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Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

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PATIENCE AND PERSEVERANCE IN INVENTION.

It is unfortunate that the person who claims, or is accorded by the public, the title of inventor should be popularly regarded as possessing powers which border on the miraculous; for, as a matter of fact, the most successful inventors have ever proved to be men of a practical turn of mind and of clear vision; who loved to pursue their investigation on logical lines, laying the foundation broad and firm as they proceeded; men who were marked above everything else by unwearying patience and a perseverance that was unconquerable. The inventor is possessed of no sixth sense, whereby he probes more deeply into the secrets of the sciences than others can go. If he turn up nuggets of priceless value, it is not by virtue of any divining rod which he carries, but because he digs deeper than other men to find them.

This is a truth which the average inventor too often fails to grasp; and if success does not attend his first or second attempt, he is liable to throw down his tools in disgust at the very time when a little more experimental work would have achieved the desired result.

The archives of the Patent Office can show thousands of cases where a discarded invention, which lacked but one feature to insure its success, has ultimately been taken in hand and perfected by a later inventor, who has had the patience to work out the necessary details. It is true there have been many notable cases in which he has stumbled upon his invention in the very first hours of his search; but they are rare. In the majority of cases the great inventions of any age, and particularly of this present age, have first presented themselves as a vague idea, embodied in forms more or less crude. It was only after this crude form had been laid on the anvil of the mind, and hammered and rehammered, day in, day out, and in some cases for years at a stretch, that the rough conception became the perfected mechanical shape, and brought fame and wealth to its author.

One of the great inventors of the age is Mr. Edison, who has been called in terms of well intentioned, but doubtful, compliment "The Wizard of Menlo Park." There is no spirit of necromancy to be found brooding among the vast collection of apparatus in Mr. Edison's laboratory. The whole place is devoted to invention as expressed in the good old Latin root meaning of the word: "to come upon," and hence to find. Invention, in the case of Mr. Edison, is a search; and the search is prosecuted along multitudinous lines with a perseverance which may have been equaled, but has never been surpassed in the history of the world. Speaking of himself and his work, Mr. Edison has said: "In my own case but few, and those the least important, of my inventions owed anything to accident. Most of them have been hammered out after long and patient labor, and are the result of countless experiments, all directed toward attaining some well-defined object. All mechanical improvements may safely be said to be inventions, and not discoveries."

It is not the man who dreams of better mechanical ways of doing work, but he who by intelligent experiment works out the mechanical forms that translate the dream into a reality, who is entitled to the name of inventor.

It is said that Elias Howe, as he lay one night watching the busy needle of his wife, dreamed of mechanical sewing. Doubtless other men had so dreamed before him. For a whole year he labored on a mechanical stitch; but when he tried the machine, it was a failure. Most inventors would have gone back to dreaming; but Howe threw aside his double pointed needle and continued inventing, or searching, until he found the fundamental idea in a combination of needle and separate shuttle, and gave to the world the sewing machine of to-day.

There is no invention in any age that has exercised so powerful an influence upon the destinies of the nations of the world as the steam engine, of which Watt may be truly said to have been the father; and yet it is a fact that a steam boiler, and an engine propelled by steam, were constructed by Heron, one hundred and twenty years before the Christian era. The apparatus was very crude and elementary; but the root idea was there. Had the ancient experimentalist persistently followed up the line of investigation which his curious experiments suggested, the history of mechanics might have been set forward 2,000 years.

Denis Papin, in 1688, with his piston inclosed in a cylinder, and Thomas Newcomen, of later date, with his condensing engine, were both standing on the very threshold of the greatest mechanical invention of the age; but it was only when Watt brought his powers of intelligent and patient search to bear upon Newcomen's crude mechanism that the steam engine of the nineteenth century was produced.

The bicycle, with its two wheels pivotally connected, up to a few years ago was restricted to the use of those who were acrobatically inclined. The introduction of the chain and rear driven wheel gave us the safety, and the popularity of the bicycle was thereby largely increased, although the most important feature of all was yet lacking. It was only when the pneumatic tire—an old idea—was perfected and applied to it that the bicycle became the most popular means of recreation in our day.

Stephenson's claim to be the inventor of the modern locomotive is based upon the fact that he was the first to combine the several features of horizontal cylinders, the vertical blast nozzle in the smokestack and a tubular boiler, and that by this combination he produced the type which is practically the same that we use to-day. Stephenson was not the author of the iron rail, nor of the idea of a steam driven vehicle running upon iron rails and carrying its own water and fuel. These leading features were present in the earlier engine of Trevithick. Had Trevithick labored to remedy the defects of his locomotive with the perseverance which was so strong a characteristic in his successor, it is likely that he, and not Stephenson, would have been named the father of the modern locomotive.

And so, throughout the whole field of invention, it will be found that the greatest achievements have been in the strictest sense inventions rather than discoveries; the work of practical mechanics who as often as not wrought out in concrete form the dreams of their fellowmen.

The obvious moral to be drawn from these reflections is that where the inventor has good reason to believe that the root idea of his invention is sound and useful, he should never become discouraged by failure in the minor details. Patience under the sting of failure and perseverance in new lines of search will often secure to the first inventor those fruits of his toil which are now too often gathered by other hands.

To Mend Cracked Vulcanite Dishes.

BY REV. T. PERKINS.

A mishap occurred to my only 12 by 10 developing dish a few days ago. A servant, in her misguided zeal for tidiness, finding the dish full of water on the table, and thinking it had better be put into its usual place set up against a wall, proceeded to lift it by one corner, with the result that a piece of the walls of the dish, including the angle, was completely broken out, so that the dish would no longer hold any liquid. Living as I do in a remote country village far from all dealers and unable to get another dish, I found this a serious matter, as I had just returned from a club "field day" with several 12 by 10 plates to develop. So I resolved to see if I could make good the damage. This I have done so that the plates have been successfully developed and are washing as I write. I first bored several small holes with a hot darning needle near the edges of the broken part, and also corresponding holes near the broken edges of the dish to which I wished to fasten it, so that I could rivet the broken part to the dish with rivets formed of wire similar to those used by the menders of broken china. Thus the broken piece was firmly held in place, but of course the dish leaked; so I melted some beeswax and resin in a spoon over a lamp, and when it had cooled a little poured it into the corner of the dish. At first it ran through the crack, but very soon set, completely filling it up and rendering the dish perfectly watertight. The developing solution has had no effect on this cement. Whether it will last long I cannot say. Anyhow, the repair was quickly effected, and should the dish leak after a time, I shall be able to melt the wax and fill up the cracks with it again.—The Photographic News.

Cumbrous Legal Machinery.

When a judge and jury have tried an offender and reached a verdict, the appellate court proceeds to try, not the prisoner for his guilt, but the trial judge for his procedure. Unless the latter can show that throughout the long and wearisome trial he made no mistakes, the case is sent back for new trial, by which time the witnesses have generally disappeared. The consequences of prolonged discussions and voluminous judicial essays on such details as the empaneling of a jury, the spelling of a juror's name, the initials of a witness, or the omission or misstatement of some legal fiction or antiquated phrase, tend not only to remove punishment far off from the criminal, but to depreciate the dignity and usefulness of courts. The decision of the court that tried the case comes to be of small consequence in public estimation, when it may be and often is reversed by some distant judge who never saw the jury or heard a witness. The court above, after many months of delay, often decides on minute points, sometimes of mere practice, which non-professional persons can scarcely regard except with hilarity. Hence frequency of appeal in criminal administration has a mischievous tendency to minimize the respect with which every community should regard its local court, and to impair the prudent reflection with which the people should select their judges. For what signify the qualities or capacity of a county judge, if he is to be a mere conduit through which all cases where the prisoner has any money must flow on to more distant courts for the only real and final decision?—I. J. Wistar, in June Lippincott's.

The First Five-Day Experiment with a Respiration Calorimeter.*

The respiration calorimeter at Middletown, Conn., designed by Professors Atwater and Rosa, of Wesleyan University, has been in process of construction and development for the last three years. It has this winter been perfected so as to render accurate experiments with it possible. A Swede, janitor of the laboratory, has been used from time to time for trial experiments of a day or so; but when it became possible (and, in fact, almost necessary, to insure accuracy) to make runs of a longer period than two days the Swede objected, and volunteers on the force were called for to give apparatus a fair test experiment running over a period of from five to ten days. Mr. A. W. Smith and myself offered our services. It fell to me to make the initial trial, and the date of my entering the calorimeter was fixed for March 16.

The object of a respiration calorimeter in general is to offer a means of determining the respiratory products of the lungs and the heat given off by the body of the animal or man experimented upon. Pettenkofer, a German, was the first to try a respiration calorimeter. He experimented with animals. His analyses of respiratory products were more or less inaccurate, and, as far as measuring heat was concerned, only the grossest approximation was obtainable. The apparatus in Middletown is the first to render possible accurate determinations of respiratory products, carbonic acid gas and water, on a large scale, and to afford anything like accuracy in the measurements of radiant heat from human beings. The appliances for measuring the heat are electrical, and the greatest delicacy of registration has been attained. With this apparatus it is designed to determine the heat given off when a man rests, works mentally, and works physically. But all these things are only steps leading up to the great principle of the conservation of energy in the physiological world. This has long been assumed, but has never been definitely proved. In order, however, to accomplish anything definite in this line, the whole income and outgo of the body must be known. In other words, a digestion experiment must be made, together with a calorimetric experiment—that is, a given amount of food is given a man; this food has a definite heat value or a definite amount of potential energy. By taking account of the waste products and their heat values, and the heat radiated by the individual, we see whether this is equal to the heat value of the original food. This appears easy, but a good many factors hard to estimate come in—for example, the storing of food in the body as muscle, fat, etc.—which complicate the case very considerably.

Four days before I entered the calorimeter I began to live on a particular diet, which I kept up without change till I came out. The diet chosen and maintained from first to last was:

Breakfast--Apples, three ounces; two eggs, six ounces; potatoes, five ounces; bread, two and one-half ounces; butter, one-third of an ounce; coffee, two thirds of a pint; milk, one-fifth of a pint; and sugar, three-quarters of an ounce.

Dinner—Beefsteak, Hamburger style, made into thick balls and broiled, four and-one half ounces; potatoes, four and three-quarter ounces (plain mashed); bread, two and one-half ounces; butter, one-third of an ounce; tea or coffee, two-fifths of a quart; milk, two ounces; sugar, three-quarters of an ounce; and canned pears or peaches, five ounces.

Supper—Peaches, seven ounces; milk, one pint; sugar, one-third of an ounce (on the fruit); and bread, two and one-half ounces.

From this another interesting phase of the subject presents itself. Different diets can be administered from time to time, and different sorts of labor can be done by the person experimented upon, to see which is the most efficient and economical diet for a certain kind of work. The solving of this problem will inaugurate a new era in economic progress.

I entered the calorimeter about 10:30 A. M. March 16, through the open aperture, a window, and the glass of the window was puttied in tightly behind me. With me I took a cot bed, a chair, table, some cushions, rugs, and books. The only means of getting anything in to me was through a brass cylinder about eight inches in diameter. This was closed ordinarily at both ends. To pass anything in, the outer cap was removed, the material placed in the cylinder, and the cap replaced. I then removed the inner cap and took out whatever was there. Everything I ate had to come in this way.

From the one window I received plenty of light to read and work by. In the evening an electric light was hung directly against the window outside, which gave even better light than daylight. I busied myself reading, writing, and working on some calculations I had on hand. By keeping busy I didn't mind the confinement at all. For exercise I would walk about the box, which has about thirty square feet area, run back and forth, and go through various movements with my legs and arms. Sometimes mornings my head would feel rather dull, but it would always pass away after breakfast. A constant stream of air was supplied me, which was analyzed as it went in and came out. The air seemed to keep very good. The dullness in my head on arising I ascribed to the slight shaking of the calorimeter caused by a motor in the room. I slept well, my appetite kept up on my monotonous diet, and on coming out on March 21, I found I had gained two pounds.

The experiment was a success in showing that a person can remain in the calorimeter with perfect security, and, so long as he keeps busy contentedly, for a considerable period of time. Further results have not as yet been worked out, but everything seems to indicate that it was a success in every way.

* By Olin Freeman Tower, Ph.D., Middletown, Conn., Assistant Chemist, Agricultural Experiment Station, Wesleyan University.—From the Medical and Surgical Reporter.

Improving Lake Trade.

The Bessemer, the first of Rockefeller's line of twelve steamers and consorts, was launched at Cleveland recently, says the New York Press. She is 412 feet long and will carry 4,600 tons of freight on 15 feet draught. She was one of three steamers launched that day at lake shipyards, one slightly smaller and the other slightly larger than the Bessemer. The shipyards of the Great Lakes had ninety vessels of various classes and dimensions under construction when the season opened this spring. A fleet of this number a dozen years ago would have meant comparatively little, for the size would have averaged far less than this one does now, for only twenty-four are less than 100 feet long, and there are eight that will carry 5,000 tons each, and there are twenty others that will carry 4,000 tons or more, all on a draught of 15 feet. Nearly fifty of the new boats are to be of steel, which is now supplanting wood for all vessels of large size, in spite of the extreme liability of all metal bolts to receive serious injury from contact with rock, which abounds in the passages between the lakes. Fortunes are lost every season by raking the bottoms of the big carriers on the rocks, but the ease of repairing them and rendering them as good as new holds the steel construction in favor. This new fleet will cost when finished a trifle less than $10,000,000, and it will have a carrying capacity of close to 200,000 tons at a single load. As two weeks is rather more than the average time for a vessel to make a round trip on the lakes, unless it tows as well as carries, the amount of freight that the new fleet will move in the season of eight months is seen to be enormous; when it is added to the already great fleet in operation, some vessels of which are carrying more than 5000 tons of freight at a load, the size of the lake trade may be imagined. Now as to ocean] shipbuilding at home. There are under construction on our seaboard, east and west, seventy-one vessels, most of them steel steamers, but many of them of moderate size. Only one, the cruiser Brooklyn, is 400 feet long. This is her exact length, while of the lake list there are thirteen that are 404 feet long or more. The total length of the new ocean fleet is 12,500 feet instead of the 20,000 feet of the unfinished lake fleet. Business on the lakes is much better than was indicated when boats began to move a month ago. Most rates of freight are firmer and some are higher.

Low Temperature Research.

At the Royal Institution, London, Prof. Dewar, F.R.S., recently made some interesting remarks upon the apparatus to be employed and the difficulties to be overcome in approaching the zero of absolute temperature. Below —210°, he said, to obtain a single degree of greater cold involved a positive struggle with nature. The present aim of low temperature research was to get below the critical point of hydrogen, and the only means by which this was possible was by the adiabatic expansion of hydrogen itself. The principle discovered by Thomson and Joule, that cold was produced if gas at high pressure was allowed to escape from a very minute orifice, had been utilized with success. Thus, if a jet of air at high pressure issuing from an orifice one-quarter inch to one-tenth inch in diameter were made to impinge on the outside of a tube containing air, so much cold was produced that the air in the inside tube would condense on the sides in a liquid form, provided, of course, the whole apparatus were efficiently isolated with regard to heat. In a similar manner, a hydrogen jet could be used, as was experimentally shown, to produce a temperature low enough to freeze air to a hard, white solid. A hydrogen jet at ordinary temperatures, however, would give no reduction of temperature; that would only be obtained if the gas were initially cooled to a temperature much nearer its critical point. The efficiency of such a process was by the nature of the case very small, and the fact that the expansion of hydrogen at a pressure of 500 atmospheres and a temperature of —200° would only produce about 7° of greater cold than would be won by its expansion at the same temperature from a pressure of 100 atmospheres, showed the difficulties encountered in attempting to reach temperatures sufficient to liquefy hydrogen. Even suppose the liquefaction accomplished, the difficulty of collection was very great, for the density of liquid hydrogen at the boiling point could not be above one-tenth that of water. But, in spite of these obstacles, says the Colliery Guardian, Prof. Dewar believed that some day some one would succeed in collecting it and carrying out investigations upon its properties.

American Clock Making.

More than a hundred and twenty years since, Isaac Doolittle, an original warden (1770, April 16) of Trinity Church, in New Haven, and the most important man among its founders, was a brass founder and maker of the old time brass wheel clocks. He was a citizen of character and enterprise, whose mark in his generation was that of striking originality. Not only did he supply clocks in the colony, but in 1774 he advertised that he had built a bell foundry and equipped it for the casting of bells. In the war of the revolution he joined Jeremiah Atwater and Elijah Thompson in making gunpowder at Westville, near New Haven, so much to the discontent of the Trinity Church Tories that from 1778 to 1783 they dropped him from the office of warden.

The more extensive modern making of clocks, after new patterns and in considerable number, began with Eli Terry, nearly a hundred years since, and somewhat later, with Chauncey Jerome and his nephew, Hiram Camp. Terry, the father of wood clock making by machinery—i. e., wheels of wood to save the expense of brass—was born at East Windsor, Conn., 1772, April, and in 1793 began, in a small way, clock making at Plymouth, Conn. In 1807 he bought an old mill and fitted it up to make clocks by machinery. The next year he began five hundred clocks at once, a thing never before ventured. In 1810 he sold his works to Seth Thomas and Silas Hoadley, and Thomas developed upon this foundation a very large business. Terry invented, 1814, a style of clock called the pillar scroll top case, and, selling a right to Thomas for $1,000, they each made about 6,000 a year, at $15 apiece, and later 10,000 to 12,000 a year—each clearing by 1825 about $100,000 from the manufacture.

Chauncey Jerome, under whom clock making was to become a world-wide interest, worked for Terry in the winter of 1816, and the next spring, when his job was finished, began for himself, and effected that year his first great sale—twelve wood clocks for $144 in cash. In the winter and spring of 1821–22 he secured a shop, in Bristol, Conn., and in the fall of 1824 formed a company, which, in 1825, built a small factory. The same year Jerome's device of what he called the bronze looking glass clock made an epoch in the trade, many pushing into the business, and large profits resulting, from 1827 to 1837; after which the next great development was his device of a one day clock—i. e., a simple clock with wheels of brass instead of wood—the idea of which he worked out early in 1838. The zinc dial instead of wood was first introduced with this precursor of all cheap clocks. After reaching, 1841, success represented by $35,000 profits in one year, Jerome started an English agency in London, 1842, against prejudice which at first absolutely barred making any sales at all, until a merchant was induced to permit two clocks to be left with him, and, finding that they sold at once, allowed four more to take their chance, and then twelve more, thus initiating a trade which, in ten years, reached $150,000 a year, a profit of $20,000. As soon as the English business was under way, the revenue officials, in view of the low price at which the clocks were invoiced, took a couple of cargoes, at the ten per cent advance which they had the option of giving, to take whatever came in, but did not meddle further with the American clock invasion.

In 1843 Jerome's works at Bristol grew to extensive proportions by the addition of two large factories, fitted with machinery and tools for making brass movements; and the next year, 1844, he started a factory in New Haven, for making cases and boxing the finished clocks. A year later, 1845, April 23, a great fire destroyed the Bristol works, including seven or eight buildings, extensive and costly machinery, and from 50,000 to 75,000 brass movements. This caused the transfer at once of the whole business to New Haven, where the brass movements making was under way again by the middle of June. Rapid making by the best machinery was now reaching a marvelous perfection; competition was very keen; and some makers were flooding the market with poor clocks. Jerome's final device in clock making was a "timepiece" sold for a dollar or less—a time clock but not a striking clock. In 1850 Jerome united with the Benedict & Burnham Company, of Waterbury, Conn., to form the Jerome Manufacturing Company, each putting in $35,000. After a year or two of large and profitable business Jerome bought out the other stockholders, his son mainly managing the business from this time, and new parties coming in, with an increase of capital to $200,000. But the ensuing period proved one of disaster, in which internal management and financial relations with P. T. Barnum played a part. Six months after the connection with Barnum, 1855, the company failed, and its founder was hopelessly ruined.—Boston Journal of Commerce.