Scientific American,

MUNN & COMPANY, Editors and Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW (PARK BUILDING), NEW YORK.

O. D. MUNN. S. H. WALES. A. E. BEACH.

☞ "The American News Company," Agents,121 Nassau street,New York.
☞ "The New York News Company," 8 Spruce street.
☞ Messrs. Sampson, Low, Son & Marston, Crown Building, 188 Fleet st.; Trubner & Co., 60 Paternoster Row, and Gordon & Gotch, 121 Holborn Hill, London, are the Agents to receive European subscriptions. Orders sent to them will be promptly attended to.

☞ A. Asher & Co., 20 Unter den Linden, Berlin, are Agents for the German States.

VOL. XXI., No. 22...[NEW SERIES.]...*Twenty-fourth Year.*

NEW YORK, SATURDAY, NOVEMBER 27, 1869.

Contents:

(Illustrated articles are marked with an asterisk.)

OUR WORK AND ITS RESULTS.

The SCIENTIFIC AMERICAN has now been in existence upwards of twenty-four years. From a small beginning it has grown to a large and prosperous enterprise, and its weekly issues reach every latitude and longitude where the English language is read. Its aim has been from the first to stimulate inventive talent, to educate the masses and familiarize them with the great landmarks of science, to give the earliest information in regard to discoveries important in their industrial applications, or likely to become so, to discuss general topics relating to health and the welfare both of individuals and society, and to aid in the development of the great industrial resources of this country, which, when the first number of this journal was published, had but scarcely emerged from an embryonic condition into permanent prosperity and enlargement.

The extent to which these resources could be developed were but dimly recognized by the statesmen of that day. The vast network of railroads which was to cover this continent had only been commenced. The first electric-telegraph line, as now employed, had just been erected, and its brilliant history had yet to be written. The art of daguerreotyping, from which was to spring such immense results, had but just been introduced into the country, and in all departments of the arts and manufactures there remained a wide field for improvement and invention.

We may, without assumption, claim to have done much towards the rapid onward march of improvement since that period. The records of the United States Patent Office will show that of all the patents issued a very large share has been taken out through our agency, and the history of these inventions would doubtless show that many of them originated either in some want made known, or information imparted through our columns.

Since the commencement of the SCIENTIFIC AMERICAN, many branches of industry have been created, and old ones have been revolutionized. The severe labor of the farm has been superseded by the work of most admirable and efficient machinery, the value of which to the world it is impossible to estimate. The sewing machine, that marvel of mechanical skill, has added its help to modern progress, and the metallurgic arts have extended beyond what the boldest prophet would at that time have ventured to predict. The printing-press, that great disseminator of light and knowledge, has also had its capacities more than doubled, and electrotyping has become general.

The records of our office show that in all these great improvements our readers and clients have played an important part, and that the inference is just that the SCIENTIFIC AMERICAN has done more to advance the industrial interests of the United States than any other journal ever published in the country.

Begun at a time when scientific information was very sparsely diffused among the masses, it has grown with the distribution of such knowledge, until it now circulates more widely than any similar journal published in the world. It has made this vigorous and healthy growth against much competition, and has succeeded because it has steadily striven to deserve success.

We are fast approaching the close of the seventh decade of the eighteenth century. This period is crowded with the most remarkable events of American history. It has witnessed the connexion of the two hemispheres by telegraphic cables, and of the two great oceans by the Pacific Railway. The origin of these great works was American, and they have, to a large extent, been carried to successful and unprecedentedly rapid completion by American enterprise. The next ten years will witness the birth and maturity of other giant enterprises and will be crowded with important discoveries. With all future progress we shall, as we have in the past, endeavor to keep pace, and our readers may depend that no effort will be spared to make and keep the SCIENTIFIC AMERICAN the leading paper of its class. The more extended our circulation the better shall we be able to perform this task, and if our friends and patrons second our efforts, as they have hitherto done, and our subscription list shall continue to increase in the same ratio for the coming ten years as it has done since 1860, we shall enter the year 1880 with one hundred thousand subscribers.

MECHANICAL ACCURACY.

The attainment of even an approximation to mechanical accuracy is a matter of great difficulty; perfect accuracy is unattainable. This is, however, trite and well understood by mechanics in general; the reasons are not so well understood.

Why is it not possible to make two things precisely alike? In vain the painter essays to reproduce a picture, or the sculptor to remodel a statue. In vain the counterfeiter strives to engrave a bank-note plate which will exactly resemble the one he attempts to imitate. He may, in some rare instances, succeed so well as to deceive all inferior eyes, but he himself can perceive defects, and these defects cause him many fears and anxieties that others will discern them. Go to any heap of newly-struck coins, you can find no two which exactly resemble each other. The joiner lays out his work with the utmost care, and works to line as nearly as possible only to find that when the parts come together a shaving must be taken off here or a joint is open there; some imperfection mars his work let him do the best he can.

Now there must be some fundamental reason for this. What is it?

We find upon close analysis two physiological causes at work to prevent regularity and uniformity in anything we do. One is imperfect sensation, the other imperfect command of muscles. It is only by cultivating in the highest degree the senses, and disciplining the muscles to become as much as possible subordinate to the will, that the artisan becomes skillful. These things accomplished, the physical education of a workman is completed; all other things requisite may be acquired without manual practice, but practice alone can perfect sensation and give power to the will over muscular motion.

It may be said that much of the imperfection of workmanship arises from imperfections in implements; but it is easy to trace these imperfections to defective sensation and execution. It has only been by a gradual division and reduction of imperfections, that we have obtained more perfect tools than savages use. From the stone used to crack nuts to the steel hammer of the present day a great many slow steps have been taken. How wide the difference between the auger and drill of modern times and the stone drill of the ancient races of North America; yet this difference has been attained by slow progression. Even yet our most delicately constructed instruments are not quite perfect.

The two senses most to be charged with imperfect workmanship are sight and touch, but sight betrays us far more than all the others put together.

In astronomical observation the habitual error in recording the instant of an astronomical event is ascertained as nearly as possible, and the formula expressing it is called the *personal equation*. This is allowed for in reducing all observations, and will generally be found pretty nearly constant. It amounts in some cases to one half a second.

The British mint allows twelve grains to the troy pound for variation in weight in coining; and this may be taken perhaps as the measure of the nearest approach to mechanical accuracy in coining. It is fifteen seventy-seconds of one per cent.

But there are other causes which lead to imperfection in workmanship not yet named. The variable textures of the materials used and the different thermometric and hygrometric conditions both of materials and tools, all tend to defeat accuracy. There are scarcely any two days in the year when a boxwood rule is precisely of the same length, and the variations in metallic rules are even greater than in those of wood. In very accurate drawing the draftsman finds it necessary to make a scale on the same paper as that upon which the drawing is made, that the hygrometric expansion and contraction of the paper may not mislead the workman. Surveyors find errors creeping into their measurements from the expansion of their chains; and we might go on to show that no material or implement can be made entirely free from one or the other of these adverse influences; while many are subject to both.

By clearly recognizing these facts, and with a full knowledge of the nature of materials and how they are affected by heat and moisture, the mechanic may attain very much greater accuracy than would otherwise be possible, no matter how skilled may be his eye and hand; and it has been by attending to these nice points in combination with skill in other particulars that the *chef-d'œuvres* of handiwork have been achieved.

DEATH OF INVENTORS.

We regret to announce the death of Mr. Paul A. Sabbaton, which took place at Albany on the evening of Nov. 1st. Mr. Sabbaton was a distinguished gas engineer and inventor, and resided formerly in New York. He was an esteemed client, and at one time a frequent contributor to the SCIENTIFIC AMERICAN. He had reached the advanced age of eighty-one years. We also regret to announce the death of Mr. Otis Tufts, of Boston, an inventor of considerable note. He was the builder of the iron steamer, *R. B. Forbes*, and one of the improvers of the steam engine. He invented a power and a hand printing press, the latter of which is still in use; and he was the inventor of an excellent elevator for hotels, stores, etc., which has been extensively used both in America and Europe.

WHAT WILL YOU DO WITH YOUR EVENINGS THIS WINTER?

Winter is fast approaching. Already it has sent out its skirmishers, in the form of stinging winds, and bitter snow-squalls. With it will come long evenings of leisure. Young men, what do you intend to do with these evenings?

There are a thousand inducements to squander them. The gayly lighted billiard-room, opens its doors and invites you to enter. The theater, the ball, solicit you. All sorts of similar temptations allure you to spend your time and money; and many of you will be drawn into extravagant expenditure, by these, in themselves, innocent amusements.

Another and worse class of temptations will beset you. The drinking saloon, the house of ill-fame, will invite you to enter, and with delusive excitements seek to blind your moral perceptions and lead you to ruin.

What are you going to do with these precious evenings? Will you throw away their golden opportunities, and take upon you a burden of vain regret for the years that are to come? Do you not see their value, if improved?

There are thousands of young mechanics who will see these words, and will, some of them, perhaps, resolve that *this* winter shall not be spent as was the last. This winter shall be devoted to neglected arithmetic, algebra, or book-keeping. They will seize the coming leisure to perfect their knowledge of drawing, or to complete their perusal of some scientific, historical, or literary work begun long ago, but still unfinished. They know the value of time and they will no longer squander it.

Alas! how few of these wise resolutions will be kept. Yet we are hopeful that some will be influenced by our exhortation to use their time in a more profitable manner than do the majority of pleasure-loving young men.

The means of self-improvement are now so widely diffused that no one seeking knowledge can fail to obtain them, and while we do not counsel the utter renunciation of innocent amusements, it is always wisdom to subordinate these things to higher purposes.

Young mechanics, and young men of whatever occupation you may be, you may refer your future success or failure to the way in which you employ this winter's leisure. Then what will you do with your evenings?

A HUGE JOKE IN BRASS.

The age of bronze has returned, although this time it manifests itself in morals rather than in mechanics. Mr. Cornelius Vanderbilt is a rich, shrewd financial operator, full of years, and—we were about to say wealth, but his still eager pursuit of dollars shows that, like Oliver Twist, he yet asks for "more." He is not full of honors, or at least was not, until the tenth instant at one P. M. when, as Mrs. Partington would say, his "brass figger" was unveiled to the world, and simultaneously inaugurated at the Hudson River Depot and the Stock Exchange.

Many celebrities were invited, but few assisted at the ceremonies at the depot. Many celebrities were not invited, but many were present at the Stock Exchange. Enthusiasm rose to the highest pitch at the absurd burlesque performed by Van Schaick and his *confreres* at the latter place, while at the equally absurd ceremonies at the depot it sunk to zero.

As our readers are aware, the depot is a large and commodious store house for the Hudson River Railroad freights, recently erected on the site of the old-time St. John's Park, formerly an aristocratic portion of New York city. Upon this building is placed the statue which is reported to have cost an immense sum of money.

An inaugural speech was made by Mayor Hall which reads as though his Honor—who is a philosopher and wit—must have meant to be bitterly ironical. When the canvas was removed from the statue, the sailors stationed on the roof of the depot to pull up the curtain took off their hats and cheered some, while a few straggling "Hurrays!" terminating in that peculiar cadence indicative of the absence of enthusiasm and carelessness to conceal the want, found vent from throats below. It is evident that the people do not love Vanderbilt intensely, and that the names of such philanthropists as Peabody, which Mayor Hall saw fit to associate with that of Vanderbilt in his fulsome eulogy on the great waterer of stocks, could not avail to wring a hearty cheer from the people at the show.

Of the statue itself as a work of art there is not much to be said in the way of commendation. The Commodore stands erect, arrayed in a driving coat of fur, ample to protect from frost a Siberian sledge driver. The surrounding *bas reliefs* are absurd, and in many respects ridiculously so. The position of the statue is badly chosen. The street is too narrow to afford a proper view of it. The figure appears to be making a bashful attempt to step out of its sheltering niche as if afraid of too much publicity. The *bas reliefs* portray immense birds more prominent than the ships and locomotives, and apparently struggling to fly away with the whole design.

The two trains of cars appear to move on very dangerous curves, suggesting the probability of an impending smash up. The bronze locomotive has its boiler and piston-rods apparently bent to fit the crook of the rails. The derrick in front of the locomotive is out of proportion, and would more properly stand near the poor representation of the depot than in the way of the advancing train.

Commodore Vanderbilt is widely known as a "self-made man," and he has stuck to the one idea of self with wonderful pertinacity. On the whole, we conclude that this brassy compliment, in its gross unfitness in purpose and execution, can only be regarded as a huge joke in brass.

ELECTRO-PLATING WITH IRON.

The Hon. Cassius M. Clay, late U. S. Minister to Russia, has recently returned from St. Petersburg, bringing with him some fine specimens of iron electrotypes, done after the process of Prof. Jacobi and Klein. We have before alluded to this important discovery. By its use, nearly all forms of electro-plating, such as engravings, stereotypes, medallions and ornaments, may be done in iron, with a fineness of texture which is really surprising.

Its importance and value will be appreciated when we reflect that the iron electro-plates are about five times more durable than the ordinary copper electro-plates.

Mr. Clay has presented us with an iron electro-plate copy of a copperplate engraving of the Prince Imperial of Russia. This plate is six inches square, and beautifully done. It is one thirty-second of an inch in thickness, and has a color closely resembling that of zinc. These iron electrotypes are now used by the Russian Government with complete success for the printing of bank notes.

The process was patented in this country through the Scientific American Patent Agency, Sept. 29, 1868, and further information can be had by addressing C. M. Clay & Co., 45 Liberty St., New York.

The following description of the process we copy from the patent specification:

"Our invention consists in the application of a practical galvano-plastic process as to the deposits of iron on molds, or any other form, for reproducing engravings, stereotypes, and for other useful or ornamental purposes.

"The galvano-plastic bath we use is composed of sulphate of iron, combined with the sulphates of either ammonia, potash, or soda, which form, with sulphate of iron, analagous double salts.

"The sulphate of iron may also be used, in combination with the chlorides of the said alkalies, but we still prefer the use of sulphates.

"The bath should be kept as neutral as possible, though a small quantity of a weak organic acid may be added, in order to prevent the precipitation of salts of peroxide of iron.

"A small quantity of gelatin will improve the texture of the iron deposit.

"As in all galvano-plastic processes, the elevation of the temperature of the bath contributes to the uniformity of the deposit of iron, and accelerates its formation.

"For keeping up the concentration of the bath, we use, as anodes, large iron plates, or bundles of wire of the same metal.

"Having observed that the spontaneous dissolution of the iron anode is, in some cases, insufficient to restore to the bath all the iron deposited on the cathode, we found it useful to combine the iron anode with a plate of gas-coal, copper, platinum, or any other metal being electro-negative toward iron, and which we place in the bath itself.

"As a matter of course, this negative plate may also be placed in a separate porous cell, filled with an exciting fluid, as diluted nitric or sulphuric acid, or the nitrates or sulphates of potash and soda.

"For producing the current, we usually take no more than one or two cells of Daniels' or Smee's battery, the size of which is proportioned to the surface of the cathode.

"It is indispensable that the current should be regulated, and kept always uniform, with the assistance of a galvanometer, having but few coils, and therefore offering only a small resistance.

"The intensity of the current ought to be such as to admit only of a feeble evolution of gas-bubbles at the cathode, but it would become prejudicial to the beauty of the deposit if gas-bubbles were allowed to adhere to its surface.

"The same molds, as employed for depositing copper, may also be used for depositing iron, only it is advisable, in employing molds made of lead or gutta-percha, to cover them previously with quite a thin film of galvanic copper, formed, in a few minutes, in the usual way, and then oring them, after having washed the molds with water, immediately in the iron-bath.

"The film of copper may be removed from the deposit either by mechanical means, or by immersion into strong nitric acid.

"The deposited iron is very hard, and rather brittle, so that some precaution must be taken in separating it from the mold. By annealing, it acquires the malleability and softness of tempered steel.

Condensed Food.

Experiments have recently been made with satisfactory results to test the practicability of supplying the North German army and navy with compressed or condensed food. The principal object was to ascertain the best means of furnishing the soldier in the field with a three days' stock of provisions reduced to a minimum of weight and bulk. It has been found that a sort of meat-bread is admirably adapted for this purpose, as it may either be eaten dry in the form of cakes or can be converted with very little trouble into soup. Similar attempts have been made to compress hay and other provender for horses.

[We find the above item in a recent number of the *Evening Post*. The idea of using condensed food in the manner described was first patented in 1850, by Gail Borden, Jr., then a resident of Galveston, Texas, since better known in connexion with Borden's Condensed Milk, an article of large consumption in this and other cities. Mr. Borden has devoted a great deal of attention to the preparation of condensed food, and may be regarded as the pioneer in that branch. His patent of 1850 consisted in the concentrated extract of alimentary animal substances, combined with the vegetable flour and meal, made into cakes and baked into bread, and was readily converted into a wholesome food.—EDS.

AERIAL NAVIGATION.

NUMBER THREE.

Mr. Porter considers the proper form of an aerial float to be the "revoloidal spindle," round in its transverse section, its sides curving uniformly from end to end, and having its length ten times its diameter. But this may be varied according to the business for which it is intended, and made longer for great speed, or larger in diameter for carrying freight. It should be made of the strongest linen cloth, varnished on both sides with a varnish that will not injure the strength of the fiber; and the strips of cloth should be sewed together with double seams, the seams being covered with thick elastic varnish. The cloth is supported inside by twenty rods of white spruce, extending the entire length, the joints being secured by tin tubes, and the cloth being attached to the rods by tack nails, driven through strips of white oak or elm, half an inch wide and one-eighth thick; the tacks being two inches apart.

A medium-sized float should have a capacity of 266,796 cubic feet. The longitudinal rods for a float 400 feet long should be one and one half inches in diameter, but tapering to three fourths at the ends. The buoyant power of 266,796 cubic feet of hydrogen gas, is 19,051 lbs. The weight of the cloth, including two transverse partitions, is 2,000 lbs., and that of the rods 2,000 lbs., leaving a net buoyancy of 15,051 lbs. The proper proportional length of the saloon is 133 feet, and its diameter 10 feet; being square in its transverse section, and having its four sides covered with painted duck, and curving to a point at each end. The engine room should be in the center, 10 feet long by 6 feet wide, leaving a passage way of two feet on each side. There would then be space for two cabins 20 feet long, and a ladies' room, and kitchen, each 8 feet long. The spaces left forward and aft, would be used for baggage and stores. The saloon would have ten windows on each side, the central two being each seven feet long, and sufficiently prominent at the center to enable the pilot to look forward or downward. The engine room should have a large skylight. The sides of the saloon should be supported in their position by very light frame work, and 100 steel or copper wires, whereby it should be connected to various parts of the float. The floor should be made of spruce boards 3 inches wide and one eighth thick, supported by sleepers 40 inches long, 2 wide, and three eighths thick, and 6 inches apart; and these should be supported by four longitudinal sills, 28 feet long, 4 inches wide, and seven eighths thick. These sills should be supported at every ten feet by wires from the float above. The floor or platform which supports the boiler should also be connected to the float by wires, independent of the saloon, and so arranged as to be readily detached from the aeroport at any time. In the center of the forward cabin, there should be an elevating car, 10 feet long and 39 inches wide, surrounded with a balustrade and furnished with seats; the floor of this car constituting a part of the floor of the cabin, but not connected thereto. This car should be supported by four ropes attached to its four corners, passing up over four pulleys to a revolving windlass connected to the engine, which may be disconnected at pleasure. Upon this windlass shaft, should be placed a grooved wheel, around which is a coiled cord, one end of which should be attached to the grooved periphery, and the other end to a small crank windlass, in the center of the said car, so that parties may thereby, either lower or elevate themselves, as occasion may require.

The form of rudder preferred, is a hollow square, ten feet long and five feet in diameter, made of painted cloth stretched over a light frame, open at both ends, with a rod of wood in its longitudinal center, the forward end of which is connected to the float by a universal joint. From the four forward corners of this rudder, four cords, steering lines, extend forward, pass over four pulleys, and thence down to the pilot's window in the saloon below.

Every alternate longitudinal rod of the float is connected to the alternate nine at each end; but the other ten have a slight longitudinal liberty, so that they may occasionally be drawn toward the longitudinal center for the purpose of reducing the size and capacity thereof; and for this purpose a series of cords are attached to the free rods, and passing to the center, and over a corresponding number of central pulleys, unite in one cord, which, passing centerward and over another pulley, extends down toward the bottom of the float and connects to a vertical wire, which, passing through an air-tight stuffing box, goes down to the engine room. Other sets of cords and pulleys are arranged at different points, and all uniting at the main center as described, the engineer can at any time, compress either section of the float as occasion may so require.

In addition to this arrangement, two flexible pipes or hose, ascend from the engine room to the float, and passing to the interior, and longitudinal center, turn right and left, and extend to both ends of the float and up through the upper side; so that the exhaust steam from the engine may be occasionally turned into those pipes, for the purpose of warming and thus expanding the gas within the float; the compressing cords being slackened for that purpose. By these means the float may be made more or less buoyant, without increasing the quantity of gas, or discharging ballast. But in general the float may be readily made to ascend by means of the helm only.

The engine room should be furnished with a self-regulating gas replenisher, which may be described as follows: A square box, four feet long, two feet wide, and twenty inches deep, is made of pine boards fastened with copper nails, coated outside with shellac varnish and inside with beeswax. Within this box is another, in length and breadth two inches less than the first, and six inches deep, covered without and within with beeswax, and open at the top. This box should contain twenty plates of zinc, each plate being five inches wide, one fourth of an inch thick, and long enough to extend across, enter, and be secured to vertical grooves in the sides of the box. Both ends of this box should be half an inch higher than the sides, so that being inverted within the larger box, the ends only rest on the bottom. In the center of the top of the smaller box should be a hole one inch in diameter, to admit the end of a lead pipe, which, passing up through the top or lid of the large box, is to be cemented air-tight thereto, and the said lid is to be screwed down air-tight and covered with beeswax cement. This lid should have another hole near one end, through which a fluid may be poured in. A waxed cork or lead stopple may be used to stop this hole. This vertical lead pipe, ascending one inch above the lid, should have a lever valve at its top, mounted on a fulcrum pivot at or near the side of the pipe, and having an arm or beam of the lever extending horizontally eight inches. The valve end should be a flat plate, having attached to its under side a disk of leather, fitting and pressing upon the top of the pipe. Around this valve, and attached to the box lid, should be a circular ledge eighteen inches in diameter, two inches high, and one inch thick; and having attached to the top one edge of a flexible leather circular belt nine inches high; the upper edge being attached to the periphery of a disk of pine board of the same diameter, thus constituting a circular bellows that will collapse by the weight of its top. To this bellows' top the end of the valve lever should be connected by a cord or chain; so that by the inflation of the bellows and elevation of the disk, the valve would be closed. Through one side of the circular ledge, is to be pierced a horizontal hole, having one end of a small flexible pipe fitted to it, which extends up to the float. The box below is to be furnished with a mixture of one part sulphuric acid to five parts water, to the depth of from five to six inches; this immediately acts upon the zinc plates, and hydrogen gas is produced, and ascends through the bellows and flexible pipe to the float; but when the float is sufficiently full, so as to produce a reaction down through the pipe to the bellows, the top will be lifted and the valve thereby closed. The accumulation of gas within the box of plates will then expel the fluid from the box, and relieve the plates from the action of the acid, until the top of the bellows descends, and thus opens the valve, liberating the gas and allowing the acid to renew its action upon the plates. The effect of this arrangement is to hold the valve so nearly closed, that no more gas can be produced than sufficient to keep the float uniformly inflated. The zinc plates will require to be renewed about once a month.

The two propelling wheels would be each twelve feet in diameter, having each eight radial fans; each being four feet wide at the outward end, and set at an angle of 45 degrees with the shaft. Each fan would be also curved forward so as to counteract, in a measure, the tendency of the air encountered, to escape radially by its centrifugal force. The fans are best made of light-painted cloth, each stretched between two arms radiating from a shaft five feet long and six inches in diameter at the part where the arms are set, and tapering thence to the ends. Their pivots should be two inches long and half an inch in diameter, running in composition boxes, each of which has four short radial arms. Each arm should have a small hole through the end to receive a wire whereby it is supported; two of the wires ascending to the float, and two descending to the saloon. The pivots should have heads or nuts to prevent drawing out of the boxes; and upon each shaft should be a wheel 16 inches in diameter, with chain cogs six inches apart, to receive the links of a chain belt, whereby the fan wheels are made to revolve in contrary directions, the upper fans moving outward from the main center. Upon the top of the engine room, two other chain wheels should be placed to receive the lower bout of the chains, having cranks, which are operated by two pitmans connected to two engines below. The pitman cranks are to be placed at the rear ends of the wheel shafts, and at the forwards ends are two other six-inch cranks set in opposite directions and connected to each other by a rod of wood, the two ends of which are mounted upon the two crank pivots. To the center of this rod is connected by a pivot a vertical rod, suspended from a pivot six feet above. The horizontal rod is three inches wide and half an inch thick, sharpened at its edges to obviate resistance, and supported by wire braces above and below to give it the requisite stiffness. The effect of this arrangement is to cause the two-wheel shafts to revolve in contrary directions; and the two pitman cranks being adjusted at right angles with each other, the application of the power of the engines to the wheels is alternate, and consequently more uniform.

It has been remarked that one main obstacle to aerial navigation by steam power has been the excessive weight of steam boilers; but the boilers invented especially for this use have been repeatedly proved to produce five times as much power in proportion to their weight as any other boiler in use. A twelve-horse power boiler is described as follows by Mr. Porter: Two iron pipes, five feet long by an inch and one half in diameter, are placed parallel, three and a half feet apart, and each end of each pipe is screwed into one side of a three-inch cube of cast iron. Three other parallel pipes are