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George Henry Corliss, Engineer and Business Man

THE full development of an art has always required two types of invention. No new thing under the sun ever came full fledged into being, and the pioneers in every art have necessarily left their inventions in sketchy form, the detailed arrangements which made them really practical being filled in by later comers.

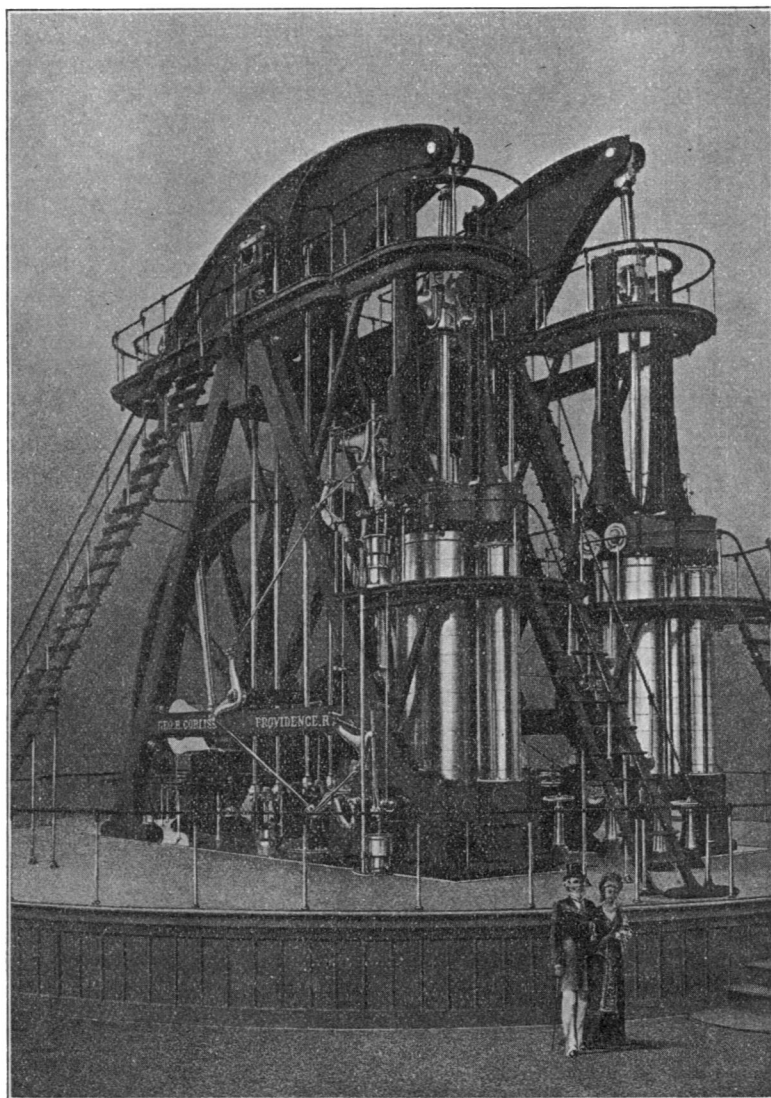
A package of letters patent, correspondence, etc., coming from Providence, Rhode Island, shed some personal sidelights on the history of a man, Mr. George Henry Corliss, who made a most important contribution of the second type to the development of the steam engine. The first steam engine that ran, like most new inventions, was an inefficient affair. A walking-beam, arranged like a teeter-board, supported at one end a pump-rod, which hung down the mine shaft, and at the other, the moving piston of the engine which hung down its closely fitting upright cylinder. The weight of the pump-rod was greater than that of the piston and its rod. It therefore pulled the piston to the top of the cylinder, drawing in after it a cylinderful of steam of only atmospheric or "tea-kettle" pressure. To pull the pump-rod up again, this steam was condensed by spraying water into the cylinder. A vacuum, more or less complete, was thus created under the piston, whereupon the pressure of the atmosphere on its top pushed it down. This worked well if one did not care how much steam was used or coal burned, but its extravagance was appalling.

The main source of loss in this form of engine was corrected by Watt. This was in the heavy cylinder condensation. It was caused by the cooling of the walls of the cylinder by the water sprayed in to condense the steam, so that much of the incoming steam made no effective contribution toward filling the cylinder on the upward stroke. He partly solved the problem by returning the steam to water in a separate condenser, a procedure still followed. He also eliminated a lesser source of loss due to the fact that the steam had to come in hot through the same valve passage through which it went out much cooler to be condensed, and there was a good deal of condensation and reëvaporation in this passage at each stroke. Other early engines, however, did not have separate passages for the hot and cold steam. Even without this feature, however, the new type was a vast improvement over its predecessor.

Another minor loss, though still an important one, was due to the cylinder's being filled quite full of the incoming steam, instead of only partly filled, so that the lesser charge could expand or attenuate with the further travel of the piston. Some pressure, preferably a considerable amount, would have lifted, or helped to lift the piston, doing away with the heavy overbalancing of the pump-rod, or perhaps with any overbalancing of it at all.

As the art developed, it became clear that good steam economy demanded high pressure, sharp fractional cut-off of the incoming steam at such part of the stroke as the load required, and separate incoming and outgoing valve passages, so that the hot incoming steam should not have to re-traverse the passage just occupied by the cool outgoing exhaust. Mr. Corliss was the first to design, develop and build on a commercial scale, an engine that met all these requirements, capable of high economy and of rotational speed that suited it to the needs of mill and factory drive. His inventions mark a turning point in the efficient development of steam power. Their working out showed, in a minor sense, the same sort of mechanical insight that made Watt able to carry out his own behests, in combination with a business ability which enabled him to reap the material reward of his genius.

Corliss began his education in Greenwich, New York, where his father, a doctor, moved when George was eight years old. After leaving school and working for several years as a clerk in a country store, he entered Castleton Academy in Vermont, where he spent three years. One of his letters, in which he writes his father his first impression of the academy, is interesting from the glimpse it



**GEORGE HENRY CORLISS' 1400 HORSE-POWER ENGINE, WHICH MOVED
ALL THE MACHINERY FOR THE CENTENNIAL EXPOSITION
AT PHILADELPHIA IN 1876.**

gives us of young Corliss, earnest in his opinions, alternately pedantic and picturesque in his description of his new surroundings.

"It is truly an inestimable privilege," he writes, "to have a Father before whom we can lay our concerns and ask advice. . . . I will endeavour to lay my case before you in such a way as that you may understand it. I would willingly sit up nights and saw ten cords of wood if I could be home tomorrow noon and get out of this scrape honorably. . . . I can assure you I would sell my right and title to the privileges of Castleton Seminary pretty cheap. . . . I was obliged to wait seven hours in Salem for the stage the greatest part of which time I spent in the bar room disgusted at seeing men and boys step up to the bar and take their cigars wine beer and cider and once in a while called for something a little stronger as they called it. . . . I arrived here about eight in the evening. . . . I was led into a room that looked more like some shoemakers shops I have seen than anything else I can think of, the wall was almost black with smoke the plaster torn off in more than forty different places. It was marked up all over with white red & black chalk and ink, the stove and pipe looked as if it had been used in a grog shop ever since the Revolutionary war. . . . There was chips and dirt enough on the floor to raise a hill of Potatoes, perhaps not a very large hill but it would raise enough potatoes for one dinner if you did not happen to be very hungry."

After he left Castleton, he opened a country store at Greenwich, where he first demonstrated mechanical ability in temporarily rebuilding a bridge that had been washed away by a freshet, after such a structure had been pronounced impracticable by the wise heads of the town, who had resigned themselves to the inconvenience of a ferry until a permanent bridge could be built. The list of subscriptions for the bridge, with the names of the subscribers and the amounts, ranging from twenty-five cents to five dollars, and aggregating \$52.00, is among the papers.

His first invention was a machine for stitching leather, before the date of the original Howe sewing machine. This, like a number of other devices before Howe's, does not seem to have come to anything, commercially. It led, however, to his going to Providence for the purpose of interesting capitalists in the machine. While he was there, he took employment as a draftsman with a steam engine company. The letter of Edward Bancroft, of Providence, to Corliss, offering him a position, is interesting in the light of Corliss' later career.



SOME OF THE MEDALS WON BY THE CORLISS ENGINE. THEY ARE TWO FROM PARIS, THE BELGIAN "ORDER OF LEOPOLD," ONE OF THE RUMFORD MEDALS, AND ONE FROM THE CENTENNIAL EXPOSITION AT PHILADELPHIA.

“If there still remains a difficulty about some of its operations,” writes Bancroft in regard to the sewing machine, “I have no fear myself but time will develop some way to overcome them — . . . I think you have no reason to despair — as yet — I would advise you however to suspend your operations with the machine a while and employ yourself about something else — it will give your mind new vigor and your ideas will have freer scope — and you will in some measure be able to dispell the shadows that an ‘empty Purse’ is casting round you — you ask me what kind of business you had best go at — now this is a question I am unable to answer — but I will say this that I should have no fear of your succeeding in a business connected with ‘Steam Engines & other Machinery.’ You would find some trouble at first no doubt in mastering the thousand and one different ways of coming at the same thing — but for a person who sees the ‘why’ of a thing as readily as you do the trouble would soon change to a pleasure provided as you say there was something coming in for it — We have been in want some time of a competent person to execute our various drawings — and since the receipt of your letter . . . we have concluded to invite you to come to Providence and attach yourself to our concern in the capacity of Draftsman and in any other way that you can make yourself valuable.”

In Providence he made improvements in the steam engine, culminating in his invention described above. In 1856 his own company was incorporated. Unlike so many inventors, he enjoyed the fruits of his labors, both financially, and in the fame which his invention brought him during his lifetime. For this he received awards in Paris and Vienna, the Montyon Prize being the highest honor which the Old World could confer for a mechanical achievement. The King of Belgium made him an “Officer of the Order of Leopold,” and he was presented with the Rumford Medals by the American Academy of Arts and Sciences in 1870.

Another work of his, spectacular but less fundamental, was the construction of the great engine which furnished the power for all the machinery at the Centennial Exposition at Philadelphia in 1876. As a member of the United States Centennial Commission, he submitted plans for a single engine of 1,400 horse power to move all the machinery in the exhibition. Engineers were pessimistic about such a project, predicting that the machine would be noisy and troublesome, but it worked perfectly. Corliss spent \$100,000 on it above the appropriation, and infinite care and time. Some of

the praises bestowed on the engine show that he was justified by the results. Mr. Bartholdi, in a report to the French Government, said enthusiastically that it belonged to the category of works of art, from its general beauty of effect, and its perfect balance to the eye; while Professor Redinger, of the Polytechnic School of Vienna, pronounced it "systematic in greatness, beautiful in form, and in every detail a masterpiece."

The Corliss collection contains his medals, and a copy of the Diploma of Honor he won at Vienna, in addition to the patents and correspondence. Much of the latter is concerned with the awarding of the Rumford Medals. It is largely between Corliss and James B. Francis of the Rumford Committee. The former seems to have been very particular about the wording of the description which was to be read when the medals were presented. However, a form was at length agreed upon, with but one rift in the lute, when Mr. Francis was moved in a moment of impatience to depart from the generally eulogistic tone of the letters to say:

"Your memo I have read with interest. Prof. Gray being a Botanist will no doubt prefer yours as the most flowery."

For the most part relations seem to have been most satisfactory. There is little in his later correspondence to give the reader a very clear idea of Corliss as a personality. Their diction is businesslike, and more or less formal, in spite of the informality of their appearance, owing to the writer's having crossed out several lines at a time in some places. Those written to him show contemporary opinion of his inventions, whose dicta have been borne out by time. For from 1876, when his huge engine drove the machinery at the Centennial, to the coming of the steam turbine, the Corliss engine was the standard mill and factory prime-mover of this country.

Westward by Canal

"HERE and there in Ohio, Indiana and the Eastern States," says Alvin F. Harlow in his book, *Old Towpaths*, "the pedestrian . . . may sometimes notice the faint indication of an embankment or a shallow depression, weed-grown but stretching away with such regularity of line as to rouse his belief that it may be an artificial work. . . . If he will inquire in the neighborhood he may find some white-bearded ancient who remembers that these poor ruins are all that is left of what was once a great internal improvement, the pride of the locality and the State — a canal."