus landed, will be completed on the 28th of next October.

In the time of Columbus, the calendar instituted by Julius Cæsar, as revised by Augustus, was generally followed, and that calendar, which is still used by Russia and Greece, differs from the one which we now use by twelve days. It will therefore be October 12 with them, and four hundred Augustan years will have elapsed when it is October 24 here.

S. W. BALCH.

The Acids of Fruits.

We know that many vegetable and fruit products are esteemed rather for their pleasant or refreshing taste, and for their anti-scorbutic properties, than for any nutritive value which they may be assumed to possess. Yet even fruits of that character are especially valuable as additions to our daily diet, on account of the potash salts and mild vegetable acids they contribute to the blood. We learn from Johnson's *Vegetable Food of the World* that the grateful acid of the rhubarb stalk arises from the malic acid and binoxalate of potash which it contains. The acidity of the lemon, orange, and other species of the genus Citrus is caused by the abundance of citric acid which their juices contain; that of the cherry, plum, peach, apple, and pear from the malic acid in their pulp; that of gooseberries and currants, black, white, and red, from a mixture of malic and citric acids; that of grapes from a mixture of malic and tartaric acids; that of the mango from citric acid and a very fugitive essential oil; that of the tamarind from a mixture of citric, malic, and tartaric acids; the flavor of asparagus from aspartic acid, found also in the root of the marshmallow; and that of the cucumber from a peculiar poisonous ingredient, called fungin, which is found in many species of fungi, and is the cause of the cucumber being objectionable to some persons.

It will be observed that rhubarb is the only product which contains binoxalate of potash in conjunction with an acid. It is this ingredient which renders rhubarb so wholesome at the early commencement of the summer, though in certain cases, known to medical men, its use may be injurious.

The following table, compiled from some analyses by Prof. Berard, shows the percentage average chemical composition of five unripe fruits and of eight ripe fruits, comprising apples, pears, gooseberries, grapes, plums, cherries, apricots, and peaches:

PERCENTAGE AVERAGE COMPOSITION OF FRUITS.

	Unripe.	Ripe.
Water	85·7	78 7
Albuminoids	0·7	0 6
Sugar	4·0	12·9
Vegetable acids	1·5	1·3
Pectose and gum	4·3	3·7
Cellulose, etc.	3·8	2·8

The data thus given show that there is a considerable decrease in the watery particles of fruit as it approaches its full ripe character, resulting in a difference of 7 per cent, while the sugary constituents increase during maturation in a corresponding degree, rising from an average of 4 to nearly 13 per cent.

There is very little actual decrease in the percentage of acids from the green to the ripe stage of fruits, but the acidity becomes neutralized by the increase of sugar as the fruit approaches maturation.

Many persons know from experience how much more pleasant and agreeable fruit is when gathered and eaten direct from the tree. This is undoubtedly in part due to the freshness and briskness of the vegetable acids contained in the fruit, which, when so gathered and eaten, have not time to change into any other substance. Stale fruit, on the other hand, is unpalatable from the very fact that it has lost this pungent and brisk taste.

Pectose forms the substance known as vegetable jelly, and it is to this constituent of fruits that jams owe their firmness. Cellulose is the fibrous part of fruits, and it is in this portion that we should find the largest proportion of mineral salts, potash, etc.—*The Gardeners' Chronicle.*

Smokeless Powder.

On July 2, on the invitation of the directors of the Smokeless Powder Company, a number of gentlemen interested in military matters inspected the new works of the Smokeless Powder Company at Barwick, near Ware, England, and witnessed an exhaustive trial of the qualities of the explosives manufactured by the company. About a hundred gentlemen were present, among them being Colonel Mackinnon, secretary of the National Rifle Association; Major De Hoghton, from the School of Musketry at Hythe; Colonel Henry Platt, of the Carnarvonshire Militia; Mr. Dougall, the managing director of the company; Mr. Rigby, well known both as a rifleman and as an expert in the making of rifles; and representative members of the leading firms of gunmakers.

The morning was spent in inspecting the various buildings, spread over a space of 126 acres inclosed in a ring fence, and in watching, without understanding, the process of manufacture, for, as may readily be conceived, the delicacies of the process are kept absolutely secret at this establishment, which claims to be the only one in the kingdom in which smokeless powder is produced. The visitors saw rolls of coarse paper churned into fluff as fine as cotton wool and washed in a mash tub. They saw, also, men engaged in mixing malodorous acids. They saw great grindstones crushing some yellow substance, understood to be a combination of the acids and the paper in some unknown proportions; they saw the yellow powder treated by the granulating sieves, dried, sifted, packed, and stored; and at the end they were no wiser than they had been in the beginning. After luncheon, however, came proof positive that the various grades of nitro-compound produced by the company, a compound said not to be affected by damp or heat, had several definite virtues. First came a trial with a revolver, then trials with rook rifles, cadet rifles, and like weapons, at short ranges. Neither with them nor a sporting rifle nor with a fowling piece was there any substantial smoke. A slight blue and evanescent wreath of vapor rather than smoke followed each discharge, and the smoke following the discharge of a cartridge or two loaded with black powder was in marked contrast.

The more effective trials, however, were at a longer range. First the powder was tried in the Mauser, Beaumont, Mannlicher, and various other foreign rifles, as well as in the 0·303 and the Martini. Not only was there no smoke, but excellent practice was made, particularly by Mr. Luff, of the North London Rifle Club. Then five men, having the spectators at the 400 yards firing point, fired volleys at 300 yards and at 200 yards, the result being that no substantial wreaths of smoke were visible. Finally, 500 shots were fired with the powder from the Maxim gun, with the result that there was very little smoke to be seen, although ten shots with black powder made an opaque cloud. Altogether the trial was of high interest and importance.—*London Times.*

The Bacillus of Measles.

Germs have been found by various investigators in the blood and secretions of patients suffering from measles. None, however, have been certainly proved to be active agents in the production of the disease. Very recent investigations are those of Canon and Pielicke, of Berlin, and they are reported in the *Berliner Klinische Wochenschrift* for April 18. There seems ground for the belief that the germ they have discovered is the active cause of the disease. It is a bacillus varying considerably in length and appearance under different conditions. It was found in the blood of fourteen patients sick with measles. A similar germ was also found in the sputa and the nasal secretions. It was present during the whole course of the disease, and occasionally for two or three days after active symptoms had disappeared. It was most abundant at the time of defervescence. In seven cases in which active symptoms had disappeared, but in which the rash had not wholly faded, the bacillus could not be discovered. This bacillus is undoubtedly different from any germ yet described in connection with measles. It is to be hoped that the belief of the discoverers will soon be confirmed by the investigations of others.—*N. Y. Med. Jour.*

George Sydney Percival.

The death of George Sydney Percival on the 1st inst. cut short a career of unusual promise. With what seemed at times almost a genius for mechanics, a love of study, and a conscientious devotion to his work, regardless of time or personal comfort, Percival at the age of 25, and with only two years' practical experience, had won the confidence of one of the principal engineering firms in the country, being intrusted by it with novel designing as well as the erection of costly steam plants. He was a member of the American Society of Mechanical Engineers, also of the First Battalion Naval Reserve, and a graduate of the Columbia College School of Mines.