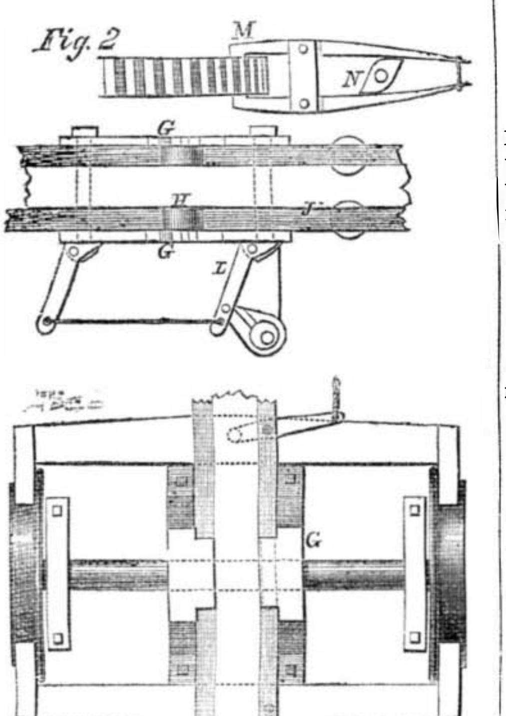
geared. As the machine is shown in the engraving it would make very slow progress, and the idea of the inventor is merely illustrated and not the actual plan of construction. The truck wheels behind will be replaced by small drivers, and the forward truck made with the usual arrangements, four wheeled, springs, &c., as in all the modern locomotives.

The gear which assists the locomotive in ascending the grade is thus arranged:—

The engines are connected to a shaft and crank at C, and upon this shaft there is a pinion, D, which meshes into the large gear, E, one of which is provided for each engine, upon this latter gear-shaft there is a large spur wheel, F, working in a rack laid between tracks. Of course when the engines are started the force exerted by them is communicated to the hind axle through the pinion, D, and thus the engine ascends. To aid the adhesion of the engine to the rails and prevent any liability of upsetting, there are two stout arms, G, underneath the engine (shown in detail at Fig. 2). which have rollers, H, on their extremities, and said rollers run on the under side of the rack-rail as at I, in the large engraving. There are also two side plates, J, having four or more wheels set in them, which grip the central track so that in



addition to the mechanical power afforded by the gears mentioned previously, this central or roller frame adds very greatly to the ascensive power of the machine. This roller frame may be worked by separate engines if it is found necessary, though it is preferred to simplify the engine as much as possible by having a superabundance of piston area in the large cylinders, which can be used for the purposes set forth. This roller frame moves sideways and is thrown in and out of connection with the track at pleasure from the foot-board by the levers, L, and suitable apparatus above.

For descending heavy grades the hold-back gear, independent of the reversing or back pressure afforded by the cylinders, is thus arranged. The main spur wheel is gripped by a set of brakes as at M, Fig. 2, which are worked by a cam, N, from the foot-board of the engine; these brakes have friction rollers, and a heavy strain can be thrown on the wheel so as to retard its velocity. There are also preventer pawls as at O, Fig. 1, which must be thrown out when backing down, their principal use is to act as a safeguard in ascending. The wheels of the truck carriage under the passenger car are also rigged with the same friction gear and brakes as those described on the engine, and as the power and the strength of these parts can be increased indefinitely, they furnish efficient preventives against disaster, should the rack give way or other accident happen to the engines. There are also the usual block or wooden brakes applied to the periphery of the truck wheels.

The State of New Hampshire has granted Mr. Marsh an exclusive charter for twenty years to ascend the White Mountains by steam. The invention examined by many of the first railroad men and others of scientific reputation; these gentlemen have considered it both possible and feasible. The distance up the mountain is not over three miles, and it is intended to ascend very slowly, say in an hour. There is any quantity of timber at the foot of the mountain, and one great advantage of this enterprise would be to afford a means of taking lumber and other materials to the top of Mount Washington, for the purpose of erecting a large hotel on its summit; this hotel could be kept without the difficulties now in the way, if this road was in operation. If those who would be benefited by such an enterprise will lend their aid, it can be completed in two years. The cost will not be great, as no uniform grade is required according to this plan; thus avoiding all expense of blasting and grading for the superstructure. Letters of inquiry must be addressed to Sylvester Marsh, Esq., Box 3,047, New York City, by whom this invention has been patented.

THE MOST IMPORTANT AMERICAN DISCOVERIES AND INVENTIONS.

No. 2.

THE COTTON GIN.

Whitney.—1792.

Eli Whitney was born in Westborough, Mass., on Dec. 8, 1765. His father was a respectable farmer who worked on his own farm and had his sons work with him, but Eli always showed more fondness for mechanical employment than for labor on the farm. At the age of 12 years he made a very good violin. The most complicated piece of mechanism that had ever come under his notice was his father's watch, and he had great curiosity to see the inside of it. But his father would not trust him with it. One Sunday, however, he pretended to be sick, and after his father had gone to church, he went to the room where the watch was kept, and soon had the wonderful instrument all in pieces. He was a little afraid that he should not be able to put it together again, but finally succeeded so completely that his father never suspected what had been done till long afterwards, when Eli told him.

When 23 years of age, Mr. Whitney entered the "freshman" class of Yale College, and graduated in 1792. Soon after he took his degree, he made an engagement with a gentleman of Georgia as a private tutor in his family. Among his fellow-passengers on his way to Savannah was Mrs. Greene, the widow of Gen. Greene. When he arrived in Savannah, Mr. Whitney found that the gentleman who had engaged him had employed another tutor in his place. In this emergency Mrs. Greene invited him to make her house his home until he had completed the study of the law. He accepted the invitation and accordingly took up his residence at the house of Mrs. Greene, at Mulberry Grove, near Savannah. Here he soon had an occasion for his mechanical skill. Mrs. Greene was at work upon a piece of embroidery, and complained that the tambour caught her thread Mr. Whitney made a new tambour, which greatly pleased Mrs. Greene, and was regarded by all who saw it as a triumph of ingenuity.

Soon after this a party of gentlemen, some of whom had been officers under command of Gen. Greene, came to Mulberry Grove to pay a visit to Mrs. Greene, and while there the conversation turned on the recent introduction of the green-seed cotton. It was remarked that if some machine could be produced that would clean the cotton from the seed with facility, the cultivation of this cotton would be of great value to the country.

Mrs. Greene remarked that if they wanted any machine invented they had better call on Mr. Whitney, for he could make anything. Mr. Whitney was accordingly sent for, and introduced to the company; but he disclaimed any pretensions to mechanical genius, and said that he had never seen any cotton in the seed in his life.

The idea having been suggested, however, in a few days he went to Savannah, and, after a considerable search, succeeded in finding a small quantity of cotton which had not been separated from the seed. He carried this home and in the course of two or three weeks he finished the small model of a "gin." A temporary building was then erected, and with such tools as he could find on the plantation he began the construction of a working model.

His plan was to insert a number of wire hooks in the periphery of a wooden disk, and to allow these hooks, as the disk was rapidly revolved, to enter a narrow slit in the side of a hopper near its bottom; the hooks catching the fiber and pulling it through the slit, while the seed was retained in the hopper by the narrowness of the opening. The cotton was then swept from the hooks by a rapidly revolving brush. A series of the disks were placed on the same shaft, and provided with corresponding slits in the hopper. He contemplated also forming the hooks upon the edge of a circular iron plate, and this modification was afterwards adopted.

It is remarkable that no time was wasted in unsuccessful experiments. The first simple idea conceived by Mr. Whitney has never been superseded. For 70 years his machine has been in operation. It has determined the pursuits and affected the condition of millions of persons—building up hundreds of villages, towns and cities, and changing the face of a considerable portion of the civilized world.

At Mulberry Grove was a Mr. Miller, a graduate of Yale College, a man of some means, who afterwards married Mrs. Greene. He proposed to furnish Mr. Whitney with funds to take out a patent, and build machines, for half interest in the invention. Mr. Whitney accepted the proposal, and a written agreement to this affect was signed on May 27, 1793.

Mrs. Greene had shown the gin to a few gentlemen, and as a knowledge of its existence spread in the community, the greatest curiosity concerning it was excited. Persons came from long distances to see it, but it was not thought best to show it till the patent was secured. The excitement, however, in regard to it increased, and finally, before the patent was secured, some persons broke open the building in the night, and carried the machine away. From this model numerous gins were constructed, and the machinery passed into very extensive use before the patent was granted.

Miller and Whitney committed an error quite common among inventors—that of being too greedy for enormous profits. Instead of manufacturing and selling gins, they attempted to monopolize the whole business of ginning cotton, and not having capital sufficient for this, they strengthened very much the temptation to infringe their patent rights. They became involved in debt, and finally in bankruptcy, and Mr. Miller soon died.

On the 19th of Dec., 1801, the Legislature of South Carolina passed a law appropriating $50,000 for the purchase of Whitney's patent right for that State. In December, 1802, the Legislature of North Carolina levied a tax of two shillings and sixpence on every saw in the gins in use in that State, for the benefit of the inventor; and this tax was faithfully collected and paid over, giving Mr. Whitney the principal revenue, which he received from his invention. In 1803, the State of Tennessee passed a similar law, assessing a tax of 37 cents per annum, on each saw for four years.

These sums enabled Mr. Whitney to pay his debts, and to carry on his law-suits in Georgia, where he continued to prosecute the infringers for eleven years. Though he at last obtained decisions in his favor, he never realized any income in that State from his invention.

In the United States Court, held in Georgia in December, 1807, in a suit against Arthur Fort, Mr. Whitney obtained a decision granting a perpetual injunction to prevent the use of his invention without his consent. In giving his decision, Judge Johnson remarked:—

"With regard to the utility of this discovery, the Court would deem it a waste of time to dwell long upon this topic. Is there a man who hears us who has not experienced its utility? The whole interior of the Southern States was languishing, and its inhabitants emigrating for want of some object to engage their attention, and employ their industry, when the invention of this machine at once opened views to them which at once set the whole country in active motion. From childhood to age it has presented to us a lucrative employment. Individuals who were depressed with poverty and sunk in idleness have suddenly risen to wealth and respectability. Our debts have been paid off. Our capitals have increased, and our lands trebled themselves in value. We cannot express the weight of the obligation which the country owes to this invention. The extent of it cannot now be seen. Some faint presentiment may be formed from the reflection that cotton is rapidly supplanting wool, flax, silk, and even furs in manufactures, and may one day profitably supply the use of specie in our East India trade. Our sister States, also, participate in the benefits of this invention; for, besides affording the raw material for their manufactures, the bulkiness and quantity of the article afford a valuable employment for their shipping."

In 1807, the cultivation of cotton was in its infancy, and the vast effects of Whitney's invention had but just begun to be developed.

Mr. Whitney afterwards embarked in the manufacture of arms for the United States Government; using machinery of his own invention. He was the first to make each of the parts of a musket to fit the parts of any other musket.

The later years of his life were passed in the enjoyment of wealth, which he used with much benevolence. In January, 1817, he married Miss Henrietta F. Edwards, youngest daughter of Hon. Pierpont Edwards, late Judge of the District Court of the State of Connecticut. He died at New Haven, January 8th, 1825, and a fine monument, modeled after the tomb of Cæsar, is erected over his remains in the cemetery of that place. Upon it is inscribed—

"ELI WHITNEY,

"THE INVENTOR OF THE COTTON GIN."

THE GREAT NAVAL CONTROVERSY.

Donald McKay, the eminent ship-builder, has addressed a communication to Senator Grimes respecting the merits and demerits of the navy, which have so recently been brought into dispute by Mr. Dickerson in his recent tilt with Mr. Isherwood and others. Mr. McKay, with an evident degree of fairness, characterizes Mr. Dickerson's attack as unjustifiable; and he thinks "he should be punished and made an example of." The letter is very long, and so much of it as refers to personality we omit; but that portion which draws a comparison between the American and English naval vessels, in point of speed, contains matter of interest, as bearing on the controversy now going on between Mr. Dickerson, Mr. Isherwood and the lesser lights who have entered the lists:—

"Understanding that there was to be an investigation regarding Mr. Isherwood's machinery and his official course as an engineer, I present the following table of British war-steamers, with their speed at the measured mile; and I know full well what the delusion of a measured mile trial is, and know that at sea, under ordinary circumstances, they do not equal the measured mile time by at least fifteen per cent, and often more. In running the measured mile (and I have seen it done, and know all the jockeying) the sea must be perfectly smooth and no wind, the ship trimmed and made ready, boilers and fires clean, furnaces full of burning coal, and steam kept bottled up until they near the first "post;" then the valves are opened wide, and the mile is run. The tables of speed of our own naval sloops are taken from the ships' logs in a sea-way, with sea-sick firemen, and in some cases burning bad coal. I know that there are no steamers in the English and French navies of the size of the *Sacramento* class, that, under the same circumstances, are so efficient in point of speed, economy, and destructive powers. I think they admit this. We have no ships to compare with the *Mersey* and *Diadem* frigates—a class of vessels used in the British navy, which carry powerful batteries, have great steam-power, and are very fast. For instance, the *Mersey* frigate, tunnage 3,726, draught of water 22 feet 7 inches, horse-power 4,000 (the length of the stoke-hole, or boiler-room, in this steamer, is over 68 feet, having 32 furnaces); speed at measured mile, Stoke's Bay, 13·29 knots. The *Minnesota* class of frigates are their equals in armament, but not in speed.

"Our side-wheel gun-boats are far ahead of anything of the kind used in Europe, and with a light draught of about eight feet of water maintain a speed hardly, if at all, equalled by any of our fastest merchant steamers, and carry a very heavy battery. Also the screw gunboats are vastly superior to the English and French gunboats, both in speed, battery, and generally efficiency; also for operations on our coast, their very light draught of water makes them a valuable arm of offense.

"Regarding the sloops of the *Sacramento* class, they combine high speed with powerful batteries, although their exceedingly light draught of water prevents their being good sea-boats, as they will roll excessively, yet they have not their equals in the above good points in the British or any other navy. And these sloops have been presented to the public as complete failures, having very slow speed. I will present a table of the fastest screw corvettes and sloops in the British navy, having nearly the same tunnage. This table is compiled from a list of forty-seven corvettes and sloops, and is the speed made at the measured mile, and not their full speed at sea, where the conditions are changed and speed much less:—

	Tuns.	Speed per hour.
Racoon	1,467	10 knots.
Pearl	1,469	11.31 "
Pylades	1,275	10.11 "
Satellite	1,462	11.4 "

"As I mentioned above, these are the fastest of a class that correspond with the *Sacramento* and other of our new sloops, and have an average draught of from twenty to twenty-two feet of water. These vessels would be entirely unsuitable for operations on our coast, owing to their great draught of water; and having this great draught a large propeller can be used, will be deeply immersed, and can be made more efficient than with a lighter draught. This is the opinion of engineers, and has been confirmed by experience.

"The following table gives the speed of our new steam sloops of about 1,367 tuns, and with the very light average draught of about fourteen feet of water:—

	Tuns.	Knots per hour.
Sacramento	1,367	12.5
Adirondack	1,367	12
Shenandoah	1.367	12.25
Ticonderoga	1,367	12.5

"The above speeds were made at sea, and, as their officers say, 'under the usual condition of cruising ships.' We can all see that at the measured mile trial (after the manner our English friends have of getting the maximum speeds) a much higher rate could be obtained.

"Their machinery is much like the well-tried English plans, having the same valve gearing, but with 'surface or fresh-water condensers," and much higher steam can be carried by using fresh water in the boilers; also many other important advantages are gained by the use of a 'surface condenser.' And it seems that the 'Sewall condenser,' now in use on our naval steamers, is all that can be desired; at least the best in use.

"Mr. Isherwood advocates the use of a smaller cylinder and higher steam,* and is opposed to complicated machinery, made to expand the steam to its fullest extent, believing the end does not justify the means, and that it is safer and just as economical in the end to employ simple and always reliable valve machinery. The success of the English machinery is entirely due to extreme simplicity and strength. After the painful experience with the complicated machinery of the *Pensacola* and *Richmond*, it does seem that Mr. Isherwood is right in his views. We are a fast people, and want everything we have to do with to be fast. Our naval steamers are fast, yet they must go faster, even if they break down in so doing. This is the way the public feel in this matter, and the performances of the *Alabama* and her consorts have made us all crazy in matters of speed. It is one thing to see them at sea, then to overtake them, afterwards to capture them. I do not think any of these privateers steam thirteen knots, and believe they will yet be captured by our new sloops.

"I hope our navy will be efficient, as it always has done its duty, and desires that the best talent in the land shall be at the helm, but do not see that others can do any better than our chiefs of bureaus have done; that our ships and machinery are failures; or that Mr. Isherwood is incompetent because he does not agree in all points with those assailing him.

"The *Nypsic* gunboat came to the Navy Yard at Boston from Portsmouth, and her officers said 'she made eleven knots under steam, and has since been very efficient on the blockade.' The *Pequot*, a gunboat of the same class, has just returned from a trial which, from all that I can learn, has not been entirely satisfactory, and did not give the speed of the *Nypsic*. Also, the *Saco*, of the same class, now fitting out at the Boston Yard, has, like the *Pequot*, new and peculiar machinery, in both cases experiments. I mention this to show that private establishments are engineering for the navy, and without Mr. Isherwood's success."

* [This is correct. The gravest charge brought by Mr. Dickerson against the engineering capacity of the Navy Department is, that it has, through Mr. Isherwood, its chief engineer, introduced small engines, and diminished opportunity for expansion and high steam pressure in nearly all the new vessels of the navy. Mr. Dickerson denounces this method as ruinous, because attended with enormous expense without any corresponding increase of speed, and declares it to be also contrary to good engineering. He affirms that the true plan—that which the experience of nearly all engineers (Mr. Isherwood excepted) has demonstrated to be the best—is to have *large cylinders with plenty of area for working steam expansively*. The experience of engineers, generally, is as Mr. Dickerson has stated. There can be no doubt that engines of great piston area, using steam expansively, are better calculated to secure speed with economy than small engines, little expansion and high pressure. Fast vessels can be made on the Isherwood plan, but their consumption of coal will be enormous. Equally fast vessels can be built on the other plan with a great economy of fuel. Nearly all of our privately-built steamers have their engines made with a view to this economy. The example of the *Pensacola*, which Mr. McKay appears to regard as conclusive in favor of the Isherwood system, ought not to have any weight in the matter, for there are two histories of this vessel, one of which favors Isherwood and the other Dickerson; both well sustained by evidence.—Eds.

The Committee on the Decimal System.

We see that a committee has been appointed by the House of Representatives to examine and report on the adoption by this country of a decimal system of weights and measures. It seems to us that the course of this committee is perfectly clear. Our scientific associations have been in the practice for many years of appointing committees on the same subject, and the labor of these committees have been barren of results from the fact that they wasted their efforts in long discussions rather calculated to display their own learning than to accomplish the object of their mission. Whatever may be urged against the French system, it is, to say the least, about as good as any that can be devised, and it has the very great advantage of being already in operation in a considerable portion of the civilized world. Even in our own country it is habitually used among men of science, and in scientific books and periodicals. To adopt any system other than the French would be ridiculous. To the minds of common-sense, practical men the agreement is closed. All that our Congressional committee has to do, is to ascertain exactly what the French system, as now in operation, actually is; and to report a bill for its immediate adoption in this country. The ready adaptability of our people would soon conform their transactions to the improved system, and we should be forever relieved of the vast labor of computing by our present complex and irrational methods.

A NUMBER OF THE "SCIENTIFIC AMERICAN" WANTED.—We are having numerous pressing calls for "Number *One*" of this volume. In consequence of the destruction of a train of cars by fire, on one of the Western roads, nearly our whole Western edition of "Number *One*" was destroyed, and we have none now on hand. If any of our readers, who do not preserve their numbers for binding, can send us copies of this missing number, we shall esteem it a great favor.

A GENEROUS and wealthy Englishman, Mr. George Elliot of London, has bestowed 1,000 tuns of coal as a free gift to the Sanitary Commission of this country. This donation was entirely unsolicited, and will prove a most valuable and timely addition to the resources of the soldiers' friends.