



ELI WHITNEY

ELI WHITNEY, famous as the inventor of the cotton gin, was born on December 8, 1765, in Westboro, a pleasant little village of Massachusetts, sixteen miles east of Worcester. The house of his nativity was destroyed long ago; its site, on Johnson Road, bears a bronze tablet as a memorial. Whitney's father, who bore the name he gave his son, was of English blood, and so was his wife. In good Yankee fashion he was both a farmer and a mechanic. When he had nothing to do on his land, he made chairs for his neighbors, and wheels for their wagons and carts. Beside a complete kit of tools for cabinet-making, he had a lathe to turn his chair posts and rails. All this came under the eye of his son as a child, and under his fingers, as he grew big enough to handle a jackplane or a gimlet. Eli soon preferred tasks in the shop to tasks on the farm; his handiness with hammers, chisels, and saws proved him right. At school he stood high in arithmetic, and in nothing else; it was at his workbench that he excelled. When he was twelve he made a fiddle, having learned what woods and strings were to be chosen; his dexterity was rewarded with an instrument of fairly good tone. He now began to repair fiddles for Westboro musicians, and to execute other work requiring a nice touch. His father had a watch that had cost him a round sum. Eli thought it the most wonderful piece of mechanism he had ever seen. One Sunday, while the family were absent at church, Eli, who had feigned illness and stayed at home, took the watch to pieces and re-assembled its parts. No mishap befell the exploit, but Eli's father was an austere man, so that years elapsed before his son divulged this daring feat.

Eli's mother died when he was a child: when he was thirteen his father married a second time. His step-mother, as part of her dowry, brought home a fine set of table-knives for occasions of state. Eli examined them with the remark: "I could make knives just as good with the right tools." Not long afterward one of these knives was accidentally broken, when Eli kept his word to the letter. Further additions to his tool chest enabled him to earn a decent profit at making nails, then in active demand, owing to the Revolutionary War. He was quick, too, at other tasks: he sharpened knives and axes, replaced old knife-blades with new, and gave every job so good a finish that, boy though he was, no mechanic in town surpassed him. His business grew large enough to demand a helper. His quest for this helper took Eli forty miles from home through a succession of workshops, where he saw many a tool and device to be copied on his return to Westboro. When peace with England was declared, nailmaking was no longer worth while, but fashion smiled on our young mechanic, and gave him as good a market as had war. Just then ladies fastened their bonnets with long metal pins, and in their manufacture Whitney built up a lucrative business. Not only ladies, but men, now became his customers: at odd times his lathe was a-whirl to turn out walking-canes. Plainly enough here stood a born mechanic, and a young fellow of energy and enterprise withal.

As Whitney passed into youth he felt within him a pulse of power which called for the best training: at nineteen he resolved to enter Yale College. This project his step-mother warmly opposed, and Eli was twenty-three before his father said yes, decisively. In the meantime he taught school at intervals, finding, as many another teacher has found, that teaching is a capital mode of learning. At Yale he paid his expenses partly by a loan from his father,

whom he repaid within three years of graduation. At college he wrote essays like those of his classmates, ambitious of topic, and rather flowery in diction. In discussions he acquitted himself with credit. Meanwhile his mechanical aptitudes were not gathering rust. One day a tutor found a piece of experimental apparatus out of order. Said he: "It must go abroad for repair to the shop it came from." "I think I can mend it," promised Whitney. Within a week he mended it so thoroughly that it worked as well as ever. Not long afterward he espied a carpenter busy in a house near the college, plying tools of a new kind, which Whitney asked to borrow. "No," said the carpenter, "students always spoil good tools. The owner of this house is your landlord, get him to go bail for you, and then I'll lend you these tools." Bail was given, and Whitney began work. At once the carpenter exclaimed: "There was a good mechanic spoiled when you came to college."

In 1792, in his twenty-seventh year, Whitney was graduated. In those days of short and simple courses, he was about seven years older than most of his classmates. There was gain in this lateness of his education, as knowledge, unstaled by premature familiarity, dawned upon the mind of a man. To-day students of the Whitney stamp take up engineering as a profession, and soon make their mark. At the close of the eighteenth century there was no profession of engineering to attract and develop Whitney's unmistakable talent, so he chose teaching as his field, for a time at least, remembering his success in earlier years with his pupils. He secured an engagement with a school in South Carolina, and took passage on a ship from New York to Savannah. On board was the widow of General Nathanael Greene with her family, on their way to Mulberry Park, their home, twelve miles from Savannah. Mrs. Greene saw at once that the young New Englander was a man of brains and character. Furthermore, he was an

alumnus of Yale, the college of Phineas Miller, the manager of her husband's estate, and who afterward became her husband. When Whitney reached Savannah he found that the salary offered him was not a hundred guineas, as he had expected, but only fifty, which he declined. Mrs. Greene then hospitably invited him to her mansion, where he would be at liberty to study law, the course upon which he had now determined. Whitney availed himself of this kind offer, took up his abode at Mulberry Park, and began to read law. In her ungrudging hospitality Mrs. Greene soon discovered that she was entertaining not an angel, but an inventor of the first rank.

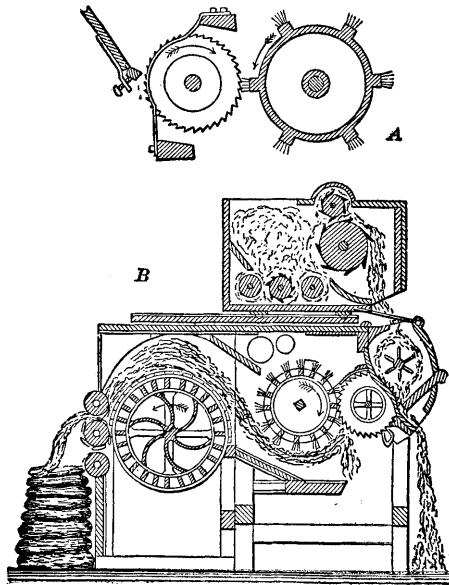
One evening, as his hostess sat embroidering, she complained that her tambour frame tore the delicate silk of her pattern. Whitney saw at a glance how he could make a better frame, and this he accomplished next day to her delight. Early next year Mrs. Greene received a visit from three comrades of General Greene, who resided on plantations near Augusta, and who often talked about sowing and reaping, with their vital bearing on profit or loss. They agreed that much of the up-country land belonging to themselves and their neighbors yielded good cotton, but that cotton had little or no value owing to the high cost of dividing lint from seed. At that time, to part a pound of lint from its three pounds of seed, was ten hours' work for a quick hand. Usually this task was taken up when regular work was over for the day. Then the slaves, men, women, and children, sat around a taskmaster, who shook the dozing and nudged the slow. One evening, as her visitors deplored the lack of a machine to supplant this tedious and costly process, Mrs. Greene said: "Gentlemen, apply to my friend, Mr. Whitney; he can make anything," showing them her tambour frame with an array of her children's toys which he had made or mended. Whitney, thus appealed to, said that his home had lain so far north that he had never

seen cotton as plucked from the bolls, with its seed firmly attached to its lint, so that the task of separation had never occurred to him.

So deeply did the conversation impress Whitney, that next day he went to Savannah, and obtained a small packet of seed-cotton. As he pulled the seeds one by one from their lint, he felt that it was high time that fingers of iron did this simple work, instead of fingers of flesh and blood. In the basement of the Greene mansion he forthwith set up a workshop with a bench and a few common tools. These assembled, he began to consider his problem. The roller gin, of immemorial form, was then used on Sea Island cotton with its long staple. Such a gin consisted mainly of two rollers, grooved lengthwise, and kept about one-sixteenth of an inch apart; their rotation drew the lint inward to a box, while the seeds, too large to pass between the rollers, were torn off and fell into another box. Occasionally a small seed was caught and crushed by the rollers, and became mixed with the lint, greatly to its damage. Upland cotton, such as Whitney had to treat, was shorter than the Sea Island variety, and its seeds were smaller and more firmly attached, so that the roller gin, either as it stood or as it might be modified, was out of the question. He thought that a good plan would be to thrust the lint through slits a little narrower than the space between the cylinders of a roller gin, so that the seeds would be broken off and remain behind.

First, then, how was he to thrust the lint through these narrow slits? Diverse plans suggested themselves. Teeth cut in circular iron plates, "ratchet wheels," as he called them, would have answered, but he was not able to try these wheels until later, when he found iron plates thin and strong enough for the purpose. Iron in another form was at hand, and this he adopted for his first experiments. One of Mrs. Greene's daughters had a pet bird, and a coil of

iron wire to make its cage had just been unpacked. This prompted the notion that wire needles or prongs would serve to thrust lint through narrow openings. But the wire was too thick. Nothing, then, but to draw it to a suitable thinness by appliances which the untiring mechanic made there and then. Day by day he tried various lengths



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of wire, and disposed them in various angles and curves. He discovered that the prongs worked best when protruding about an inch from their cylinder. He found, also, that the wire should have a gentle curve opposed to the direction in which the cylinder rotated. Week by week this armed cylinder was tested, and for a few minutes the lint would be duly thrust between the slits in a breastwork, and the seeds forced off with gratifying thoroughness. But

soon the wire teeth became clogged with lint, so that work had to stop. Whitney was puzzled by this difficulty, when, one morning, Mrs. Greene picked up the hearthbrush and asked: "Why don't you use this?" The very thing! Behind his breastwork Whitney set up a second wooden cylinder, armed with bristles to form a rotary brush; when this ran four times as fast as the wired cylinder, it swept the lint from its prongs into a box, and trouble was at an end.

Toward the close of the winter, Whitney completed a model so easily turned by hand as to ask no more exertion than a grindstone. Mrs. Greene now invited her friends from near and far to view its hundreds of tiny fingers, each doing as much work as a human hand. The planters in her assembled company were enthusiastic in praise of the inventor's ingenuity, and they clearly saw what his gin meant for the South. They urged him to patent at once his amazing invention, which was certain to bring him wealth and honor. Whitney declared that he was loth to bid farewell to law, the profession for which his studies had prepared him, and embark on the troublous sea which surrounds every inventor. At last he yielded to the entreaties of his friend, Phineas Miller, who proposed that Whitney and himself should become equal partners in patenting the cotton gin and setting it at work throughout the South. Miller agreed to provide the necessary capital, and, as the event proved, unfortunately he did not foresee how much would be needed. On May 27, 1793, the two friends entered into partnership as Miller & Whitney, a firm to be long remembered in the industrial history of America.

Whitney now posted to Connecticut to execute the model required by the Patent Office, and arrange for the manufacture of his machines. His model was soon beautifully constructed by his own hands, and on June 20 he petitioned

for a patent to Thomas Jefferson, the Secretary of State. Philadelphia, then the capital of the Union, was that year devastated by yellow fever. This delayed the issue of a patent until March 14, 1794. In the meantime Mr. Jefferson examined Whitney's model with a thorough comprehension of its extraordinary merit and promise. He addressed a cordial inquiry to the inventor, asking how the gin was built and used, and requesting that a machine be sent to him. This good news Whitney repeated to his classmate and lifelong friend, Josiah Stebbins, adding, with characteristic restraint: "I hope to make something of the gin yet."

Miller, whose services included supplying cash for preliminary outlays, soon came to the end of his resources. It then became necessary to borrow \$2,000; for this loan, besides legal interest, a premium of five per cent. was exacted. Miller's credit slowly sank from bad to worse; a few years later he had to pay five per cent. a month, then six, and at last seven per cent. This lowness of exchequer, which constantly harassed Miller & Whitney, meant that their cotton gin, while mechanically a success, was an utter failure in yielding them a revenue. In the very year of its invention it had prompted the planting of a crop which yielded about five million pounds of cotton, every pound of which passed through Whitney's gin. And every year thereafter saw more and more cotton planted, until soon this became the main product of the South. Why, then, was Whitney denied any share whatever in the vast wealth he had created?

At the outset Miller & Whitney fell into a cardinal error: they sought to own all the gins in Georgia themselves, and take as their toll one pound in three of their product. This levy was exorbitant, and it aroused the planters to anger and resistance. Their provocation was increased when, in March, 1795, the gin factory established by Whit-



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ney at New Haven was destroyed by fire, cutting off for many months the supply of new machines. These machines were simple enough to be easily imitated by local blacksmiths and carpenters, and serviceable copies were set going by the hundred throughout the South. Miller & Whitney soon found that their tolls were too high, or certainly higher than planters would pay, so they agreed to accept a royalty for the use of their gins, gradually lowering the fee until it stood at \$200. Even this moderate toll was withheld, partly in downright dishonesty, and partly through an omission in Whitney's patent, which opened the door to a vexatious infringement.

On May 12, 1796, Hodgen Holmes, of Georgia, patented a gin which, instead of wire prongs or needles, employed circular saws of the kind now universal. The teeth of these saws were kept slightly dull, so as to tear the lint less than did needles, and the Holmes machine, therefore, was a formidable competitor. Miller & Whitney sued Holmes for infringement, and secured a judgment against him. He acknowledged the justice of this decision by paying Miller & Whitney \$200 as royalty on one of their gins. It had been clearly proved in court that Holmes' machine was essentially the Whitney gin, using a saw of the kind which Whitney had openly employed in early experiments, and discarded in favor of his wires. In the first rough draft of his claims as a patentee, Whitney had included saws as alternative devices with these wires. It was the chief misfortune of his life that in his patent only wires were mentioned, without inclusion of saws either in his claims or his drawings.* But the contest with Holmes was by no

*In 1804, Miller & Whitney sued Arthur Fort and John Powell for infringement in the United States District Court in Savannah, winning an injunction. As part of their evidence they adduced a certified copy of Whitney's patent, which copy remains on file to this day, with its drawings, in the Court House. In 1836, the Patent Office in Washington was destroyed by fire, and Whitney's original

means at an end when judgment was rendered against him. His further course was narrated by Whitney in a letter to Josiah Stebbins :

“ . . . Several patents have been issued for machines on my principle. One of the patentees [Holmes] claims as his invention the making the rows [as] teeth of sheet iron instead of wire. The fact is, he was told that was my original idea, and my machine was perfectly described to him, even by drawings of every part. It is also plain that the principle is the same in whatever way the teeth are made, and that they may be made in a variety of ways. We commenced a suit against this man to have his patent vacated. After a tedious course of litigation and delay, we obtained a judgment on the ground that the principle was the same, and that his patent was surreptitious. His patent was vacated and declared to be void. He came forward and paid up the costs and purchased a license of us to use the machine for which he pretended to get a patent, and we now hold his note given for that license. By some neglect of the judge, or mistake of the clerk in entering the judgment, upon a new Democratic District Judge being

patent, with its drawings and model, was reduced to ashes. In 1841, thirty-three years after the patent had expired, and sixteen years after Whitney's death, alleged copies of his patent and drawings were placed in the Patent Office by some one whose name cannot now be ascertained. Mr. D. A. Tompkins, in "Cotton," published by him in Charlotte, North Carolina, in 1901, reprints these alleged copies side by side with their originals, disclosing a singular falsification. The specifications of 1841, abridged from those of 1793, close with a paragraph not in the original patent:—"There are several modes of making the various parts of this machine, which, together with their particular shape and formation, are pointed out and explained in a description with drawings attached, as the [Patent] Act directs, and lodged in the office of the Secretary of State." These drawings differ widely from the originals: they include saws as alternative devices with prongs or needles: saws had no place in the drawings of 1793. Nor did the draftsman of 1841 take the trouble to watch a cotton gin at work. He applies its rotating handle to the brush cylinder instead of to the thrusting cylinder. The machine he drew, if executed in oak and iron, would refuse to work.

appointed he found means to revive the cause. After another series of delays, and when his own judge was obliged to give judgment against him, still these designing rascals pretend to uphold his claim and make a handle of it to our disadvantage, and although I have no idea that any court can be so abandoned as to take any serious notice of it, yet I should like to obtain such testimony as will show it [the circular saw] to be my invention, and thereby put a complete stopper on that business. We have already one positive witness of the fact, the first person to whom the machine was shown, besides Miller's family, which was in the spring of 1793. . . .”*

From Whitney let us return to Governor James Jackson, of Georgia, who led the fight against him. In the course of his message of November 3, 1800, he thus refers to the Patent Act of 1793, and to Whitney's cotton gin as protected by that Act:

“The operation of this [patent] law is the prevention and cramping of genius as it respects cotton machines, a mani-

*Professor Denison Olmsted, in his “Biography of Whitney,” first published in the *American Journal of Science*, 1832, says:

“In one of his trials, Mr. Whitney adopted the following plan, in order to show how nugatory were the methods of evasion practised by his adversaries. They were endeavoring to have his claim to the invention set aside, on the ground that the teeth in his machine were made of wire, inserted into the cylinder of wood, while in the machine of Holmes, the teeth were cut in plates, or iron surrounding the cylinder, forming a circular saw. Mr. Whitney, by an ingenious device, consisting chiefly of sinking the plate below the surface of the cylinder, and suffering the teeth to project, contrived to give the saw teeth the appearance of wires, while he prepared another cylinder in which the wire teeth were made to look like saw teeth. The two cylinders were produced in court, and the witnesses were called on to testify which was the invention of Whitney, and which that of Holmes. They accordingly swore the saw teeth upon Whitney, and the wire teeth upon Holmes; upon which the Judge declared that it was unnecessary to proceed any farther, the principle of both being manifestly the same.”

fest injury to the community, and in many respects a cruel extortion on the gin holders. The two important States of Georgia and South Carolina, where this article [cotton] appears to be becoming the principal staple, are made tributary to two persons who have obtained the patent, and who demand, as I am informed, \$200.00 for the mere liberty of using a ginning machine, in the erection of which the patentees do not expend one farthing, and which sum, as they now think their right secured, it is in their power to raise to treble that amount. . . . I am informed from other sources that gins have been erected by other persons who have not taken Miller & Whitney's machine for a model, but which, in some small degree, resemble it, for it has been asserted that Miller & Whitney's gin did not, on trial, answer the intended purpose. The rights of these improvements, however, it appears by the present [Patent] Act, are merged in the rights of the patentees [Miller & Whitney], who, it is supposed, on the lowest calculation, will make by it in the two States [Georgia and South Carolina] \$100,000. Monopolies are odious in all countries, but more particularly in a government like ours. . . . Their tendency is certainly to raise the price of the [produced] article from the exclusive privilege—to render the machine or article worse from the prevention of competition or improvement—and to impoverish poor artificers and planters who are forbidden from making, vending, or using it without license from the patentees, or, in case of doing so, are made liable to penalties in a court of law. The Federal Court docket, it is said, is filled with these actions. I do not doubt the power of Congress to grant these exclusive privileges, for the Constitution has vested them with it, but in all cases where they may become injurious to the community, they ought to be suppressed, or the parties be paid a moderate compensation for the discoveries from the government granting the patent. . . .”

Whitney, on behalf of his firm, replied to Governor Jackson:

“. . . It has always appeared to us that the private pursuits of individual industry are entitled to the most sacred and inviolable protection of the laws, and that a good

cause, where private right alone was concerned, must suffer trivial injuries without acquiring the claim to be presented before the solemn tribunal of public opinion. But when the title to our property is slandered, and political persecution openly commenced against us, under pretense of official duty by our chief magistrate, silence on our part might be supposed to sanction the abuse. The urgency of the case must, therefore, be our apology for meeting Your Excellency on this ground, and, in making a defense of our property right, we shall draw a veil over the passions which have brought it into question, and, passing over the degraded condition to which the State has been reduced, shall only notice the measure in which we are immediately implicated, and shall consult the genius of our government rather than the acts of your administration, to enable us to preserve towards you that respect to which your office is entitled.

“In the first place, Your Excellency will permit us to remove the deception which is palmed on the public to our disadvantage in the opprobrious term ‘monopoly.’ The respectable authors [Edward Coke and Adam Smith], whose names were brought forward to sanction your opinion on this subject, speak of the exclusive right to carry on a trade or manufacture as a ‘monopoly,’ and not of the protection which government chooses to give the arts. The principle of the patent law, Your Excellency will please to observe, consists of a fair compromise between the Government and the author of the invention. There can be no doubt but that an invention in the arts must remain the exclusive right of the inventor under the most oppressive laws, while the secret is confined to him, and many instances have occurred of the preservation of the secret for years, and even of its final loss to the public on the death of its inventor.

“To remedy which evil and to stimulate ingenious men to vie with each other, governments, by enacting patent laws, substantially agree that they will afford to the author of the invention the most ample protection in the use of his discovery for a certain term of years, on condition that, after that period, it shall become public property. And in carrying into effect all such discoveries, it is well known that every inventor must incur the whole expense and take

on himself the entire risk of the success of his invention, in which, if he fails, his loss of time and money does not always constitute his greatest mortification, and, if he succeeds, the public advantage must of necessity go hand in hand with his acquirements [acquisitions], since the inventor cannot expect his invention to be employed, or paid for, unless it excels all others in point of utility. In the present case, we believe the utility of our invention well known and candidly admitted by all rational men. At the time it was brought forward, there were millions of pounds of cotton in the seed, which awaited some improvement in the mode of ginning, and wealth, honor, and gratitude were promised to the fortunate exertions of genius which would insure the culture of green-seed cotton to the up-country.

“Under such flattering auspices and under protection of the law, the invention was perfected, and, at great expense in money, which has never been repaid, and of time and labor which is unrewarded, and now Your Excellency would direct your influence to blast the harvest so hardly earned, and which for many years has waved in distant view and buoyed up our hopes under adversity and oppression, which would have better suited the perpetrators of vice than the industrious and successful improvers of so useful an art.

“The idle stories which Your Excellency condescends to repeat, with a view to dividing with some other person the credit of the invention, are not new to us, we have always considered them as harmless, while they only served to amuse some ingenious mechanic, but the place they hold in the executive message requires us to observe that we know of no pretensions of this kind which can stand the smallest examination, and we shall challenge the most distant parts of Europe and Asia to produce a model, or a well attested account of a machine for cleaning cotton upon the principle of ours, which was known previous to our invention. We have not even ascertained that a single improvement has been made upon the machine, of which we have not complete evidence of our previous knowledge, and experimental use. But whether the form that we have adopted [the needle gin] is the best and deserves the preference to that in common use in the up-country [the

saw gin], experience must determine. At present public opinion, we acknowledge, in this respect, to be against us.

“The alternative which Your Excellency suggests of paying a moderate compensation to the patentees, or suppressing the patent, appears to us to be injudiciously chosen, for in the first of these cases, if the bargain is to be all on one side, and the persons who would defraud us of our right are to be the sole judges of the compensation to be made, the oppression would be too manifest. The proposition of suppressing the patent is so bold a thing that we forbear giving it comment. . . .”*

Spurred by this appeal, Governor Jackson appointed a committee to examine the cotton gin question, and report with all despatch. This committee recommended that the Senators and Representatives of Georgia in Congress endeavor to obtain a modification of the Patent Act in so far as it affected the cotton gin, “as well as to limit the price of obtaining a right to using it, the price being at present unbounded.” In case this modification did not prove feasible, then Congress was to be induced to compensate Miller & Whitney for their invention, their patent was to be cancelled, and the Southern States relieved from a burdensome grievance. And now entered anticipation of the House of Governors established by President Roosevelt in 1908, as suggested by William George Jordan of New York. The Governor of Georgia, in conclusion, was to be asked to transmit copies of this report and its recommendations to the Executives of South Carolina, North Carolina, and Tennessee, to be laid before their Legislatures, with a request for the coöperation in Congress of their Senators and Representatives.

South Carolina, as the chief cotton-growing State, was the first to respond. Her planters, in thousands, petitioned

*These communications are given in full in “Cotton,” by D. A. Tompkins, published in Charlotte, North Carolina, 1901. This book contains other data of prime interest.

their Legislature to buy the Whitney patent, and on terms which seemed liberal, to the petitioners at least. In September, 1801, this news came to Whitney in New Haven, from his friend and agent, Russell Goodrich. It was now the eighth year of his patent, and the unfortunate inventor had received from it little or nothing. With hope rekindled, he started in an open sulky, as was his wont, from New Haven for Columbia, the capital of South Carolina, pausing in Washington for a few days' rest. From President Jefferson, and from James Madison, Secretary of State, he received letters so cordial that they rendered him good service in his later negotiations. Whitney duly reached Columbia, and pleaded his case with tact and skill. By this time the yearly cotton crop was more than thirty-five million pounds, many cotton planters had grown rich, and the whole broad belt of cotton country was thriving as never before. Whitney maintained that South Carolina should pay not less than \$100,000 for his patent. After prolonged discussion, a vote of \$50,000 was passed on December 16, and this vote Whitney with reluctance accepted, \$20,000 being paid to him on account. To reimburse itself, the State levied a special tax on cotton gins, requiring Miller & Whitney to refund such license fees as they had collected in the State, and to furnish the State with two model machines.

On November 15, 1802, North Carolina followed suit, enacting a tax of two shillings and sixpence a year for five years on every saw within her borders. This tax, less six per cent. for collection, was to go to Miller & Whitney. It netted them about \$20,000. Next year Tennessee fell into line, imposing an annual tax of one shilling and sixpence per saw for each of four years. Tennessee paid about \$10,000 to the patentees. From other States, Mr. D. A. Tompkins estimates that \$10,000 was received by Miller & Whitney; so that their gross revenue was \$90,000, of course

greatly diminished by their legal and other expenses. This was their sole reward for having created for the South its principal crop, and added incalculably to the value of Southern plantations.

Within a year of its vote to Miller & Whitney, the enmity against them in South Carolina, frankly declared from the first, had grown strong enough to control the Legislature. Its contract with the patentees was annulled, the promise to pay them was rescinded, and suit was entered to recover the \$20,000 paid them a few months before. To gross dishonesty was added sheer brutality. In a bitter remonstrance the inventor cried:

“I was seized and dragged to prison without being allowed to be heard in answer to the charge alleged against me, and, indeed, without the exhibition of any specific charge, in direct violation of the common right of every citizen of a free government. . . . I have manifested no other disposition than to fulfil all the stipulations entered into with the State of South Carolina, with punctuality and good faith; and I beg to observe farther, that I have industriously, laboriously, and exclusively devoted many years of the prime of my life to the invention and improvement of a machine from which the citizens of South Carolina have already realized immense profits,—which is worth to them millions, and from which their posterity, to the latest generations, must continue to derive the most important benefits, and, in return, to be treated as a felon, a swindler, and a villain, has stung me to the very soul. And when I consider that this cruel persecution is inflicted by the very persons who are enjoying these great benefits and expressly for the purpose of preventing my ever deriving the least advantage from my own labors, the acuteness of my feelings is altogether inexpressible.”

It is a heart, not a voice, that speaks to us here! Ostensibly the action against Whitney proceeded on the ground that a Swiss inventor had anticipated him in devising a machine which was, in effect, a cotton gin. It was

further charged that his firm had not refunded license fees as agreed, and had not delivered the two models as promised. Whitney showed that the licenses not yet refunded amounted to only \$580; and pleaded that his delay of a few months in furnishing his models was due to a wish to embody improvements, and execute the construction with his own hands. Incomparably more important was the question, Who invented the cotton gin? At the instance of General Charles Cotesworth Pinckney, and other steadfast friends of Whitney, this question was referred to a committee of the Legislature. This committee took evidence with fulness and impartiality: it concluded that Whitney's claim as inventor of the cotton gin was unquestionable: and that, therefore, the State should reenact the agreement with his firm. When this report came up in the Senate, its adoption was defeated by a tie vote. But the House of Representatives voted favorably, whereupon the Senate took a second vote, recording 14 Yeas to 12 Nays. If a single Senator who voted Yea had changed sides, Miller & Whitney would have lost their case, and, in all probability, have been forced into bankruptcy. We may be sure that they rejoiced greatly when at last they received their \$30,000, completing the \$50,000 voted them by South Carolina. As this sovereign State had been copied by her sister commonwealths in recognizing the rights of Miller & Whitney, so also was South Carolina followed in her attempt at repudiation. Twice the lawmakers of North Carolina sought to abolish the tax imposed for the benefit of the patentees of the cotton gin, and twice the attempt was a failure. Tennessee, halfway in the four years of her agreement, suspended its tax. Little wonder that Phineas Miller, worn and worried by unending contests with plunderers, fell into bad health and died on December 7, 1803, leaving Whitney to combat his foes single-handed.

His foes prevailed. When Whitney applied to Congress for a renewal of his patent, it was refused. A few Representatives from the cotton districts favored his petition; they were overborne by a multitude of opponents. Thus ended, as far as Whitney was concerned, one of the most remarkable chapters in the annals of industry. In vain did Whitney recount that his gin multiplied a thousandfold the efficiency of labor, so as to confer stupendous benefits upon the Southern States, by enabling them to supply the civilized world at a low price with its chief clothing. From no State had he received as much as half a cent a pound on the cotton separated by his machines in a single twelve-month. Whitney, in the course of a letter to Robert Fulton, reviewed the forces which withstood him:

“The difficulties with which I have to contend have originated, principally, in the want of a disposition in mankind to do justice. My invention was new and distinct from every other; it stood alone. It was not interwoven with anything before known; and it can seldom happen that an invention or improvement is so strongly marked, and can be so specifically and clearly identified; and I have always believed that I should have no difficulty in causing my rights to be respected if my invention had been less valuable, and been used only by a small portion of the community. But the use of the machine being immensely profitable to almost every planter in the cotton districts, all were interested in trespassing upon the patent right, and each kept the other in countenance. Demagogues made themselves popular by misrepresentation and unfounded clamors, both against the right and against the law made for its protection. Hence there arose associations and combinations to oppose both. At one time but few men in Georgia dared to come into court and testify to the most simple facts within their knowledge relative to the use of the machine. In one instance I had great difficulty in proving that the machine had been used in Georgia, although, at the same moment, there were separate sets of this machinery in motion within fifty yards of

the building in which the court sat, and all so near that the rattling of the wheels was distinctly heard on the steps of the Court House."

Whitney, indeed, created the keystone for which the arch of textile industry stood agape. Hargreaves invented his spinning-jenny in 1767; two years later Arkwright devised his spinning-frame for warp; in 1774, Compton effectively united both machines: then came Cartwright's power-loom. All these were cheaply driven by the steam engine of Watt. And yet, for lack of cotton at a low price, its manufacture had but limited scope. Cotton came to Great Britain mainly from Asia and the West Indies, where slaves or coolies plucked lint from seed with their fingers, or turned the slow and faulty roller gin. Here and there in the Southern States of the Union a little cotton was sown in gardens, chiefly because of its handsome flowers. In 1784, an American vessel arrived at Liverpool, says Denison Olmsted, Whitney's biographer, with eight bags of cotton on board. It was seized by the Custom House, under the conviction that cotton could not be grown in America. In 1785, five bags were landed at Liverpool; in 1786, six bags; in 1787, 108; in 1788, 282. In 1793, the year in which Whitney devised his gin, at least 5,000,000 pounds of cotton were harvested in the Southern States. This huge figure was soon utterly eclipsed; in 1825, the year of Whitney's death, the cotton exported from the United States was valued at \$36,846,000; and all other exports at \$30,094,000, considerably less. Let us leap now to 1912, with a crop estimated at 7,000,000,000 pounds, worth about \$770,000,000.

For seventy years after its birth the cotton gin exerted as striking an influence in the field of politics as in the markets of the world. Whitney's wheels undoubtedly served to rivet the shackles of the negro slave. When cotton planting was still unknown in America, the tasks for

field hands were few and not especially gainful. No sooner were Whitney's machines set up, than planters entered upon a new and immense profit. To plow the ground for cotton, to sow and weed and till its fields, to pluck the bolls in their successive harvests, and then to gin and press the lint, gave all hands lucrative work the year round. The wealth and power thus won played a leading part in Secession, so that, during four years of Civil War, the fate of the Union trembled in the balance. Thus entangled in the skein of invention are its threads of bane and blessing.

Whitney's saw gin, little changed from the form he gave it, separates most of the cotton grown in America. Fans have been added to its brushes, and steels, much more flexible and lasting than those of 1790, appear to-day in the machines descended from his model. Since his time, the roller gin has been much improved, so as to gain a little upon the saw gin, as less liable to damage the staple. These are times when cotton culture, like every other industry, is being overhauled in the light of scientific management. In this work the Bureau of Plant Industry at Washington is playing a leading part. Its assistant director, Mr. Nathan A. Cobb, has divided cotton into eighteen grades, each of a specific length and strength of staple. He places a fiber betwixt two glass plates, and throws its enlarged image upon a screen; the length of that fiber is at once measured and recorded as he runs a small toothed wheel along its devious line. It is probable that all the Cotton Exchanges of the Union will adopt this simple apparatus and the standard grades suggested by the Bureau, so as to abolish disputes as to the lengths and qualities of specific fibers. Experiments, also, are afoot with a view to ascertaining the speed at which a given grade of cotton should be ginned. Tests of length and strength of staple, before and after ginning, will settle this question, and will further decide upon the claims regarding new models of gins.

To come back to Whitney and his defeat. When he became convinced that he must abandon all hope of an income from his invention, he cast about for a field of enterprise suited to his talents. He chose the manufacture of firearms. Here he introduced economies which have so greatly inured to the benefit of industry as to parallel the revolution he wrought in cotton production. All this began quietly enough, and in distant France. There, about 1765, General Gribeauval reduced the gun-carriages of the French artillery to classes, and so designed many of their parts that they could be applied to any carriage of their class. This was the beginning of standardization in manufacture, which took a vast stride under the guidance of Whitney. The methods which he originated in the production of arms we shall presently observe. Those methods passed long ago, with inestimable gain, to the production of tools, machines, and engines, from plows to divide furrows to the steam turbines which impel ocean greyhounds.

Manifold, indeed, are the gifts of war to peace, and many a tool of industry is but an old weapon in a new guise. A flint, as an arrowhead, has cleft skulls by the myriad: to-day not one man in a thousand is deft enough to shape an arrowhead such as were common in prehistoric days. It was probably in smiting one flint against another for battle, that sparks were struck for the first fire-kindler, with all that that has meant for art and comfort. From ruder stones have plainly descended the hammers of our shops and factories. Battle-axes, strong and sharp, told early foresters how to fell oaks and cedars with a new ease. Swords, keen and elastic, are the dignified parents of knives and planes, of the chisels of carpenters and masons. To-day at Toledo a steel-worker offers a visitor as a memento not a sword or a scimeter, but a pair of scissors. Prodigal experiments, such as governments alone conduct, were in hand for years by the chief War Departments of Europe

to produce steel armor of the utmost resistance, and steel projectiles of surpassing might. Alloys thus created, which otherwise would never have seen the light of day, were then calmly appropriated by builders of turret lathes, steam turbines, motor-cars, and even scoops for dredges.

Gunpowder, when first handed to soldiers, changed the face of war, by making a steady aim and a clear eye count for more than prowess. Let us note what industry does with this compound of saltpeter. During the years of the Civil War, which broke out in 1861 at Fort Sumter, the Northern States burned more gunpowder in their mines, tunnels, and quarries than on their battlefields. It is gunpowder that carries across sea and fog the lines of every life-saving station in the world. That Napoleon might transport his powder carts and heavy artillery, he gave Europe the best roads since those of Rome. To-day these highways bear burdens greater than Napoleon ever laid on them, as they carry the freight and passengers of Italy, France, and Switzerland.

And throughout its vast and expanding breadths, what is the organization of modern industry, under such a captain as Whitney, but military rule over again, with due modification? Instead of a commander in uniform, we have a chief at his desk, who, like Grant or Kitchener, is at the head of his army because he deserves to be. His duty is to plan the cutting of a canal, the building of automobiles, or the construction of a railroad. Every man in the ranks, whether endowed chiefly with brains or with hands, is well aware that most will be done and most divided when orders are faithfully obeyed. A worthy successor to Eli Whitney is Frederick W. Taylor, of Philadelphia,* who has quadrupled the output of metal-cutting machines by an elaborate study of how they are best designed, fed, and operated.

*His methods are set forth in "The Principles of Scientific Management," and "Shop Management": New York, 1911.

Under such a leader the rule of thumb gives place to the much more gainful rule of science. No machine-tender of intelligence demurs to an instruction-card drawn up for him by such a chief. The best way to exert himself is sketched before his eyes, and to do anything else would be to produce distinctly less. For ages have brigades, shoulder to shoulder, fought opposed brigades. Incidentally, all learned self-control, courage, discipline, loyalty to a competent leader. These lessons have been inherited by free men who employ their knowledge and skill to build, not to destroy. They turn their steel not upon other men, but upon the obstacles of nature, that nature may let fall its arms and become their friend.

To return to Eli Whitney, a standard-bearer in this transition from weapon to tool, from war to peace. In 1797, when he was in the thick of his law suits in Georgia, with the stream steadily against him, he despaired of winning any reward whatever from his cotton gin. So he cast about for a field where his ingenuity and organizing faculty would yield him a competence. This field, wherever found, must be safe from depredators. His choice fell upon the production of muskets for the United States Army. Through the influence of Oliver Wolcott, Secretary of the Treasury, Whitney on January 14, 1793, received a contract for 10,000 stands of arms at \$13.40, amounting to \$134,000, a good deal of money in those days. Of these arms, 4,000 were to be delivered by the end of September, 1794, and the remaining 6,000 within the twelvemonth thereafter. Bonds for \$30,000, signed by Whitney's friends, were given for the due fulfilment of his contract.

He began work without a day's delay. He had not only to build, he was obliged to design, many of the tools and machines he needed. He must gather and test unfamiliar woods, metals, and alloys. His workmen had to be trained to tasks never before attempted in America or elsewhere.

He had hardly any capital, but his credit was high. Solid men of New Haven knew his ability, and were proud to become his sureties when he borrowed \$10,000 from the Bank of New Haven. Secretary Wolcott, on behalf of the Government, advanced \$5,000 when the contract was signed, and stood ready to grant more as soon as manufacturing was fairly under way.

Whitney chose, as the site of his factory, a stretch of land at the foot of East Rock, two miles from New Haven, where a waterfall gave him the motive-power he required. When once work proceeded in earnest, he found his main difficulty to lie in the poor quality of his raw recruits. He wrote to Mr. Wolcott :

“ I find my personal attention and oversight are more constantly and essentially necessary to every branch of the work, than I apprehended. Mankind, generally, are not to be depended upon, and the best workmen I can find are incapable of directing. Indeed, there is no branch of the work that can proceed well, scarcely for a single hour, unless I am present.”

The slow pace of his work-people perturbed his calculations. At the end of a year, instead of 4,000 muskets, he could deliver only 500. It was eight years instead of two before his contract was out of hand. His factory was planned as a single huge machine, of a type wholly new. In an armory, before Whitney's day, one man made locks, another made barrels, another carved stocks, and so on. Each man, highly skilled, produced by himself a distinct part of a musket. This division of labor Whitney supplanted by so apportioning work that little or no skill was demanded. He separated the various tasks necessary to produce a musket,—planing, filing, drilling, and the like. Then, at each of these operations, simplified to the utmost degree, he kept a group busy. For their assistance he introduced three aids, since indispensable in manufacture—

drilling by templets or patterns, filing by jigs or guides, and milling irregular forms. From first to last a model musket was copied with precision, so that every lock, for example, was exactly like every other among thousands. When all the parts needed to form a weapon were assembled, they united as a musket much superior to an arm produced on any other plan. In case of repair, a new part exactly filled the place of an old part, and at trifling cost. Year by year Whitney invented many tools, machines, and improvements as need arose. None of these did he patent: he had patented the cotton gin, and that was enough. It is a great achievement to contrive a new and useful machine. It is a much greater feat to confer a new efficiency on all the machines in a broad field of manufacture.

Whitney's methods were duly adopted by the Government Armories at Springfield, Massachusetts, and Harper's Ferry, Virginia, where their economies soon exceeded \$25,000 a year. In 1856 the British War Office installed similar plans, and in 1871 and 1872 the example spread to Russia and France, Germany and Italy. Every advance of design in engines and machines gives standardization a new field and a new gain. Engine-lathes, automatic planers, modern milling machines, and the Blanchard lathe for carving irregular forms in wood, are but new fingers for the hands of the men who to-day follow the footsteps of the musket-maker of New Haven.

A striking contrast appears between the Springfield Armory of Whitney's day and that Armory as now operated. Colonel Stephen English Blunt, in command, says under date of May 16, 1911:

"With the Springfield plant equipped as it is, with sufficient machines so that each of the 1,004 machine operations on the rifle has its particular machine, thus avoiding the necessity of changing fixtures and adjusting of tools and machines, it requires 24 working hours to make a com-

plete rifle. To make 10,000 rifles would, therefore, require 240,000 working hours, or 30,000 working days of eight hours each. On account of the size of the present Armory it would, of course, not be economical to work as few as 100 men. The smallest economical working force for this plant would be 600 men; they would make 10,000 rifles in 50 working days. It would take 100 men at least two years to make 10,000 rifles. The Springfield Armory has a plant capable of manufacturing 10,000 rifles in less than seven days, working double shifts if the necessity should arise.

"The musket manufactured by Whitney under his contract of January, 1798, was a flint-lock, 59½ inches long, .69-inch caliber, had about 45 component parts, and fired a round bullet of one ounce, at a muzzle velocity of 800 feet per second; while the latest Springfield rifle is a magazine rifle 43.2 inches long, .30-inch caliber, has 105 component parts, fires an elongated and sharp-pointed jacketed bullet weighing 150 grains, less than one-third of an ounce, at a muzzle velocity of 2,700 feet per second."

In 1812, Whitney was awarded a further contract by the War Department, this time for 15,000 stands of arms. Then followed contracts with the State of New York, and with leading firms throughout the Union. His system was constantly extended and improved, so that he earned an ample competence, as he had hoped at the outset. He was now sure that he could safely incur the responsibilities of matrimony. In 1816, he became engaged to Miss Henrietta Edwards, a daughter of Judge Pierpont Edwards. They were married in the following January, a son and three daughters being born to their union. But the happiness of the great inventor was to be brief. His repeated journeys between North and South, taken, as they were, in an open vehicle, and often at inclement seasons, had impaired a frame naturally rugged. In the course of 1824 he developed a distressing malady, which ended his life on January 8, 1825, shortly after he had completed his fifty-ninth year. His conduct as a patient was in line with his

career as an inventor. He inquired minutely into the causes and progress of his disease, examining charts of anatomy by the hour. In the intervals between his paroxysms of agony, he devised surgical instruments for the relief of himself and of others in like extremity. Eli Whitney, in his years of vigor, had created for his fellowmen benefits beyond computation: under the shadow of death he sought to subtract from their pain. He had planned a new mansion for himself and his family: he requested that it be duly reared after his death.

What manner of man was Eli Whitney, as in health and strength he strode across the Green in New Haven? Like George Stephenson, he was cast in a large mold, and stood head and shoulders above ordinary folk. He was a kindly man, whose friendships were warm and clinging: his hand never relaxed its grasp of the chums of his youth. Many a man is honest: this man was scrupulously honorable: it was his fate often to be scurvily treated, and then his resentment made him terrible. His chief faculty, of course, was invention, his ability to strike a new path out of an old difficulty. This talent was not confined within the walls of his factory. Every building he reared, and these included dwellings for his work people, bore the marks of his original brain. He used cement liberally for foundations and walls, with prophecy of its wider applications to-day. The drawers of his desk were fastened by a single lock, in a fashion now usual. Even the mangers for his cattle were improved at his hands. He placed a small weight at the end of each halter, so that its wearer could move its head with ease, and yet could neither entangle itself in its rope, nor waste its hay.

His judgments were slowly matured: they were never expressed before they were ripe. In experiment, in his quest for materials, in his choice of lieutenants, he was patience itself. He could plant to-day, and for ten years

calmly await his harvest. Unlike most inventors, whatever he began he finished. New projects beckoned to him in vain, so long as unfinished work remained on his hands. The unflinching will of the man revealed itself in the hour of death, as his tremulous fingers were lifted to close his eyes.