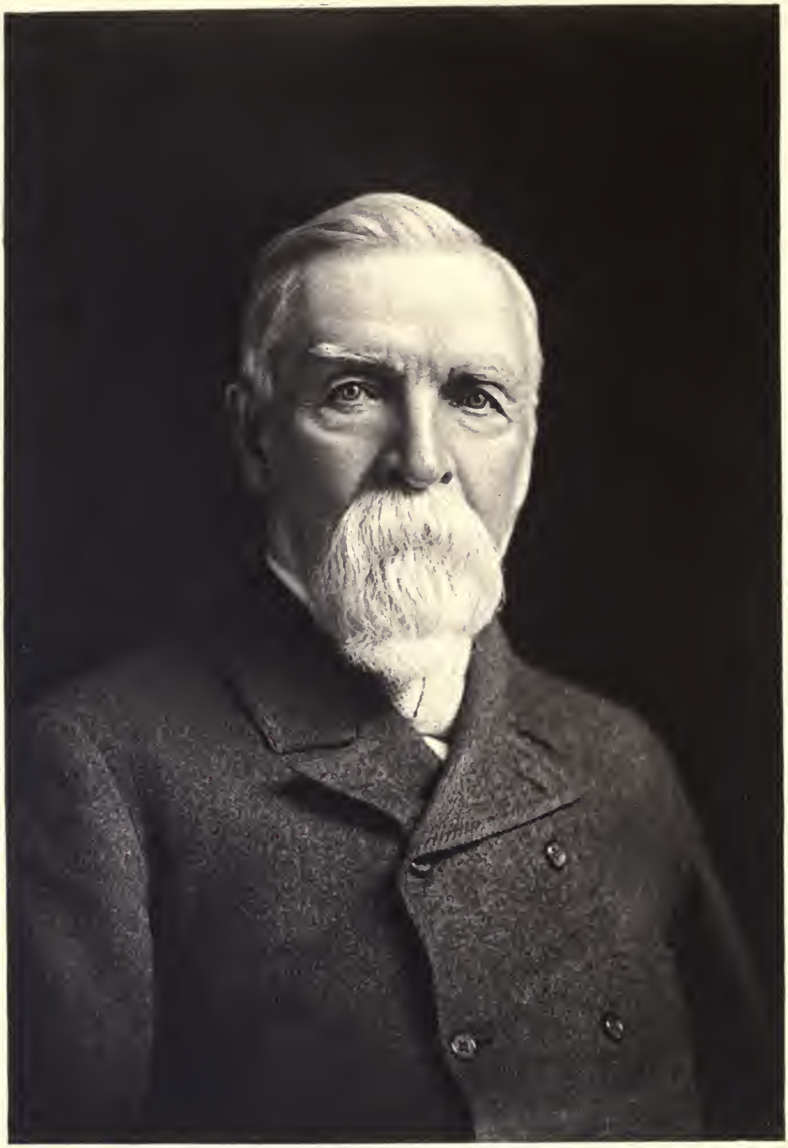
JOHN FRITZ
AUTOBIOGRAPHY



HONORARY MEMBER
PRESIDENT 1896
OF
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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AUTOBIOGRAPHY OF JOHN FRITZ

HONORARY MEMBER AND PAST PRESIDENT

NEW YORK
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DEDICATION

THIS book is dedicated to the loyal, able, brave and fearless men who so faithfully stood by me throughout my career. To them all, in whatever capacity employed, I am ever grateful, and I should like to call each one by name and to thank them personally, from the depth of my heart, for their most valuable assistance and for the uniform kindness they have ever shown me. They deserve the plaudits of the country for the innumerable blessings they have conferred in performing the great amount of mental and physical labor necessary in accomplishing the marvelous changes and wonderful results that have marked the development of the iron and steel business from my first connection with it some seventy years ago.

John Fritz

PREFACE

In this short preface I wish to tell my friends who read this book how it was that I came to write it. My undertaking it came about wholly through the persistent urging of a number of old friends, who insisted on my writing out for them, in my own words, an account of my life struggles ; and the publication of my autobiography before my death is again owing to the fact that, against my wishes, these good friends would not wait for it, but insisted on having it now. And so I have jotted down the record of my life, and it is given to you as I wrote it. You must not expect fine language nor eloquent periods, but only the honest record of the hard-working life of one who loves his country and his fellow men, and who has tried to serve both.

TABLE OF CONTENTS.

FOREWORDS FROM OLD FRIENDS.

Many men have written their autobiographies, giving the details of lives which had been more or less useful to their fellow men, and covering periods in the world's history during which events of greater or lesser moment had occurred. It is my privilege to write this foreword to the self-told story of a long life of great activity, whose every accomplishment was for the advancement and betterment of civilization. If ever the appellation of "a self-made man" was correctly applied, it is emphatically so as relating to John Fritz. Born from sturdy stock, given very limited opportunities for education, but blessed with splendid physical health and strength, and endowed with a clear and logical mind and inherent mechanical genius, he resolutely set himself the task of mastering every problem which might confront him in life's struggle, and persistently sought the problems. This necessitated a life of hard labor and frugality, in which was developed a character of great strength, but also one of equal integrity, remarkable simplicity, and broad sympathies. So active a life of necessity encountered frequent opposition and many contests, defeats as well as triumphs, but always commanding respect and generally receiving affection. Respect and affection for Mr. Fritz are not confined to his own country or continent. He has been honored by many of the Scientific Societies of the whole world, and has had many and remarkable evidences of personal esteem and affection from his fellow men, while to the whole Iron and Steel fraternity, as well as to his neighbors, he is, in his old age, respectfully and affectionately known as "Uncle John."

Mr. Fritz's more than 89 years have covered the most eventful era in the world's history; in fact, it is hard to realize that any one life could have witnessed so many and such wonderful achievements; — placing on a practical basis the construction and operation of steam and electric railways; the invention of the electric telegraph; that of the daguerreotype, and the art of photography; the laying and operation of ocean cables; electric lighting; the telephone; the phonograph; and the other wonderful electrical engineering developments — perhaps the most startling of all — wireless telegraphy; the making actual of submarine navigation; and the until lately unbelievable science of aviation. In Mr. Fritz's own particular field of engineering, he witnessed the discovery, and participated in the development of the epoch-making Bessemer process, followed by the Acid and Basic Open-hearth, and now the electric furnace; and besides those, the other tremendous developments in the Iron and Steel arts, in which he was an active factor.

It is fortunate that the incidents of such a life should be recorded in Mr. Fritz's own way and in his own words; and speaking for those of us who are left of the many who were associated with him and therefore who knew and loved him, I thank him for this his latest work.

ROBERT W. HUNT.

In July, 1861, the clouds of war hung dark over the placid valley of the Brandywine. News had come that Bull Run had been fought and lost. In a plain farmhouse, a depressed wife went about her daily tasks, when a slender lad entered. "Mother," he said, "I have enlisted; I am going to the war." She only turned and rejoined: "Well, my boy, never let me hear that they shot you in the back."

That woman was the mother of John Fritz; the boy, his youngest brother. If his mother never had occasion to use this Spartan encouragement to her eldest son, we know that her training of him had been on the same lines, and we also know that never did any of the Fritz children, boys or girls, ever turn their backs on any duty, any hardship, any danger. But, side by side, with this stern teaching there acted upon them the gentle, though not less powerful, influence of the father, the German farmer, whose very glance, though never hand or voice was raised against his children, was more feared by them than the mother's, we may be sure, always unmistakable corrections. This man, George Fritz, John Fritz's father, was one of Nature's noblemen; a born mechanical genius, a clear thinker, with a gentle heart and keen sense of humor, all of which qualities he handed down to his son.

The humble home built by these people was the university of John Fritz. His post-graduate course was taken in the battle of a long and varied life, covering, we may say, the entire period of modern development. In these two schools he acquired those qualities which characterized the parents and helped to create his own commanding personality. There he learned, and learned well, the great lessons of humanity and life. Let us rejoice that there were no universities and hardly any schools in reach of Chester County, Pennsylvania. If there had been, America would never have had a John Fritz. He would, no doubt, have become a great personality, but one moulded in the common form, and of the usual type; he would have been one of several others. Now, he has been unique, alone in his class.

Untaught, as far as printed education went, he entered life at the bottom, but with a vision always above and beyond the surrounding horizon, whilst ever holding close to the practical possibilities of the world in which he lived. He advanced, led, always led. Often opposed by the timid and commonplace with whom he sometimes had to work, he generally achieved that which he set out to do, because it was practical, logical and needed.

John Fritz started out with the best of educations — the example of his parents. His clear head, his correct judgment, his justice, his tact and his kindly heart did the rest. And thus it is that he has now given to us who know him and to the several generations of men with whom he, during the better part of a century, has come into contact, glimpses of that education, of the life work built on it and of the man it made. And it is this personality, made up of strength, cautious daring, resource and judgment, but also of gentleness and honor, that his nearest friends, his brothers in profession, his aides, his workmen, and all the many who must remember him with gratitude as a helping friend in need, a sound and sympathetic adviser, a charitable judge, do, and always will, honor and admire.

It is to John Fritz, "The Man," that the technical world and his countrymen give homage in his old age when his life work is done, even more than to the great engineer who built the guns and armor which won the battle at Santiago.

This is the fact which I, by these lines, wish to point out and emphasize to those who will now read his own simply told story of his life work. And it is again this personality of John Fritz, seen between the lines of his book, which will always give this autobiography a special value to the host of American engineers amongst whom he now stands honored and revered as the only surviving representative of that advance guard of engineers who, small in number, strong in resource, perseverance and genius, laid the foundation for and started the building of the greatest industrial empire the world has ever known.

AXEL SAHLIN.

When I was working for the Bethlehem Iron Works under the direction of John Fritz, he was ready at all times to consider suggestions from anyone. It is a great faculty to be able judiciously to discuss matters with those about us, and gather the consensus of opinion. This consensus of opinion is generally nearer right than any one man's judgment, and I believe that Mr. Fritz's ability and willingness to do this probably contributed much to his great success.

He concerned himself not about money but about results that should be advantageous to his associates and the human race. If he had in hand a man or a machine they had to produce results. He could see the essence of a subject as none other could, and he could apply a remedy for a difficulty as none other could.

The material engineering works of Mr. Fritz are ample to give him lasting fame, but the successful construction of the Bethlehem Iron and Steel Plants and his other previous great undertakings are far from being his most useful and enduring work.

The best work, in my judgment, done by him was the training of the young men who worked under him. They have gone out to carry and spread broadcast his creed of initiative industrial progress, and through them Mr. Fritz's work is still going on from the St. Lawrence to the Rio Grande in all sorts of industrial enterprises based on his engineering methods.

D. A. TOMPKINS.

"What man is there among us who coming in contact with a great soul is not made the wiser, better and happier thereby. A drop of water on the petal of a lotus glitters with the lustre of a pearl."

And who among us that have had the honor and privilege to know the author of this book, to know Uncle John Fritz, but will say we have come in contact with a great, a noble soul.

Who of us will ever forget the cordial greetings, the delightful talks he has given us, the cheery smile on his face as he has told us of his life work; aye such men as Uncle John "help to move this dark world nearer the sun." They fail not to pour good oil on the axis of this old round earth that she may run smoother on her bearings as we journey around the sun. It is such men that

> "Give us the glad good morning
> As we pass along the way,
> And leave the morning's glory
> Over the livelong day."

The world knows Uncle John Fritz as the great engineer, his loved ones and we his friends of ye olden time know him as a man among men.

JOHN ALFRED BRASHEAR.

THE AUTOBIOGRAPHY OF JOHN FRITZ.

CHAPTER I.

FAMILY HISTORY.

I WAS born August 21, 1822, in Londonderry Township, Chester County, Pennsylvania, and was the oldest child of a family of seven children, three brothers and four sisters.

I was born of parents of exemplary character, my father being a man of high moral standards; he fully impressed upon my mind the importance of absolute integrity, energy, and economy. My mother was a true Christian woman, and early taught me to read and revere that book of books, the Holy Bible, and to trust in the Supreme Being; and that to respect and obey His laws was a duty which mankind should not disregard. At this distant day, to my mind, the moral and religious training received from my parents was the most important training I could possibly have received; and I have ever thought the highest honor I could pay to their memory was to endeavor to follow their noble example.

My father, George Fritz, was born July 26, 1792, in Cassel, Hesse Cassel, Germany, and came to this country, landing in Philadelphia August 26, 1802, with his father and mother, Johannes and Gertrude Meinhard Fritzius, and their children, Conrad, Margaret, John, and Henry (Elizabeth, Catherine, and Mary were born in this country).

They were accompanied to this country by my grand-father's brother, J. George Fritzius, and his wife, Eva Catherine. My great-uncle and his wife immediately went West and were never afterwards heard of.

My mother, Mary Meharg, was born June 18, 1799, in Londonderry, Chester County, Pennsylvania. She was a daughter of William and Hannah Connor Meharg. My Grandfather Meharg emigrated from Tobermore, Londonderry County, Ireland, about 1787. He was of Scotch-Irish Presbyterian stock.

My father and mother were married July 26, 1821, at Hepzibah Church, East Fallowfield, Chester County, Pennsylvania, by the Rev. Jethro Johnson, a famous Baptist minister of that day. They had seven children. John, the subject of this sketch, married Ellen W. Maxwell and had one daughter, Gertrude, who died at the age of seven years; Hannah Ann married B. Frank Stroud; Catherine married Isaac E. Chandler; George married Ella Maclay; Sarah married Robert Russell; Elizabeth married Hiram E. Russell; and William married Eleanora Paddington, of Baltimore, Maryland.

My brother George was born December 15, 1828, in Chester County. He early displayed a proclivity for mechanical pursuits, a talent which he certainly inherited from his father. When about the age of eighteen he was apprenticed to one of the leading master builders of Philadelphia, to learn the carpenter's trade. He became a first-class workman, but I could see no great outlook for him in that line of business and believing he had much mechanical ability, I made up my mind to get him, if possible, into the mechanical engineering line. I was at that time in the employ of Messrs. Moore & Hooven of the Norristown Iron Works, Norristown, Pennsylvania. Fortunately for both George and myself, there was quite a good machine

FIG. 2.—BIRTHPLACE OF JOHN FRITZ.

shop in Norristown, and a highly esteemed friend of mine, Mr. Archibald Johnston, was financially interested in and also the manager of the shop and was an able mechanical engineer. I told him about my brother George being a good carpenter and that I wanted to get him in the engineering line, and said to him, " Sometime when you are in want of a man to do the coarser work in the shop, I should be pleased if you would give him a trial." He said, " Send for him at once; I am in want at this time of just such a man." This I did, and inside of three months George was on the best work in the shop and soon proved to be a first-class pattern maker, an important person about a manufacturing plant. When I went to Catasauqua I took him with me and also to Cambria. There I found him apt in any place I put him and he soon became useful to me and learned the business rapidly. When I left Cambria in 1860 he succeeded me as Engineer and Superintendent of the Cambria Works and remained in that position until his death.

When the War broke out he was connected with a volunteer company and at once offered his services. The company was accepted and he was in his place ready to fulfill his duty. The Cambria Company requested him to remain at home and upon his refusing to desert his comrades in arms, Mr. Morrell, the General Manager, appealed to the men, showing them that if George went with them the rolling mill would be compelled to stop. It was only at the earnest request of his fellow soldiers that he reluctantly consented to remain at home. Later when drafted, although exempted through the loss of part of all the fingers of his right hand, he refused to claim his right under the law and contributed to the support of the Government by paying the exemption money. Not satisfied with this, he subsequently furnished a representative recruit. While making no profession of religion, he contributed largely to the building of the Methodist church at Johnstown, as well as looking after its erection. He died August 5, 1873.

William was born in Chester County, Pennsylvania, February 26, 1841. When fourteen years old he followed us to Johnstown and apprenticed himself to the Cambria Iron Company as a machinist. He remained in this capacity until 1860, when he went to Bethlehem. At the outbreak of the War, he responded to his country's first call and enlisted in the three months' service in the First Pennsylvania Infantry, and after his first term had expired he enlisted in a cavalry regiment and served for three years. While thus engaged, he was seriously wounded and was granted a furlough. When the Government erected its rail mill at Chattanooga, according to plans I prepared at the Government's request, he was placed in charge of it, and ran it successfully until the War was over. He then accepted the superintendency of the Abbott Iron Company of Baltimore and remained there several years. Later he entered into partnership with Horace Brooke in the blast furnace business in Baltimore, Maryland. About five years before his death he was obliged to give up work on account of failing health. He died March 20, 1884.

CHAPTER II.

EARLY FARM LIFE.

At this distant day I look back to my early boyhood, when I lived on the farm, as the most pleasant period of my life. In the summer we waded in the brook, caught butterflies, and, as we grew older, had the more exciting sport of fighting and destroying the bumblebee and hornets' nests, which required both skill and daring, and we often came out of the encounter somewhat wiser, but many times not so good-looking.

The most innocent, interesting, and instructive pleasure that we, as youths, so much enjoyed was the time we spent with the young stock in the fields, — the colts, calves, and lambs; and it would, to the people of to-day, who know nothing of farm life, be a great surprise to know how tame and companionable they can be taught to be, — the colts, of course, first, as the noble horse is always in the lead; they could be taught to rear up, and lie down. We would twist straw into ropes and make what we called straw harness and dress them up in the most fantastic style, and march them around for hours at a time, they seeming to enjoy themselves as much as we did.

The calves would follow us all around and were very tame and gentle, but seemingly had some object in view and generally wanted something to eat. They were not susceptible of being taught like the colt, but at times were quite playful.

The lamb became very domestic and playful, and there was one trick that he would readily learn and that was to butt; unfortunately, however, he would never forget it and often became troublesome and at times vicious, frequently practicing his early learned tricks on people, much to their annoyance and sometimes to their detriment, which caused timid people to give him a wide berth. At times some of his butting was amusing to spectators, but annoying to his victims.

Children on a farm also get a correct knowledge of all domestic animals, such as learning how to take care of the noble horse — to handle, harness, and drive him. They also learn about the forests, — the names of the various trees, and their peculiar properties, the character of the wood, and the various purposes it is used for. They have an excellent opportunity to study botany, learning the names of flowers and plants and how to cultivate them. They visit the orchard, and in season pluck the ripe and delicious fruit from the trees with their own little hands and eat it with a relish that they will never experience in after life. They hear the birds sing and admire their beautiful plumage, and learn their manner of building their nests and rearing their young. They learn a useful and instructive lesson from the industrious ant and the busy bee. The study of the habits of the bee is an exceedingly interesting one, not only to naturalists, but to all people who take an interest in the habits of the more intelligent insects, amongst which the bee ranks high. They visit the sweet little brook and see the small fish darting through the water; they wade and dabble in the stream, which is as clear and fine as their own dear little hearts. Where can children have such an opportunity to commune with nature as on the well-regulated farm? Moreover, the information gained in early youth is frequently retained in the mind, when that which is gained in after years is forgotten.

Between the ages of six and seven years my farm labors commenced by dropping corn, in grains to the hill. When the corn was about three inches high, I rode the horse, attached to the harrow, to guide him between the rows. Next the corn had to be kept clear of weeds, which had to be pulled up and hoed out. By this time the hay harvest was on and mowing commenced, and it was my duty to carry drink to the harvest men in the field. This consisted of fine old rye whiskey and fine water fresh from the spring near by.

About the time the hay was secured the wheat was quite ready for the sickle, and in addition to seeing that the men had all they wanted to drink and water quite fresh from the spring, I gathered sheaves between drinks, — which were quite frequent. Shortly after the wheat was housed the oats were ready for the cradle if erect; if down, the scythe was frequently used; the oats harvest is generally easier and more quickly over than the hay, wheat, or rye. My duty continued the same until the crop was all in the barn, and as I now remember I was not at all sorry the harvest was over.

I now supposed that my duty as grog boss and gathering sheaves was ended, and I began wondering what would turn up next, but did not have long to wait. The next morning after the completing of the harvest, I was called as usual at about four o'clock. I walked down two pair of stairs, as I slept next to the shingles, rubbing my eyes, feeling somewhat tired, but more sleepy. I went out and took down the tin wash basin which was hanging by the side of the house, filled it with water, and gave my face, neck, and eyes a good washing, which refreshed me very much. About this time my father came up from the barn and said, "Good morning, John. This promises to be a fine day. We will raise the potatoes; the ground being dry no soil will adhere to them, and they will go in the cellar clean and dry, which is important, they being much more likely to keep well than if put away wet and dirty. After you have driven up the cows, come to the field."

It was the custom on the farm to go to work at sunrise, the women doing the milking, properly putting the milk in place, and feeding the young stock and chickens before breakfast, which was taken at seven o'clock. After breakfast we again went to the field, all having been previously arranged for the plow. It was started and a furrow was made as close to the potatoes as possible without injury to them. Then spades or shovels were used to turn them out. There was no use for old rye in digging potatoes, consequently not so much water was used. My duties were, therefore, changed to that of picking potatoes, a task which did not to me savor much of a promotion, as it required neither technical nor practical knowledge; but being a private, it was my duty to obey commands and to faithfully do as ordered. My father being a particular man and at times exacting (at least as a boy I often thought so), everything had to be done in the best possible and most careful manner, consequently the potatoes were put in a basket and gently placed in the cart or wagon without a bruise or an abrasion of even the outer skin.

I mention this fact as an illustration not only of how I was taught to pick potatoes, but also of how I was taught to do everything, for all I was called on to do had to be done in a like manner, to the best of my ability. And I unhesitatingly say that much of the success that I may have attained in life is largely due to the careful and exacting training received in early youth from a kind and exacting father.

It was early in the hot month of August and a hot day. In picking potatoes you can neither stand erect, sit, nor lie down, but must be in a stooping position, and as the hot sun was shining on my back I fully made up my mind that I would rather be grog boss and gather sheaves in the harvest field than pick potatoes. But it was a duty and had to be done, so I stuck to it, saying nothing, but my mind was active. I was next sandwiched into school for a short time, until the time to get ready for the fall seeding was on.

Being now in my eighth year and large for my age, and healthy, I was able to do a considerable amount of work in the way of getting the ground ready for the plow. I assisted in loading and spreading the manure on the field, which my father told me was very healthy work and not as hard as carrying sheaves and drink to the harvest men, so I was happy. By the time seeding was completed the corn was ready to cut and stack and in a short time was ready to husk. When this work was finished and the corn and fodder had been taken care of, the time for threshing out and winnowing the grain had come; this work was at once commenced and soon completed. Both grain and straw were put in their proper places.

It was now November and next in order was to prepare for the winter. As coal at that time was not used, at least not in the farming districts, wood had to be cut and so placed that it could be easily secured during the winter. The cattle of all kinds were housed and made comfortable, the farming implements looked up and put in their proper places, under cover. The leather had come from the tanners and the shoemaker was in the house, as was the custom at that time, ready to make each member of the family a pair of shoes, which were calculated to last a year. Our dear mother furnished all the family with a good supply of woolen stockings, much better and more serviceable than can be gotten to-day, knit out of yarn, that was spun off the distaff, by her own hands, from wool sheared from the sheep that were raised under her fostering care. Society was then more economical and simpler in habits than it is to-day, it being the custom for people to raise wool and flax, to spin, knit, and weave, and largely make their own apparel. The people were industrious, contented, and happy, and full of sympathy for the poor and unfortunate.

CHAPTER III.

SCHOOL LIFE.

My father, having attained celebrity in his trade as millwright and machinist, and being pressed by people who were greatly in want of his services, decided to devote his time wholly to his calling. Doubtless thinking I was rather fresh to become a full-fledged farmer, he concluded to put the farm, or rather lot, in some other hands to work it for a time.

I was then over eight years old and as I had had but little schooling my parents were both anxious to get where I could have the benefit of six months' schooling in a year. This was a number of years before the time of free or public schools, and the only opportunity of securing an education was limited to three months in the summer and the same in the winter. It was before pedagogy had become a science, and the teachers were not so well qualified for the discharge of their duties as they are at the present time.

We moved to a place much nearer the school than where we had formerly lived, so near that I could attend in all kinds of weather. For three months of the time in summer I was very fortunate in attending a school kept by a lady, Miss Rebecca Clark, who was educated at the Friends' School, at West Town, Chester County. She was a born teacher, and I am sure that I learned more in the three months that I attended school with her, as teacher, than in three times three months with any other teacher I was ever with. She was a lovely woman with a magnetic and commanding presence, kind-hearted, and gentle, yet possessing a moral firmness, which she skillfully applied, always reproving with kindness and in the most gentle manner, endeavoring at all times to command the confidence and respect of the children, which is so essential for the success of both teacher and pupil; this she accomplished in an eminent degree, not only with the children of the school, but also with all who knew her.

The winter school was some two and one-half miles from where we lived; the snows were much deeper than those we have now, and the roads were generally so badly drifted that it was scarcely possible for one of my age to attend regularly. The next summer Miss Clark failed to get a sufficient number of scholars to warrant her enough compensation for her labor. This was owing to the establishment of a school at the other end of the district, which I was compelled to attend, in consequence of Miss Clark's failure to secure a school. I was disappointed, and, as the teacher was incompetent, I learned but little. Probably it was much my own fault. Miss Clark was an ideal teacher, greatly loved and respected by all her scholars. As I was compelled to go to an indifferent teacher who was not liked, satisfactory results were not likely to be fully realized. As one of the objects my father had for leaving the farm (that of giving me an opportunity for an education) was in a measure a failure, as his business required him to be from home so much of his time that he grew weary of it, and as he was fond of his family and all were happy when he was with them, it was agreed all round that it would be best for him to go back to the farm.

I was now nearly ten years of age, stout and healthy, and was able to do much of the farm work. The farm or lot we had formerly lived on was small, and as quite a family of children were growing up, both father and mother thought it very desirable to have more land. Consequently, they sold the farm and bought a larger one, of about fifty acres, about one and a half miles from a school. This enabled the girls to attend the summer quarter and the boys the winter.

It was here in an old country log house that I took my scholastic degrees. The building was under the jurisdiction of the Society of Friends, generally known at that time as Quakers. They held service in their meeting house twice a week, first-day and fifth-day meetings as they were called, which were attended regularly whether in seedtime or harvest. They also had what were called quarterly meetings, which took place every three months, and which it was the custom for all the school, when in session, to attend; all walked over to the meeting in a body under the eye of the teacher, and remained until it was over. I have been informed that I heard Elias Hicks speak, and I have no doubt it is so, but I cannot remember him. He was an able man, and a great leader of the Friends, and it was his views on the Divinity of Christ that caused the separation of the Society into two parts, now known as Hicksite and Orthodox. The Friends were a most excellent people, good neighbors, charitable, peace-loving, and peace-making; in early life I was much amongst them, and I have no doubt that I profited by association with them.

In order that the present generation may fully comprehend the difficulty of securing an education when I was a boy, some eighty odd years ago, it will be quite in place to state, very briefly, the condition of the schools, as they existed at that date. It was a number of years prior to the time when the great commoner, Thaddeus Stevens, made his eloquent and farseeing appeal to our State legislature, sixty odd years since, in favor of our common school system. The predictions he made in that memorable address when the bill was under discussion have been fully verified. The benefits the youth have derived and are deriving from the free school system, viewed alone from a social and economic standpoint, are incalculable, and the impetus public schools have given to agriculture, manufacture, and commerce is of great importance to both state and nation.

Well, we were on the new farm and were pleased with the change and with the new farm also. My father was from home but little the first summer, leaving only for some important work and then only for a few days at a time. My duties were practically the same as those of my two former years on the farm. As the farm was large, the work was somewhat harder and the harvest season longer. When the seeding was done, the corn all in, and all fall work completed, I was next gotten in order for my three months' schooling, which generally commenced in the latter part of November or early in December. I was then over ten years of age, and had only about one and a half miles to walk. I attended school every day it was in session, up to the latter part of February, or the first of March, when the winter term closed.

The teacher was a Mr. Baker, who was considered a very competent person. He had succeeded in obtaining subscriptions for about forty scholars, which was quite a good number for that time. He was a stern, resolute person, qualifications that many people at that day thought essential, especially for the winter term, when only boys attended. As a great many of the boys were from fourteen to twenty years of age, people were of the opinion that to insure proper control it was necessary for the teacher to know how to handle the rod. In this line Mr. Baker was an expert, ever looking for an excuse to use it. An opportunity one day occurred in the most unexpected manner. The older boys took delight in plaguing the kids, as they called the younger boys, by breaking up the plays, whatever they were, and annoying them in any way they could. One day when there was snow, the younger boys, I being one of them, were passing by the end of the Friends' meeting house. I spied a knothole in the shutter of the gable-end window, and having a snowball in my hand I inadvertently threw it to see how near I could come to striking the hole. Of course all the rest, boylike, must see how near they could come to striking the mark. About the time we were getting our best work in, we received such a volley of snowballs from the older boys that we were compelled to make a hasty retreat, much to our chagrin. But we did not have to wait long for revenge and it came in a most unexpected manner. The older boys at once took the cue to see if they could put a ball through the hole, but they threw such a volley against the time-worn shutter that it went to pieces. About this time we younger boys saw our teacher coming up the road. We stepped out of the way, but where we could have an eye on him. He halted a short distance from the older boys and took in the situation. As he was in the rear of them, they did not see him until he was quite close. Then, of course, they began snowballing each other. He passed them seemingly without taking notice of what had happened, but knowing the pleasure he seemed to take in the use of the rod, and that he was always on the lookout for an opportunity to use it, we could see danger ahead. But, as the larger boys had done the damage, we consoled ourselves with the thought that they would get the worst of it, and we would have the satisfaction of seeing them severely chastised for the rude treatment we ever received from them.

We did not have long to wait to see what was going to happen. As soon as school was called to order and all had taken their seats, Mr. Baker called the older boys whom he had seen snowballing the shutter and ordered them to stand in line. He then took down one of his choice rods, of which he kept a number on a couple of pins in the logs back of his desk, stepped to the front, and addressed them. I do not remember the words, but their substance is clear in my mind, and knowing him well as a man and neighbor, and being familiar with his disposition and his manner of talking to the boys, I think I can give quite a clear idea of what he said, but probably more certainly of what he thought. He at all times greatly magnified any offense the boys were so unfortunate as to commit. He said, "You seem to be possessed of a malignant spirit and prone to do evil. The defacement of property used as a place of worship by a God-fearing and unassuming people, to whom you are indebted for the use of this building for a schoolhouse (in which I yet hope to teach you all to see the evil of your ways), is not only a great outrage against the Society of Friends, but also against the community, for which offense you must be punished. While I greatly regret that you have committed this outrage, it gives me some pleasure to administer to you the chastisement you so richly deserve." He began at one end of the line, and gave every boy a severe whipping, sending each one to his seat as he completed the punishment. He then returned to his desk with a benignant smile on his face, as though he had done his duty, but somewhat exhausted.

Being looked on as rather a leader of the younger boys, I must confess this was an anxious period for me. As I was not sure that the teacher had not seen the younger boys in the same act and that some questions might not be asked who commenced it, I quite naturally supposed that I might be called on to answer that question. Had I been asked I should have promptly said, as we had entire confidence in each other, that I was the one, and that would have been all I knew about it. There was no fear of squealing among the boys so long as no disgraceful or wicked act was committed. There were, however, no questions asked, much to the relief of the younger boys, myself included.

CHAPTER IV.

SCHOOL LIFE. — Continued.

In looking back at this distant period to my schoolboy days and taking all the conditions into consideration, I think that next to Miss Clark, Mr. Baker was the best teacher I ever had. Yet their mode of teaching and manner of keeping order were diametrically the opposite, the former accomplishing the purpose by kindness and simple persuasion, the latter with absolute despotism. But in fairness to both teachers it is proper to say that the make-up of the schools was widely different. As Miss Clark taught in the summer, her scholars were principally girls and the younger boys, but few of them being over ten or twelve years of age. As Mr. Baker taught in the winter, his school was entirely of boys, from eleven upwards to seventeen, and frequently twenty years of age. The winter schools were the only chance the farmer boys, who were old enough and able to work, had to get an education. This condition of affairs (primitive as the schools were) necessarily caused a large attendance. The last three winters that I attended school, at the age of thirteen, fourteen, and fifteen, the attendance numbered daily over forty scholars, all boys, and of all ages from eleven to eighteen, and some up to twenty-one. The reader, if he knows anything of boys of the ages referred to, can well imagine the difficulties the teacher had to contend with in keeping proper order, to say nothing of the time necessary for the proper instruction of the students.

Fortunately for the teacher, but very unfortunately for the scholars, the studies were few and simple in character. However, had they been otherwise, a very large majority of the boys could not have given them proper attention, as after school they had long distances to walk, the stock on the farm to take care of, the wood for the night to put in the box, then supper. The principal light used in the rural districts at that time was the tin dish open lard lamp, and the tallow dip, with frequently the spitting wick. In the morning the duties of the night previous had to be repeated; after this was done, then the long walk to school in all kinds of weather. When I look back from this distant period to my boyhood days and compare the economic conditions of the school system of that time with those of the present, with the beautiful and comfortable schoolhouses (I might, comparatively speaking, say palaces), located at most convenient distances, divided into rooms suitable for elementary teaching, and to some extent technical, under the charge of teachers graduated in the science of pedagogy, all under the watchful eye of the county superintendents, who are, generally speaking, persons well educated and intelligent, comparing favorably in that respect with most of our learned professors, and when I consider the high schools where the graduates who receive their diplomas are well fitted to accept responsible positions or to study almost any one of the learned professions, I feel that the youth of to-day should be most profoundly grateful for the almost marvelous opportunity they have for securing, in our free schools, an education that will fit them for almost any position in life.

When I was going to school, some of the well-to-do farmers would send their sons to an academy and their daughters to what was called a Young Ladies' Seminary, but neither of these schools could be compared with our present system of high schools. The Friends, or Quakers as they are now generally known, would send their children, for a year or so, to their own school at West Town, when they were say about fourteen to sixteen years of age, but the poor farmer with a mortgage on his farm (as was generally the case), and with a large family of children to raise, and interest on a mortgage to be paid, had but little chance to give any of his sons an education beyond what they could get at the winter subscription schools.

It was my good fortune to get along well with the teachers. I do not remember getting a whipping at school or even a severe rebuke. I do not claim that I was any better or freer from pranks than other boys, but in school I was a student. When out, I was a boy amongst the others. At that time the schoolmaster was a perfect despot, making his own rules and enforcing them absolutely. Should his oral commands not be obeyed at once, the rod was applied until the command was complied with, and there was no appeal. Should the victims complain to their parents, the reply was, " Behave yourself and do as the master tells you, and you won't get thrashed." This was cold comfort, consequently but few complaints were made at home. In the winter schools, the course of instruction was extremely simple. Comly's spelling book, with definitions, was studied; in reading, the introductions and sequel of the English reader, and the Columbian Orator were the books used; history, geography, and grammar were not taught. In mathematics, Pike and Bennett's Arithmetic completed the studies, except in the case of a very few pupils, whose parents lived near the school and were able to let their children attend in the summer; boys who had mastered Pike and Bennett struggled with mensuration for the purpose of becoming surveyors, a title that commanded some respect at that time, and to see a surveyor with his instruments and chain measuring the farms and roads, caused much excitement with the boys of that day, and should any of the boys be so fortunate as to help carry the chain, they forthwith would become surveyors. The instruction received in writing was, if possible, even more meager than that in the other subjects. Learning to properly hold the quill-pen, making letters, and imitating headlines written by the teacher, was the limit. Such a duty as writing an essay or composing a sentence we were never called on to do.

CHAPTER V.

BOYHOOD DAYS.

We had now lived on the new place one year, and as I was one year older and as my father was more from home, I had much more and somewhat harder work to do than the previous year. I had this year to learn to do all the important work on the farm, such as plow, harrow, mow grass, and reap grain, — all hard work. There were no mowing or reaping machines at that time; all grass and grain had to be cut with the scythe or sickle. All this I had to learn and do something at. My father was doing more at his trade this year than the previous year, and this not only put more work on me, but more responsibility. I had a slight offset against this, however, as I occasionally had to take my father's chest of tools to where he was going to work. This I enjoyed very much, as I got to see the country, and besides it gave me an opportunity to see the different mills, — flour mills, cotton and woolen mills, for all of which my father did work. This was a rare treat for me, deepening and broadening the foundation for the love of machinery that I already possessed, and gave me the opportunity of seeing and becoming familiar with the various operations and the ingenious and delicate machinery that was used in the different processes of manufacture.

The spinning and weaving of cotton goods was the kind of manufacture which I had the best opportunity to see, as there were two mills but little over a mile from where we lived, and my father did all the difficult repairs for both of them. This necessitated my making frequent visits to the mills, and when I could possibly spare the time I would spend it in the manufacturing department. It commenced at what was at that time called the picker, or beater, which prepared the cotton for the carding machine, which properly arranged the fibers of the cotton. The throstle and mule did the spinning and put the yarn in shape for the loom. All of the machinery interested me greatly, but the shuttle flying or shooting from side to side was a mystery that I was unable to solve. But of all the machines in the factory, the mule was to me the most interesting and instructive. But why it was called a mule I was at a loss to know. But however degrading its name may have been, it was the one machine that completely captivated me. To see a machine some thirty feet or more in length, with its many spindles, spinning yarn, with one-half of the machine fixed and the other part moving back and forth through a space of some eight feet or more, spinning the thread as it ran out, and winding it on spools or bobbins on its return, making it ready for the loom, was to me most marvelous. Being young, with mind free, clear, and active, and not yet crowded, the impression was the more lasting, and although eighty years have passed over my head since I first witnessed that almost bewildering sight, and I have changed from a tow-headed boy to an old gray-headed man, with a mind filled with events that have taken place during my long, eventful, and active life, the feeling of astonishment, and I may say of fear, that I experienced when the door was opened and I was, for the first time, ushered into the noisiest place I had ever been in, is almost as clear in my memory as it was on that first day.

The machine, or mule as it was called, was placed at the end of the building, and so close to the wall that when the traveling part of the machine was out the space was so narrow that it looked dangerous. When I first entered, the man in charge, called the mule spinner, was placing his knee against the pad to start or push the moving part back, as I supposed, to its place (they are now driven by power), but it immediately started back again, coming directly toward where I was standing. Not knowing the exact place it was going to stop, I rather instinctively moved sideways toward the door to await results. After seeing it moving in and out several times, always stopping at the same place, my fears were, in a great measure, quieted, but the noise was at first something terrific. After a few visits, however, I got quite used to it, and lost but few opportunities to get in to watch the machines at work.

I must now come back to the farm again. The next two years on the new farm differed but little from the previous year, except that as I grew older I had to do all kinds of farm work, and I was quite proud of my attainments. My father being a very particular man, everything I was called on to do had to be done in the best manner possible. The furrow must be kept straight and of even depth; if the plow struck a stone in the bottom, that was too large to be taken out quickly, the place was marked and the stone was either taken out or buried deeper so that the plow would not touch it. This had to be done before the ground was harrowed and finally prepared for seeding. This training was a good thing for me, as it taught me to do everything well, an important lesson for me in after life, as principles instilled in the mind in youth are seldom forgotten.

The duties and routine of farm life were so similar to those of the previous year that it is unnecessary to allude to them. The next two winters of school also were practically the same as far as routine was concerned. Of course some progress was made in learning; but no new books or new studies were introduced.

I shall now very briefly describe the last two years of my farm life as one; as they were so similar and the routine of the farm changed but little, it is useless to go over it fully. I was at that time in my fourteenth year and made a full hand at any work on the farm. In the harvest field I held the post of honor, pitching on on the near side in the field, and pitching off in the barn, the two hardest positions to fill in harvesting. During these two years we burned lime to put on the farm. The limestone quarry was about two and a half miles distant from the kiln in which it was burned, and it fell to my lot to do the hauling; this was done in the spring, after seeding and before harvest, or after harvest and before fall seeding time. The hours for all workmen at that time were from sunrise to sunset. It was my duty to be at the quarry, have the wagon loaded and on the scales waiting for the workmen to take the weight of the load. This required early rising in order to get the team in proper shape and in the quarry at the time named. But this I did not mind, as all farmers at that time were early risers. I was anxious to have some knowledge of everything that was necessary to be done on the farm, and the burning of lime was about the only part of the business that I had no experience in. Hence, it was a source of pleasure, as at all times I tried to get all the information possible about everything I had to do with. This practically completed my farm education; as it was before the introduction of agricultural machinery, all work was done by hand. It was a source of great satisfaction to be able to say that I had done all kinds of work on the farm, and to feel fully conscious that I had not only done it, but had done it well.

Having given a very brief account of my last two years of farm life, I will next give briefly something of my last two winters of school life.

First, we had a new teacher, by the name of Elisha Jefferis, the son of a well-to-do Squire, who lived close to the schoolhouse, and whose sons were so fortunate as to have had the advantage of both winter and summer schools; besides this, our teacher had attended an academy for two terms, and was quite a well-educated man for that time; he seemed to be a good teacher, was very generally liked by the scholars, had good order, and used the rod but little in comparison with the previous teacher. There was little or no change in the books or in the system of teaching, especially during the first winter. The boys generally seemed to be getting along quite well with their lessons and were pleased with the new teacher. In spelling and definitions I was doing so well, standing at the head of the class in which I was the youngest, a large majority of the class being from sixteen to eighteen years of age, that I became ashamed of standing at the head, or rather sympathized with the others, and asked the teacher to let me stand at the foot of the class as long as I missed no word in either spelling or definition, with the understanding that if I missed any he should place me in the class, where, in accordance with the rules, I properly belonged. He agreed to do this, and it was so rarely that I failed that he let me remain at the foot permanently, and it seemed to have a good effect on the older boys.

In arithmetic I got along quite well and I was very fond of it; my father told me that it would be very useful to me in the future, consequently I did my best. But five days in the week for three months in the year, is too short a time for the proper study of Bennett's Arithmetic. The teacher, however, was well satisfied with the progress I was making. This pleased me very much, and my parents also, and their satisfaction added much to my previous stock of pleasure. But this was not all that was in store for me. Being handy with the ball, and lively on foot, I was asked by the older boys to take a place with them in their ball game, sometimes called long town ball, the predecessor of modern baseball. In the simplicity of my boyhood days I thought this a very great honor, and imagined that it was a great step on the road to manhood, the goal of boys' ambition. This was the second of the two winters and the last school that I attended.

Being now between the ages of fifteen and sixteen, I was fully impressed with the importance of a good education, and did my best at this session to get it, and not without some good results. At the close of the session, the teacher commended me for what I had accomplished in the way of mathematics, and said that the next winter I should take up the subject of mensuration, as it would be a useful branch of education in after life. That subject was attainable at the schools as they then existed, but, most unfortunately for me, it was the last schooling I received, except the one month of schooling provided in my articles of apprenticeship. But it was not only in mathematics that I was successful, as I ranked second in the ball game, as it was played at that time. Judging by the interest some colleges of to-day take in baseball and football games, success in them is more important than in mathematics and all other studies.

I have given a brief account of the last two years of farm life and the last two years of my happy schoolboy days. I said good-by to my loved companions and the playmates of my early youth, a large majority of whom I have never since seen, and many never heard of. Having no class or graduating days, and no Alumni Associations, to hold or call us together, except by mere accident, we lost sight of each other for all time. I often think, when I hear and read of the meetings of the Alumni Associations of the many colleges and schools, how thankful the graduates should be for the opportunity they now have for securing an education compared with that of seventy or eighty years ago. Now there are free schools for all, with their well-educated and trained teachers, under the eye of able, practical, and scientific Superintendents, with rooms to suit the various classes and teachers for each of them, and with the studies scientifically arranged. An education can be obtained at the public schools to-day superior to that of the country academy, as it existed before the days of free schools. At that time the academy filled a gap between the day or subscription school and the college, much the same as the preparatory school does to-day between the public school and the college, for those who are so fortunate as to have an opportunity to secure a collegiate course of education.

As I now had but one more summer to spend on the farm, and as I have previously referred to the various duties as being largely routine, I will make no further allusion to them, except to say that I occupied the same leading position that I had been occupying for years previous, until the harvest was all properly stored and the fall grain in the ground. This ended my early days on the farm. Receiving my father's most favorable congratulations on what I had done and on the manner in which it had been done, and hoping that whatever should fall to my lot in the future might be equally satisfactory to my employer, the time of my departure had come. Notwithstanding the long hours and hard work that had to be done on a farm (as before stated, it was prior to the introduction of agricultural machinery, and everything had to be done by hand), yet the life on a farm is so natural and so free and interesting, and above all so independent, that when my time came to leave it, and to go into a new field of business, with all to be learned, I must confess that the separation caused me much regret; and to leave a plain and happy home, looked after by kind parents, surrounded by affectionate sisters and brothers, to go for all time out into the world to meet no one but entire strangers, was a source of very great anxiety, and it was difficult for me to fully realize that such an event was about to take place.

CHAPTER VI.

MY APPRENTICESHIP DAYS.

EARLY in October, 1838, I went to Parkesburg, Chester County, Pennsylvania, as an apprentice, to learn the trades of blacksmithing and country machine work. These consisted of doing such work as was required by the farmers and small manufacturers of the neighborhood, such as the shoeing of horses, ironing wagons, carts, and carriages, and all work required of a smith; and in the machine line, repairs wanted by the farmers on their threshing machines and other machinery used about the farms, and also both the smith and machine work for repairs and renewals required by the cotton, woolen, and other manufacturers, such as grist and saw mills, blast furnaces, and forge plants.

At the shop where I worked there were four smith fires, four anvils, and for that time a fair supply of small smith tools and stocks, taps, and dies for cutting screws. There were also two small lathes for turning iron, and a small lathe for doing pattern work; at times the latter was used for turning and finishing light brass work, all on wooden shears or beds. There was also a very good makeshift of a drill-press bolted up against a ten-inch wooden post. All of these tools were of the crudest character, but capable of doing, in a very elementary way, such machine work as was required in the neighborhood. In addition there was a set of rolls for bending boiler plate, shears and punch, and a kit of small boiler maker's tools, which put the shop in a position to do boiler making in a small way.

The power to drive these tools was a six-horse-power engine and boiler; both had, practically speaking, been built in the blacksmith shop by my new master. It was a rude machine, but worked quite well, and I don't believe there is to-day one mechanic out of one thousand that could, under the same conditions, build such an engine. He would have to make his own drawings and patterns, make his own forgings, and fit the work all up, without tools, except makeshifts. To-day as many men work on an engine as there are parts to it, and each man has a special machine, specially designed to do his work on. There are few all-round mechanics to-day such as there were sixty years ago; even good all-round machinists, valuable as they are to-day, are getting scarcer daily, and the present shop practice is better calculated to make machines out of men than to make good all-round mechanics.

After pumping the bellows and handling the sledge for some days, I was set to holding the dolly against the rivet heads on the inside of a thirty-inch boiler shell, with two awkward fellows on the outside doing the riveting, frequently missing the rivet, striking the sheet, and making such a noise as made my ears buzz like a nest of bumblebees. The diameter of the shell was so small that the shell had to be placed in a vertical position to rivet the sections together; after some four or five feet in length were done the rivets had to be taken in from the top. Picking them off from there in so small a space and placing them in the holes was no very easy job, and the heat in the rivets and the mild October weather, combined with the noise made by the riveting and the cramped position I had to do the work in, made the job a very undesirable one.

To make things a little more lively for me, and to have a little fun for themselves, the workmen commenced to play tricks with the cubs, as the apprentices were called at that time. Being quite familiar with the men and boys of the cotton and woolen mills, I had learned something of the pranks they would play on each other, and this placed me on my guard. Consequently, I was not so easy a victim as they had anticipated. I talked but little to them, but watched for an opportunity to turn the tables, and had not long to wait. One day one of the workmen complained in my presence that his feet were troubling him. I asked him if he had greased his shoes and on receiving an affirmative answer I asked how the grease had been applied. He answered, "On the outside." I replied, "Why, you booby, you ought to put the grease on the inside of your shoes and then you won't have any more trouble." My trick was such that they played no more tricks on me, and I was at once admitted into their confidence.

I worked on the boiler — chipping, calking, riveting in the heads and flues, and the like — until it was completed and tested. I was not sorry when the work was over; my head was in a buzz from the noise in riveting and my hearing has never been as distinct as it was previous to my boiler-making experience. In chipping and calking I used the hammer in the right hand, consequently the left hand was a subject for sympathy, being covered with sores. No bones were broken or fingers mashed, however, and in a week or ten days the hand was all right again. This trouble was not unlike some of the diseases incidental to children, rarely occurring the second time. This ended my first experience in boiler making. While it was somewhat rough, it was of great value to me in after life, and will be referred to later.

My next advancement made me helper to my boss, Thomas Hudders. My duty was to pump the bellows, use the sledge, and do anything and everything I was told to do. As his fire was the largest and best equipped one in the shop, and as he was a good workman, the heaviest and most difficult work was done at his fire. Consequently, I was in the best possible place to learn, and I made good use of the opportunity. My boss, having the business to look after, was necessarily at times away from his fire. At first he left me, during his absence, doing small and light work, such as could be done without a regular helper, but in a short time, when he might be absent from the fire for half a day or so, he would give me a striker, and would leave heavier and more difficult work for me to do. This was my opportunity and I did my best.

I remained in this position for some months, when my boss was taken sick and was unable to get to the shop to remain long. I, however, continued at the fire and learned rapidly.

I had now reached my second year of apprenticeship. The boss had gotten able to be in the shop most of the day, but was unable to do any physical work. One morning he said to me, "There is a very heavy wagon that must be ironed and it must be done soon, and I want you to do it." The wagon was what was called, at that time, broad tread, with tire five inches in width, and, as I recollect, about three quarters of an inch in thickness. The magnitude of the job almost took my breath, and I could only say that I didn't know how to do it, whereupon my boss said, "I will tell you." This was the heaviest job that up to that time had ever been done in that part of the country. There were no proper facilities for handling that class of work, and no rolls of sufficient capacity to form the tire; altogether it was a most formidable undertaking for a sick man and a boy. My boss, though unable to work, was in the shop the greater part of the time and could give instructions as to how to do the work. Under his direction, and with the assistance of two helpers, we succeeded in doing the work, and the boss said it was a very creditable piece of workmanship. I was very proud both of what he said and of the workmanlike manner in which we had succeeded in doing the job. When my boss got well, he and I ran the large fire, doing the best and heaviest work.

Primitive as the shop was, it was the only shop in the neighborhood that could do any heavier class of work than that required by the farmer, and in addition to being able to do the heavier and a better class of forgings it was the only shop of the kind that had power and machine tools. These consisted of a drill press, lathes, shears, and punches for boiler-plate work, and taps and dies for cutting screws. They were all of the most primitive construction. The drill-press head was cast off a sixteen-inch lathe head pattern and bolted to an upright post about ten inches square; the table consisted of wooden blocks of various thicknesses piled upon the shop floor until they were of the proper height for the job that had to be drilled. But crude as the tools were in both design and finish, we were able to do a variety of work on them, and the experience was useful to me in after life, as it taught me how to do work in case of an emergency, without proper tools. An ability to do this is, at times, of the utmost importance, especially about an iron and steel plant, where delays are very costly and at times dangerous.

Some time during the year 1839, I first saw a shotgun, with the percussion cap lock. I at once saw it was so much superior to the flint lock then in use that it would surely come into general use. Having in my own right a very good gun with the old-fashioned flint lock, I made up my mind to have it changed, if possible, to the cap lock. As there was no gunsmith nearer than Lancaster or Philadelphia and as I had no money to pay for the change, I decided to make the change myself, or at least to make the attempt. The result was so satisfactory that every person in the neighborhood who had a gun and used it brought it to me to have it changed. It was no uncommon thing to see a number of guns in an old chest that I kept for the purpose, waiting their turns, or for the money to pay for the change, as there was no trust for gunsmith work, it being a separate business from the smithy. As I was the sole proprietor and as there was no other gunsmith nearer than Lancaster or Philadelphia, I had something like a monopoly and the Attorney General did not interfere. I did all the work myself and at night when other people were having a good time or were sleeping. Saturday night was my harvest time, as I could work all night. I would make the forgings in the early morning and the noon hour, during the week. All the fitting and putting together was done at night. The light was a tallow dip or an oil lamp, both of them bad for this class of work. All of the parts that were needed for the change, so far as I was concerned, had to be forged. Consequently, it necessitated much work to fit them up in good and proper shape, and a good and smooth finish was essential to make the change look well. The owner, in turn, was proud of the change and took pleasure in showing his gun to his friends. This was to my advantage, as it brought more work, and another important benefit to me was the fact that it impressed upon my mind, as a boy, the importance of making a job, of whatever kind it might be, look pleasing to the eye, which I ever after endeavored to do. The work was also a valuable experience for me, as I learned how to use small tools and do small and light work in a creditable and workmanlike manner. During my apprenticeship quite a variety of work was done in the shop, the new and especially the most difficult jobs were generally assigned to me to do. All this was of much value in after life.

Parkesburg was situated on the line of what was known at that time as the Philadelphia and Columbia Railroad, now a part of the great Pennsylvania system. The shops for the repair of the motive power were located there, consequently I soon became interested in the locomotive. The Superintendent of the shop, William Hardman, who was an Englishman and boarded with my master, was quite a talker, and at that time I was a good listener, and showed him some attention, while the other boys would at times be rude to him. The consequence was that he and I became very friendly and he would tell me anything I asked of him. This was before the link motion was in use, and with some of the engines, especially the Baldwin, which used but one eccentric for both forward and back motion, skill was required to get the valves so set as to exhaust evenly, in both motions. The Superintendent, when he could do so, would arrange the time for setting the valves so that I could be with him, until I fully understood the principle and was capable of doing the work myself. We became fast friends, and the knowledge I obtained from him was of great value to me in after life, and he ever has had a warm place in my memory. He went South to take charge of the motive power on a road, as I remember, in Georgia, and wanted me to go with him as Assistant Superintendent. I was very anxious to do this, but my mother did not want me to go so far from home, as it seemed to be at that time; consequently I somewhat reluctantly abandoned the idea of adopting railroading as a calling.

There being several wheelwright shops in the neighborhood, I was induced to start a smith shop to do their work, but this business, after I had my mind set on railroading, did not prove congenial, as there was but little or no outcome in it. The little knowledge I had gained of mechanics only made me eager for more, so I made up my mind to take up the iron business as a calling. But here a more serious difficulty was encountered, which, for the time, prevented me from carrying out my more advanced ideas. It was in the early forties, when the general business of the country was in such a depressed condition that the iron works, small and primitive as they were at that time, had little or nothing to do, so it was not possible for me to get employment in that line. As stated before, my father was a millwright by trade. This caused him to be from home the greater part of the time, consequently the farm was necessarily more or less neglected; so, for a time, like Cincinnatus, I returned to the plow and to my first love, the farm, where I was one of a happy family, and I again took up the work I had left some five years previous.

CHAPTER VII.

NORRISTOWN.

In the latter part of the year 1843 business, to some extent, revived, and in the autumn of '44, much to my delight, a party commenced to build a mill, in Coatesville, for rolling bar iron. This was a branch of the business that I was most desirous to enter into, but unfortunately the condition of the iron business of the country did not warrant the proprietors in pushing the work to completion. This was to me a grave disappointment, but I did not despair, and at once I made up my mind to try to get work of any kind in some one of the distant works.

At that time the Iron Works, at Phœnixville, Pennsylvania, were considered the largest and best in the country, and I concluded to see if I could get employment there. I arrived there on a Saturday at about noon and found the mill standing idle. Upon inquiry as to where I would be most likely to see the Superintendent, I was told somewhere about the mill. I looked him up and told him I was looking for employment. I received, at once, an unfavorable reply. The Superintendent said business was very dull and that they had more men than they knew what to do with. Thus ended my first interview.

Knowing there was quite a large iron works at Trenton, I concluded to go there. I had heard that a new mill was being built at Norristown, and so I thought it prudent to stop off, as it was on the road to Trenton, and I might possibly be successful in securing employment. I landed in Norristown on the same afternoon at about three o'clock and went direct to the office, and there met both of the proprietors, Messrs. Moore & Hooven, and found them both to be courteous gentlemen. I told them what I wanted. They said in reply they were sorry they could not give me employment, as their mill was not completed; if it had been, they said, the times were so bad, they would not start it. So I left their office for Trenton.

In returning to the street, I passed through the mill and was looking at some of the machinery when Mr. Moore, one of the owners, came towards me. A thought passed through my mind that he was going to order me out, but this thought was soon dispelled. He at once commenced to talk to me in a pleasant manner. Being a Friend he used the plain language, which caused me to feel quite friendly toward him, as most of our neighbors at home belonged to the same persuasion and of course used the plain language. After a pleasant talk he asked me if I was used to hard work, to which I frankly answered, "Yes." He asked where I was raised; I told him, on a farm, and what I had been doing. To all his questions I gave a prompt answer. He then said, "Young man, I like thy looks; will thee remain here until Monday?" I replied that if there was any probability of my getting employment I should be pleased to do so. He then said their manager was absent, but was expected to be at the works on Monday morning, and that I should call at about eight or nine o'clock; so I remained over. But it was both a long and an anxious period, from Saturday evening until Monday morning, and in a strange place.

At length the appointed time came around, and I was on hand promptly. In a short time Mr. Moore, accompanied by a large, fine-looking man, walked leisurely into the mill. Near to where I was standing they came to a halt and held a short conversation in an undertone. To me this was a most trying ordeal, as it was to determine my fate as to whether I should get a job in Norristown (situations were not asked for at that time) or should have to go to Trenton and find out what the chances of work were there, with the probability that owing to the general depression of business the result would be very unfavorable.

After the brief conversation before alluded to, Mr. Moore and the other gentleman walked up to where I was standing and Mr. Moore introduced the gentleman with him as John Griffin, their general manager. I confess that I had some dread of meeting him, as the words general manager at that day seemed to my simple mind as though I were to meet a supercilious kind of a person who would hold one at a distance, but the contrary was the case. Mr. Griffin was a fine-looking, affable, and intelligent gentleman; the last-named trait worried me, as I did not know how to talk to him. After some hesitation, I mustered up the courage to tell him what I wanted. He then asked me what I had been doing, and if I was afraid of hard work. I answered both questions in a manner that seemed to be entirely satisfactory, and he told me to come to work the next morning.

When I entered the mill first to go to work, I fully realized that I was amongst entire strangers, without prestige to aid me or compass to direct my course, with mind untrained for systematic work or study, with but scant education and untrained talent. My thoughts naturally went back to the scenes of my boyhood days, and to the old home where my kind parents and my loving sisters and brothers still remained. My feelings at that time can be better imagined than described. I now fully realized that I was enlisted, as a private, in the army for the great battle of life, and I made up my mind that I would faithfully do my duty in whatever position chance might place me.

I was put to work by the foreman to assist the mechanics

FIG. 3.—JOHN FRITZ IN HIS YOUTH. (From an old daguerreotype).

in erecting the machinery, boilers, and furnaces in the mill. I went diligently to work, keeping my eyes and ears open and my mouth shut. In a few weeks I was advanced to the grade of a regular mechanic, and continued in this position until the mill was completed and in operation. I was soon after placed in charge of all the machinery of the plant. This was quite a responsible position, and soon proved to be an onerous one. There were three sets of rolls in the mill, all driven by one engine. This made a number of gear wheels necessary, in order to have the trains properly located and the proper speed for each set of rolls. In order to have the rotation of one set of rolls changed to deliver on the opposite side of the other two, idlers were used. These idlers soon proved to be a source of great trouble, as all idlers do, whether animate or inanimate. It was here that my most serious trouble commenced, and simultaneously my rolling-mill education commenced.

The cogs in the wheels would break out, and at times would get out of mesh with the wheels in contact; a general smash-up was the result, and the whole plant would come to a standstill. Then it was work day and night, in the grease, until all was ready to start again,— a job which sometimes would take a week or more. At times only a cog or so would break out, and we would dovetail and bolt others in their places temporarily, at all times a most dangerous practice, but so expeditious that we would frequently assume the risk. But the trouble became so serious and costly that the idlers were taken out and replaced by two wheels of proper diameter to gear into each other, thereby entirely dispensing with the idler. This portion of the mill gave but little trouble after the change was made, but the product was delivered on the wrong side of the rolls, and had to be passed back over them. This caused delay and was to a small extent costly, but the consequent delay and cost could be reckoned absolutely per ton of finished product, while the cost resulting from the delay and repairs of a breakdown could not be foretold.

It was there that my hostility to all geared mills commenced, and I said if ever I had an opportunity to build a rolling mill, there would not be a cog wheel in the rolling department, and my opinion has not changed. It was here that the little knowledge I had gained about the locomotive, combined with a small amount of practice with hammer and chisel, and also a pretty good amount of experience in how to do rough machine work without tools, was a great advantage to me in keeping in order and making repairs on the engines and the general mill machinery. At last the machinery in the mill was gotten into what was, for that time, fairly good working order.

Having previously made up my mind to learn the iron business, practically, in all its departments, I concluded to take up puddling first. This was the most difficult branch of the business to learn and properly control, and at that time the most important and most arduous. As my time was fully occupied in the day in looking after and keeping the machinery in order, the only possible time under the then existing conditions was to spend the evenings after supper at the puddling furnaces until about ten o'clock. This I did every evening, until I obtained a good practical knowledge of the art. At the same time I gave the furnace much thought and discovered that when the furnace was new it did not work as well as when it was about burnt out. I made up my mind that the roof was much too low. When put in, the bricks were nine inches in length and the furnace would be run as long as the bricks stayed in place, until the roof, in places, was but little over one inch in thickness. This at once led me to the conclusion that the roofs were too low, but I wanted to be sure I was right before I made any suggestions. After several months of long hours, and hard and laborious work, and much thought on both the process of puddling and the improvement that was possible on the furnace, I concluded that I had gained sufficient practical knowledge to enable me to build a much-improved furnace, for both puddling and heating.

During all this time I had charge of the mechanical end of the business, which of the many branches of this great iron and steel industry is the most essential for success. It matters not how well you may be skilled in all other branches, if your machinery is imperfect you will surely come to grief, and the only possible way to attain success is to obtain a thorough practical knowledge of both the engineering and the mechanical construction of all the machinery used in the art. My desire to secure this knowledge became inordinate, as I soon learned that without it success could at most be only partial. Having already mentioned some of my troubles in this line, it is only necessary to say they were many and great and constantly increasing. Never shirking a responsibility and never missing an opportunity to acquire knowledge was at all times my guiding star.

Now, having by hard and hot work and long hours succeeded in acquiring a good knowledge of puddling, which at that time was the only process known to make cheap and fairly good iron out of pig iron made in the blast furnace with a mineral coal as a fuel, and being quite well satisfied that I could make important improvements in the puddling and heating furnaces, I turned my attention to the heating and rolling departments, which are both important, and spent my evenings there in the same way I had done in the puddling branch of the business, in order to get a thorough practical knowledge of the heating, rolling, and finishing departments. This was the only way possible to secure the knowledge I had fully made up my mind to obtain. While the work was much less laborious than that which I had performed in the puddling department, there were many problems met that were difficult to solve and at the commencement gave me much anxiety, owing to the secretiveness of the workmen, especially of the rollers and roll turners, who kept their templets in their pockets. At that time the practical men in the mill, especially the rollers and roll turners, were generally English or Welsh, and they were very jealous of any person whom they suspected of having any desire to learn their secrets. This made it exceedingly difficult to get any information direct from them. The experience I had gained in using tongs in the smith shop now became useful, and the rollers were much surprised at my skill in handling them. Consequently, I soon learned to roll on the puddle rolls, and on the roughing or breaking-down rolls, as they are frequently called. Both being hard work, the rollers did not object to my taking the tongs and giving them a rest for a spell. This gave me an opportunity to get quite a good knowledge of the proper shape and of the amount of work that was being done. At the same time I became better acquainted with the men and had in no small degree gained their confidence, which is a great step forward in the management of men. Much to my surprise, this soon proved to be a great advantage to them.

CHAPTER VIII.

NORRISTOWN. — Continued.

About this time I was called to the office by the proprietors. This was so unusual that it caused me some misgivings as to what they wanted. I promptly responded to their call, however, and was informed that they wanted me to take charge of the mill on the night turn. This was truly a great surprise, as such a possibility had never entered my mind. After my surprise had in a measure subsided, I said to them that I did not think I was capable and did not wish to assume so great a responsibility. I also said there were several young men who had been in their employ longer than I had and were entitled to promotion, and as there was some clerical work to be done, they, being much better educated than I, would be better prepared to fill the position. I gave their names, two of them being nephews of Mr. Moore, who was the spokesman on that occasion. In reply he said, " John, if I were going to look for thee in the evening until ten o'clock, I would come to the mill." This was the first intimation I ever had that the owners of the works were paying any attention to what I was doing after working hours. After some further conversation on the subject, both Mr. Moore and Mr. Hooven assured me that it would be a source of great comfort to them to know that I was in the mill at night, it being important to have a practical mechanic there at all times. Knowing this even better than they did, I accepted the offer, but I did so reluctantly, as I feared it might, in a measure, interfere with my plans for gaining a more practical knowledge of the iron business; this I had fully determined to practically work out in each and every branch. My mind had become, if possible, more fully imbued with the importance of the iron business, and I believed that it was sure to become the leading branch of American industry.

After taking charge as Night Superintendent, I soon found that the practical knowledge I had gained by working at nights at the puddling furnace, and the attention and thought I had given the heating and rolling departments, had fairly well qualified me for the position I was placed in. After some five or six months of hard and vexatious work I was placed on the day turn, in order to relieve Mr. Hooven, the acting partner, of much of the active work. By this change, Mr. Hooven and I could consult together on every problem that might arise. Such problems were at that time of almost daily occurrence, it being previous to the application of that beautiful and wonderful science of chemistry to the metallurgical arts, especially in the iron and steel industries.

I will allude to only one of the problems, and that one simply to give an idea of the difficulties that we encountered, and the roundabout way we had to resort to in order to find out what the trouble was, and how to avoid it. To-day we simply take a piece of iron or steel to the laboratory and say to the chemist, "This piece of metal is cold-short or red-short, and I want you to tell me what causes it to be so." In a short time and, comparatively speaking, at a trivial expense, we get the desired information, which enables us at once to remedy the evil, whatever it may be. In making bar iron, flats and squares, the iron has to be made neutral — that is, neither cold- nor red-short. Consequently, neutral iron is much more troublesome and expensive to make than either cold- or red-short. This was prior to the introduction of what is known as the boiling process, which is in use at this time, generally called puddling.

The difference in the practice of to-day and that of fifty or more years ago is principally in what is called the fixing or lining of that part of the furnace in which the iron is worked. In the old-time practice, called the dry or fermenting process, soapstone was used for the lining, and only white or mottled pig metal was suitable. In the present practice iron ore is used. Phosphorus is the principal element that makes iron cold-short (a fact which at that time we did not know), and all pig iron contains more or less of it; consequently it was a most difficult task to get a pig iron that was right, and the only way we had of learning was by experimenting, which was both troublesome and expensive. After succeeding in finding an iron that could be used successfully, another and unexpected trouble turned up. In making round iron for shafting and car axles, red-short pig iron was used. When we would change back to neutral iron for flat and square bars, we would find for a time that the neutral iron had become red-short. This was a surprise and caused great annoyance, expense, and delay. It was thought that the men who had charge of the pig iron had made some mistake, and had gotten the different irons mixed, but we could find nothing wrong there. Next the blast-furnace men were accused of using different ores, or hot blast, but they vigorously denied it. After a more thorough investigation it was found that the trouble occurred every time the change was made, and that the trouble righted itself in a few days. This thoroughly satisfied us that it was not the fault of the pig metal but that the trouble was somewhere in the manipulation, and the only cause to which we could, in any possible way, attribute it was the cinder used in charging the furnace. Accordingly we had the cinder, made while puddling neutral iron, kept separate, and when the change was made from red-short iron to neutral, the cinder was correspondingly changed, and the trouble ended. This was an important lesson, and one that I will refer to later.

Being now practically in charge of the mill and being in touch with Mr. Hooven, I had the opportunity to talk with him in regard to a number of improvements which I had thought out while I was working at night at the puddling and heating furnaces. The one to which I had given the most thought, before alluded to, was the increase in the height of the roof over the puddling furnace. I considered this to be of the utmost importance, and I wanted the roof raised some nine or ten inches. Mr. Hooven thought I was a little wild and suggested the width of a nine-inch brick — that is, about four and a half inches. At the same time I thought it would be an advantage to have the furnace longer, but this was not possible except at a great expense, and the height of the roof could be raised only some four inches, except at a considerable expense, which the condition of the business at that time did not warrant. So the roofs were raised only about four inches. Later they were raised nine inches. This made quite an improvement in the working of the furnace and thoroughly satisfied me that the change was in the right direction. I shall refer to this later on.

I was now completely installed in my new position, and found both Mr. Hooven and Mr. Moore very clever and companionable gentlemen. They soon seemed to place entire confidence in my ability to look after the mill, not only in a general way but in detail. This I did and it pleased them very much.

Notwithstanding I was now practically in charge of the mill, my hat still fitted me, and, as formerly, I came to the mill every evening, not to work at the puddling furnace, as

I had previously done, but to go through the works leisurely, seeing what was being done and how, and thinking whether any improvements could be made, either in the machinery or in the practice. As the mill was in charge of the night foreman, I was in a measure relieved of the responsibility that I was subjected to during the day, in looking after the mill and seeing that the machinery was kept in proper order, and in addition having everything made ready for the night turn. The night foreman had only to see that the work was properly done and the machinery well looked after. My mind being much relieved at night-time, it was in a much better condition to imbibe and retain any improvements that might be suggested.

One night an amusing incident happened. We were short of steam and I put a cut-off on the engine; as we wanted it finished, we concluded to work on it at night. Archie Johnston was doing the work. Mr. Hooven took a great interest in it and stayed with us all night. While I was busy at work at the engine house, they got to talking. The flywheels used to go to pieces in those days. Mr. Hooven said, "Now, I've got a flywheel in my mind that will not go to pieces." Archie said, "What is it?" Mr. Hooven said he wasn't going to tell. After a while Archie said, "I've got a puddling machine in my mind." Mr. Hooven said, "What is it like?" "Well," said Archie, "you tell me about the flywheel and I'll tell you about the puddling machine."

At that time the mill men, such as puddlers, heaters, and rollers, were generally English and Welsh, and they got a full share of my time. In the evenings between heats, while they were smoking their pipes, cutties as they generally called them, I would sit down on a charge of pig iron and listen to them describing their mills in England and Wales, and their method of working. In all of this I was greatly interested, and at the same time I gained their confidence, which is so essential in the management of workingmen. In all my experience I have ever sought to secure and retain the good will of the workmen. With confidence fully established between the workmen and their employer, strikes rarely occur. I continued spending evenings in the mill as usual, and did so as long as I remained at Norristown. My friends were all the time saying that it was all foolishness to spend so much time at nights in the mill, but what I learned in this way helped me greatly in the discharge of my duty as Superintendent on the day turn, and proved to be of inestimable value to me in after life. In fact, it was the foundation of whatever success I may have attained.

I was now in a position to learn thoroughly the rolling-mill practice, as it then existed, which included the manufacture of merchant bar iron of all general sizes, — flats, squares, and rounds, and in addition boiler plate, tank plate, skelp plate for making welded pipe, cut nails and spikes of all sizes. All of these branches were practically under my general charge. Mr. Hooven, attending to the office and the general business, had but little time to be in the mill beyond giving orders as to the work that should be done. All this work was done in the daytime and was consequently under my general charge, but I found that looking after the machinery, which had to be kept in good order, was the most onerous, difficult, and uncertain duty I had to perform, and above all the others combined the source of the greatest anxiety. When the machinery went wrong, as it frequently did, the whole plant was brought to a standstill. So serious were the breakdowns, that they would at times keep the plant idle for a week or more at a time, compelling us to put in new gear wheels, and new teeth in some of the old ones, which caused me trouble. Many years after (at the celebration of my seventieth birthday), I was arrested, tried, and convicted for practicing dentistry without a diploma.

With all the troubles that beset us we made some improvements and a little money, and established the reputation for making the best iron in the country. I was very proud of this reputation, and I have ever endeavored to follow the example set me by Mr. Hooven, of never allowing anything to go out of the works that was not the best in its line. This policy, if rigidly carried out, will surely pay, and to a conscientious person it is a source of much gratification to feel conscious that he has done his best.

Quite a pleasant episode took place one day in the office, which at first seemed as if it might prove to be a source of embarrassment, as for a short time it did. A gentleman representing the Delaware, Lackawanna and Western Railroad, came into the office quite hurriedly and with but little formality, and said: " I want to talk to you about car axles. Some two or three years ago we got some from your works, and I was told you used nothing but charcoal pig iron in your plant." Mr. Hooven's face all at once became red, and I must even at this late day confess that I did not feel very comfortable, as there had not been a pound of charcoal used in the manufacture of those car axles. I had had no little to do in bringing this condition of affairs about, and whatever might have occurred I would have to face the music. Mr. Hooven, supposing there was something wrong with the axles, asked him what the trouble was. The visitor said, " Nothing at all. They were the best axles we ever had on our road, and we want a thousand more just like them." Then Mr. Hooven explained to him that, in a measure, he had been misinformed; that while it was true we used nothing but charcoal pig iron in the manufacture of bar iron, — flats, squares, and small rounds, — yet heavy rounds, such as shafting and car axles, were made entirely out of pig iron smelted with anthracite coal. The gentleman then said he did not care what they were made out of but that he wanted one thousand more axles just like the others. He said that they had had a train of cars going up a heavy grade; near the top of the grade the cars broke loose at the tender and ran back at a furious speed, and on striking a curve went off the track down an embankment and were piled on top of each other and all smashed to pieces; wheels and axles had been broken in all sorts of ways, but not one axle with "Norristown" stamped on it was broken. The pig iron used had been largely made at the Robesonia furnace, out of Cornwall ore, and had been puddled by the old dry process, and I doubt if equally good iron could be so successfully made at this time by the same process of puddling. At that time we were in the dark for a reason why the iron was so perfectly free from cold-shortness, and we did not know until after the introduction of the Bessemer process, a practice that compelled us to know absolutely what was in the ore. It was then that the chemist was called in to tell us some of Nature's wonderful secrets. This will be referred to again, and more fully, under the Bessemer process.

In 1849 Messrs. Reeves, Abbott and Company arranged to build a rail mill and blast furnace at Safe Harbor, on the Susquehanna River, about twelve miles below Columbia and ten miles from Lancaster, Pennsylvania. Having in mind that the furnace and the rail branches of the iron industry were in the near future destined to become important parts of the business, and having quite a good knowledge of rolling-mill practice, and a very good practical knowledge of machinery, such as was used in the rolling mills of that day, I made up my mind that it would be a good thing to learn something practical about the manufacture of rails and blast-furnace practice. Being determined to learn all I could, and having an opportunity to assist in building both the furnace and the mill, I concluded to accept the position.

It so happened that Mr. John Griffin, who was General Manager of the Norristown Iron Works when I went there, had been made the General Superintendent at Safe Harbor, and wanted me to go there with him, but did not want me to leave Moore & Hooven without their consent. So I went directly to them, fully and frankly stated the position in which I was placed, and also told them how important it would be to me to get such a practical knowledge as could be obtained in assisting in the erection of the rolling mill and furnace plant. At the same time I told them Mr. Griffin would not take me without their consent and that consequently I was at their mercy.

At first they both demurred, saying they did not want me to leave them; they moreover pointed out that Mr. Griffin could not afford to pay the salary they were paying me. "In this," I said, "you are correct, and I do not expect it, but the knowledge gained will much more than compensate for the difference in salary." My Norristown position was paying me $1000 a year, but I gave this up for a $650 position in order to obtain knowledge of another branch of the iron business. I asked them, especially Mr. Moore, who was a very liberal and broad-minded man, to give the matter full consideration. In the course of a few days I was called to the office and Mr. Moore said they had thought the subject over very fully and had come to the conclusion that my views on the subject were correct and that they could not conscientiously stand in the way of my accepting the situation. We parted the best of friends, as we had ever been, and remained so until death called them both to their long home.

The time at length arrived when I had to say good-by to the proprietors who had been so good and kind to me, and to the loyal and kind-hearted workingmen, who had ever faithfully performed their duty, and were ready to obey any proper command. During the three long years, which, if measured by the hours I was in the works, compared with the time now spent in a similar position, would surely be over five years, so good and faithful were the employees that I cannot remember having had to discharge a single workman, or having had occasion to severely reprimand one. This was no doubt largely due to the mutual confidence which at all times existed between us; and this kindly and loyal feeling was no doubt established while I was working at night at the puddling furnace, gaining all the knowledge I could from them in regard to the art of puddling, the most essential branch of the business. During the talks between heats, before referred to, I gained quite a good knowledge of the arrangement of the mills and the methods of management, all of which was useful to me, and my familiarity with the workmen doubtless had much to do in bringing about the pleasant relations that ever existed between workmen and myself. I was never happier than when surrounded by them, and I found that if properly treated, they were ever loyal and faithful. I said to one of my good friends that I went to work in Norristown an entire stranger and now I left with a host of friends, to whom I sorrowfully bade good-by to try my fortune in another place and in another branch of the business, which, in my opinion, was destined to become more and more important. I had made up my mind that I would know something about it, well knowing it meant a year or more of the hardest and most vexatious class of work ever encountered, but I had no fear of hard work and would gain knowledge that would surely prove valuable in after life.

CHAPTER IX.

SAFE HARBOR.

In May, 1849, I went to Safe Harbor. In Lancaster, while waiting for a conveyance to carry my trunk to its destination, I met a gentleman whom I happened to know, who knew all about Safe Harbor, and who tried to persuade me not to go there, saying it was the worst place in the whole State of Pennsylvania for fever and ague, and that no stranger ever escaped it. From the way he talked the probabilities were that I would die with it. I told him my object in going there. He shook his head, smiled, and said good-by. I arrived at Safe Harbor in the evening and secured a boarding house, but not a very homelike one. After supper I walked down to the confluence of the Susquehanna River and the Conestoga Creek, quite a large stream, about a third of a mile from my boarding house. After taking a somewhat cursory view of the waters and their surroundings, I became somewhat apprehensive that my Lancaster friend's predictions might prove correct. However, my mind was made up to try to learn something of the rail business, and bad and all as the fever and ague was, it required something more dreadful to cause me to change my purpose.

The next morning at five o'clock I was at the works. At that time the mechanics worked twelve hours for a day's work. At about seven o'clock Mr. John Griffin, before mentioned, the General Superintendent, came into the mill where I was and said, "Well, Fritz, how are you? I'm glad to see you here. You have got here just in time. The machinery is now coming and I'm anxious to have it put in place as soon as possible." How different was this meeting from our first meeting in Norristown several years previous, when we met as entire strangers, and I not even knowing what I would be called on to do or what I could do. Now we met as friends, with full confidence in each other personally, and he was satisfied that I was competent to do the work he had designated for me. At that time the duties of a person in charge of the erection of machinery about an iron works were very different from what they are to-day. It was expected that he should, in a general way, understand rolling-mill practice. Most of the machinery, except the engines, was fitted up in the mill, and there were no planers or slotting machines large and heavy enough to do the work on. The two-handed chisel and sledge were substitutes for them, and men that were skilled in their use could do a large amount of work in a day, so well that but little work with the hand chisel and file was required to make the parts fit for use. All of this work had to be looked after by the person in charge and it was essential that he should be a practical mechanic, and besides he had to do his own erecting. At that time the facilities for hoisting and handling heavy weights were about as inadequate as the machines were for doing heavy work.

The plan of the mill being much the same as that at Norristown, I was quite at home in it. The gearing was well fitted up and made heavy and strong, so as not to break, — but it did break, as will be mentioned later. I got my crew organized, mostly Pennsylvania Germans, fresh from the farm, without any knowledge of what they were going to do, but they were good and willing workers and apt, soon becoming expert in handling the heavy parts of the machinery, and in doing the general work, such as is common in the erection of a new iron plant.

After getting the men fully organized, we got along with my part of the work so rapidly that it was evident that the rolling mill would be completed before the blast furnace. Then the blast furnace superintendent would be in trouble, as the mill could not start until they could get pig iron. Mr. Collins, the furnace manager, came to me and begged me to help him get the furnace completed so that he could be making iron before the mill was ready to start. I told him to see Mr. Griffin and that I would do whatever Mr. Griffin wished me to do. Consequently Mr. Griffin came to me and told me that Collins was in trouble and wanted me to help him out, and he, Mr. Griffin, wished to know if I was willing to go. I said, "Certainly." I was at all times ready to do whatever he might want me to do, but I told him I would prefer not to work with the men who were putting up the blowing machinery, as they were too slow and their gait would demoralize my men. I suggested to him that I put up the gas and hot-blast pipe and the hot-blast stoves, or ovens, as they are at times called. This I was anxious to do, as it was an important part of furnace work — a branch of the iron business that I had made up my mind to learn. Both Mr. Griffin and Mr. Collins were pleased that I was going to take hold of that part of the plant, but they had no idea of the difficulty that was in store to get the pipe in place. In order to have the plant built quickly, different parts of the work had been done in various places. This fact caused me much anxiety, the probability being that the work from the different shops would not come at the same time. Being about a hundred miles from the shops where the work was done might cause much delay, and I might be blamed for a part of it. When mistakes are made, there is too frequently a disposition on the part of the parties who make them to shift the blame on some one else.

Well, the first part of the work I took hold of was the pipe that conveyed the gas from the top of the furnace to the hot-blast stove and boilers. The total length of the pipe was about seventy feet, the diameter sixty-six inches. It had three angles in it, and it was shipped in three pieces for convenience of carriage. After some trouble I got a mast long enough to hoist the pipe in place, but the pipe did not fit, the error in the angles being so great that it would not go in place. Mr. Collins was at hand and, being of an impetuous disposition, he fairly exploded in the use of language that was both expressive and impressive. We next sent for Mr. Griffin. He looked it over and calmly said it was a bad job, and that it would have to be sent back to the shop. This would take several weeks and be an expensive job, as the pipe would have to be hauled some ten miles on a wagon to the railroad, that being the best route to take it for the quickest transportation. From the first, my mind was made up that the best and quickest way was to do the work right there, and after the excitement was somewhat allayed I so told them. They wanted to know who was there that could do it. I told them that I could do it. They said, "It requires a boiler maker, and you are not one." In reply I said, "I do not pretend to be a boiler maker, but having held the dolly for riveting up boilers, worked the punch lever for punching the plates, turned the rolls for bending them, chipped and calked the joints and seams, and done some boiler patching, and knocked the skin off my left hand during my apprenticeship, I am quite sure that I can make a creditable job out of it." Besides I looked upon it as much more of an engineering problem than a mechanical one. Finally, Mr. Griffin said, "If you feel sure you can do it, go ahead." This I did and at once set to work to get the proper angles.

While I was at this part of the work, much the most difficult I had there, a fine-looking, elderly gentleman came along. It being a very hot day he was carrying an umbrella, which was uncommon at that time unless it was raining quite fast. He looked up at the pipe and said, "Young man, that does not seem to have the proper angles." In reply I said to him, as pleasantly as one could do under the circumstances, as I thought it was none of his business, "They are not right." After getting the correct angles, we took the pipe down and in one week's time made the change and had the pipe up again in its proper place, all right. Just as we had gotten the derrick down and the place cleared away, the same gentleman came along again. He looked up at the pipe and said, "Young man, you have made a good job of it." After he went away I asked one of the workmen who had been at the works from the start who that gentleman was. He said, "He is one of the owners, but I do not know his name." Soon after I learned from Collins that it was Mr. David Reeves, who afterwards became one of my lifelong friends.

After completing the work at the furnace which was assigned to me, I returned to the mill, and took up my work, which was in the same condition as when I left it. In the meantime, the erection of the machinery had become well advanced, so much so that it became necessary for me to hustle in order to be ready by the time the driving power was completed. Very fortunately, as it proved afterwards, we got one of my old Norristown companions, Mr. Louis Bowman, who was a good machinist and a good worker, to come and help me. Thus far my force consisted of none but handy laborers, but the time had come when there was much machine work that had to be done, requiring good mechanics, who were used to that class of work. All went smoothly until the works were started; then trouble commenced. As the squeezer was driven by bevel gear, placed underneath, the cinder would fall in the gear wheels and on the journals, which caused them to cut and grind out to such an extent that the mill could not make good time. We finally took the squeezer up and made a shield of boiler plate to fit tight around the shaft. Here the knowledge I had of boiler making came in handy again. After the shaft and journals were completely protected they did not make much trouble.

The next trouble that turned up was with the flywheel shaft. They called me up at about three o'clock one morning. I went to the mill and found one of the journals cut and ground down from twelve to eight and one half inches in diameter. Just before sending for me they had sent for Mr. Griffin, and he came in shortly after I had gotten there. The day and night superintendents were both there, and the engineer whose fault it was. They all had a powwow over it, and all concluded there must be a new shaft, which would, at that time, take at least two weeks to get.

I stood a little in the background, but was taking in all that each of them had to say. Mr. Griffin was in the habit, when any trouble occurred, and I was about, of saying, "Fritz, what would you do?" This was what I was expecting to come. He turned toward me, and said, "Fritz, this is a bad case, what would you propose to do with it?" I said, "Mr. Griffin, I would turn it up in place." He asked if I could do that. I said, "Yes." Then they all said it would be too light to stand the work, and would surely break and might kill a number of people. I then told them I would get a new pedestal six inches longer than the present one, and would make the journal six inches longer by trueing up six inches of the body of the shaft, which was twelve inches in diameter. Should the smaller part of the journal break, this would keep the shaft in place, and it would be perfectly safe, so far as the workmen were concerned. I suggested, however, that a new shaft be ordered at once, that we might be prepared for future emergencies. Mr. Griffin said, " All right, go ahead day and night until you have it completed."

The workmen at that time were very skeptical, and did not believe the job could be done as I proposed, and so reasoned from the fact that I had suggested the ordering of a new shaft. There was a heater named John Griffith, a Welshman, who was a first-class heater, and a very intelligent man. He had listened attentively to what had been said, and soon after the crowd had left, he came to me and said, " You have but little skilled help that will be of any use to you in doing this job, and I am something of a machinist and am quite sure I can be of service to you, if you will give me the opportunity." I said, " John, come on and go to work, as I want all the good help I can get, and must have one good man for the night turn." My right-hand man, Louis Bowman, had had a part of his thumb taken off in the machinery and had gone back to his home in Norristown to have it taken care of. Personally, I was suffering from fever and ague. Altogether things were in a bad shape to take hold of such an unusual job as that which confronted us. Yet with all the impending difficulties, and they were many, we went to work, raised the fly-wheel shaft to its proper place, and put a temporary bearing under the journal. Notwithstanding that all the tools and fixtures had to be improvised, the next morning we commenced turning the journal. In about a week's time the mill was in operation again, and the shaft ran for years, with the new shaft lying close by, and did not break, but was replaced by the new one during some extensive repairs. John Griffith proved to be a good mechanic and was a great help to me, having charge on the night turn during this vexatious job.

Shortly after starting up again, Mr. Griffin said the mill was not getting out the amount of work that it should do, and asked me what I thought about it. I told him that I fully concurred with his views. He was anxious, indeed it was absolutely necessary, to produce a much greater tonnage in order to make their contract deliveries, and he asked if I would take the mill by contract, so much per ton. I told him that I would like to do so, but that together with the fever and ague and the hard work I had been doing since I had been with him, I was fearful that I could not keep up under any more of a load, having to do the roll turning, which at times was about all that one man could do. After some thought over the subject, and being fully satisfied that the tonnage could be greatly increased, which meant increased compensation, I told Mr. Griffin that Bowman would be back and that if he was able to go to work, and would join me, we would take hold of it. On Bowman's return, I stated Mr. Griffin's proposition to him and what he would have to do to make a success of it. He agreed with me in everything and was anxious to accept Mr. Griffin's proposition, which we did.

Now, having almost practical control of the manufacture, we did our very best to get the mill in good shape, and in the course of a month we about doubled the output, a condition of affairs which pleased Mr. Griffin very much, and much elated both Bowman and myself. Besides the pride we had in what we had done, we were each of us earning much more money than we had ever earned before.

CHAPTER X.

FEVER AND AGUE.

In the course of two or three months, the fever and ague increasing in violence, and the attacks becoming more frequent, together with the hard and exacting work which required a strenuousness that I could not endure, I was compelled to leave the place or die. I naturally chose the former course and went home to the old farm. Having great faith in the old family physician, I thought he surely could cure me, but he utterly failed to do me any good.

There was a lady — a lovely woman — living on an adjoining farm, who practiced the Thomsonian system of medicine, which, at that time, had many followers, and being a good neighbor and a kindly woman, she took a great interest in me and most thoroughly diagnosed my case. I told her of all my efforts to prevent the chill from coming on, that I had lain on a three-inch-thick plank between two heating furnaces, both at work, and only thirty inches apart, that the chill and shake had come on while I was lying there, that the suffering I had endured was simply indescribable, and that it had become a matter of indifference to me whether I lived or died. I also told her that every person I met, black or white, had a cure for me. After I had told her all, she said if I had faith she could surely warm me up. I told her I ought to be very strong in faith, as I had drawn but little on my stock on hand of late. The first thing she gave me was a concoction of lobelia, as an emetic, which made me so sick I thought I should surely die. After I had in a measure recovered from the effects of the emetic, she gave me a dose of the concentrated essence of all the heat-giving plants known in the science of botany; it was so hot that I was fearful I should take on fire, but she at once assured me that there was no danger, and that she had now accomplished what was absolutely essential. Before convalescence could be expected, the cold needed to be completely expelled from the system and must be driven from the center out. The good woman was greatly elated when I told her she had certainly warmed me up. She was now confident that she could cure me, but you can imagine her surprise when she came the next morning and found me suffering with one of my worst chills, and I told her I did not have any faith in the Thomsonian theory of medicine. It was useless to pursue in that direction any further.

In the meantime, my former employers at Norristown, Messrs. Moore & Hooven, had learned where I was and wrote for me to come back to them. I answered their letter, saying I was totally unfit to do anything but sit about, and in the morning try to keep from freezing, and in the afternoon try to keep from roasting. They replied to come over at once, as I could sit in Norristown as well as I could in Chester County and they could have the benefit of my experience.

Mr. Joseph C. Herr of Philadelphia, a good friend of mine, owned some iron ore property in Michigan about ten or twelve miles from the Lake Superior shore. He was going out to see it, and wanted me to go with him. He and others of my friends thought a change of climate and surroundings would certainly, in a measure, be beneficial to my health. Of one thing I was quite sure, the journey could not make me any worse, and so I arranged to meet him in Cleveland and go with him. In the meantime on my way to Cleveland I took in Newcastle and Sharon, Pennsylvania, to see the iron works at those places and in the vicinity.

On the morning of the Fourth of July I went down to Beaver to take the boat for Wheeling. While waiting for the boat I had one of my worst chills and went down to the bank of the Ohio River and lay in the hot sun with a heavy overcoat on, shaking like a nail-packing machine. Every party that came along had something to say, generally asking what was the matter with me. Some of these remarks were quite amusing to me, even cold as I was. One fellow said, " Come on, all's the matter with him is he has got too much of the Fourth of July in him." I told this class of people, " You'd better go on, as you may catch the fever and ague and it is worse than the cholera." There was cholera about at that time. The more sympathetic class would want to know what was the matter with me. I told them it was fever and ague, but that they should not be alarmed as it was not contagious. They wanted to know if there was anything they could do for me. I told them the only thing that they could do was to stop the first boat that came down the river and put me on board for Wheeling, which they did. While they were very kind, yet I think they were glad to get me away, fearing something might happen to me.

The first thing I did after my arrival in Wheeling was to secure the services of a good physician. After spending several days in Wheeling under the care of a doctor, I recuperated sufficiently to enable me to get to Cleveland and meet my friend, Mr. Herr, at the time appointed. After spending a few days in Cleveland, we took passage on a steamboat for Ste. Marie, this being before the canal was cut at Sault Ste. Marie, connecting the waters of Lake Superior with Lake Huron. When we arrived at Ste. Marie, we had to wait some two or three days for the arrival of a boat on Lake Superior to take us to Marquette, that being the nearest landing to the iron mines we most wanted to see. At that time there were only two boats on Lake Superior. Some time after they collided and one of them sank, and, as I now remember, several lives were lost. The trip from Cleveland to Ste. Marie was very pleasant; the water on Lake Erie, Lake Huron, and Lake Superior was all the time very smooth. The passage through Detroit River, Lake St. Clair, St. Clair River, and St. Mary's River is quite narrow in many places, so that we could, without a glass, see both shores at the same time. There were quite a number of passengers aboard, most of them very pleasant people, including some stage celebrities, one of them being Miss Charlotte Cushman, then in her palmy days. In addition there was a brass band on board, which would occasionally blow, in order to stir the animals up. Altogether, it was a very pleasant and enjoyable trip, and one that even at this late day I look back to with pleasure.

The voyage on Lake Superior from Sault Ste. Marie was rather monotonous until we were nearing Marquette, when the lake quite suddenly became rough. This caused an epidemic which continued until we arrived at Marquette. There were no deaths and many of the patients landed there, and all their stomachs were in fine condition to receive a good square meal. This was no easy matter to get, there being at that time, as my memory serves me now, only three or four houses, one of them a hotel built out of boards in shanty style. Ground rents being cheap, kitchen, dining room, sitting room, parlor, and sleeping rooms were all on the first floor.

We landed in the evening. Early the next morning we looked for a guide and transportation. The former we found without delay, but the latter was very difficult to procure. The best we could find was a single mule which we chartered, concluding that we would ride and tie, which means that one of the party rides the animal for say half an hour, then gets off, ties him and goes on foot; when the other party comes up to the mule, he gets on him and rides the same length of time, and ties. We soon found that the plan did not work in this case, as both of us walked faster than the mule, consequently we put Mr. Mule in charge of the guide and let him hurry him along, and Mr. Herr and I footed it together, which was more comfortable than riding the mule.

We went first to see what was called the Cleveland location, which showed a body of ore that, to a person used to mining brown hematic ore, was truly marvelous. We wanted to see what was known at that time as the Jackson location, a few miles distant. The guide did not want to go, saying there was more ore where we were than could ever be taken away. At that time I was told that a controlling interest could be secured in said Jackson location for $25,000, and I at once made up my mind when I returned home I would try to induce some of the iron men to take the subject up.

The next day we returned to Marquette and went up to Eagle Harbor to see a copper mine. On the boat were several gentlemen who were interested in the mine I was going to see. As we had gotten pretty well acquainted on the boat, they invited us to go with them, and go down in the mine and see the native copper about which they had much to say. Of course I accepted their invitation and went with them. The mine was of some depth, but I cannot remember how many feet it was. After reaching the bottom and creeping through a small hole, we saw a mass of fine copper they said would weigh five or six tons, which, to my mind, would cost more to get out than they could get for it in the market. They had to take out the rock over it to give room for the workmen to swing the sledge, as it had to be cut in small pieces in order to get it out of the mine.

In the evening, after we got back to the hotel, as it was called, they asked what I thought of the native copper I had seen in their mine. I told them that to me it was a marvel, but would cost too much to get to the surface to ever make it pay, and said if I had money to invest, I should certainly put it in the iron mines I had seen near Marquette, as they would surely become very valuable. But their heads had been so completely turned by the solid copper they had seen that day that they did not seem to know that there was such a thing as iron ore in the world. I afterwards learned they lost all the money they put in the copper mine.

Now, having seen all that we intended to see, and my health being seemingly much improved, so much so that I was anxious to get back to work again, we turned our faces homeward. I anticipated much pleasure in getting back to Safe Harbor and felt able to fill my position again.

But how soon one's fondest hopes are blasted. At Detroit we had to change boats, as I wanted to go to Dunkirk, my friends going to Cleveland. While waiting for my boat, I had unmistakable evidence of the return of my old enemy. I went on board as soon as I could and at once went to my room and got to bed, and suffered with a most violent fever all night. I arrived in Dunkirk at about half past eight in the morning, about an hour late. The express train for Philadelphia, with which the boat was to connect, had gone about half an hour before. Rather than lie there all day, I took an accommodation train for Elmira. Soon after we left Dunkirk, the chill came on. After every stop the train made the conductor would come along, saying, "Tickets, gentlemen." Any person who has ever suffered with fever and ague will fully appreciate how annoying this was. At last I lost all patience and said to the conductor that any man that could not remember a passenger sitting in a car behind the door, with a heavy winter overcoat on, shaking with ague on a hot August day, was totally unfit to be a conductor on any railroad. After this short conversation he disturbed me no more.

I arrived at Elmira in the evening, and as soon as I got to the hotel I told the proprietor I wanted him to send for the best doctor in Elmira. This he did at once. In a short time the doctor came to my room, and said, "Young man, what's the matter?" I told him I had fever and ague. He wanted to make a diagnosis of my case so that he could treat me more intelligently. I told him that was useless, and would only be a waste of time, as I had fever and ague, pure and simple. I then asked him if he had any remedy other than quinine; he said he had not. I then told him to give me a prescription on the best druggist in town for thirty grains in three doses. He asked me when I was going to take them. I replied, "All before twelve o'clock." He said, "That will not do, the dose is too large; it will make your head buzz like a lot of bumblebees." Experience told me it would do so.

The next morning I took the train for New York and escaped the chill, but my head was in a bad condition for several days. I went from New York directly home to Chester County and remained there for a few days and then went to Safe Harbor, to give it another trial, but I could not remain, as the attacks became more frequent and so violent that I was compelled to leave the best job I ever had up to that time. I was again a complete wreck and cared but little whether I lived or died, so I bade Safe Harbor a final adieu, and again went home to Chester County.

When I got back from Lake Superior in 1852, after visiting the iron mines out there, the iron business was in an awful condition. Every one who had anything to do with iron was out of patience. In an effort to get them interested in the Jackson location, I went to see Coleman, Kelton & Campbell, Commission men in Philadelphia, and they were the only people who would talk about it. I was almost a boy, but they treated me very nicely, said they saw the value of the proposition, but that business was very dull and the property was too far away. Another iron man said I might as well talk about bringing iron ore from Kamchatka as from the Jackson location. In reply, I said, "You will see iron ore from Lake Superior sold in Philadelphia within ten years." Receiving no encouragement, I finally gave the matter up. If I had had $25,000, I would have bought one half interest in the Jackson location and it has been worth millions and is still extremely valuable.

I was now in my old home, and in the midst of the surroundings where I passed my boyhood days, the happiest days of my life, but now in a condition that I did not know or care what I was going to do. In the course of a week or so my old Norristown employers learned that I had left Safe Harbor and had gone back home. They wrote me, saying they wanted me to come back to them. I replied, saying I was unfit for work of any kind. I was simply able to sit around, sometimes in the house or shade, sometimes in the sun; some days, if able, I would get to the barn. To this they replied, the same as previously, saying to come on, I could sit around as well with them as I could in Chester County and they could have the benefit of my experience and advice. Consequently, I made up my mind to go.

A few days after I had been at Norristown, an old friend of mine came into the mill to see me and expressed much delight at seeing me back again in my old place. He said in a brusque but familiar manner, "What the devil ails you?" I told him I had the fever and ague. "Damn you," he said, "you ought to have it." I said, "What do you mean?" "Why," he replied, "I told you a year ago what to do and if you had done it you would surely be cured." "Yes," I said, "but almost every person I have met for the last year has told me of a certain cure; many of them I tried but all failed and I became disgusted and repudiated them all." In reply he said, "If you will go where I told you to go, to Dr. John R. Rowand, of Philadelphia, I will pay all expenses if Dr. Rowand does not cure you." He said the doctor had cured his brother of the same complaint after suffering with it for several years. He was so positive that Dr. Rowand would cure me that I told him I would go to see him the next day. This I did. Dr. Rowand asked me when I expected the next chill. I told him in a day or so. He then handed me a bottle of medicine, telling me to take three doses during the day. He said, "Ague goes by the multiple of seven and if you get it to-day, you will be most likely to get it in seven days from to-day. On the sixth day again take the medicine and continue taking it in periods of seven days for a month or two." This I did and I have never had the least touch of ague since, although it was a long time before my general condition became normal. I do not know what the remedy was, but I do know that I cured a large number of my friends of ague, by sending them to Dr. Rowand.

To show that a first-class doctor is not necessarily an expert in other professional lines I will tell the following anecdote about Dr. Rowand. After he had cured me of the fever and ague he consulted me about a scheme of his that he thought would revolutionize the transportation of coal. His plan was to construct cylinders about six feet in diameter with flanges on the outside to fit the rails. He enthusiastically explained how easily these cylinders would roll along the rails. After I had shown him that the coal would be powdered by that process to such an extent as to become useless he thought that if partitions were put in the cylinders the scheme would work. I had such difficulty in convincing him that the plan was impracticable that I came to the conclusion that he was worse than the ague.

CHAPTER XI.

NORRISTOWN, SECOND TIME.

I NOW entered the employ of Moore and Hooven for the second time, and in my old position, which I filled as far as my health would permit. It was pleasant to be back in my old place and with my dear friend, Mr. Hooven, and to be in the midst of the mill workingmen who had ever been considerate and kind to me and who received me with true respect.

Some weeks after I had left Safe Harbor, Mr. David Reeves, the largest proprietor of the works, was there and said to Mr. Collins, who had charge of the blast furnace, " I don't see the young man about who put up the work at the furnace." Mr. Collins said, " He has gone away." Mr. Reeves asked why and was told that it was on account of fever and ague. He then said, " We can't afford to lose him; where has he gone to?" He was told to Norristown. Mr. Reeves then wrote me, asking me to call at his Philadelphia office, as he wanted to have a talk with me. I called as requested and found him to be a very courteous gentleman. He asked if I had left Safe Harbor for good; I told him I had. He said he was sorry as he did not want me to leave there. I told him I also was very sorry to leave, but that it was not possible for me to stay there on account of fever and ague. He then told me he would like to have me go to Phœnixville and take charge of the shops and all the machinery in the works; in other words to be their mechanical engineer. He said if I would go there he would pay me a good salary. I learned afterwards it would have been $1500 a year, a big salary for that time. Although I was getting only $1000 a year at Norristown, I declined Mr. Reeves' offer.

He then told me that he had personally leased the old Kunzie Furnace on the Schuylkill River, about twelve miles from Philadelphia and asked me if I would be willing to go there and take charge of the rebuilding and changes which he proposed to make. I said I should be glad to do so, as I had been pretty well schooled in the rolling mills and I was well satisfied that the mineral coal furnaces must soon come to the front, as timber was becoming too scarce and too valuable to be used any great length of time for charcoal furnaces; that I wanted very much to get a practical knowledge of the blast furnace, but that I had just arranged to go back to the Norristown Works with Mr. Hooven. Mr. Reeves said he thought that all could be arranged as he and Mr. Hooven were good friends and the rolling mill business was very dull at that time, — and I knew well that was so. Mr. Reeves now told me that at the Kunzie Furnace he could afford to give me but little more than half the salary he could give me at Phœnixville. I asked him what he could give me. He said, eight hundred dollars per year. I told him if I could get away honorably from Mr. Hooven, I would accept the position.

When I returned to Norristown, I told Mr. Hooven frankly the talk Mr. Reeves and I had had and gave him my reasons for wanting to go. I told him that I had quite a fair knowledge of all branches of rolling-mill practice up to that time and was very anxious to learn something of blast-furnace practice. After some days and several talks it was agreed that I should stay with him long enough to get the mill in good order, which would take some six or eight weeks. I so reported to Mr. Reeves, and he at once agreed; consequently all was satisfactory.

After completing my engagement with Mr. Hooven, and when the time had come for the separation for the second time from one who had ever been a true and kind friend to me, to engage in what was at that time, comparatively speaking, a new business, with strangers to work with, who, in all probability, knew but little if any more than I did about it, and my friends all the time telling me how foolish it was to leave such a position as I had and to accept such a one as I was going to, and at a lower salary, — I must confess that I reluctantly left. It was, however, my desire and determination to get all the information possible in the practical branches of the iron business that compelled me to go.

CHAPTER XII.

KUNZIE FURNACE.

I NEXT reported to Mr. Reeves for instructions. He told me the plans, drawings, and specifications would be furnished by the Phœnix Iron Company, from Phœnixville, Pennsylvania. The machinery, castings, etc., would have to be made at different places, and my duty would be to see they were all right and have them properly erected, and get the furnace ready for blast. I also learned that Mr. James Collins, of Safe Harbor, was going to be the Business Manager, an appointment which was very agreeable to me. The furnace had been built by Mr. Kunzie (of the firm of Farr & Kunzie, manufacturing chemists of Philadelphia), who was an able chemist but was without mechanical or practical metallurgical knowledge, and the furnace had been unsuccessful from a business standpoint.

Mr. Kunzie's wife relates a story on him, that gives a good idea of the little chemical knowledge they had at the time of Mr. Kunzie's first experimenting in blast-furnace practice. He had much difficulty in blowing in, as we call it to-day, in other words in getting the furnace properly started in making iron. After having much trouble, and after several unsuccessful attempts to get properly started, he employed Benjamin Perry, known as Ben Perry, an Englishman, who was quite a good furnaceman for that time, to blow the furnace in, which he did successfully. Mr. Perry then wanted to get away to blow in a furnace for some one else and gave notice to that effect. Mr. Kunzie, not wanting him to leave, invited Mr. Perry to come to his house that evening for the purpose of having a talk with him in order to get him to remain. Mr. Perry, being an uneducated man, who could neither read nor write, supposed it was a social and that he would get a drink, consequently called. Mr. Kunzie, being a thorough chemist and well read up on the theory of blast-furnace practice, at once commenced to talk to Mr. Perry about the effect the different gases had on the proper working of the furnace and had much to say about oxygen, hydrogen, and nitrogen. Mr. Perry, supposing he had been invited to have a drink, said to Mr. Kunzie, " I don't know a damn thing about oxygin or hydro-gin, if you have some good Holland gin I will take some of that."

Here let me say the problem in the early forties was, — can iron be made in the blast furnace with anthracite coal as a fuel? It was said (and I believe correctly), that Mr. Kunzie had experimented with a cupola to learn if heat sufficient to smelt iron ore could be gotten with anthracite coal; having demonstrated to his satisfaction that sufficient heat could be so gotten he then built the furnace to prove it practically. But while he was experimenting, Mr. David Thomas (afterwards affectionately called Father Thomas in honor of his being the first man in this country to make iron with purely mineral coal as a fuel, on a commercial basis) built the Number One furnace for the Crane Iron Company's Works at Catasauqua, then called Craneville, and it was a success from the start.

Mr. Kunzie deserves much credit for what he did and had he been so fortunate as to have had a good practical man with him he would have made a success. In changing the old plant, I saw some good ideas had they been properly carried out.

In a short time we had that part of the plant that was to be changed torn out and the place cleaned up all ready for the mechanics to commence to rebuild, and the machinery was coming in and was being placed in position as fast as it arrived. Everything so far had gone smoothly, but some of the work was not up to the standard. I called the attention of the machinist in charge to it, requesting him to notify the engineer who had charge of the designing of the work, that part of the work was not up to standard and also that some of his plans should be modified. This brought a great storm over my head, but it was not of long duration. The engineer came down on me full of fight, wanting to know what authority I had for criticizing the workmanship. I told him it was my duty to see that the work was done and to have the furnace erected. " In regard to my criticism of your designs," I said, " they were made for your good, for I assure you, that, if erected on the plan you now propose, the furnace will be a dead failure. The modification that I would suggest can be made very readily, and while it is not good engineering, it will do the work and do it well, and is the best thing, in my opinion, that can be done to utilize the work that is already done." He became very angry and said the furnace should be put up as per plan.

I then told Mr. Collins what had taken place between their engineer and myself, and I also told him what I had never done before (as I did not want to humiliate the engineer), that the plan would not work, and that I did not propose to put up a job of work that I knew was wrong and would not answer the purpose it was intended for, and that he should get some one else to take my place, as I did not wish to be discharged. I also told Mr. Collins that Mr. Hooven wanted me back at Norristown, and I would go where I could have work done as it should be.

Mr. Collins, without my knowledge, went at once to Philadelphia to see Mr. Reeves, and told him what had taken place between the engineer and myself. Mr. Reeves said, " You can tell Fritz that no one has the authority to discharge him outside of myself, and that I will be up to-morrow and see what the trouble is and see if it can't be arranged satisfactorily to both parties." He came up the next day and we together looked the plans over and he said I was right but he still wanted me to put the hoisting machinery up according to the engineer's plan. This I objected to, saying I could see no reason for going to that expense when we knew that it would not work. He said, " The engineer is a good fellow but seems to forget that you have had an experience that he has not had, and it will do him good when he finds the hoisting machine will not work; he will begin to think that there are some people in the world that know a little more about some things than he does. He does not seem to have taken into consideration that you have had more practical experience than he has had, which is so essential in changing and repairing work."

At Mr. Reeves' request I put up in place the work in dispute just as it was received at the works. As soon as the furnace was completed it was tried and my predictions were completely verified. The material — coal, ore, and limestone — was taken to the tunnel head in cars on an inclined trestle work. The difficulty was in stopping the cars at the proper time and keeping them in the proper position, while the barrows containing the ore, coal, and limestone were taken off and the material dumped in the furnace.

When ready to start I asked Mr. Collins to have Mr. Reeves and the engineer on hand and on the top of the furnace, to see how their arrangement for getting stock up was going to work, and to have them near the lever that was to control the car, being well satisfied that they all could not get it out of gear. I placed the engineer at the throttle with instructions to run slowly and keep his eye on me. I would place myself in a position where I could see the men on top and him and I would signal him when to stop. I also instructed the leverman and manager to try to stop the car before it reached the top.

All being ready we started up. When the car was about some twenty feet from the top the leverman tried to stop it, but failed. Mr. Collins then jumped to the lever, then the engineer who had designed the plan, and finally Mr. Reeves. All failed to get it out of gear, so I signaled the engineer to stop the engine. They all came down and came into the engine house to see me. Mr. Reeves said, " Well, Fritz, I think we are all satisfied that this design will not work, and I want you to change it to the plan you first proposed and no one shall interfere with you in any way." So at it I went and made drawings, such as were made at that time, had such patterns made as were actually necessary, and castings were made, set up and in place in about ten days' time.

All worked to our entire satisfaction and in about two weeks we had the furnace in blast and everything going well and the changes that were made all working as intended. The furnace continued to do well, made good iron and for that time a large quantity, and was considered the best furnace on the Schuylkill. Everything operated so satisfactorily that Mr. Reeves sent his furnaceman and engineer to see how nicely all was going. The engineer and I talked over the failure of his plan for the hoist, and he said it went to show that one man did not know everything and that I had one great advantage over him and that was experience, which was all important to the engineer. From that day until his death we were close friends and consulted with each other on important problems.

One important improvement in furnace practice that was made at that time was brought about, I might say, by accident. One of the keepers was Mr. Collins' brother, and the other one was a Welshman. On the latter's turn the most and best iron was made. Mr. Collins, the Manager, was constantly finding fault with his brother, and charged him with negligence, especially on the night turn, where the difference was at all times the greatest when Collins was on duty. Being anxious to learn all I could about blast-furnace practice, I spent my spare time about the furnace, consequently knew much better what was going on there than the Manager did. My sympathy was with the brother, who was at all times watchful, and in my opinion, the more competent man.

At that time there was a space under the tymp, which was about two feet from the inside of the crucible, and the dam plate about three feet from the tymp, making the opening about five feet in length and some thirty inches in width. This was used when the furnace was in blast, the idea being that it was necessary to clear the hearth or bottom of the crucible of anything that might collect there when the furnace was in blast. After the iron was run out of the furnace it was the practice to clean this space, with bar and sledge, at the expense of a great amount of hard work. The space was then filled with coal dust and loam, then covered with a heavy cast-iron plate held in place by a prop against a cast-iron plate or lintel in front of the tymp; this had to be done after every cast and once between casts, the time for casting being morning and evening. This working of the furnace, as it was called, was done about the middle of the day. This intermediate working, I made up my mind, was worse than useless. I could see no sense whatever in driving the heavy long cold bars in at the bottom of the crucible where it was essential that the furnace should be hottest. Some of the bars, called ringers, were ten feet long, so that they would reach the center of the crucible. They were driven in with a sledge, then four or five men would take hold of the end of the bar and work it round and round and get a lot of hot fuel out of the very place where it was most wanted. Besides, the blast was off the furnace all the time this working was being done.

I now paid close attention to the two keepers to see how they worked the furnace and how long each of them had the blast off. I soon found out that Collins worked the furnace much more thoroughly, driving the cold bars into the furnace, and keeping the blast off longer. While this explained the matter in a measure, there was still a mystery why the Welshman should do so much better than Collins on the night turn, both in make and in quality. The intermediate time for working the furnace on the night turn was between twelve and one.

I next directed my attention to the night turn and soon solved the mystery. Mr. Collins worked the furnace at midnight, the same as he worked it in the daytime, while the Welshman rarely worked the furnace at all in the night. This at once solved the problem, and proved that the intermediate working was not only useless, but was detrimental to the natural working of the furnace. This was an important discovery, and fully confirmed my theory that it was wrong to put cold bars in the crucible and work out a lot of good hot fuel and material that was, practically speaking, on the verge of fluid metal, filling the space with crude and colder material, and that in the bottom of the crucible below the tuyeres, the most sensitive part of the furnace. Mr. Collins the Manager, his brother, the keeper, and myself got together and talked the whole subject over, and were unanimous in the conclusion that the frequent working of a furnace was deleterious.

It had already been shown to the satisfaction of us all that the intermediate or second working was now, beyond any question, injurious, and should at once be abandoned, but the question of the first working, after casting, known amongst furnace men as cinder raising, was not so easily disposed of. The long forehearth was filled with coal dirt and loam. After casting and after the blast had been put on, the cinder would, in the course of an hour or more, come up to the tuyeres. The blast was then slackened, the plate heretofore designated was taken off, the coal dirt and loam was shoveled out up to the tymp, and the cinder flowed in and filled the place up and was allowed to run out until it was level with the tapping hole on the dam plate. Then the cinder was covered with loam, and the heavy plate was placed in position again, and the blast put on; then the cinder was tapped as often as it came up to the tuyeres until casting time came around.

It was now arranged that at the next cast the loam and coal dirt should be shoveled out to about eight inches from the tymp and the space be filled with loam, well rammed down up to that point and a narrower plate put on, and that at cinder raising, instead of opening up and working the furnace, a single bar should be driven in under the plate until it reached the cinder and then be withdrawn. It was supposed that the cinder would flow out after the bar was removed.

The next morning Mr. Collins was on hand at casting time and had the forehearth filled up as before arranged, and when the blast was put on he said to the furnace men in the most emphatic manner and in language that would not be becoming to a church member that if any man put a bar into the furnace other than in tapping for cinder he would at once discharge him. We now had an anxious wait of an hour or so to know what the result might be; we watched the tuyeres with much interest and when the cinder began to bubble there, we all knew that the crisis had arrived, and all went to the front to see the result of our long, anxious, and interesting investigations. The keeper cut a small gutter in the loam from the tymp to the dam plate, some three or four inches in depth, in order to guide the cinder to the notch in the dam plate. The place selected to drive the bar for cinder was some four inches below the tymp and about twelve inches below the tuyeres. The keeper placed the bar as directed by Mr. Collins and it was driven in some fifteen inches without any difficulty. When the bar was withdrawn the cinder flowed out rather slowly but it was sufficient to guarantee success, as we well knew that the next flush of cinder would be hotter. It was, and the result was entirely satisfactory. Taking into consideration the condition of furnace practice at that time, this was a marked improvement, making in all respects a closed front. Some years later Mr. Lürmann, of Germany, made an improvement on what we had done by the introduction of the water cinder notch, patented it, and it is now in general use.

After being in Mr. Reeves' employ some twelve months, doing all that I was called upon to do and getting the practical furnace experience I so much desired, I concluded, as Mr. Hooven wanted me to go back to Norristown, to do so, and I told both Mr. Reeves and Mr. Collins of my intention to leave them and return to Mr. Hooven at Norristown. They both objected, saying they did not want me to leave them. In reply I said to them that the furnace was going smoothly, and there was but little for me to do, and that I would be much more useful to Mr. Hooven than I could be to them, and besides I would be near by in case they had any trouble. " I could be with you," I said, "within an hour's time." They both were satisfied with this arrangement, so we parted in the most pleasant manner, and I confess that I left them with regret.

I did business with four generations of the Reeves family. My first employer was Mr. David Reeves; the next generation was Samuel; the next generation was David. When I was recently doing some work in Chester County, I wanted some beams and I sent over to Phœnixville for them. When Mr. David Reeves came to answer my letter, he said to his son William, "You attend to this matter and then you can say to Mr. Fritz that he has done business with four generations in this firm." William mentioned that fact to me and said, "I cannot tell you anything about the fifth generation; I am twenty-six, but I have not yet come across a woman that pleases me."

CHAPTER XIII.

CATASAUQUA.

I NOW returned to Norristown for the third time, but not with the intention of remaining there. A party was planning to build a nail mill and wanted me to build it for them and take the superintendency of it. My intention was to do some work that Mr. Hooven wanted done and get the mill in good order, then take hold of the nail-mill project. As business was dull at that time, however, the project was deferred for a year.

In company with my brother George and two brothers-in-law, Mr. B. F. Stroud and Mr. Isaac E. Chandler, who were then living in Catasauqua, we built a machine shop and foundry there, with the view of doing work for blast furnaces and rolling mills. But before we got fairly started, the party that had intended building the nail mill abandoned the project altogether on account of the dullness in the iron business. It so happened that Mr. David Reeves, whom I had been with at the Safe Harbor Iron Works and the Kunzie Furnace, had become interested in the Cambria Iron Works, at Johnstown, Pennsylvania, and wanted me to go there as General Superintendent. He asked me to meet him at his office in Philadelphia, which I did, and it was arranged that I should go to Johnstown as soon as I could get away. My stay in Catasauqua was not only brief, but somewhat unprofitable. I made some good friends, however, whom I esteem most highly at the present time.

CHAPTER XIV.

CAMBRIA.

In June, 1854, my family and I landed in Johnstown at about nine o'clock at night. It was a dark and uninviting place. Looking down the Conemaugh in the direction of the works, the only light that could be seen was the reflection from the coke ovens. We went to a hotel and spent an uneventful night. The next morning, while waiting for breakfast, I went out to see how the town looked in daytime, and I can truly say it was the most unattractive place I had ever been in. The streets were of clay, or rather of a dark loam, and organic matter; the sidewalks, with few exceptions, were of boards or plank, and in a great part of the town were of the same material as the streets. Cows, hogs, and dogs, all ran at large; the dogs would get after the pigs, they would squeal, the cows would bawl, the dogs would bark, and fight. I should have been amused if I had not been there to stay. After I had been at Johnstown a short time I met Governor Porter, who told me that he had recently crossed the mountains in a stage, sitting outside with the driver. He said, "In looking forward I saw a number of houses. I asked the driver what place we were coming to. He said it was Johnstown. When we came near to it the driver said it was a darned shame to spoil such a nice piece of ground to build such a town on it."

I next went down to the coke plant, which was on a level with the tunnel head of the furnace, some eighty feet above the valley in which the rolling mill and shops were located. After taking a bird's-eye view of the plant, I went to the mill and found it unfinished and not at all to my liking, but too far advanced to make any changes. Consequently, I concluded to complete it as designed and as early as possible, at the same time well knowing there was trouble in store for us when we came to start. One of the blast furnaces had been in operation for some weeks and there was some pig iron in the metal yard, which I examined and found to be a very inferior metal. I was told by persons who knew something about the reputation of the metal that it was no good, that it could not be sold or given away in Pittsburg, and that it could never be made into a rail. This, in connection with my own opinion, was enough to chill the ardor of a veteran.

In starting the mill we made the pile in the usual way, and when it went into the rolls it split in two pieces and went out into the scrap yard. The conclusion was, too much heat. We tried another at a lower temperature; result, it split about halfway. We then turned end for end and passed it through the rolls, which closed it together; sent it back to the furnace and reheated it, and then rolled it into a rail; the result was, flanges on both sides all torn from one end of the intended rail to the other. The rolls were then taken to the lathe and altered, put in place and tried again; result no better. Anticipating trouble, I had a set of new rolls quite ready, put them in the housing, and tried them; some improvement, but the flanges of the rails were still seriously torn and the head of the rail badly cracked on both sides.

It was now evident that my worst fears were going to be fully realized, and that we must have some better iron and devise some plan to get along with the least possible quantity. It was now that my Norristown experience proved helpful, as I had had much to do in getting up the piles for the various classes of work. This required different qualities

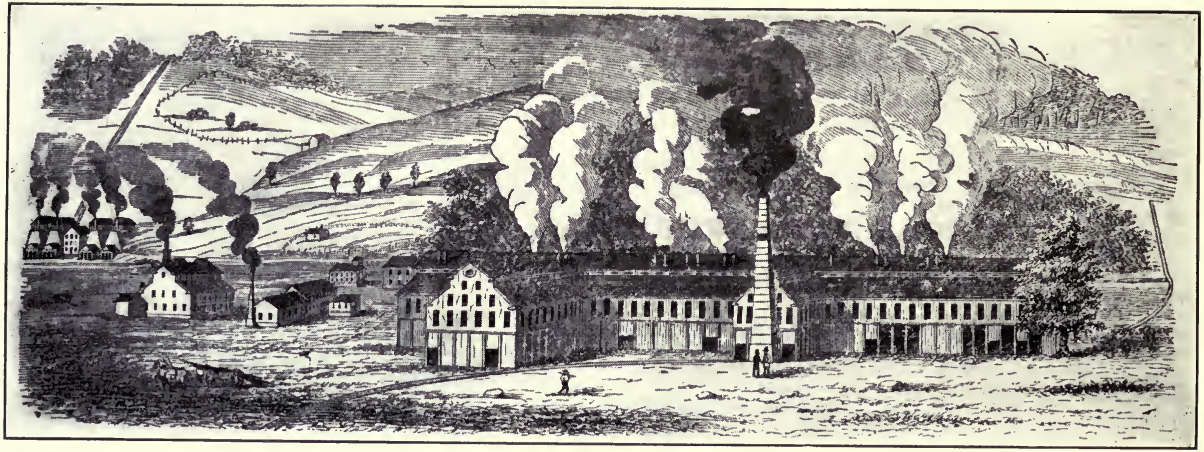


Fig. 4. Cambria Iron Works, Johnstown, Pa., in 1854.

of iron, some cold-short, some red-short, and some neutral, the neutral being the most desirable; to obtain a good quality of it at a reasonable cost was the only way that I could think of to get over the difficulty.

When I told the owners of the trouble and that we must have some good iron to help us out, for a time matters looked serious. They had been told, when they leased the property, that they could make pig iron for about six dollars per ton, and the kind of iron that I wanted for the flanges and heads of the rails had to be of a much superior quality, but after being told how small a quantity I thought would help us out, and that it was not possible to make rails without some better iron, they concluded to get it, hoping that later we could get along with a less quantity of the superior iron. In this view of the situation I gave them no encouragement whatever, well knowing it would only be waste of time as well as of money to make any further attempts. Consequently, I let the mill stand until we got the better iron.

When the good iron arrived we had it puddled and started up the rail mill to try the experimental pile. So far as the pile was concerned, it was a success and the form was never changed in the least. A sketch of the pile is shown in Figure 5 on page 96, and this method was used as long as the Cambria Works made iron rails. On some orders we used what was called second-bottom iron, as shown in Figure 6 on page 96. This second-bottom iron was rolled out of the crop ends of rails into bars one and one-half inches wide, and of the same thickness as the puddled iron bars, generally about five-eighths of an inch. We had a pile that was eminently satisfactory so far as making the rail was concerned, if rolled on edge. How well the rail would wear was a very serious problem in my mind. Nothing short of an experiment would demonstrate the wearing

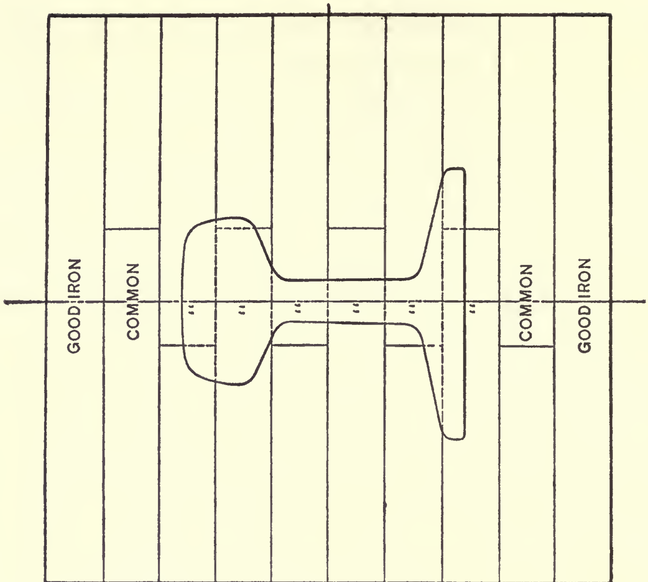

GOOD IRON
COMMON
COMMON
GOOD IRON

Fig. 5.

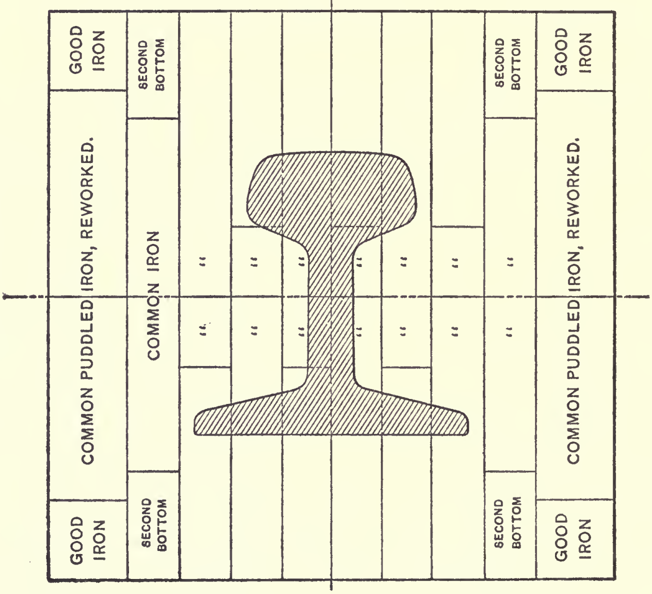

GOOD IRON
COMMON PUDDLED IRON, REWORKED.
GOOD IRON
SECOND BOTTOM
COMMON IRON
SECOND BOTTOM
SECOND BOTTOM
SECOND BOTTOM
GOOD IRON
COMMON PUDDLED IRON, REWORKED.
GOOD IRON

Fig. 6.

qualities of such a rail, and at that time it would have taken too long to make the test. My fear was that the rails would split under the load. I finally made up my mind that if the piles were properly heated and that if the second-bottom iron bars in the rail pile were in contact with iron on its flat with a good heat, no trouble would occur. This in the end proved correct, but my anxiety did not cease until the rails were tested in absolute use.

I was now satisfied that with a very small quantity of suitable iron for the flange and head an excellent rail could be made out of the iron produced at the Cambria furnaces, and that with such a mill as could be constructed the company would be a great commercial success. But to attempt to run the mill as it was would have been commercial ruin.

We now started the mill again, and while the flanges and heads were much better, the splitting was worse than before, as the strong iron in the top and bottom would bear more heat than the puddled iron in the center of the rail. I again tried, with no success, to make a pig iron that would stand more heat, so as to prevent splitting, but having only one kind of ore little could be done. I then had the rolls taken to the roll lathe and the work on the roughing rolls reduced. The result was only a slight improvement, and I felt that I had done all that could be done under the existing conditions.

I had now fully made up my mind that there was but one thing to do and that was to build practically a new mill, making it three-high. That would require a large amount of money, which was hard to get in those days. The only thing that could then be done was to start up and do the best we could. As before stated, the reduction of work on the roughing rolls helped slightly, and by careful heating we could get some work out. Consequently, we made what we called a final start.

In the meantime, we had gotten up a heavy buggy which we used as a battering ram and when the pile did not split open too much we would use the buggy to force the piece into the rolls so as to save the time and labor of turning the piece end about, but there were many piles that in the first or second pass would split or that would get too cold to roll and had to go in the furnace again. All this caused much delay, and the amount of patching of flanges that had to be done made me seasick, but the greater the difficulty the more determined I was to fight it out, as I could see in my bed at night, when I should have been asleep, visions of a three-high rail mill, but in the distance. Yet I had faith that it would come, and I was certain in my own mind that it would be a great success, and that Cambria was destined to be the greatest rail plant in the world. But the road that had to be trodden was long, hard, rough, and dreary, and besides was beset with great danger. But, to use a lawyer's phrase, the Cambria Company was my client, and no lawyer ever worked harder for his client than I did for mine, both mentally and physically. I knew no hours day or night, except time to eat, and but little to sleep, and that irregularly.

This was the time that my all-round practical experience, which I worked so hard for and made so many sacrifices to obtain, came into use, and, coupled with courage and a spirit that bears it company, I felt able to meet any contingency that might arise. I did not have long to wait for an opportunity to put my mental, physical, and courageous qualities all to test. The puddle-mill engine flywheel was thirty feet in diameter, with a fourteen-inch-square rim; the segments were held together by double-headed T-bolts, which had been put so close to the end of the segment that the metal pulled off and the tees and the end of a segment went across the mill. Fortunately, no one was hurt.

The mill was stopped at once and made safe. The repairs were made as follows: ten inches from the end of each segment across the face of the wheel grooves were cut in each end of the segment, two and one-half inches in width and of the same depth. There being sixteen segments in the wheel, this made thirty-two grooves. Iron bands, sixteen in number, made out of two and one-half by three inch best wrought iron, were then put in on edge. These bands, or rather links, had to be made in a common blacksmith's fire and without a steam hammer, as the steam hammer and also many other important tools were not in general use at that time. The grooves in the segments had all to be cut by hand. The grooves were first roughed out with a two-handed chisel and sledge and then finished with the hammer and chisel. This was a big job for that period, and I can assure you that I got but little sleep during the time this work was on hand. We double-turned the work, both in chipping the grooves and making the links, and not a single man shirked his duty, but each did all he could to get the job done. We had neither gas nor electricity and had to use the old coffee-pot tin oil lamps to give light.

We got the mill all in operation again but in a short time the rail-mill flywheel, which was built in the same manner as the flywheel on the puddle-mill engine, was considered unsafe to run at a speed that was absolutely essential for rail making, consequently we had to stop and fix it. This was a big, tiresome, and expensive job, and besides it kept the rail mill standing and nothing coming in, which, under the circumstances, was a very serious matter. Finally, we got in operation again and were getting along, making rails about as well as it was possible to do, with the mill as it was, and with the smaller mishaps that were daily occurring. These were not serious when compared with what we had gone through, but were exceedingly annoying, keeping the mill idle so much of the time, when the company was seriously pressed for money, and making it impossible to run the plant with economy; but I kept my temper as near zero as possible, and remained hopeful. Anticipating all shortcomings as far as possible, and being ready for them when they did occur, was the only thing that could be done, and by constant vigilance in all minor details and by making betterments when possible, we made a marked improvement in time of running, increased the output in a greater ratio, greatly reduced the cost of rails per ton, and also improved the quality.

In the midst of all my troubles, the company took a contract to make several thousand tons of rails with hollow heads. It was impossible to make them out of their own iron, and I told them so at once. In reply, Mr. D. J. Morrell, the business manager, told me that hollow-headed rails were at that time being made at Wheeling out of pig iron that was made at Johnstown of the same ore that Cambria was using. I said it was not possible and some one was not telling the truth, and that we would go down to Wheeling at once and see for ourselves what they were doing. We arrived at Wheeling in the evening. After supper, Mr. Morrell proposed to call and see the proprietor of the mill where the rails were being made. I said, " No, we will call at the works to-morrow morning at about daylight." This we did, and hunted up the roller and found him, and he and I at once recognized each other, as he had worked for me in the Norristown Iron Works. After a few casual remarks, I said to him, in the presence of Mr. Morrell, " How are you getting along with the hollow-headed rails?" He said they had been having terrible trouble with them in trying to make them out of Johnstown iron and found it utterly impossible. He said they then got some better pig iron, which gave fairly good results, and used but little of the Johnstown iron. I asked to see the puddle mill and stockyard and saw they were using about enough of Johnstown iron to say it was a part of the mixture.

At about eight o'clock, I remember, Mr. Stephens, the President and owner of the Wheeling plant, and the inventor of the hollow-headed rail, came into the works and was evidently much surprised to see us there. I told him frankly what I had come for and that we had seen all we wanted, and that they were using but little of the Johnstown iron in their mixture. He said, "You are mistaken about that; you have been wrongly informed." I said, "No, we have seen the mixture in the furnaces and I know the Johnstown iron wherever I see it."

We now returned home and I was feeling somewhat better, and told Mr. Morrell we must have some good iron to start with and find out what we could do, that I thought we could use considerable of our own make of pig iron and that he could rest assured we would use as much as possible of it.

I learned from Mr. Morrell that he was responsible for making the contract for the rails, and he understood from Mr. Stephens that they were using the Johnstown iron to make the rails out of, but he was now satisfied, and I told him I would do the best I could. This seemed to be a great relief to him. When we got well under way in making the rails, we found we could use considerable of the Johnstown iron and got out of the trouble much better than we first thought.

We had now gotten the mill generally in pretty good shape, and running about as well as could be expected, and making some money, when an event occurred which was very serious. Previous to the time that my employers, the lessees of the mill, took the property, as I remember, Mr. Simeon Draper, a banker of New York, had advanced money for a certain railroad company to the original

Cambria Iron Company, for rails to be made for them as soon as the mill was completed, and had taken a mortgage on the property to secure the loan. The original company having failed to complete the plant, the railroad company held the lessees liable for the fulfillment of the rail contract; and here appeared the United States Marshal, looking as gentle as a preacher, but we soon found him as firm as a judge. Next came the sheriffs of the adjoining three counties, where the Cambria Iron Company held property, then came the constable with orders to attach anything that was movable, from a goat to a locomotive. We were now up against the real thing,— want of money,— and to make rails for the company on their contract without money was simply impossible, and we so told them.

It was a gloomy day for Cambria. The workmen were restless and threatened to quit work, which I thought would help me in a proposition I had in mind to make. In company with the United States Marshal, there was a gentleman whose name I think was Mitchell. He proved to be a very clever man, and was to remain there to look after the interest of the railroad company, while their rails were being made. I said to him, " There is, so far as I can see, but one way that you can get your rails. The men are dissatisfied and may quit work at any moment, and as soon as we commence work on your rails, unless there is some provision made that will insure their pay, they will quit work, and I understand there are judgments against this property that can be foreclosed at any time. In that event you will never get a rail or one dollar of your money. If your company will let us roll some rails not merely for you, but for other people, so as to obtain enough money to pay the laborers, I think you will eventually get all your rails, and I will promise you to do all I can to help you get them." The proposition was finally accepted.

When we came to start making rails the workmen demanded that the rails be delivered to some person authorized to receive them and be held by him until they were paid. The company appointed their business manager, but the men would not accept him, and asked that I should be appointed; their request was granted. I was also made the agent for the railroad company, and every evening after the day's work was finished I received the rails, first to secure the pay of the men, and secondly, in the name of the railroad company to see that it got them. This plan seemed to work well and was satisfactory to all parties, and the sky seemed clearer and brighter for the success of the works than I had ever seen it. But at all times it was on the verge of bankruptcy, and the lessee company, tired of being harassed, not only by its own debts, but also by the obligations of the parent company, concluded it must in some way secure more capital. This at that time was no easy matter, especially when the concern was in such a complicated financial position as Cambria then was.

The mill was shut down, and I was ordered to Philadelphia to in a way become a promotor, a new business for me, and I had to do some talking to make some of the party I met believe that there could be any money made out of the works. But I assured them the Cambria Works could be made a great money-making plant if put in proper shape. All this time the three-high mill was uppermost in my mind, but I did not say a word about it, fearing it might provoke discussion; this I did not want at this time, as several of the party were in rather a passive frame of mind and I thought it wise to let them remain so, as it would have proved fatal to my long-cherished idea to have the subject brought up in any way until after the matter now in hand had been settled. I was sure there would be opposition, and my chance for success would be much better then, as I believed the opposition would be in the minority but could not well back out. For several days but little was done beyond some small skirmishes about the propriety of putting more money into a manufacturing business that had made two failures in two years. This seemed to be the knock-down argument, and the fact could not be ignored.

During this time I fortunately made the acquaintance of Mr. Edward Y. Townsend and soon gained his confidence. He was connected with the mercantile house of Wood, Bacon & Company, one of Philadelphia's best-known houses. This gave him a standing with capitalists, the men that were wanted. His firm looked upon the project with favor, which was encouraging. Then came up the question as to the amount of money that would be wanted. Here I was again placed in a vexatious predicament, being called on to name the amount required for the mill, well knowing that, if the three-high mill and other all-important improvements that really should be made were named, it would surely defeat the whole scheme. I concluded to make the amount as small as possible. Some of the party were inclined to think well of the property.

We met at Mr. Charles Wood's office to talk over some plan of organization, and see what amount of money could be raised and how it could be done. They had previously decided it would require about one hundred and eighty thousand dollars, that this amount should be divided into six shares of thirty thousand dollars, that each share should have one representative only, but without limit as to the number of persons that it might take to make up each share, and that the name of the firm should be Wood, Morrell & Company. This was a wise arrangement and probably at that time the only way the project could be accomplished.

The six representatives of the shares, who were all the stockholders that were known to outsiders, were the business managers. As I recollect they were Mr. Charles Wood, Mr. David Reeves, Mr. Matthew Newkirk, Mr. Edward Y. Townsend, Mr. Daniel J. Morrell, and Mr. George Trotter. All of them were successful business men and men of high standing and character.

They next went to work to get all the shares fully made up, and in a few days succeeded. We thought everything was completed and that I could soon take the good news with me to Johnstown, and I was planning to go the next day, but we were mistaken. An unexpected trouble about the lease turned up, and for several days the atmosphere was gloomy and it seemed as if all our labor had been for naught. This condition of affairs existed for several days, but on the last day of grace in which they had to make the lease, they got all the six holders of the six shares together and at about nine or ten o'clock at night they agreed to sign the lease, but Mr. R. D. Wood, who was largely interested, despairing of their agreeing to sign it, had previously gone home and gone to bed, and so the others had to go to his house, where all were in bed, call them up, and get Mr. Wood out of bed to approve the lease before twelve o'clock. Otherwise, as I now remember, the property would have been sold the next day by the sheriff.

This was a close call and to me was a period of intense anxiety, not so much on my own behalf, as in the interest and welfare of some three or four thousand men whose existence and that of their families depended upon their daily labor; and for all this time, nearly two weeks, they had been idle. How those men with large families managed to get along is more than I can tell, but they were sympathetic, generous, and would share the last bite with each other.

The next morning I started for Johnstown as the bearer of glad tidings. The morning after my return, I met the workmen and told them what had taken place (all of which they received joyfully), and further said, by way of encouragement, that I did not see what could happen that would prevent the works from starting and running steadily, but I must confess that in the face of so many setbacks I at times had some misgivings, fearing something unforeseen might turn up. However, I told the men to get their furnaces ready to start up and said, "We must all work together and do our best to make it go. If we do this, success is assured." I was ordered to start the mill, and the workmen and the citizens of the town were all happy. All that could be seen from the Johnstown end was of good omen.

But after I had left Philadelphia for home a very great difference of opinion had shown itself in the new company in regard to the appointment of the officials in Johnstown. This resulted in the appointing of two General Managers, one General Superintendent, and one Assistant Superintendent. The last-named official was not needed. Mr. D. J. Morrell was made General Manager to succeed Mr. James, then the General Manager, and Mr. Wyatt Miller was supposed to be assistant to the Superintendent, but was not so named. I was again placed in a very embarrassing position. Mr. James, having been the General Manager of the previous company, and having been requested by the minority stockholders to remain, had no disposition to resign. The result was that for some weeks we had two General Managers. Mr. James was a very clever man, to whom I had become much attached, and he was a brother-in-law of Mr. David Reeves, who was a good friend of mine. I had been in Mr. Reeves' employ for some years, and was sent to Cambria by him, and his uniform kindness placed me under obligations to him, but the majority of the firm were in favor of Mr. Morrell. Consequently, I decided my course should be absolutely neutral. The majority party did all they could to get me to side with them, but I positively refused to do so; in an unguarded moment, however, I said there was no use for two General Managers or an Assistant Superintendent. This was true, but it was not said to be used by them to get Mr. James or Mr. Miller out. This they did, however, much to my surprise and chagrin. They put them both out, and it naturally caused a coldness on Mr. Reeves' part toward me, which I greatly regretted, and it was some time before I got an opportunity to explain the matter to him. Mr. D. J. Morrell now became the sole General Manager. He was a very clever gentleman, but knew nothing about the iron business, which, to say the least, was unfortunate. Mr. Charles Wood was made the head of the firm and Mr. Edward Y. Townsend his assistant.

CHAPTER XV.

CAMBRIA.—Continued: THE THREE-HIGH RAIL MILL.

After the new organization was completed and the officials got well in their places and all was working smoothly so far as they were concerned, the change in the official organization of the company did not remove or lessen the troubles in the manufacturing department, or increase the output, both of which items were absolutely essential to insure success. To continue to run the mill as it was, I could see nothing ahead but a most disastrous failure. Having previously given the whole subject my most thoughtful consideration, even to its most minute detail, I was prepared to submit my plans and recommendations to the new company. My proposal was to build a new train of rolls, three high, and twenty inches in diameter. This involved a new engine that would run with safety one hundred revolutions per minute, and it practically meant an entirely new mill. To this proposition they demurred, saying that it could not be done, as the expense was too great; besides, the mill they had was entirely new and was supposed to be the best mill in the country, and they were at loss to see why good rails could not be made on it. After some time and a great amount of earnest talk, I succeeded in convincing some of the representative stockholders that it was absolutely necessary to make some changes and improvements, and that, if my suggestions were adopted, success was sure.

At the next meeting the subject was taken up with a full board, and, as I was informed afterwards, the matter was fully discussed, and it was decided to build an eighteen-inch two-high train, geared, to replace the train we had, and I was ordered to go ahead at once with it. This was to me a very severe setback, as I supposed I had Mr. Townsend converted to the three-high direct-driven mill. To this order I replied most emphatically that I would not build the geared mill, as it would be money thrown away and time lost. In reply to my refusal to build the mill as ordered, they said my position was high-handed and most arbitrary and one I had no right to assume, as I was in their employ on a salary for the purpose of managing their works and had no right to dictate to them what they should do. I in a measure assented to this, at the same time telling them that if they persisted in running their works on the lines they had laid down for me, there would be a humiliating funeral, and I did not want to remain to attend it, especially as one of the mourners. In a few days after receiving my reply, they gave me permission to build the mill as I wanted it, but suggested that I make the roll eighteen inches in diameter instead of twenty. I consented, as a compromise,—a great mistake,—and commenced at once to build the mill, and make other important improvements.

About the time the patterns for the new train and also for the engine were completed, a protest was received at the works in the form of a legal document from the minority partners notifying the managing directors that they would hold them personally responsible for the building of the new mill. This was a most unexpected setback, and all the work on the new mill was suspended for a time, and the directors made another effort to get me to change my plans and build the old two-high geared mill, which the company had previously so earnestly urged me to do. I told them I was tired out trying to make rails on the old mill. They suggested that I could make a better mill two-high that would give less trouble, and consequently do more work. I admitted that it could be done, but the advantage to be gained would not warrant the expenditure, and the only thing that could possibly be done to make the enterprise a success was to build the three-high mill.

The next Sunday morning Mr. Townsend came to the mill, where he found me in the midst of the regular Sunday repairs. After I was pretty well through with them he took me aside and showed me the protest. My hands being greasy, I asked him to read it to me, which he did. After all these years have passed, there is no person other than myself who can fully appreciate the trying position the managers were placed in. On the one hand, I was urging them to build a mill, on an untried plan, as a strong minority called it, this minority also legally notifying the managers that they would hold them personally responsible for the result. On the other hand, I was absolutely refusing to build the mill they wanted, and besides all this, they ridiculed the idea of adopting a new and untried method that was against all practice in this and the old country, from which at that time we obtained our most experienced iron workers. Moreover, the prominent iron makers in all parts of the country had said to Mr. Morrell that the whole thing was a wild experiment and was sure to end in a failure, and that young, determined, cracked-brained Fritz would ruin him. The heaters and rollers all opposed the three-high mill and appointed a committee to see the managers and say to them that the three-high mill would never work, and that they, themselves, would suffer by reason of its adoption, but that if the managers would put in a two-high geared train, which they said was the proper thing to do, the mill would go all right.

As I now look back to that eventful Sunday morning, many long years ago, sitting on a pile of discarded rails, with evidences of failure on every side, Mr. Townsend and myself quietly and seriously talking over the history of the past, the difficulties of the present, and the uncertainties of the future, I cannot but feel, in view of what since has come to pass, that it was not only a critical epoch in the history of the Cambria Company, but that as well the future well-being of my life was in the balance. For, as Mr. Townsend was about to leave, after a full discussion of the Cambria Iron Company's condition at that time, he turned to me and said: " Fritz, go ahead and build the mill as you want it." I asked, " Do you say that officially?" to which he replied: " I will make it official," and he did so; and here I wish to say that to no other person so deservedly belongs the credit, not only of the introduction of the three-high-roll train but also of the wonderful prosperity that came to the Cambria Company, as it does to Mr. Edward Y. Townsend, then its Vice-President.

Notwithstanding I now had the consent of the company to go on with my plan for the new mill, many of my warmest friends, some of whom were practical ironmen, came to me and urged me not to try such an experiment. They said I had taken a wrong position in refusing to build the kind of mill the company wanted. " By so doing," they said, " you have assumed the entire responsibility, and in all probability the mill that you are going to build will prove a failure, and being a young man your reputation will be ruined for life." To this I replied that possibly they were right, but that I had given the subject the most careful consideration and was willing to take my chances on the result.

The work was now pushed as fast as possible. In the construction of the rail train I made a radical departure from the old practice, which was to place breaking pieces at dangerous points in the train; these pieces were expected to give way under certain strains so as to save the roll from breaking. One of the previous methods was to make the coupling boxes and spindles light, so that they would break when any extra strain came on them; and the leading spindle had a groove cut around it to weaken it, so that it would be sure to break before the rolls. The result was the constant breaking of some of these safety devices. In addition to all these devices, there was what was called a special breaking box on top of the rolls which held the rolls in place. This was made hollow so as to crush if the strain on the rolls became too great. I directed the pattern maker to make this box solid. The mill manager, seeing the pattern was solid, went to the pattern maker to have it changed and made hollow, as he supposed it had been made solid through a mistake. The pattern maker refused to alter the pattern, saying the old man (as they called me over fifty years ago) had ordered it to be made that way. "Well," said the manager, "the old man has gone crazy; and if that box is put in as it is, the mill will be smashed to pieces, and I am going to see him about it." This he did, and I told him the box was going in solid, as I would rather have a grand old smash-up once in a while than be constantly annoyed by the breaking of leading spindles, couplings, and breaking boxes, to which he replied: "By God, you'll get it."

When it became known that I had abandoned all safety devices another violent storm arose, and it was of such a character as to much annoy Mr. Morrell. He was a very clever gentleman, without experience in the manufacturing end of the business, and, being known as the General Manager of the plant, he was naturally worried. This, of course, gave me much trouble, to keep him in line, as every person he would meet that knew anything about the business would tell him of the great failure that was in store for the Cambria Iron Works. Some one told Mr. Wood, the President of the company, all about what was going to take place when the mill was started. I was told afterwards that he listened attentively to what they had to say, and then said to them: "Mr. Fritz has done many clever things for us that were said would never work, but always did, and I shall not interfere with him or his plans."

The next and last person to talk to me on the subject was Mr. James Hooven, proprietor of the Norristown Iron Works, one of my dearest friends, with whom I had spent several of the happiest years of my life. He came to pay me a visit and to learn for himself what I was doing. He remained with me for several days and we talked the whole subject over, and, like the rest of my friends, he thought I was assuming an unwarrantable risk. "If this is a failure," he said, "your reputation is ruined for life. Have you thought this over?" I told him, "I have, and it is my rule not to make a move in any new thing until I have thought it over, not only as a whole, but also in all of its details, and I assure you this is no exception, and I now feel that success is assured." While he was with me I took him into the mill so that he could better understand why the change was so important. He at once saw that great results could be gained if the plan could be successfully carried out, but he could not see his way clear to indorse it, and thought I had attempted to do too much, all at one time, and thought it very dangerous to do away with all safety devices, as they at times might prevent serious accidents. To this I replied that the only possible good such safety devices could do was the saving of a roll, and that it was very rarely that any roll was broken, except the finishing roll; if the collars were as deep and fitted as closely as they should do to insure good work, and the safety device, or breaking box, as it was generally called, should crush, one end of the roll would go up and it was more than likely that some of the collars would be broken and the roll rendered useless. The loss by delay, caused by the breakage of the safety devices, was not only annoying, but was expensive. The train had to stop; all hands in that end of the mill were idle, heating furnaces damped up, coal and iron wasted in the furnaces. Add to this the loss in production and it became a matter of much importance, not only to the proprietors, but also to the workmen.

The train was now practically completed, with all breaking devices abandoned. The old mill was stopped on the evening of the 3rd of July, 1857, and after the 4th I commenced to tear the old mill out, and get ready to put the new one in, and also to put the new engine in place at the same time. Everything in the rail department was remodeled and the floor line raised two feet. On the 29th of the same month everything was completed and the mill was ready to start. I need not tell you that it was an extremely anxious time for me, nor need I add that no engraved cards of invitation were sent out, that not being the custom in the early days of iron making; had it been, it would not have been observed on that occasion.

As the heaters to a man were opposed to the new kind of mill, we did not want them about at the start. We secured one, however, out of the lot, who was the most reasonable one amongst them, to heat the piles for us. We had kept the furnace smoking for several days as a blind. At last, everything being ready, we charged six piles. At about ten o'clock in the morning the first pile was drawn, and it went through the rolls without the least hitch of any kind, making a perfect rail. You can judge what my feelings were as I looked upon that perfect and first rail ever made on a three-high mill, and you may know in part how grateful I felt toward the few faithful and anxious men who were about me and who stood by me during all my trials and difficulties, among whom were Alexander Hamilton, the Superintendent of the mill, Thomas Lapsley, who had charge of the rail department, William Canam, and my brother, George.

We next proceeded to roll the other five piles. When two more perfect rails were rolled we were obliged to stop the engine, as the men were all so intently watching the rolls that the engine had been neglected, and, being new, the eccentric had heated and bent the eccentric rod so that the engine could no longer be worked. As it would have taken some time to straighten the rod and reset the valves, the remaining piles were drawn out of the furnace onto the mill floor. About this time the heaters, hearing the exhaust of the engine, came into the mill in a body, and from the opposite end to where the rails were. Seeing the unrolled piles lying on the mill floor, they took it for granted that the new train was a failure, and their remarks about it were far from being in the least complimentary. Mr. Hamilton, coming along about that time and hearing what they were saying about the mill, turned around, and in language more forcible than polite told the heaters, who were Welsh, that if they would go down to the other end of the mill they would see three handsomer rails than had ever been made in Wales, where the greater part of the rails used in this country at that time came from, as well as the heaters who were so bitterly opposed to the three-high mill.

CHAPTER XVI.

CAMBRIA.—Continued:

FIRE AND RECONSTRUCTION.

The next day being Friday, the regular day turn was put on in the morning, and in the evening the regular night turn was put to work, and all went well up to Saturday noon. It was the custom to stop rolling at about twelve o'clock on Saturday. Mr. Hamilton and I left the mill at about six o'clock, and on our way home we congratulated each other that our long line of troubles and disappointments was now over, and that we should have more time to give to changes and improvements that were so essential in other departments of the works.

About an hour later I heard the fire-alarm whistle blow, and, rushing back to the mill, I found it one mass of flames from one end to the other, and saw at once that it was absolutely useless to attempt to save any part of the mill or anything in it. The shops were all close to the mill building, the end of the machine shop being within twenty-five feet of the end of the mill. It being of the utmost importance to save the shops, all our energy was centered on them, but all hands seemed paralyzed for a time, thinking it useless to attempt to save the shops, as all of them were frame, with wood shingles for roofs, and all of them — pattern shop, foundry, and machine shop — were regular fire traps and all huddled together. It looked useless to try to save them. The company had a large boarding house near by. I ordered some of our best men to go there and get all the carpets and blankets they could find and take men enough to have them all brought up at once. I directed another party to get the ladders, fire hose, buckets, ropes, and hooks. As soon as the blankets and carpets came, the blankets were wet and the best men wrapped themselves in them, and ladders were gotten ready. Fortunately the roof on the end of the shop next to the mill was low and quite flat, so the men could walk on it readily. In a few minutes the roof was covered with carpets and blankets and two streams of water were playing on them. By the time the men got down off the roof the steam was rising off the carpets and it was so hot that we were fearful that the shop would share the fate of the mill. The crucial time would be when the mill building fell, and it was important which way it fell. If it fell in, the shops would be safe; if out, then another hard fight was before us. The next few moments were of intense strain and excitement. But, if the walls fell out, we were prepared, as we had hooks, chains, and ropes ready, to pull the falling and unburned timbers away. I had instructed the foreman in each department to have his men all organized, and go to the foundry, get all the chains there were there, and ropes, hooks, etc., so that they could fasten to the charred and unburned timbers and pull them away from the engines and all important machines. I directed all to be at their places the moment the building fell, free the machinery from heat as quickly as possible, and see there was no water put on the machinery. Fortunately our suspense was of short duration. In less than one hour from the time the fire started, the whole building was lying on the ground, a mass of ruin. When the building fell, it all fell inward, to our great relief.

The situation of Cambria affairs on that Saturday night was such as might appall the bravest heart. The result of our unremitting labors and anxieties lay there, a mass of black and smoking ruins, and the money that had been so hard to get, with which the new mill was built, was gone. The prospect was gloomy, but there was a gleam of light amid all the darkness, and that the pile of new and perfect rails which Mr. Hamilton had said had never been beaten by Wales, from which country most of the rails used at that time came. Above all, the mill had been tried and was a most magnificent success, and it was these two facts that cheered us up and renewed our courage with a determination to rebuild the mill.

The following day, Sunday, was devoted to rest and thinking over the situation; at any rate, it was not spent in the mill. During Sunday the workmen met and agreed to give the company one day's work on Monday, to help clear the rubbish away. I told them all to be cheerful and said that the works would surely be rebuilt and as quickly as possible. They all, to a man, went to work, and I never saw a set of men work harder. By Monday night the mill was clear of all rubbish and on Tuesday morning we commenced to get in shape to start up again.

On Monday morning we sent a number of axemen to cut poles or timbers, say about twenty feet long and eight or ten inches in diameter at the butt or large end, and we also sent teams to haul the logs into the works. On Tuesday morning, carpenters went to work to frame them together, and the men raised them and braced them in place to carry the steam pipe and feed-water pipe for the boilers. The larger and upper pipe was the steam pipe, about ten inches in diameter; the smaller and lower was the feed pipe for the boilers, four inches in diameter. The trestles were placed about twenty feet apart the whole length of the mill, — six hundred feet, — and were erected the same way in the transepts, which were two hundred feet long each, making the total length of ten-inch steam pipe about one thousand feet, and the same length of four-inch water pipe, all of cast iron, and cross pipe leading from the main steam and water pipes to the boilers, made of four-inch wrought iron and copper. The old cast-iron steam and water pipes were almost totally destroyed. Where the pipes were not broken in two, the branches on them for the boiler connections were broken, and the cross steam and water pipes, which were made of wrought iron with copper turns for expansion, were so bent and twisted that many of them could not be used. Shafting, pulleys, and all light machinery were badly injured. The engines were all more or less damaged. The roll bearings, being soft metal, were generally melted out, and the rolls all had to be taken out and new metal put in.

The outlook was most discouraging. The mill workmen were in sore distress, having been told by some persons that it would take a year at least to get the mill ready to run again. They came to me to know what they should do, as they could not live without work until the mill would start up again. I at once assured them that we would make rails inside of thirty days, and that we would give them all the laboring work we could during that time. This cheered them up very much. In twenty-eight days from the time of the fire we were running the mill on full time, but without a building; we put up a temporary frame to carry the hooks, and the workmen were covered temporarily with boards throughout the mill.

The building that had just burned down was of wood, and I suggested that we rebuild with brick. This was vehemently opposed by some of the stockholders, but, there being a brickyard with good clay at the door of the mill, I at once made a contract with the men who had charge of the yard for all the brick that it would take to put up the building at $2.62½ per thousand. The building, whose total length, including transepts, was over one thousand feet and width one hundred feet, was put up and ventilator completed and under roof with slate by January 1, 1858. At that time it was the finest rolling-mill building in the world, and I think it was the best building ever put up in this country at the same cost. It was put up and roofed while every man was at work and the mill working up to its full capacity, and not a single person hurt. This was something that I was always proud of, but I never left the building while the trusses were being put in place. They could not be put together on the ground and raised as a body on account of the pipes and machinery and the hot iron that was constantly in motion on the mill floor; consequently they had to be put together in place over the heads of the workmen, while they were all at work. This was a most difficult task, requiring extreme care; consequently I was on the building while every member of every truss was being raised and put in place. This was the most trying ordeal that I ever had, not that there was any serious practical difficulty in doing the work in the manner we were doing it, but it was the danger that the men both above and below were constantly exposed to that rendered it so hazardous. The falling of a member of the truss, or a bolt, nut, wrench, or tool of any kind, striking a man on the head, would cause instant death, and no person but myself knew what a load was off my mind when the last truss was in place and I came down off the building for the last time, late in December, 1857, and could say that the building was practically completed and not a single person had in any way been hurt, so as to disable him even temporarily. This was a source of gratification that well rewarded me for the intense anxiety I had been laboring under from the commencement to the finish of the erection of the building. During all the time we were erecting the new building, the mill was working nicely and doing good work, which, under the circumstances, was also a source of untold satisfaction.

Previous to starting the three-high mill we had commenced to increase the output of puddled iron, as the new mill was capable of doing over four times the amount of work the old one could do. It was most important to take up this end of the work, which had, in a measure, been necessarily neglected. The puddling furnaces were originally all single, but we had already changed some of them to double. We now put on all the force we could and changed all the furnaces to double and built some new ones. This greatly increased the output. In order to roll the increased quantity of puddled iron, we had to build a new top and bottom mill, and at the end of the same we put in a set of rolls for flattening old rails so as to pile them in with the puddled iron in the rail pile. Up to this time the tops and bottoms for the rail pile had been rolled on the puddle train. By removing the rolls to the new train we had place for another set of puddle rolls. We also had to put in a Burden squeezer, as the Winslow squeezer originally installed could not take care of the increased quantity of puddled iron that was being made.

Up to this time, in order to make smooth heads and flanges, we were compelled to use two pieces of top and bottom with head on flange, an expensive method of manufacture. This led to the building of a sixteen-inch train to roll bars one and a half inches wide by five-eighths of an inch in thickness. In the middle of the pile next to top and bottom was placed a puddled bar five inches in width and five-eighths of an inch thick; on each side of this was placed a piece one and one-half inches wide by five-eighths of an inch thick. These bars were generally rolled out of old rails, thereby saving a large amount of reworked iron, and on the same sixteen-inch train was rolled all the bar iron that was used about the works. We also built two heating furnaces for this mill. From the first, the plant was short of steam. The boilers were plain cylinder, under-fired, but as fast as the puddling and heating furnaces were changed and new ones built, boilers were put over them. At length we had all the steam that was wanted. The puddling furnaces, Burden squeezer, and puddle rolls, the top and bottom furnaces, and rolls were all working well, also the heating furnaces for the rail mill, and the new three-high rail mill worked most magnificently. All this made a better and more perfect rail and made cold-patching a thing of the past. We put in new hot beds and curving plates, substituted the straightening machine for the sixty-pound old-time sledge, greatly improved the punching machines, and by the introduction of the driven rollers on the rolls the mill could turn out four times as much work as could possibly have been done on the old mill and with less than half the labor and no wear and tear of muscle.

Having gotten all the furnaces of both kinds and all the rolls and machinery in the mill in good shape, we next took hold of the handling of the puddled and top and bottom iron to see what improvements could be made in that line. Up to that time the puddled and top and bottom iron, especially the puddled bar, had been dragged from the rolls, out on the bank, as it was called, and when cold taken to the cold shears, cut to length, and taken on a wheelbarrow to the heating furnaces and there piled. This made it impossible to keep the space about the furnaces clean and tidy, and the place was at all times cluttered up with puddled and top and bottom iron of various lengths which could not be used in the pile. To remedy this, we placed a pair of shears in front of each set of rolls, both puddled and top and bottom, and in an iron frame of proper length we placed rollers opposite to each shear. As the iron came from the rolls it was fed into the shears and cut to proper length for the piles. The iron was neatly laid at the shears, a two-horned buggy was put under it, and the bars were taken to the bed and let cool; then the same kind of buggy was used to take it to a place arranged for piling it. The iron was not touched by hand from the time the pig iron was charged into the puddling furnace until it came to the piler. This arrangement greatly lessened the cost and made the work much lighter for the men. We put rail tracks from the place of piling to each heating furnace and had cars made that would hold one heat of piles, and the iron was piled on the car and taken to the furnace as wanted. This arrangement worked admirably, and the mill looked like a parlor as compared with the other rolling mills of that day.

In regard to the blast furnaces, they were old-fashioned, and short of blast and water. We did not have sufficient water on the coke yard to properly extinguish the fire in the coke as it was drawn from the oven. The first and most important thing was more blowing capacity. As the furnaces were located on an abrupt rise in the ground, it made it very expensive to get a place for more blowing engines on account of the excavation that would have to be made to receive them, and, having already used so much money in making improvements in the mill department, I did not want to spend any money on the blast furnaces that was not absolutely essential. In carefully looking over the blowing-engine room, I concluded that I could design a short-stroke quick-running upright engine that would give all the blast needed, and would go in, one in each corner in the rear of the present engines, and save a great amount of expense. The engines were built by Matthews & Moore, of the Bush Hill Iron Works, Philadelphia, and they worked quite satisfactorily. While this engine was designed for a special plant and purpose, the design was adopted and used for a long time in Western Pennsylvania and Ohio. We also put in a new pump to get more water for the tuyeres. As water was very hard to get, we had to collect the tuyere water and pump it up to the coke ovens, to be used in putting the fire out of the coke as it was drawn out of the ovens. After these improvements were put in things went along much more comfortably about the furnaces and coke ovens than they had been doing for some time previous.

CHAPTER XVII.

CAMBRIA.—Continued: RETROSPECT.

It was in 1854 that I went to Johnstown. Previous to this but little had been done west of the mountains in making iron in the blast furnace with mineral coal. I think there was not a blast furnace in Pittsburg at that time. Mr. Benjamin Perry, who was referred to in Chapter XII, as having been at Kunzie Furnace, and who probably ranked next to Father Thomas as a pioneer in the anthracite region, had charge of the Cambria furnaces when I went there, but they were not in blast. He was an unlearned man, was said by almost every person there to be very troublesome and one I would have to get rid of if I wished to keep peace in the family. I told everyone I came there to manage the Cambria Works and not to send men away if they did their duty. I found Mr. Perry to be a good furnace man, but like many other uneducated men he wanted to be handled without his knowing it. This I did most successfully, and he remained in charge of the furnaces over two years, and left of his own accord to take another position where he thought he could do better, and I was sorry to see him go away. He was a man, unfortunately for himself, who would not brook contradiction. Mr. John Griffin, one of the best-learned iron men of that day, was once on a friendly visit to see me, and having heard much of Mr. Perry wished to meet him. Consequently I invited Mr. Perry to my house in the evening. Soon after being introduced they began talking on the subject of iron making. Mr. Griffin asked him about the coal we were using for making coke, to which Mr. Perry replied that it was bad, being full of brass. Mr. Griffin said, " Mr. Perry, you mean iron pyrites." " Well," said Mr. Perry, " you may call it what you damned please, but I tell you it is brass," and the manner in which he spoke was so emphatic that Mr. Griffin wisely concluded not to pursue that branch of the subject any further. Yet Mr. Perry was one of the best practical furnace men that I knew at that time.

After all that has been said of the conditions of the Cambria Iron Company when I went there and what I went through, I feel that I have come far short of showing the real condition of affairs as they then existed. The works were divided into a number of small principalities, each of them being governed by a despotic foreman who would neither go out of his kingdom to do any work nor let anyone else come in. I soon found out that arrangement would not do, but I thought it best to bide my time until a good opportunity should occur to correct the evil. One day, soon after the blast furnaces were put in blast, the iron broke out. The day was hot and the men soon gave out, and Mr. Perry sent word to me of what had happened, asking for some extra help. There being trouble in the mill, I could not well get away at once, so I sent word to the coke-yard foreman to send Mr. Perry some help, and said I would be up as soon as I could get the trouble in the mill all straightened out.

In the course of an hour I went up to the furnaces and found Mr. Perry and his men all quite used up, and saw that no extra help had come to his aid. I asked Mr. Perry if he had sent my message as directed to the foreman of the coke yard. He replied that he had done so. I then sent word direct to the foreman that I wanted to see him at the furnace at once, to which he promptly responded in person.

I asked him why he had not sent the help to Mr. Perry as I had requested him to do. He at once said that his business was to look after the laborers on the coke yard, and he did not intend to do anything else, and that he was employed by the President of the company and not by me. In reply I said to him that from that time on I intended to manage the works and not the President. He then said, "You can have my resignation at once." I replied, "What I want you to do is to send Mr. Perry at once half a dozen good men, and to think over the subject of your resignation until to-morrow morning, and then come and see me." When he came the next day I said to him, "You seemed a bit hasty yesterday, but now you seem to be in a good humor, and I want to have a talk with you, which I hope will answer for all the foremen around the works. It was true what you said yesterday. You were hired by the President, but I want you and all the foremen about the works to know that I was sent here to manage these works, and from this time on I intend to do it. And I further wish to say to you and to all the persons in the employ of the company whose services are needed that you will be retained as long as you do your duty to the company, and that while I fully expect the foremen to faithfully discharge the duty assigned to each of them, I want you to assist each other when in trouble, as far as possible, without detriment to your assigned duties; and I want you to bear in mind that you are all in the employ of the Cambria Iron Company, and it is your bounden duty to look to its best interests." After this talk the gentleman withdrew his resignation and apologized for what he had done the day before. From this time forward there was no further trouble, and no set of men could have worked more faithfully for the best interest of the company than they did, and it was a source of much consolation to me when in trouble to know that all the foremen were loyal and working in harmony with each other.

The mechanics I had to rely on to do the work in the shop and mill had never before done any mill work, and but few of them had ever been inside of a rolling mill, and for a time I had an uphill business. Fortunately I had had a severe schooling in that line and was able at all times to properly direct the beginners. As they were desirous to learn and energetic, they soon proved themselves equal to the emergency, and by the time we had the new mill in operation and the whole mill in good shape, the Cambria Works had the best set of men about them in the country. In proof of this I can point with pride to the number of men that have gained prominent positions in other works. The training they received at Cambria was such as to well qualify them to fill any position they might assume. The men would frequently say that all the passport they wanted was to say they had worked in the Cambria Iron Works.

I feel as though I could not commend too highly the brave, energetic, and loyal men who so faithfully stood by me in times of sore disaster, and were it not that it might prove invidious I should like to call many of them by name. How little the young men who are connected with the immense iron and steel plants of to-day know of the difficulties the old-time ironmen had to encounter! A drill press, cast off the pattern of the fixed head of a sixteen-inch lathe, bolted to a ten- or twelve-inch post upright, with blocks of timber for the table, a small lathe or two, the crudest kind of a machine for turning rolls, a few small tools, the greatly respected chipping hammer, cold chisel, and file, about completed the list of tools, but in the hands of skillful and energetic mechanics there was but little they could not do. It seems ridiculous to compare the facilities and mode of doing work of fifty odd years ago with those of to-day, with ponderous tools and massive cranes. To-day the casting is taken from the foundry to the machine shop, the heaviest housing that is made is lifted and placed on a large, heavy, powerful, and ingeniously planned tool, is set, placed on the planer, which has a slotter combined, planed on the inside, the recess that contains the bearing for the roll-neck slotted out, the base slotted off, the hole for the screw bored out to receive the nut which contains the screw, the casting taken from the planer to the mill and placed on a shoe or bedplate, which is cast in one piece, the whole length of the bedplate planed off from end to end, so that the housing can be placed at will anywhere to suit the space for the length of the rolls. The fixings that go into the housings that secure the rolls in place are all planed to a templet, so that they will go in place easily and all at one setting and on one tool. There need not be a chisel or file mark on the whole job. After the shoes are in place the housings and fittings are put in position without either line or level, and the train cannot get out of line. The whole of the work is placed in position by an electric traveling crane which commands the length of the train. Yet, after all, the old-time machinists, with their hammer, chisel, and file, and with their experience, are still in demand, and on the best class of work, and they are at all times the men for emergencies, — a class of workmen that are known as all-round men, who will acquit themselves with credit in any position you may place them.

As before stated, after the introduction of the three-high rail mill at the Cambria Works, and the improvements pertaining thereto, and the change of the manner of fitting up the mill, which was superior to anything that had been done up to that time, it became necessary to substitute machinists in place of the millwright and the forge carpenter, who, up to that time, had been doing the fitting up of the machinery. The mills, practically speaking, were all geared, and all the trains of rolls were driven by one engine of long stroke, consequently slow-running, the power being transmitted from the engine to the rolls through gear wheels, with the diameter so arranged as to give the roll trains the proper number of revolutions per minute, the engine practically running at a given speed all the time. The shafts at that time were of cast iron and the space on the shaft occupied by the wheel was increased in size. The shafts were generally hexagonal, but sometimes were cast square and the wheel was secured in its position by hard-wood keys about one-half to three-quarters of an inch in thickness. After the wheel was set true and the space between the wheel and the shaft all driven full of hard wood, wedges of thin steel were driven in the wood on both sides of the wheel. While this was not at all mechanical, yet if the wood was hard and dry, and if the work was well done, they gave but little trouble. The housings that contained the rolls were used just as they came out of the sand. Practically no work was done on them at all, except to chip the bumps or swells off the casting. The housings rested on a narrow shoe that was bolted to a large timber placed on the top of the foundation; the plate had lugs cast on it corresponding to the size of the base of the housing; the lugs were dovetailed and the base of the housing was made with the same angles as the lugs on the shoe. The housing was set in this shoe and bolted fast. Another and a much better plan was at times used. This was to make a casting with two shoes combined in it, the shoes forming part of the casting and being placed the proper distance apart so as to conform to the length of the roll. This was a great improvement over the two separate shoes.

When I built the Cambria mill, we got the shoes made the whole length of the train. They were made by James

Moore of the Bush Hill Iron Works and were a great improvement over the old style. The shoes were planed the whole length of the train and as a result the housings could be placed at any point and at any distance apart.

I have described the plan of fitting up the mills somewhat fully in reference to the Cambria works. This has been done in order to show the importance of substituting machinists for millwrights; in fact, the machinist of that day who was good with the hammer, chisel, and file was a more important person about the works than he is at this time. Then all the work that was done on a rolling-mill housing was done by the machinist by hand.

It is not possible for a mechanical engineer of to-day, who is well posted in the use of our modern tools, electric traveling cranes, and all the general facilities that are in use at this time for doing work promptly and correctly (with money galore), and with electric light, so that work can be done by night as correctly as in the day, to realize the condition of affairs at the time the changes and improvements were made at the Cambria Iron Works over fifty years ago, practically speaking without tools. For all parts of the work that could not be done with chisel, hammer, and file, special makeshift tools had to be designed and gotten up to suit the occasion. This required much time, money, and inventive talent of a high order. Energy, determination, and patience of a staying quality were the great requisites for doing work under the then existing conditions. We had no crane for handling or erecting the work, and had to build a kind of portable derrick which could be moved from place to place, as it was wanted, by either horses, mules, or men, but generally the last. It proved to be a most efficient machine as a makeshift for a crane. It did all the erecting and changing of rolls. It was so essential and so powerful that the men named it

Uncle Sam. We had no electric light to work by at night, or even gas when we commenced. All the light we had was made by the use of lamps filled with smoky rosin oil, as it was called.

We had no money, and at that time the iron men were looked upon as paupers. The banks would not loan them any money as long as they could get what they called first-class commercial paper, and at that time money was not in abundance, as it is to-day; consequently the iron men got but little, and that little only for a short time, the bankers fearing they would fail, as in the early days of rail making they were very likely to do. At the time when we were in the midst of our improvements at Cambria, a banker to whom the company owed twenty thousand dollars came into the rolling mill and asked me what we were doing. I told him we were making some changes and improvements. His reply was that any man that would destroy property and spend money as we were doing was a fool or a madman. I told him that I was doing it and it had never occurred to me that I was either. He took the train that night for Philadelphia, and the next morning called at the company's office and demanded his money in such an emphatic manner that they had to pay him that day. I might mention many instances showing the distrust of the bankers toward the iron men, and also what they said about myself and about what I was doing. But suffice to say that I passed through a merciless fire of vindictive ridicule to victory, with simplicity and becoming dignity, doubtless to the disgust of some of the wiseacres who had made some direful predictions.

We started to put on two feed rollers at Cambria, one on the front and one on the rear of the train. The workmen all said, "They are no good." In spite of the prophecies of the workmen, we put them on and they worked satisfactorily, but in about a week or so the belt (which had been used temporarily) broke. I came through and found the mill standing idle. I said, " What is the matter?" They said, " The belt on the feed roller is broken." Turning to the heater, I then said, " George, is it time to roll? " He said, " Yes." I said, " Go ahead. I am going to make the mill work a little without the feed rollers." The work was so much lighter after the installation of the feed rollers that the men who had a week or so before opposed them now thought it was impossible to run the mill without them.

There was so much objection coming from the workmen to anything that was new that I once told them if I got up anything new and they all said it was all right, I should look over my drawings again, thinking there must be some mistake.

Notwithstanding the many invidious attacks we were subjected to for what we were doing, every rail mill in the country had at once to adopt the three-high system, and in changing the mills made them stronger and better fitted up. Mr. Frank Jones, of Pittsburg, (B. F. Jones, of the firm of Jones & Laughlin), the leading, most practical, and successful iron man in the country, and one of the first to see the advantages of the system, said to me, some years after its introduction, that the three-high mill was the commencement of the great improvement that took place in the iron works after 1857, paving the way for the introduction of the phenomenal Bessemer process.

In July, 1860, after upwards of six years of as earnest and faithful hard work as few, if any, men ever had to endure, and without any vacation, I made up my mind that the time had come to sever my connection with the Cambria Company, a decision which in many respects caused me deep regret. In taking a retrospective view of the condition of things as I found them, and also of the trials and difficulties which had been encountered and in the face of dire predictions of the soothsayers, and others who were equally ignorant, but should have been better informed, and of the condition that the plant was in at that time, I congratulated myself in having accomplished a great work, under the most difficult conditions, in building for the Cambria Iron Company a rail mill far in advance of any mill existing at the time, and a great commercial success. As Frank Jones once said to me: " Cambria was the cradle in which the great improvements in rolling-mill practice were rocked," which revolutionized the rail mills, making a better rail, doing away with all patching, and increasing the production fourfold; and out of the two small driven rollers came the present system of handling the work in mills, by the use of live rollers, by the heavier, stronger, and better fitting up of the mill without breaking points, by the improvement in the arrangement and better fitting up of the side guards, by the closing of the grooves in the roughing mills, by the increase in the width of the pile, by the increased length of the furnace, and by the increased height of the furnace roof, which carried the heat much farther, thereby enabling us to charge eight nine-inch piles instead of six five- and six-inch piles. All of these improvements were calculated to improve the quality of the work, and increased the production, both important factors.

The improvements that were made in those trying and active years were not confined to rails alone, but all branches of the iron trade came in for a full share of the benefits of all the changes that had taken place, and they were many; many of them were revolutionary in their character, and were always met with opposition to their introduction, some of them being fiercely opposed. But I had laid down an absolute rule not to even suggest anything new or untried until I had satisfied myself that it was all right and was a proper thing to do; consequently I was well fortified and was in a position that was at all times impregnable. But this almost constant opposition became at times unpleasant to both parties. At last I became tired, yet had I yielded one jot or tittle the result would have been different, and it is not at all improbable that the great Cambria Works would not be in existence to-day. After six years of as hard, laborious, and vexatious work as ever fell to the lot of a man to do, I decided to leave the scene of my early struggles and try my fortune elsewhere, and on the morning of the 5th of July, 1860, with feelings of sorrow I said good-by to my many friends and to as loyal and efficient a corps of foremen and workmen as any man ever had the honor to have around him. On the next morning, July 6th, I reported for duty with the Bethlehem Iron Company, Bethlehem, Pennsylvania.

During the six years I was with the Cambria Company I had no vacation whatever, and with the exception of the visit to Philadelphia to raise funds, previously referred to, I was only once away from the works over two consecutive days, and then on official business, when I went down to Chattanooga for the purpose of examining an iron ore and coal property. This was in the spring of 1860.

Fig. 7.—Cambria Iron Works, Johnstown, Pa., in 1860.

CHAPTER XVIII.

BETHLEHEM: IRON ROLLING MILL AND BLAST FURNACES.

As I before said, on the morning of the 5th of July, 1860, my family (wife, daughter, and I), boarded a train on the Pennsylvania Railroad at Johnstown, Pennsylvania, for Bethlehem, leaving the scenes of my early struggles behind me, to enter into another, which, in the end, proved one of much greater importance.

We arrived in Bethlehem on the evening of the same day, July 5th. I had previously made arrangements with the Bethlehem Iron Company to accept the position of General Superintendent and Chief Engineer. On the morning of July 6th, I reported to the directors of the said company, and in company with Mr. Augustus Wolle, Mr. Charles B. Daniel, Mr. Charles W. Rauch, and Mr. Robert H. Sayre I visited the ground where the proposed plant was to be located. The next day I looked over the location again to see if any change was desirable, and I found on measurement that the space between the Lehigh River and the Lehigh Valley Railroad was not wide enough to locate the plant without encroaching on the river. The location we had made the day before was on the widest part of the land, consequently we had either to change the design of the plant or to encroach on the river, and we chose the latter.

We arranged at once with the Lehigh Valley Railroad Company to have a siding put in. Ground was broken on the 16th of July, and about the last of July we got fairly at work to erect two medium-sized blast furnaces and a rolling mill, containing eight double puddling furnaces and six heating furnaces (later, increased to fourteen double puddling furnaces and nine heating furnaces); we also commenced to build a stone building to cover them. We worked at this until winter set in, but, owing to the excitement incident to the threatened Civil War, we ceased work for the winter. When spring came we commenced work again, and during the summer of 1861 we erected the mill building out of stone.

In the fall we had one of the greatest rises known in the Lehigh River; it destroyed all of the part of the building that had been built on the encroachment on the river, amounting in length to about eighty feet. During the time the mill was being built we erected one of the blast furnaces, but in the fall and winter of 1861–62 the general outlook was so discouraging that the work on the whole plant was again suspended for the winter. In the spring of 1862 work was commenced again, and during the summer the building, including that portion of it which had been washed down by the flood, was completed; most of the foundations were in and we had much of the machinery ready to be set up in place. The machinery of the rail train consisted of three stands of rolls — two sets for rails, and one set for top and bottoms — driven by one engine connected directly to the train. There was also in connection with the finishing end of the mill one train of rolls twelve inches in diameter, with four stands of rolls, for rolling light rails and such light merchant iron as was wanted for use about the works. There were seven heating furnaces in the finishing end.

In the puddling department there was one puddle train with two sets of rolls and a rotary squeezer, driven off the end of the rolls. The rolls were driven direct from the engine. The puddling department, as stated above, contained eight double puddling furnaces, with shears and hot beds, and such equipment as was necessary for handling the iron economically. Both the finishing and the puddle rolls were twenty-one inches in diameter. All furnaces, both heating and puddling, had boilers over them.

During the summer and fall of 1862 the mill was quite completed, and in September, 1863, we commenced rolling rails. Every department worked entirely satisfactorily. The roll housings were of new design and were dressed out inside with hammer, chisel, and file; the fittings inside were fitted up in the same manner. The furnace plates, being corrugated, were strong and handsome; the building was of stone (good masonry); the train was of the largest diameter used in any rail mill in the country; and altogether the plant was completely fitted up. In addition to the rolling mill, we had erected a large machine shop and foundry, a blacksmith shop, and a pattern shop, all built of stone in first-class manner. Altogether, they made a fine show, and were for some years a Mecca for the iron men to visit. There was nothing in the world in the way of an iron plant that could be compared with the Bethlehem Works.

In the meantime, we had built the second furnace, which was a curiosity in its way. The first furnace, or Number One, was built of plate iron one-fourth of an inch in thickness. It was the first shell furnace, as they were called at that time, built in the Lehigh Valley. Iron was first made in this furnace on January 4, 1863. The second furnace, or Number Two, was also built of iron, but instead of being a boiler-plate shell it was constructed with bands of wrought iron eight inches in width, about seven-eighths of an inch thick at the bottom of the furnace and five-eighths of an inch thick at the top. These bands, or circular rings, were riveted about twenty-four inches apart to uprights, eight by half-inch, placed about thirty inches apart from center to center. As the distance from center to center of the bands was about twenty-four inches, and as the uprights were about thirty inches apart, there were spaces or openings sixteen by twenty-two inches. This is known as the crinoline construction. By leaving a small hole in each space in whatever depth in the lining seemed proper, one could see and learn something of the temperature in the furnace; should there be a scaffold, one could learn where it was; should the furnace be working hot in any place, it could be cooled off by the use of a swinging platform, which could readily be hooked to the band on any part of the furnace.

In the early seventies we built two more blast furnaces on new lines, seventy feet high and seventeen feet in diameter at the bosh. These furnaces were higher than those in general use. About this time coke began to be used in the furnaces in Western Pennsylvania and Eastern Ohio, and nearly double the amount of iron was made in the same sized furnaces that we could make with anthracite as a fuel. I thought that by building larger and higher furnaces and much more powerful blowing engines and by increasing the blast pressure from six to twelve pounds we could make as much iron in a given time with anthracite as they could with coke. Some of my Western friends came to Bethlehem to see our new furnaces and learn how they were working. They were so well satisfied with the result we had attained by high-pressure blast that they increased their blast pressure from about three and a half pounds to seven or eight, and we were again beaten about as badly as we had been before. We were the first, so far as I know, to use high-pressure blast.

The new blowing engines were made horizontal and were much criticized, but I paid little or no attention to the critics. The engines, however, ran constantly for over thirty years, to my knowledge, day and night (which is equivalent to sixty years as the great majority of engines run), and during all these years they were blowing from ten to twelve pounds pressure and frequently more, notwithstanding the fact that they were so generally condemned by metallurgical engineers, and they are still running. Two of the oldest practical ironmasters from the other side of the Atlantic, John Lancaster and Sir I. Lowthian Bell, were looking over the engines soon after they were started, and I ventured to ask what they thought of them. The former said that I had gone far in removing the objections in his mind to the horizontal blowing engine. Mr. Bell said they were certainly working beautifully, but that he would like to see them after they had been in use five years.

The result of the working of the two new furnaces was so satisfactory that I designed a new furnace, somewhat larger and higher, with some change in the lines, and with a blowing engine that would blow a pressure of twenty to thirty pounds. I had the foundation for the stack put in, but the caution of our directors was so great that they objected to the building of this new furnace, and much to my regret the subject was for the time dismissed from my mind. The advantage of higher pressure in blast-furnace practice, however, soon became apparent to practical furnacemen, and higher pressures were soon generally adopted.

CHAPTER XIX.

UNITED STATES ROLLING MILL AT CHATTANOOGA.

During the Civil War the Government felt the need of having somewhere in the South an iron rolling mill for the purpose of re-rolling rails which had been torn from the railroads by the Confederate Army. The authorities at Washington took up the matter with some of the leading iron men of the country and entirely to my surprise, as I had known nothing about it, I received, in March, 1864, a letter from Col. D. C. McCallum, of which the following is a copy:

War Department.
Office of
Military Director and Supt. of Railroads, U. S.
Washington, *March* 14, 1864.

To Whom it may concern:

This is to certify that John Fritz is authorized in behalf of the United States Government to purchase the necessary machinery and materials to be used in the construction of a Rail Rolling Mill at Chattanooga, Tenn., and any arrangements he may make will be fully carried out by the Government.

The early completion of this mill is important and indispensable to the advance of the Army, and all persons who may engage to furnish machinery or material therefor are directed to do so to the exclusion of all other business.

Very respectfully,
Your Obt. Svt.,
D. C. McCALLUM,
Col. Director & Genl. Manager M. R. R. U. S.

I took up the work at once and made plans for the mill and arrangements for securing the necessary machinery and supplies.

In connection with procuring the machinery, I was obliged to secure an engine for driving the rolling mill. I went to see Mr. George H. Corliss, of Providence, R. I., the manufacturer of the Corliss engine, at that time very famous. I explained to him just what I wanted for the rolling mill at Chattanooga, and asked him if he could supply such an engine. He told me that he was then building in the shops, and had nearly completed, an engine just such as I wanted, under a contract made previously, but that the man who had ordered the engine was in no hurry for it on account of the unsettled condition of the country. I was greatly pleased to find an engine just such as I wanted, as it was then very difficult to obtain finished machinery, and on account of the nature of the work it was essential for us to begin on the construction of the rail plant at Chattanooga as soon as possible. I said to Mr. Corliss, "This engine of yours just about meets my needs. What is the price of it?" He called his secretary, who brought in the original contract for the engine. At that time material was selling for at least double what it had sold for at the time when this contract was made. I said to Mr. Corliss, "I should like to make as good a bargain as possible for the Government, but I want to be fair with you in this matter." Whereupon Mr. Corliss replied, "You can have this engine at the original contract price, although it is worth more to-day. No good citizen can afford to take advantage of the Government in its hour of peril." In this remark he showed a public spirit and patriotism which marked all his actions.

It was impossible for me to personally superintend the erection of this plant, and also unnecessary. I saw that the plans were properly drawn up and the machinery ordered. My brother William, who had been in the army, was made Superintendent of the plant, and T. W. Yardley, later connected with the R. W. Hunt Bureau of Inspection and Tests, of Chicago, had charge of the business end as distinguished from the manufacturing end. The plant was erected according to my plans and was operated by the Government throughout the war, after which it was sold to Mr. Abram S. Hewitt, of New York City.

CHAPTER XX.

PUDDLING.

If space would permit, I should like to go more fully into the practice of puddling, commencing with its invention in 1783, and following it all through its successive stages until it reached its climax in the year 1890.

While puddling is generally going out of use and has been so greatly overshadowed by the Bessemer process that it is now rather slightingly spoken of, yet there are certain purposes for which high-grade iron is still used, and will continue to be used for some time, notwithstanding the fact that steel can be gotten at less cost.

Having had charge of puddling furnaces and puddlers for about fifty years and never having had any trouble with either furnace or puddler, I do not propose to see my old puddling friend, who has been so true and faithful, and once served the country so well, laid away without saying something of his good qualities and what he has accomplished.

Prior to the introduction of puddling in this country, or rather to the time it was introduced in a number of mills, about 1830, all the wrought iron was made in charcoal fires. It was, consequently, expensive and the quantity small, and as wood was all the time getting scarcer, in a few years the quantity of iron necessary to supply the demands of the country could not be made by that process. Then came the puddling process to supply the deficiency, which it did, and furnished the country with the iron that was so essential for the wonderful development that took place, and at the same time prepared the way for the introduction and remarkable development of the Bessemer process. The puddling process, as it was generally practiced, was a hard and laborious one, and unmechanical, and in its earlier stages it was not very scientific, yet to a person who was about a puddling furnace and gave it any attention it soon became interesting, if he did not have to do the work.

Up to the time of the discovery of the basic process by the late lamented Sidney Gilchrist Thomas, it was the only process in which a pig iron high in phosphorus could be used, commercially speaking. The name of Henry Cort, the inventor of the puddling process, well deserves to be enrolled among the list of great inventors, as one to whom the whole civilized world is greatly indebted.

While it may be out of place here to mention any special class, yet I feel that I would not be doing my duty to let this opportunity pass without paying tribute to the meritorious and hard-working class of men who, up until 1870, made practically all the iron that was used in the construction of the railroads, that, as it were, practically gridironed the country. They also made the iron for the bridges that spanned the great rivers, and for the locomotives and cars that were used on them; also the iron that was used for manufacturing, mechanical, and other purposes. In the year 1890 there was produced by this process in the United States the enormous quantity of 2,518,194 gross tons. Now I think, in view of the magnificent results that have been achieved by the process, it is surely entitled to a prominent place in the history of the iron industries of the world.

CHAPTER XXI.

THE BESSEMER PROCESS.

In 1864 the Bessemer process was introduced into the United States. Its introduction and perfection will ever remain one of the most interesting epochs in the history of the iron business, being, practically speaking, revolutionary in its character. The late Hon. Abram S. Hewitt refers to the Bessemer process as one that takes rank with the great events which have changed the face of society since the time of the Middle Ages.

During the early excitement over the Bessemer steel rail made by Mushet from metal melted in common melting pots, a steel rail was laid on the Midland Railway in 1857, at a place where iron rails lasted only about three months. The wearing qualities of the rail, which was double-headed, and which had been rolled at Ebbw Vale Iron Company, were so marvelous that I thought it might be well to see if iron ores could be found in this country pure enough to make good Bessemer steel. Having had much experience in the manufacture of good merchant bar iron, I had learned that there were but few brands of pig iron that could be used in the dry process of puddling, which was in use at that time, to make a high quality of good wrought iron. This was before the application of that most valuable science,— chemistry,— to the metallurgy of iron. But I had in some way learned that phosphorus was not permissible in the manufacture of good wrought iron. This led me to the conclusion that an iron high in phosphorus would be unsuitable for steel-making purposes.

At this time the making of Bessemer steel was a most important and interesting subject, and so far seemed to be surrounded with doubts and difficulties that looked formidable.

Having taken an interest in the process from its early inception, and closely watching the progress it made in England and Sweden, I made up my mind it was an invention of such importance to us that I would investigate it. After the patent rights for the United States had been bought by Winslow, Griswold & Holley, I made a visit to Troy, N. Y., where they had an experimental plant, to try to get the right to use the patents for a small two-and-one-half- or three-ton converter, for experimental purposes, at Bethlehem with American pig iron, to see whether our ores were suitable for acid Bessemer steel. My interview with Mr. Griswold was very unsatisfactory. After seeing him and talking the subject over thoroughly with him, he showed me a circular from Mr. Bessemer in which he said the limit of phosphorus was 0.02 in the steel. A reference to this circular was made in the discussion of a paper read by Sir Henry Bessemer at the December, 1896, meeting of the American Society of Mechanical Engineers, of which at the time I had the honor of being President. (It is reported in "Transactions American Society of Mechanical Engineers," Vol. XVIII, page 482.) When I saw the Bessemer circular I at once said, "Mr. Griswold, if that is the limit of phosphorus, it is useless to consider the subject any further, and the process will be of little value in this country." We had had, practically speaking, most of the ores of the country analyzed by William T. Roepper, of Bethlehem, Pennsylvania, and had found it was not possible to make any considerable quantity of pig iron low enough in phosphorus to meet the requirements of the Bessemer circular. I well knew it was not possible to get any large quantity of iron so low in phosphorus, as in a general way the coal and ores carried nearly that amount; consequently the Bessemer fever which I had when I met Mr. Griswold was changed to a Bessemer chill after the interview. This was a great disappointment to me. By the time I reached home I was all right, however, and I abandoned the idea of going into making Bessemer steel. Knowing the inferiority of the iron rails made in the country and knowing something must be done, I then turned my attention to the improvement of their quality, and with some success.

I set my mind at work to make all possible improvement on iron rails, and gave considerable thought to steel-headed rails. We succeeded in making a much better iron rail than had been made up to that time, and made some experiments in the direction of steel-headed rails with some promise of success. But having all the work we could do on iron rails, we paid but little attention to steel, as the information I received from Mr. Griswold satisfied me that it was useless to spend any more time on the steel question. During this time, in or about the years 1863 or 1864, William F. Durfee and Robert W. Hunt were at Wyandotte, Michigan, making experiments with a small converter. They succeeded in making steel, but their experiments could not be called a commercial success. About the same time, or probably a little later, Mr. A. L. Holley was successful in making steel at Troy, N. Y., at the experimental plant before referred to.

In or about the year 1865, the Lehigh Valley Railroad Company imported some steel rails from England. In being unloaded from the cars one of the rails was broken and it was sent to the Bethlehem Iron Company's works to be drilled and spliced. We had the drillings analyzed and found the rail to contain about 0.12 of phosphorus. The rail had broken, as might have been expected with that amount of phosphorus, Mr. Bessemer's limit being 0.02. At this time the steel-rail question did not look inviting, and I was glad we had so far kept out of it. A short time after this the Lehigh Valley sent two more steel rails, made by another English firm, which had been broken in the track. This looked so very discouraging that the end of the steel rail seemed in sight. But knowing about the marvelous wearing qualities of the one steel rail laid on the Midland Railway in 1857, I thought it important to investigate the subject further. So I sent for the track master of the Lehigh Valley Railroad and went to the place where the breakage of the second and third rails had taken place. I there learned that a loaded coal car had from some unknown cause left the rail. Upon close examination we found the flange of the wheel had struck the head of the spike that held the rail in place, causing injury to the rail, and in each case of breakage we found it had occurred at a point in the flange immediately under the head of the spike. I came to the conclusion that that had caused the breakage of the rails. We had the two broken rails analyzed and found them to contain each about 0.06 of phosphorus.

The analysis of the two rails that were broken in the track inspired new hope, and we took the ore question up again and had a number of analyses made of the Lake Superior ores, but all were too high in phosphorus, to keep as low as the two rails broken in the track; after carefully looking over the analyses of the ores we had previously made, we did find some ores in other localities that were so low in phosphorus as to give us hope that steel could be made within the limit of 0.06 of phosphorus, but the ore was not found in large quantities and was low in iron. It was a question in my mind whether sufficient ores of the quality desired could be relied on for any length of time. However, we must have a better rail in some way, and concluded to take our chance and build a Bessemer plant. We did this very reluctantly, as we could not see sufficient ore in sight to warrant a supply for any great length of time. We would have to take our chances and would have to rely to some extent on importation, probably of both ore and pig iron, and on the hope that more low-phosphorus ores might be discovered.

We started the foundations of the building in the fall of 1868.

In building the Bessemer plant and the rolling mill I made a new departure. In place of building separate buildings for the Bessemer plant, and also for the various roll trains, I built a good substantial stone building, 931 feet in length and 111 feet in width, with four transepts, two on each side, arranged in the form of a double cross. Each of the transepts was 111 feet in width and 386 feet in length and 29 feet high to the square. They were located to best serve economically the purpose intended. In one of them was placed the machinery for the converting department, one was used for a train of rolls for making light rails for mining and light tramway purposes, the other two were intended for rolling merchant steel. Near one end of the main building the converting department was located, in line with the transept that contained the machinery for operating the converting plant. This machinery consisted of blowing engines and high-pressure pumps for working the cranes and handling the converters. We put in four eight-ton converters. The object in putting in the four converters was to practically do away with night and Sunday repair work, which is expensive and a great nuisance. Back of the converters were placed the cupolas, eight for melting the iron, and two for melting the spiegeleisen. A space back of the cupola was arranged for the mixing of the refractory material for making the converter bottoms and stoppers. The floor for making them on, and an oven for drying them in, were arranged for economical working, with an eye to neatness.

The floor line of the whole plant was on a level except the casting pit, which was about two feet below the floor line. This made it convenient for the men to pour into the moulds, and at the same time protected the men in case of accidental breaking out of the metal, which in the early history of the Bessemer process frequently occurred.

The converters were arranged in pairs, two on each side of the center of the building, with distance between them sufficient to allow work to be done in the pits for each pair of vessels without interfering with each other. The converters, which as before noted were in pairs, had a hydraulic lift between them, which raised the molten metal up to the height to pour into the vessel.

The engines of the mill for blowing and rolling the steel were of the following dimensions:

The first Bessemer blowing engines had two steam cylinders thirty-six inches by sixty inches, coupled direct, with two blowing tubs forty-eight inches by sixty inches. The second pair of blowing engines (built later) had two steam cylinders fifty-six inches by sixty-six inches, with two blowing tubs sixty inches by sixty-six inches. These engines were capable of maintaining forty pounds' air pressure. The smaller blooming-mill engine had a cylinder thirty-six inches by sixty inches, coupled direct, with two stands of three-high rolls thirty-two inches in diameter. The large blooming-mill engine cylinder was sixty-five inches by ninety-six inches, with a ninety-ton flywheel, driving direct one stand of three-high rolls, forty-eight inches in diameter by ten feet long.

Both trains were supplied with movable tables controlled by two levers at one point. The first rail train, twenty-four inches in diameter, was composed of four stands of three-high rolls driven by an upright compound engine; high-pressure cylinder, thirty inches in diameter; low-pressure cylinder, fifty-four inches in diameter; stroke, fifty inches.

The large rail train, also intended to roll shapes, was twenty-eight inches in diameter, composed of three stands of rolls three-high, driven by a triple tandem compound condensing engine connected to the train direct and exerting 8000 H.P. This engine had three high-pressure cylinders thirty-six inches in diameter, and three low-pressure cylinders fifty-four inches in diameter, with forty-six-inch stroke. This train was equipped with tables.

The finishing end of the mill was equipped with the necessary saws, hot beds, drill presses, straightening presses, cold beds, and loading apparatus.

The perplexities and anxiety connected with the manufacture of Bessemer steel were fully described by me in an address delivered before the Franklin Institute in 1899, from which I quote:

" In witnessing the beautiful and interesting but simple process of blowing a heat of metal, and the regularity with which it is done at this time, and the quantity turned out, it is impossible for one wholly unacquainted with its early history to even in a measure realize the fear and anxiety of those who were responsible for the result. When a charge of metal was poured into the vessel, the blast put on, and the vessel turned up, our anxiety commenced, and as the heat increased our anxiety increased in a corresponding ratio, until both became intense. It was when the heat was greatest that accidents were most likely to happen. The refractory material with which the converters were lined, especially the bottoms, would give out, and when in that condition the effect of the heat and the blast would waste the tuyeres and bottoms away so rapidly that from one to three heats were all we could get off of one bottom. Frequently they would give out at the first heat, then out would come the metal through the bottom; and having to use much water about the converter, the place under the vessel was at all times wet, and the result was explosions, often very dangerous, as the hot metal was blown in all directions, frequently inflicting serious injuries on the workmen, a calamity greatly dreaded and the cause of the gravest anxiety to those in charge. When an accident occurred anywhere about the works the first question asked would be: 'Is anyone hurt?' If not, we would go to work at once to repair with that object only in mind. If, on the contrary, some of the workmen were seriously injured, it is impossible to describe the distress of mind that the person in charge had to endure. When the vessel was turned down it sometimes went too far and some of the metal ran out, resulting frequently in a grand pyrotechnic display of an exceedingly dangerous character.

"The next operation was to get the metal in the ladle, which was generally not a very difficult one, but it would frequently burn through the ladle, and then the only thing that could be done was to let it run into the pit and order all hands out of the way, for fear of an explosion. As soon as the metal was partially set all hands commenced to clean the pit, which was no easy task. Here were eight tons of molten steel in the pit, burned fast to ingot moulds, bottom and sides of the pit, and to everything that would not burn up. If we were so fortunate as to get the ladle over the pit in good shape, our anxiety was not yet at an end. It quite frequently happened that the stopper would pull off the end of the rod; then we had to use what we called a pricker to open the nozzle from the bottom. If the metal happened to be cold, which by that time it was apt to be, the nozzle would freeze up, as we called it; then the metal would have to be poured out of the top of the ladle into the mould, cinder and steel all together, with the result that generally the most of it got into the pit; then again, if we escaped an explosion we still had a mess in the pit. Altogether the difficulties we encountered were enough to appall the bravest hearts. My brother George once said, when at Cambria, that he did not believe there was a man who ever went into the Bessemer business, and was responsible for the result, who did not at times wish he had never gone into it; and so far as my experience goes, I can fully corroborate it. And, further, I think that, if it had not been for the interesting and exciting character of the business, but few men would have been willing to incur the trouble and anxiety, and to endure the physical labor and danger to which he and the workmen were constantly exposed, long enough to have placed the business on a commercial basis."

The difficulties that confronted us in the early manufacture of steel were grave and almost innumerable. To cite one instance: We had put in a new bottom and turned the vessel up, and out went one or two tuyeres; we turned it down to put the tuyeres in again, and we had to turn it down two or three times for the same purpose. By the time we got the metal out into the ladle, to pour it into the moulds, the stopper "froze up," that is to say, the stopper came off. Well, then we tried to prick the thing from the bottom, but did not succeed, so we had an arrangement by which we poured it into the mould. Cinders and all went in together, but in some manner the whole heat went into the pit. As soon as it got into the pit I said, "Get out of the way." It gave one of the grandest pyrotechnic exhibitions I have ever seen in my life. I was afraid someone would be burnt, but fortunately no one was injured. We got to work and cleaned up the pit. Holley, who was visiting me at the time, helped us, and after we had the pit cleared up and started up again, a workman let an ingot fall off the buggy beyond the reach of the crane. I said to Holley, "Look at that." He said, "Boss, that will lie still."

Immediately after this I was sent for to go to the blast furnace on account of trouble there. We had been discussing these bottoms right along and all blamed the tuyeres. The manufacturers of the tuyeres would say, "Well, we cannot put any more refractory material into them." The tuyeres were filled in between with ganister; we just lined the vessel with stone after that. I contended that this ganister blew out. It could not melt, because it could stand more heat than the tuyeres, but I thought the friction of the blast blew it off until the tuyeres became exposed, and they could not stand the heat and pressure both. On my way over to the furnace I noticed some sixteen-inch blast-furnace lining brick, and I used some of this as a filler between the tuyeres. On the first experiment we got twelve heats off one bottom, which was phenomenal. That was the end of the trouble.

From this time our troubles began to diminish, and instead of making ten and twelve heats per day we soon ran up to fifty and sixty heats in twelve hours, and some of the works are now making seventy and eighty. This system of making bottoms was at once generally adopted, and is still in use.

At this time the machinists before alluded to were called to the front to brave the danger and fight the great battles that have ever to be encountered in the introduction of new metallurgical processes, and in none were the difficulties more alarming and disheartening than in the Bessemer process. These men had now received a training which eminently fitted them for the duties they were called upon to perform. Having been inured to hard work, they entered into this new field with such an amount of energy and determination that it made failure impossible.

CHAPTER XXII.

THE BESSEMER PROCESS. — Continued.

One of the earliest and most graphic accounts of a Bessemer "blow" at night was written by our ever-lamented friend, A. L. Holley, to whom I have before referred. It was published in the *Troy Daily Times* in 1865, and quoted by Dr. Rossiter W. Raymond in a memorial address at the Turf Club Theater, of New York City, November 1, 1883, at a combined meeting of the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the American Institute of Mining Engineers. In describing the blow, Mr. Holley said:

"The cavernous room is dark, the air sulphurous, the sounds of suppressed power are melancholy and deep. Half-revealed monsters with piercing eyes crouch in the corners, spectral shapes ever flit about the wall, and lurid beams of light anon flash in your face as some remorseless beast opens its red-hot jaws for its iron ration. Then the melter thrusts a spear between the joints of its armor and a glistening, yellow stream spurts out for a moment, and then all is dark once more. Again and again he stabs it, till six tons of its hot and smoking blood fill a great caldron to the brim. Then the foreman shouts to a thirty-foot giant in the corner, who straightway stretches out his iron arm and gently lifts the cauldron away up into the air and turns out the yellow blood in a hissing, sparkling stream, which dives into the white-hot jaws of another monster, — a monster as big as an elephant, with a head like a frog, and scaly hide. The foreman shouts again, at which up rises the monster on its haunches, growling and snorting sparks and flame.

"What a conflict of the elements is going on in that vast laboratory! A million balls of melted iron, tearing away from the liquid mass, surging from side to side, and plunging down again, only to be blown out more hot and angry than before — column upon column of air, squeezed solid like rods of glass by the power of five hundred horses, piercing and shattering the iron at every point, chasing it up and down, robbing it of its treasures, only to be itself decomposed, and hurled out into the night in roaring blaze.

"As the combustion progresses, the surging mass grows hotter, throwing out splashes of liquid slag; and the discharge from its mouth changes from sparks and streaks of red and yellow gas to thick, full, white, howling, dazzling flame. But such battles cannot last long. In a quarter of an hour the iron is stripped of every combustible alloy, and hangs out the white flag. The converter is then turned upon its side, the blast shut off, and the recarburizer run in. Then for a moment the war of the elements rages again; the mass boils and flames with higher intensity, and with a rapidity of chemical reaction, sometimes throwing it violently out of the converter mouth; then all is quiet, and the product is steel, — liquid, milky steel, that pours out into the ladle from under its roof of slag, smooth, shining, and almost transparent."

In the early history of the process Mr. Holley, Captain Hunt, my brother George, and Captain Jones would frequently come to Bethlehem to talk over our troubles — not high finance, but the difficulties we daily met, which at times seemed almost insuperable. We did not meet as diplomats, to find out what each other wanted, without even hinting of anything they wanted, but we met as a band of loving brother engineers trained by arduous experience, young, able, energetic, and determined to make a success. I doubt if ever five natural brothers were more loyal to each other than the five brother engineers above named. What each of us knew was common to all.

Upon one occasion we all met at my house and talked over our troubles in detail, and they seemed so grave that some of us doubted if we could ever make the Bessemer process a financial success. In fact, my doubts were such that I had thought seriously of making a steel-headed rail and had made some experiments in that line, with some little show of success, when some one of the party said that if there could be a patent secured on the steel-headed rail it would be worth more than any other patent that could be taken out. To this my brother George dissented, putting his hand on the top of his head and facetiously saying that if someone would discover something that would make the hair grow there, it would be worth more money than any invention that could be gotten up. Referring to Captain Hunt, he said: "Here is Robert; he would give five thousand dollars for it."

Sometimes we were joined by my dear friend Eckley B. Coxe, who though not a steel man was one of the most able and distinguished mining engineers our country has ever known — a man so highly trained scientifically, so full of resource and suggestion that my recollections of my conferences with him are an ever present pleasure. I delighted to have him and Holley together.

In connection with the Bessemer process of steel manufacture, it is interesting to note that although the credit of it is generally given entirely to Sir Henry Bessemer, of London, England, yet an American inventor, William Kelly, had experimented for a number of years, at Eddyville, Kentucky, along the same lines. The original desire of both Sir Henry Bessemer and Mr. Kelly was to improve the quality of iron. So far as is known, neither of them at that time had in view the manufacture of steel.

When Mr. Bessemer received his patent in this country in 1856, Mr. Kelly immediately set up a claim of priority of invention, and supported this claim with an account of what he had previously done at his forge at Eddyville, Kentucky.

Mr. Kelly continued his Eddyville experiments at Johnstown, at the Cambria Iron Works, during my time there. The Bessemer and Kelly claims were considered by the Commissioner of Patents, and Mr. Kelly was granted a patent on the ground of priority, and in 1863 a company, known as the Kelly Process Company, was formed, for the purpose of making steel under the Kelly patents.

As stated before, the control in this country of the Bessemer patents was obtained in 1864 by John F. Winslow, John A. Griswold, and Alexander L. Holley, of Troy, N. Y., and the firm was successful in 1865 in making Bessemer steel at their experimental furnace at that place. A compromise was arranged between them and the Kelly Process Company. The Bessemer Company attracted more general attention than the Kelly claims; but considerable credit is due to Mr. Kelly for what he had accomplished.

Early in the history of the Bessemer process the Bethlehem Iron Company had an opportunity to make a long-time contract with the Cornwall people, on favorable terms, for a quantity of suitable ore, but the directors were not then disposed to do so, notwithstanding the fact that we had used large quantities of both the iron and the ore, and knew them to be good, especially as a mixture. The directors thought we could buy the iron and the ore as we wanted them, and would not be embarrassed by a long contract. At that time we were the only people who knew how valuable the Cornwall ore was. The other Bessemer makers were, in a general way, fearful of the sulphur, but we had learned that for rails and some other purposes the sulphur was practically quite harmless, and that we could use the Cornwall ore to great advantage up to one-half of the mixture. The other Bessemer people soon learned that the Bethlehem Company was using Cornwall ore largely and doing good work, consequently they got to using it and found it so valuable that some of them invested largely in the Cornwall ore property. This was much to our detriment, as it was about all that we could do to get the proper material to make the special high-grade steel that we had a large demand for, which was being used largely in place of open-hearth acid steel; in fact, it was the best steel that at that time was being made, and for many purposes was preferred to crucible steel.

The condition of affairs as to the quality of steel we were making was to me sickening, as it had at all times been the pride of my profession to do good work in whatever line it might lie. But here I found myself in such a position that, so far as rails were concerned, they were but little, if any, better than the greater part of the rails that were being made, and were, to my mind, very unsatisfactory. At that time we had a contract for high-carbon rails, which called for the maximum phosphorus to be below six one-hundredths, and it was with great difficulty that the phosphorus could be kept low enough. I went to the President of the company. He said the rails were as good as any others that were being made. I told him that the rails were being made under a contract, and that if they did not come up to the specifications in every way the inspector would not accept them. I said we must have some Cornwall iron, or some other that was equally low in phosphorus. At the same time I told him if we could not get a good iron for making rails, I would have nothing to do with the rail mill, At this time Mr. Algernon Roberts, of the firm of A. & P. Roberts, was making car axles at the Pencoyd Iron Works. He told me the trouble the firm had had in reducing the axles in the middle uniformly, and asked if I could help him out of his trouble. Previous to this Sir Joseph Whitworth had invented a hydraulic press for forging. I had made up my mind it was a good scheme and was what Mr. Roberts wanted, but Mr. Whitworth would neither make one nor let anyone see it. I also understood that Haswell in Vienna was using some kind of a press for making heavy drop forgings, using a press instead of a hammer, and I suggested it would be well to see what Mr. Haswell was doing. Mr. Roberts was so much interested in the press that he and Mr. James Dougherty went over to see it. On his return he came to see me, and said he did not think Haswell's press was what he wanted. I asked him if he could get the drawings of what Mr. Haswell was doing. He said he thought he could, and would arrange to do so, and said that if we got the drawings we could use them for the purpose he wanted them for. Unfortunately, shortly after our conversation, Mr. Roberts died quite suddenly, and for a time the subject was dropped, but not forgotten.

The condition of affairs in the Bessemer plant was most deplorable, but there was one more chance to get quite a large quantity of Bessemer acid ore. By ceasing to make rails and by being able to get high-grade ores in sufficient quantities to supply the demand we had for high-quality steel, we could do a profitable business in that line, and a satisfactory one. At that time we were using a small quantity of an ore known as the Tilly Foster ore, but the mine was in such bad condition that only a small quantity could be mined, and it would cost much money to put it in such shape that a large amount of ore could be gotten out. The ore was of such a character that I was quite sure it was a good business proposition to spend the money to develop the mine. Consequently, I took our best practical mining experts and made a very thorough examination of the mine and an estimate of the cost of putting it in such shape that a large amount of ore could be taken out annually. As I now remember, the estimate was about $100,000, not over twenty-five cents per ton on the ore, in addition to the royalty. Taking the quality of ore into consideration, it was a very cheap ore. The proposition, however, did not meet the approval of the management and the project was dropped. I was now at the end of my line in that direction, and told our management that it was not possible to make good special steel or good rails out of such material as we were being compelled to use. In reply they again said we were making as good rails as other works were making, and that they could see no reason why we should make them any better. I told them the work we were doing was unsatisfactory to me, that it was the aim of my life in whatever line I might be to turn out good work, that it could not be done with the material we were using, and that I would not be responsible for the result. We were now up against the real thing and something had to be done. My reputation and money were both at stake, and at my age I could not afford to lose either of them.

CHAPTER XXIII.

OPEN-HEARTH PROCESS.

In 1868 the manufacture of acid open-hearth steel commenced. The Siemens regenerating furnace was used, and the Martin system, generally known as the Siemens-Martin process. But its progress was slow, as it followed the Bessemer, which was spectacular, beautiful, exciting, and most intensely interesting in the blowing of a heat of metal. While the Siemens-Martin process is scientific and simple, it is not so interesting and exciting as the Bessemer process, and it did not command the attention and respect to which it was entitled. The fact that the Bessemer had been introduced and the machinery in use, and the knowledge gained in the use of refractory material and in the handling of steel, made the introduction of the open-hearth process easy as compared with the Bessemer. But the fact that it so modestly made its way into general use does not in any way detract from its great usefulness, and with the later introduction of the Thomas and Gilchrist basic process and its application to the Siemens furnace, the basic open-hearth process takes rank as the greatest metallurgical discovery of the age.

Taking into consideration the character of our ores and coal, and their geographical location, its importance at once becomes manifest. It is the most important and valuable invention that has yet been made in the line of metallurgy. The ores that can be used in the basic open-hearth process are known to exist in almost every state in the Union, while the ores that are suitable to make good Bessemer steel, by the acid process, are very limited, so far as is known, the phosphorus of most American ores being too high for the Bessemer acid process. The rails that were being made in this country by the Bessemer process were generally inferior in quality, and the time was near when the railroads would demand a higher quality of rails, and they necessarily had to be made in the basic open-hearth furnace. The failure to make steel high in quality is not due to the Bessemer process, but to the difficulty of procuring suitable ores, phosphorus being the most baneful element. This fact alone placed the basic process in the lead, where it will remain until some other startling process is discovered. The Thomas and Gilchrist basic process, the greatest metallurgical discovery of the age, in connection with the Siemens open-hearth furnace, has taken the lead of all other known processes in the manufacture of steel.

In or about 1871, Mr. Leach of Boston called on me at Bethlehem to have a talk over the Siemens regenerative gas furnace, for which he was the agent in this country. I wanted to use it in the Bethlehem plant. After he had agreed on the price I told him the roof was too low to get perfect combustion and that I would make it much higher. He at once said, "Do you pretend to know more than Dr. Siemens?" I told him, "No, I wish I knew half as much as he did." But I told him further that I had puddled and heated more iron than Dr. Siemens had, and had had more experience in rolling-mill practice where great heat was required; but Mr. Leach was not willing to let me make any change in the construction. He went over to New York, called on Mr. Abram S. Hewitt, and told him what had passed between us in regard to the furnace. Mr. Hewitt advised, "You go back to Bethlehem and tell Fritz to make any changes he wants." Mr. Leach returned to

Bethlehem and told me exactly what Mr. Hewitt had said. We thereon compromised on a straight roof, but I didn't build it, as I knew it wasn't right. When we came to build the furnace I built it just as I wanted it, and it was eminently successful.

CHAPTER XXIV.

BLOOMING MILL.

In 1872 the writer built a blooming mill in Bethlehem, and having had the experience of both the Holley mill at Troy and the Fritz mill at Cambria and a large rolling-mill experience, made some important changes, — making all the three rolls fixed, with grooves in the rolls corresponding with the work in reduction we wanted to put on each groove, avoiding the use of screws altogether, except for adjustment of the rolls, — a great saving in cost in construction and repairs. I had an aversion to cog gear of any kind, and the spur gears with idlers to keep the motion of the rollers in the proper direction, adopted in both the Holley and my brother's mill (at Cambria), had one serious defect. The gear on the roll to which the power was attached had to transmit the power to drive all the rolls in the table, the power being transmitted from the first roller to the second by an idler, and so on to the last roll in the table. The strain increased until it was so difficult to keep things in order that some change in the system of driving the rollers was necessary, and there was no practical way of doing it without the use of cog gear of some form. In the spur-gear system the idler was necessary, but the idlers gave so much trouble, and they became such an abominable nuisance, that some device had to be adopted to get rid of them. As it was impossible at that time to drive the mill without cog gear in some form, I adopted the mitered system and put a miter-gear wheel on the end of each roller shaft in the table, as large in diameter as could be readily put in, then placed a shaft in line with the center of the rollers, and parallel with the table; on this shaft I put a wheel cast off the same pattern as on the rollers to gear into each wheel on the rollers in the table, the shaft transmitting the power separately to each roller in the table, instead of driving all the rollers through a system of idlers from one driven spur wheel on the first roller in the table, thus avoiding the tremendous strain on the first gear, the great amount of friction, the great expense in repairs, the loss of time while repairs were being made, and a great waste of power.

The power used for driving the rollers in the table was taken from the same engine that drove the train. It was transmitted to the rollers by a belt on the flywheel shaft, which drove a horizontal shaft that conveyed the power to a set of friction clutches properly secured to the roll housing, which, in turn, connected with a square vertical shaft on which was placed a bevel cog-gear wheel, loose, which geared into a wheel on the shaft of one of the end rollers on the table, it becoming the driver, through the idlers, of all the rollers in the table. The reversing of rollers in the tables was done by friction clutches, which were always a source of trouble. The raising and lowering of the tables at that time was a most difficult problem to solve. They had to be moved up and down a distance equal to the diameter of the working rolls, at that time about thirty-two inches, and they had to run at any point within this distance, both back and forth. It was this which caused so much trouble and expense. It was not possible to do this with machinery for driving a positive fixture, and it must in some way have a yielding point automatically adjusted.

The first and most important thing was to get rid of the idlers, and by the use of the parallel shaft and miter gear we most effectively obviated them. The next thing to do was to get rid of the friction clutches, which were a great source of trouble, and also of all the complicated machinery for conveying the power to the rollers in the tables. The next and most important thing to do to make the blooming mill a grand success was a plan to convey the power to the rollers that would permit the raising and lowering of the tables and would at the same time drive them at any and all points within the travel of the tables. The device must be automatic, simple, and effective. All these combinations made quite a difficult problem to solve. A number of plans were suggested in my mind, and were well thought over, but all lacked the one all-important element of simplicity, which I had in view when we started to build the mill.

I destroyed all the bridges as I crossed over them. One plan was to use the power from the main engine to drive the rollers in the table. The friction clutches for driving and reversing the rolls were another problem — both had to be arranged for. The power to be used for driving the table rollers must be separate and must be used for no other purpose whatever. A two-cylinder engine of the proper size was the most simple way of getting the power, and by making it reverse, the friction clutches were dispensed with and became a curiosity of the past.

The only thing that remained to be done was to get some simple way of conveying the power from the engine to the table, and here for a time there seemed to be an insurmountable difficulty in the way. As the rollers were not stationary or fixed, having to move up and down, and to revolve at will in either direction, it was not possible to have a fixed or positive connection of the power between the engine and the table, as the distance between them increased and diminished as the table was raised or lowered. Many plans to get over this trouble were suggested and thought over, but all were complicated, and would surely be difficult to be kept in order — something that must be avoided. At this stage, things looked as if there was trouble ahead, and something had to be done, mechanically or otherwise.

I now took into consideration that the variation in the distance between the driving and the driven points was short, say about eight feet, and I at once concluded to put a pulley on the engine and one on the horizontal shaft on the table which drove the rollers, and connect them with a belt, and put a tightener on the belt to keep it uniformly taut. The arrangement was so complete and so satisfactory that I felt somewhat abashed to think I had spent so much time over what seemed to be such a difficult problem, and yet in the end was so perfectly simple. But I remembered that Mr. Holley and my brother George, both able men, had each of them built a blooming mill, and had doubtless given the same problem much thought; and yet, since they used a complicated scheme for the same purpose, they could not have thought of anything so perfectly simple. This was, in a measure, a panacea for my wounded feelings, as one of them was a dear friend and the other a brother. In the next mill that Mr. Holley built, he used a geared device so arranged as to accommodate the variable distance between the engine and the table, in place of belt and tightener; this answered the purpose equally well, and was much more mechanical.

This blooming mill was a complete success and was capable of doing a very large amount of work with moderate-sized ingots, such as were being used at the time it was built. But for large ingots and a great variety of work such as is being called for at this time, the reversing mill with adjustable top roll is preferable.

CHAPTER XXV.

STRUCTURAL AND PLATE MILL.

After the steel plant was completed and doing splendid work, and well knowing the want and importance of a good structural mill, I turned my attention to that subject. At that time the flanges of the beams and channels were so narrow and the angle of the flanges so great that it was difficult to construct sections that had to be riveted together; this was not only embarrassing to the engineer, but was an impediment in the advancement of his profession, and any difficulty that stands in the way of progress in any line of business should, if possible, be overcome. Consequently, I took up the subject of structural material and had drawings made of beams and channels, with wider and lighter flanges and with less angle, so that they could be punched without difficulty and be riveted together readily. I also designed a mill and rolls that would roll them out of a square steel ingot. In fact, the sections and manner of rolling standard shapes that I then proposed were practically what is being done at the present time.

I showed the whole scheme to some of our ablest engineers, and they indorsed it most emphatically, and urged me to get the Bethlehem Iron Company to go into the business. One of the oldest and ablest, Charles Macdonald, said that if they would, and would make shapes of sections such as I showed, he would put up at Bethlehem a structural machine shop for the manufacture of members of bridges and buildings and equip it with tools, and the conveniences for handling and facilitating the work, that would surpass any shop of the kind there was in the country. I urged the company with all the eloquent language I could command, but with no effect. Then I tried compulsion, by saying it was absolutely essential for the permanent success of the company to have some diversity in their business. This raised a question, and I was asked if I knew how many tons of structural material was made in a year in the country. I told them I did not know, and did not care, but there was one thing I did know, — that there was not a proper section of beams or channels in the country, or a proper mill to roll them, that the use of structural material for building purposes was in its infancy, and that steel was the material that was going to be used for the purpose, in the near future.

When the steel plant was built I arranged for a mill that small sizes of beams and channels could be rolled on, and also put up a mill that larger ingots could be rolled on, so as to make the proper shapes to roll the larger sections of beams and channels out of, knowing that in France they were rolling beams of great width with thin and wide flanges. This fact greatly increased my desire to go into the business, as wide sections with wide flanges were what were wanted in the engineering line. But it was no use, and some of the directors said I was never satisfied, but must be at something new, and could not let well enough alone. So for the time I let the subject drop.

Some years later, when the Gray and York system of rolling wide sections with wide, thin, and parallel flanges first came up, I at once investigated the principle, and to my mind it appeared a much more complete system than the French, and I once more ventured to call the attention of our people to the plan. The mention of it, however, met opposition, and I thought it best not to pursue the subject further.

Some years later, one of the directors (a railroad man) came to me, saying, "You iron men are the most inconsistent men in the country." I said, "What now?" He said, "You are at all times preaching protection, and I now want some four-by-six-inch angles and cannot get them short of going to England for them." I ventured to say rather facetiously, "If you had let me go into the structural business, you could get any shapes you wanted." I then said, "How long do you want them?" He said, "It is useless to talk about them. I have tried all the best mills in the country and they can't make them." "Well," I replied, "tell me how long you want them and in less than two weeks' time you will have them in any lengths you want them, and you can't get them from England at best short of four weeks." I at once ordered a set of rolls turned up, and in about the time named we sent for him to come and see the four-by-six-inch angle, some eighty feet in length, and see if it was all right, and would suit him. He came to see it and was much pleased with it. He said he would give us a list of what he wanted and give us the order, and said he thought the longest of them would be between fifty and sixty feet. I told him we could roll them one hundred feet if he should want them. This was the first four-by-six-inch angle that was rolled in this country. They were rolled in the old mill on the twenty-one-inch train, and I must confess we were all a little proud of the result.

The Bethlehem Iron Company made many mistakes, but their refusal to go into the manufacture of structural material at the time alluded to was to my mind the greatest. Later Mr. C. M. Schwab acquired the entire property, and erected a structural steel plant, which is now in successful operation.

Shortly after I had failed to get the company to go into the rolling of structural material, I suggested the propriety of building a plate mill, as plates of large size and high-grade in quality and finish were wanted. I said that in the future ships of all kinds and classes would be built of iron or steel, and the demand for plate must necessarily be great. In talking with one of the directors, who was a large stockholder, I found him favorably inclined toward the project, so much so that I concluded to get up a complete set of drawings of a mill and a general plan for the layout. I knew that plates were in demand, and the demand was sure to increase, and there was great money in the business. I thought it would be well to have a set of drawings and ground plan made, but the plate-mill scheme, for the time, came to an abrupt end.

CHAPTER XXVI.

FORGE AND ARMOR-PLATE PLANT.

After the failure to get the company to go into the manufacture of structural material and the plate business, I concluded that it would be well to give them time for consideration before making any further suggestions. Some one or two years later I called the company's attention to the fact that there was not a forge plant in the country where a ten-inch shaft could be properly forged. The heaviest hammers that were in use for forging were of about ten or twelve tons, but they were entirely too light for heavy forging. In order to make the blow more effective, steam was used on the top of the piston, which for forging heavy shafting was worse than useless, as the blow is so quick that the center does not receive the full force of it, and the tendency is to create longitudinal seams and circumferential cracks; the center, not receiving the full force of the blow, is in a measure elongated by the tension of the outer portion of the shaft. Knowing this to be the fact, I did not use either wrought-iron or steel shafting that was forged under a light hammer, but always, where great strength was required, used air-furnace castings made out of the best cold-blast charcoal iron that it was possible to get, and in my long experience I never had one fail. In some instances, where iron forgings failed we replaced them with air-furnace castings, and they gave no trouble.

I have known wrought-iron forged shafts to fail and be replaced by cast-iron shafts which never gave any trouble, and a person giving the subject any serious consideration will see at once why a cast-iron shaft should be safer and better than one of wrought iron as they used to be forged. In the first place, by the use of good iron, intelligently melted, in an air furnace, you can get a tensile strength of 32,000 pounds per square inch, and with a proper sink-head you can get a practically solid casting, and I might add, homogeneous and close in the grain; while, as I have already stated, the forged shaft of that day would in all probability be unsound in the center and coarse-grained, and its tensile strength little greater, if any, than cast iron.

I shall now refer to a single experience I had, believing that a brief description giving the reasons why I used wrought-iron and steel shafts in place of cast iron, which had for over forty years served me well, will be both interesting and instructive.

The reason for using wrought iron and steel in place of cast iron was that I wanted a three-throw crank for a three-cylinder engine, and I had to use a built-up crank, as at that time I could not get any other in this country. As the stroke of the engine was rather short, it reduced the distance from center of shaft to center of crank pin, so that the shafts had to be kept down to the smallest possible size, in order to get sufficient metal between the holes to give the cranks the required strength between the shaft and the crank pin.

As steel at that time was more expensive than wrought iron, I concluded to make the main shaft and first crank pin out of steel, and the others out of wrought iron. Not having at that time any overflow of confidence in either forged iron or steel shafts, and being anxious to get the best that could possibly be gotten, I consulted a friend, who was using steel shafts, and asked him where was the best place in this country to get them. He kindly advised me where to go for the steel shaft and crank pin, and I took his advice and ordered them. The iron shafts and pins were ordered from what I considered, at that time, the best forge plant in the country.

Having had some previous experience, in a small way, with both metals, with results not altogether lovely, I thought it prudent to see in what condition the metal was in the center. In order to show this, a hole about four inches in diameter was bored through the center of them all, seven in number, five iron and two steel, and all were found to be unsound in the center. In the iron the imperfections ran longitudinally and the four-inch hole practically cleaned them out. The steel shaft, which was about fourteen inches in diameter and some twelve feet long, proved so unsound in the four-inch hole, as there were imperfections in the form of large cracks or circumferential openings, that the hole was enlarged to about six and one-half inches. Some of the imperfections were still visible. The position of the shaft was such, when in use, that, should it give way, it would not be likely to do any serious damage, so we concluded to use it. When the hole was bored through the steel crank pin, the imperfections showed so badly that we placed it on the planer and cut it in half lengthwise. It was full of circumferential cracks, some of them extending almost to the edge. It was frightful to a person who was contemplating the building of a forge plant, for the purpose of making steel forgings, as I was at that time. The result was not entirely unexpected, as my experience in making steel and in heating, rolling, and forging had already convinced me that it would require great skill and still greater care to prevent internal imperfections in the steel forgings, yet I was not prepared to witness anything approaching the condition which the splitting of this forging revealed. This was a revelation to the engineers that saw it, and at the same time it furnished an argument in favor of a large forging plant that could not be gainsaid.

The chemical analysis of the steel, if I remember correctly, was very good. There had been some blowholes in the ingot, as there are in too many of them. To my mind the trouble was almost entirely to be attributed to two causes. First, the ingot had been charged in a hot furnace and

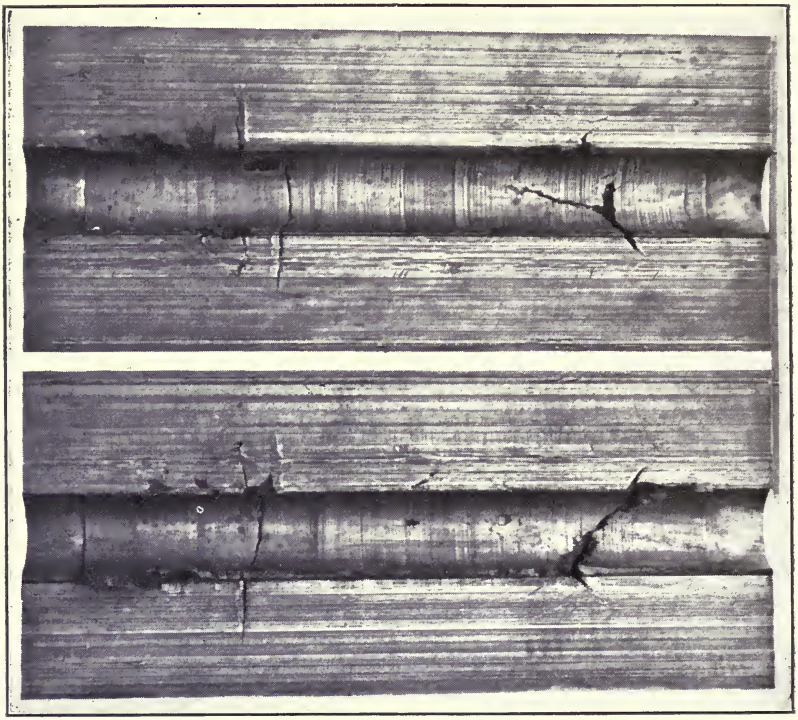


Fig. 8. — Section of Steel Shaft showing Imperfections in Forging.

heated up too quickly, pulling the center apart, thereby causing the cracks. Second, as the ingot was forged under a light hammer, in all probability using steam on top of the piston (which gives a quick stroke and does not give the metal time to flow or to reach the center, thereby elongating the outside more rapidly than the interior), the imperfections, whatever they might be, being the weaker parts, were drawn more rapidly than the more perfect parts of the ingot, consequently the imperfections were greatly augmented.

Mr. Durfee once read a paper before the Franklin Institute, on the conditions which cause wrought iron to be fibrous and steel low in carbon to be crystalline, and a most admirable paper it is, and one which every maker and user of steel should read and study. In regard to unsound ingots, he says it is a common opinion that one of the reasons why steel forgings are often found hollow in the interior is the failure to work them under a sufficiently heavy hammer, but no hammer can do more than aggravate the evil of internal ruptures in ingots of steel. This is well said, and a truth that cannot be gainsaid. It was imperfect ingots, lack of knowledge in heating and forging, and also the want of skill to treat the forgings properly after they were made, that caused so many failures in steel forgings only a few years ago, and caused many people to think and believe that there was some mysterious uncertainty in the metal, and, consequently, to discard its use altogether. To some extent, this impression is still in existence. To my surprise, only a short time ago quite a prominent engineer told me that he was still using wrought-iron shafts.

The experience with the steel shaft brought the system of hydraulic forging, before alluded to, most vividly to my mind again, but unfortunately Mr. Roberts, who was referred to in a former chapter, was no more. Consequently I went to the Pencoyd Works, with which Mr. Roberts had been connected, but as he had died suddenly the matter had been dropped and I could get no information from them. I then went to see Mr. James Dougherty, the gentleman who went with Mr. Roberts to Vienna, but could get no information from him, as he said that what little he had known at the time of his visit had passed from his mind.

This being the true condition of affairs, as they existed in the country, I concluded to try to get the directors to build a forge plant, using the foregoing in argument to prove that a good forge plant was a necessity, was practicable, and desirable. For a time I thought I was at last going to be successful, as the General Manager seemed to favor the project; but all at once he changed his views, giving as a reason that the President was opposed to going into anything new. The President was a nice old gentleman and I liked him very much; he was a man of commanding appearance, was intelligent, and could gain access to a busy railroad president when others less favored by nature and culture had to wait. He managed the business affairs of the company as they then existed most admirably, but in looking to the future it took a clear day for him to discern anything whatever that would be likely to make a change in the business of the company, consequently I was doomed to failure again. This was a dark hour for me.

For a time the situation seemed hopeless, and had it been manly I would have given up the whole matter. But the condition of the country was such that it was apparent to my mind that a good forge and armor-plate plant was indispensable — I had armor plate in my mind from the beginning. Practically speaking, we were in a most defenseless condition, having neither a navy nor modern guns for land or coast defense. We were at the mercy of the world, — a disgraceful condition for a great nation to be in. But after every suggestion that I had made had been turned down, it seemed like a forlorn hope to attempt resurrection. Having fully considered the importance of a great forging plant to the country, I was well prepared to meet any objection.

I then concluded that I would try our management from a patriotic standpoint, but that did not seem to take, as some of the directors belonged to a sect that was opposed to fighting in any way or manner. But I thought, from what some of the directors had previously said and what others did not say, that a strong presentation of the case might set them to thinking.

Armor plate was one of the things the Government must have, and as iron was useless in front of modern steel shot and shells, steel must be the material that would be substituted for it. We knew that for steel where close grain and hard surface were desired, as is required for armor plates, the hammer was superior to rolls or press. The face of the armor should be close-grained and harder than the back, and as the hammer side of a plate is closer in grain than the anvil side, a plate made under a hammer would be harder on one side than a plate made in the rolls or press. Therefore, the hammer was then superior to the rolls or press for armor plates. (This was before the invention and introduction of the Harvey process.) This fact was somewhat encouraging, as there were no patents to interfere and we could build the hammer ourselves. I now brought the forge and armor plant to the front again, but was met by the old ghost of failure, sheriff, or assignee, or the argument "better let well enough alone," which is death to all progress. But some of the directors were not quite so outspoken against the scheme as formerly.

About this time my friend, Mr. Charles Brodhead, told me about William H. Jaques, a bright young Lieutenant in the Navy, who was Secretary of the Gun Foundry Board, during its visit to Europe for the purpose of seeing the best plants for the manufacture of ordnance, and such other material as was necessary for the complete equipment of the United States Navy. Among the many plants they visited was Sir Joseph Whitworth's, where they were cordially received, and were most favorably impressed with the plant and what they saw. Up to the time of their visit no strangers had been permitted inside of the Whitworth shops, but the Board were not only admitted into the shops but were shown everything they wished to see. Lieutenant Jaques got a contract from Sir Joseph Whitworth, giving him personally authority to build a plant in the United States, the Whitworth Works to furnish plans for the plant and build the forging presses, a fluid-compression press, the machine tools, and all the necessities for the equipment of a complete forging plant. To Lieutenant Jaques is due the main credit for our subsequent acquisition of the Whitworth system of forging.

Some time after the Board returned home, Lieutenant Jaques came to Bethlehem to talk over the subject of building a forge plant at Bethlehem, under his contract with Sir Joseph Whitworth. This was just what I wanted and what the country in some way must have. I well knew it would be the fight of my life to carry it through, as it was a forlorn hope, but I made up my mind to enter the arena with sleeves rolled up to do or die, as something must be done. I could plainly see the end of the acid Bessemer everywhere, and especially with us, as the company had let every ore property that was available and suitable for the Bessemer process pass beyond their control, and the end was in sight.

When Mr. Jaques was in Bethlehem he was introduced to Mr. Alfred Hunt, who was at that time President of the Bethlehem Iron Company. Mr. Hunt was very much of a gentleman and knew how to meet any person from a king to a beggar. Of course, he treated Mr. Jaques politely, but said little that was in any way encouraging; he finally said the subject was "significant," and that he would bring it before the directors but without recommendation.

The Board meeting was held monthly, and so it happened, as I remember, that it was some ten days or two weeks before a meeting would take place. In the meantime, there was much talk between the directors, singly and myself, but it seemed to have but little if any effect. At length the time of the regular Board meeting came, but what they said I did not know. After the meeting was over I talked with the directors singly again. Some of them thought the Lieutenant was bright but young and inexperienced and not a safe adviser, as he knew nothing in regard to the practical working of such a plant; they said it was so different from what we were doing that we would have to teach all new men, which would be very costly, and they could not see where the work to keep such a vast plant as I wanted to build was to be secured, and did not know where the money was to come from to build it, and the chances were, it would be a failure and the whole plant would get into the hands of the sheriff or assignee, or some other ghostly bugaboo.

But I was favorably impressed with what Mr. Jaques told me about the plant, what Whitworth's works were doing, and how kindly the Gun Foundry Board had been treated by the people connected with those works, and with the fact that Mr. Jaques had a contract giving him permission and all necessary information to build a plant in the United States. This was more than I ever expected could be gotten from the Whitworth people, as their policy up to that time had been to keep everything secret. As there seemed some doubt in the minds of some of the directors as to Lieutenant Jaques' being able to form a correct opinion of what he had seen, I proposed to our President and General Manager to let me go over to Whitworth's and investigate the whole subject thoroughly; but they did not seem to take any interest whatever in the matter, saying the project was premature, and they looked upon it as a vague experiment, that would surely end in trouble. But, as at Cambria, my mind was made up that something had to be done or trouble would surely come, so I urged the company to let me go over to Whitworth's to see for myself and meet Jaques there. This finally they did, but very reluctantly.

As soon as I had their consent to let me go, I got things about the works in the best shape that was possible, so that I could remain from home for a month or so. In this connection, the General Manager one day placed his hand on my shoulder and said, " John, you have done more than any other man to draw us into this wild scheme, and I am going to hold you responsible for the result." I was not discouraged by this, and I told the General Manager that I would assume the responsibility, and that I had much more at stake than he had. I said I well knew that it was a great undertaking, and, indeed, compared with the then existing plants in the country, what I wanted was truly gigantic.

On the second, third, and fourth days out, if I could have been landed on the American side of the Atlantic, it is quite likely I would have done so, but on the fifth day I had gotten into a better frame of mind and stomach, and by the time I arrived in Liverpool I was as full of enthusiasm as ever on the subject of my mission.

On my return I reported to the directors. As I had had several disappointing failures to get the company to look forward to a change in their business, and well knew that they must, in some measure at least, make a change, and as Lieutenant Jaques had secured the right for the use of the Whitworth patents for hydraulic forgings, and as I had talked the subject over with the directors at various times without any success and but little encouragement, I now told them most emphatically that something must be done at their next Board meeting, which was to take place in a few days.

At the next meeting they took the subject up, and after most seriously talking it over they sent for me to come to the meeting. This I did, and I found them looking as if they were about to bury the last friend they had on earth. They had their say, all but one. They generally thought it was a wild and visionary scheme; it would take a vast amount of money, and they could not see where the money was to come from, and failure was sure to take place. Some said we had been making money and they could see no reason for a change. They asked what I had to say. I replied: " I have given you my views so often and so frankly that it seems to me useless to repeat them. I will, however say that you have turned down everything that I have suggested, and you are up against the last that I have to suggest. Some of you say, Let well alone. I say that in this case such a policy will be suicidal. Some of the directors have their doubts of my ability to carry through a job of such magnitude. Now, gentlemen, I wish to say to you all that I have given this proposition mature consideration, and from three standpoints. First, it is of the utmost importance that the nation should have within its control just such a plant as it is proposed to build; it must have it and should have it at once. Second, the engineers of the country are greatly in need of it; there is not a forge plant in this country that can forge a good steel shaft. I have shown you individually the result of my effort to get a good steel shaft fourteen inches in diameter. It looked all right on the outside, but, knowing how it was forged, I had it turned up to size, outside diameter, and cut in two lengthwise, and it showed such internal seams and cracks that it could not be used; the second one we bored a five-inch hole through longitudinally and found it unsound all the way through. The third and last consideration is the commercial or financial one; this is the one that we are most vitally interested in, and I am confident that a plant such as I propose will be a paying investment and an honor to us all. Now, to prove to you my confidence in it, I will agree to carry my share of the capital as far as it is possible to do so, and further I will say if I had the money I would put in five hundred thousand dollars."

After this Mr. Wilbur beckoned me to come out. He then said to me, " You seem to have confidence in the plan." I told him if I had not I would not have talked as I did. He said, " If the Government should want no work, would there be work in the country to keep the forging plant busy? " I said, " Not to-day, but put the forging plant up and let the engineers know what they can get and then wants will soon grow up to it." He then said, " We will build the plant."

I at once went to work, having the plans of buildings and machinery well thought over, and had drawings made for the largest and most complete plant that had ever been designed for such a purpose, and the work was completed as planned.

CHAPTER XXVII.

FORGE AND ARMOR-PLATE PLANT.—Continued.

Soon after our Civil War I gave the subject of armor plate much thought. As experiments had proved that iron was practically useless in front of modern steel shot or shell, the question naturally came up, What is the best material to use, and the proper method to adopt for its manufacture? The officials of the navies of the world were much agitated over the subject, and various modes of manufacture were suggested. The one most favored was what was afterwards known as the compound plate. In addition to armor plate, I had given guns, forgings, and large shafting much thought, and could clearly see that a forging plant capable of doing this class of work in the best possible manner was of the utmost importance to the Government and the manufacturing interests of the country at large. Both were in a humiliating condition. Practically speaking, we had no navy or guns of sufficient power for coast defense, and no plant to make them. Our seacoast cities and towns and our foreign commerce were all at the mercy of the navies of the world. The then existing conditions were disgraceful to a great nation.

At that time the civilized nations of the world, which required a navy, were giving the subject of guns and armor plate much thought. Many different methods for making the latter were suggested, and some of them patented. There are two things in the construction of armor plate that must be reckoned on: first, the face must be hard, so as to break the point of the shot; second, the back must be strong in order to resist the force of the blow, without breaking. The latter was a most difficult problem to solve.

The English navy adopted the compound system, with soft back of wrought iron or low-carbon steel, and high-carbon steel on the front or face of the plate. There were three ways of combining the metals, that seemed to be the favorites; the results were all the same, but different plans were devised to accomplish the same result. One was to form a mould of the proper material to stand the heat of the molten steel, and of the proper size to make the finished plate. This was placed on edge in the floor; then a wrought-iron or a soft-steel plate of the proper size to make the plate, but less in thickness than the pattern, was put in a heating furnace and heated to a welding heat, and placed in the mould, close to one side; this left a space which was filled with hard steel to make the face of the plate. This all had to be done in the quickest time possible, in order to get the adhesion of the two metals on which the value of the plate largely depended. When it cooled to the proper temperature, it was taken to the rolls or the press, and was finished to the proper thickness, then to the machine tools, and was finished to the proper size for the vessel.

A large amount of money was expended on these experiments, which were wrong in both theory and practice. In the first place, the plates were not welded perfectly, which was essential in order to make a good armor plate; then the soft back was a mistake, as it was not at all possible to get the required strength with soft metal to support the back against the shock; and great strength in the back of an armor plate is an all-important element, and one that is most difficult to get. My first thoughts on the subject soon led me to think that a solid steel plate was the best, and that good steel was the best material. When I first wanted the company to build a forge plant and put in a hammer, I had the solid steel armor plate in my mind. The hammer is the best system of forging to get close-grained metal.

The efficiency of the Navy would depend on high-power guns and on an armor plate that would resist solid steel shot fired out of a steel gun at a high velocity. Any plate that would not stand this test was worse than useless. Consequently, it was idle to think for a moment of ever making a wrought-iron armor plate that would be effective under such conditions, to meet the improvements that had been made in guns and projectiles.

At the time the Bethlehem Iron Company took the subject up, all Europe was speculating and experimenting on various devices, hoping to find something that would meet the conditions. Among the many plans, the compound plate above described seemed to be the favorite. To my mind it was clear that an armor plate could not be made on that principle that would stand the shock of a solid forged oil-tempered steel projectile, at the velocity specified by the Navy Department.

The ideal armor plate, I was convinced, should be made out of one solid piece of steel, the ingot being cast large enough to give sufficient work in forging to properly close the grain to prepare it for annealing and tempering. But how such a plate would stand the ballistic test could only be solved by actual experiment; there were diverse opinions on this point, but generally unfavorable, and the only way to demonstrate it would be by actual experiment, which at that time would have been very expensive, as there were no means of forging and treating the plate, or proper tools for shaping it.

About this time Mr. Schneider, of the Creusot Works in France, was experimenting in making solid steel plates, forging them under a hundred-ton hammer. This being to my mind the only way to make a good armor plate, Lieutenant Jaques and I went to their works to see what they were really doing. We spent several days there, saw

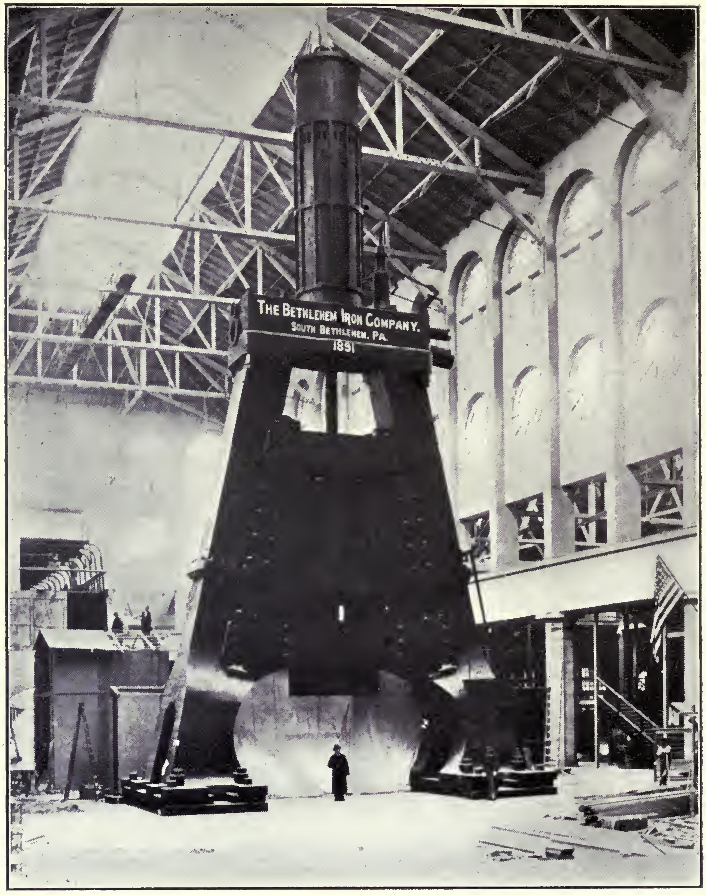


Fig. 9. — One Hundred and Twenty-five Ton Steam Hammer, Bethlehem Iron Company.

them forge a plate, and thoroughly investigated the work they had done and the results attained. While not fully satisfied, yet both Lieutenant Jaques and I had sufficient faith in the process to agree that on our return home we would recommend the Bethlehem Iron Company to make some arrangement, if possible, whereby they could use the Creusot patents and the benefit of their secrets and their experience. This we did, and we explained to the directors all we had seen and what had been accomplished, and strongly urged them to take the subject up and learn what arrangements, if any, could be made. They listened to us, but with seeming indifference. However, in a short time after this meeting, and after some delay and much talk, the Board concluded to take up the subject. They did this, but could not come to an agreement.

Mr. Jaques and I were sent to Paris to meet Mr. Schneider and learn if any arrangement could be made that would be satisfactory to both parties. This was in the summer of 1887. We met in Mr. Schneider's office with his lawyer, and after a somewhat formal introduction the subject was taken up by Mr. Jaques and the lawyer in the French language. I could not understand a single word either of them said, but I was very proud of Jaques; he kept cool and could talk as fast as that French lawyer could.

Mr. Schneider was a thorough gentleman. I thought I could see that he was not pleased with all that his lawyer said, and he would occasionally speak to me in a way that confirmed my thoughts. After a time I got tired listening to a talk of which I could not understand a word that was said, and got up and walked into an adjoining room. In a few minutes Mr. Schneider followed and said to me, "Should we fail this time to come to some understanding, will this end the negotiation?" I told him that I was not authorized to say so, but my opinion was that it would. After some further conversation on the subject, on matters of detail, he said he would accept, and have an agreement made in accordance with the understanding we had just arrived at.

Having completed our mission, I returned home, and reported to the Board of Directors what we had done.

While I did not have the honor of being a member of the Peace Commission appointed by the President of the United States to proceed to Paris to settle the difficulties between our country and Spain, yet I had the honor of being appointed by the President of the Bethlehem Iron Company, a member of this Commission, and ordered to proceed to Paris, and in company with Lieutenant Jaques, if possible, to negotiate a treaty with the Messrs. Schneider of Creusot, for the right to use all their patents and their secrets, that might be useful in the manufacture of armor plate on the Creusot principle.

After negotiations were completed with Messrs. Schneider of La Creusot, in accordance with our instructions we went to England to visit the Whitworth Works. As I had been requested by our President to return home as soon as possible, I sailed for the United States on the first ship leaving Liverpool after the completion of our labors, happy in the consciousness that we had secured the Creusot contract. After a somewhat tempestuous voyage, otherwise uneventful, I landed in New York; as the mission had been a secret one, there was no reception committee, not even a newspaper reporter, or a special train for Bethlehem. There was neither wining nor dining, not even a warm reception. Neither was there any indication that the people at large took any interest whatever in the great work we had accomplished, but I did not take the indifference of the people to heart, being conscious that we had done our duty, and had accomplished a great and far-reaching work, the result of which is now widely known; and to the wisdom, foresight, and progressiveness of the President, Directors, and Executive Officers of the Bethlehem Iron Company, and to the intelligent, indomitable energy and determination of

FIG. 10. — FOURTEEN THOUSAND TON HYDRAULIC FORGING PRESS, BUILT BY THE BETHLEHEM IRON COMPANY. TWO CYLINDERS, EACH FIFTY INCHES IN DIAMETER.

its employees, manifested in the construction of the plant, is the credit largely due for making it possible for the Government to achieve the glorious victories in our late war with Spain.

After the contract, which had been mailed from Paris by Lieutenant Jaques, had been acted upon by their lawyer, the Board of Directors accepted it.

Some of my ablest engineering friends had urged me not to undertake the building of an armor plant, saying I was not justified in assuming so great a risk, and that, should failure occur, my reputation as an engineer would surely be ruined. In reply I told them that the same argument had been used to try to prevent me from making the changes and improvements which I had made at Cambria Iron Works, and which were eminently successful. I also told them that I was well satisfied I could build the plant and make it go all right, and that it was just such a plant as the engineers of the country wanted. In addition, the shipbuilding trade was at that time quite active, and all the shafting and heavy forgings were being made abroad, generally at Krupps', and also the heavy forgings for both Army and Navy, and the gun forgings for both.

The Bethlehem plant was the first to be erected for the purpose of making armor plate for the United States Government.

After a great deal of worry and anxiety we succeeded in making several hundred tons of plates which to our joy stood the Government test, although these tests were not so severe as they were afterwards, but much more difficult for us, as armor plate was then made, than the more severe tests that later on were imposed on us by the Government.

In this connection I recall an anxious day I once spent. After we had the works partially erected, and had made an expenditure of a large amount of money, the Cammell people got our Government to believe that it was impossible to make a solid steel plate that would stand the test, and the Government went so far as to order a Cammell compound plate, and a Creusot solid steel plate, the latter

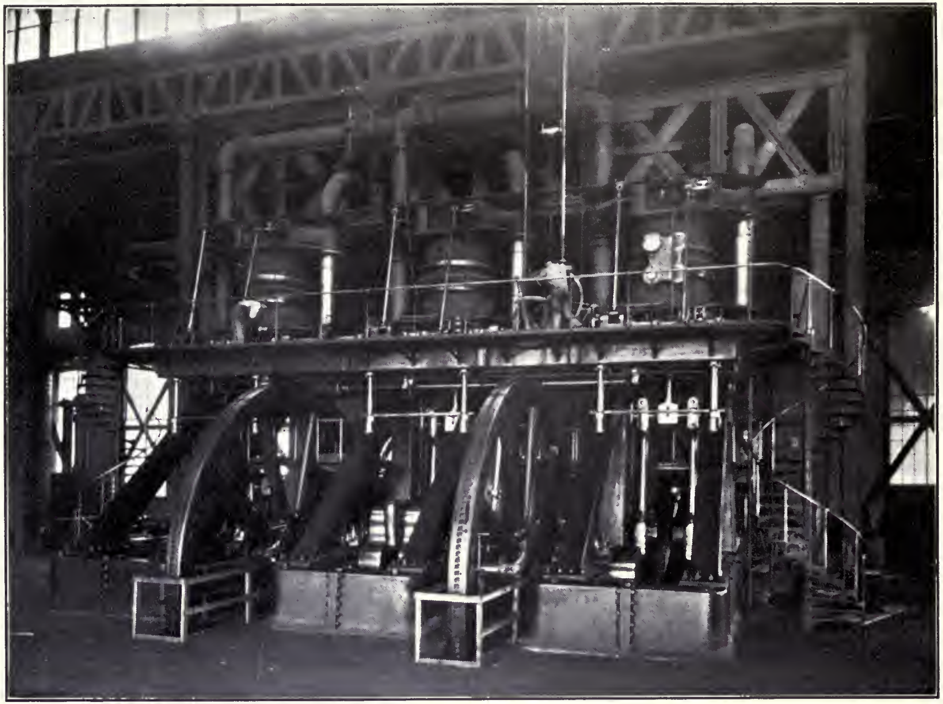


Fig. 11.—Engine furnishing 15,000 Horse-Power for Hydraulic Forging Press, Bethlehem Iron Company. Three Cylinders, Each Fifty Inches in Diameter and Ninety Inch Stroke. Designed by E. D. Leavitt and Built by the Wm. Cramp Ship and Engine Building Company.

made at the Creusot Works in France, and they were tested by the Government at Annapolis.

This trial was the source of great anxiety. While I had entire confidence in solid steel plate, yet if by any chance the compound plate should stand the test, and the solid steel plate fail, from any cause which might have occurred in its manufacture, the money which we had spent would have been practically lost, as our arrangements would have been of little use in the manufacture of compound plates. On the day of the trial Lieutenant Jaques was sent to Annapolis to witness the test. Expecting to hear from him at about two or three o'clock, and not hearing from him, my anxiety increased. At six o'clock I went home from the works with a terrific headache. I got a cup of tea and a piece of toast, and lay down on the sofa, wondering what would be the consequences if the solid steel plate failed. At about eight o'clock a telegram came. My wife received it and said, "Here is a telegram for you." I said, "Open it and read it." She opened it, but said she could not read it. I asked her for what reason, and she said she did not understand it. I said, "What does it say?" She replied, "Compound something, knocked to smithereens." I got up, but waited anxiously to hear how the solid steel plate stood the test. The telegram said, "Solid steel plate stood the test." Imagine my relief!!

During the course of the evening I reflected on the previous trial of the Creusot and compound plates made at Spezzia, Italy. In that test the compound plate failed. The solid steel plate cracked, but kept the shot out, and I concluded that it would be much better to have the plate crack and keep the shot out, than to let the shot go through the plate without cracking. Knowing, as I did, that it was an exceedingly difficult point to just reach the limit that the shot could be kept out, and prevent the cracking of the plate, I was satisfied in my own mind that such a result could be reached, and it was reached.

Later Mr. Harvey taught us all how to make the ideal armor plate with a hard face and strong back. This was a boon to the armor-plate manufactures, for which he should have received a Knighthood, but instead he was hounded by the manufacturers, by their refusal to pay him any royalty, resulting in a law suit which worried Mr. Harvey until his death. They fought his patent on the narrow principle that case-hardening was not new, and they were not generous enough to admit that a carbonized steel armor plate weighing fifty tons or upwards was a new article of commerce, but compared the carbonizing of a steel armor plate to the case-hardening of a little spring for a gunlock made out of iron, surrounded by some carbonaceous material, such as the soft parings of horses' feet, leather of old shoes, or certain kinds of old hats, wrapped up in a ball of clay not much larger than a wasps' nest, presumably heated in a smith's fire, and let cool. This is what I did when a boy, many times. Yet this argument was brought up to prove that his patent was invalid.

Up to the time the Bethlehem Iron Company commenced making gun forgings the gun hoops were made in short lengths. On the occasion of a visit to Bethlehem of Commander Folger, then Chief of Ordnance of the United States Navy, we discussed the merits of longer gun forgings, and we agreed that an improvement could be made over the guns that had been manufactured up to that time, if longer forgings were used. The Bethlehem plant was equipped for such forgings. The proposed change was made, and now guns are all made with much longer hoops, with a much better gun as a result.

In 1897, by act of Congress, a Board known as the Armor Factory Board was appointed for the purpose of investigat-

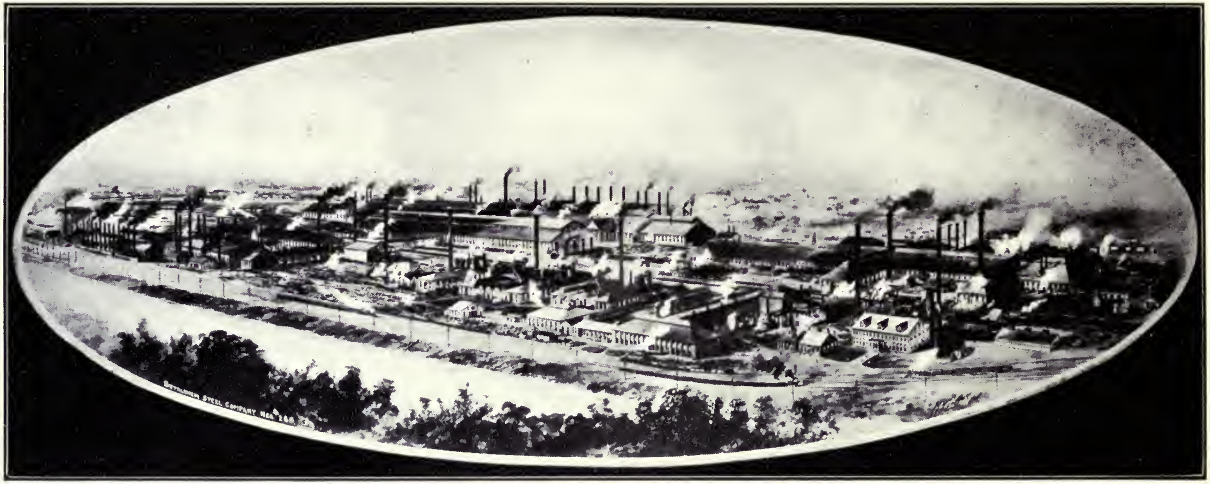


FIG. 12.—WORKS OF THE BETHLEHEM IRON COMPANY, 1893. (At the date of the retirement of John Fritz.)

ing the then existing plants and reporting to the Secretary of the Navy its findings, as to the desirability of having the United States construct, own, and operate its own armor-plate plant. This Board visited numerous steel companies of the country and urged that I help them as an expert. I had previously suggested some other engineers to serve them, but they insisted on my taking up this work. This I did, and after about three or four months of strenuous work, in connection with which I employed several engineers and draftsmen, I turned over to the Secretary of the Navy detailed plans and specifications and estimates of cost for the proposed plant. This in turn was reported to Congress at its next session. After consideration, the Government decided not to build the plant.

CHAPTER XXVIII.

CONCLUSION.

In looking back to the date of my first connection with the iron business in October, 1838, over seventy years ago, it seems almost impossible for the mind to fully realize the improvements which have taken place in the iron and steel business, especially those that were commenced in 1854, and paved the way for the enormous production that increased the quantity made from 637,000 tons in 1854, to the enormous production of 24,000,000 tons in 1909. With all of this I have been contemporary, and I had much to do with the inventions and changes which have taken place during this remarkable period. A retrospect of whatever has taken place during my long career seems necessary, as I owe much to the wonderful progress that has been made in the arts and sciences and the growing interdependence of the various branches of the mechanic arts, as contrasted with their policy many years ago.

It should not be forgotten that England is the home of the manufacture of iron and steel, and the birthplace of the Iron and Steel Institute, and much of our success is due to the information we gained from the invaluable papers read at their meetings, and the discussions that followed them. And here, at this late day, I call to mind many pleasant and instructive talks I had with the English and Welsh workmen who were employed at the Norristown Iron Works.

I wish, also, to give credit to the brave and noble workmen who, throughout my long connection with the business, ever stood ready to meet any emergency, no matter what the danger or difficulty might be. All that needed to be said was "Come, boys," but never "Go, boys," and if the difficulties were not insurmountable they were sure to be overcome; too much credit cannot be given to these fearless and energetic men for the marvelous progress that has been made in the manufacture of iron and steel in this country.

While we have properly received great credit for the unprecedented developments we have made in the iron and steel industry in the United States, we must not forget that it was the inventions of Cort, of Mushet, of Bessemer, of Siemens, and of Thomas that enabled us to accomplish such important results; and to them all civilized nations owe a debt of gratitude for the incomparable blessings their inventions have conferred on society.

Yet few of us even for a moment think of the trials, troubles, disappointments, mental anxiety, and bodily toil these men had to undergo in the introduction and perfection of their inventions, besides suffering the sneers and jibes of those who imagine that an inventor is nothing but a wild enthusiast, and treat him accordingly. The story of many inventors is truly pathetic, and none more so than that of the lamented Sidney Gilchrist Thomas. The personal side of the story of the inventor of the basic process can only be appreciated by the reading of his life. He died February 1, 1885, at the early age of thirty-four years.

When I look back to my early days in the iron business long, long ago, it brings to mind one of the happiest periods of my life.

How little do the younger men who now have charge of our great iron and steel industries know or even think of the severe mental strain, the great amount of bodily toil, the vexation, the surprises, and the disappointments that had to be endured by the men in charge during the erection and perfection of these vast establishments that are now engaged in the manufacture of iron and steel! And let me here say that this great work was not accomplished by command but by example. It was the men in training, before alluded to, who erected, perfected, and put in operation these most marvelous enterprises of the age. And to these noble, brave, and energetic men the people of this country owe much for the far-reaching results they so thoroughly accomplished, which have already changed the social condition of our vast territory. They have furnished us with a material which for quality, cheapness, and the quantity furnished in a given time is without parallel, and could not have been realized by any other known methods. Without it the building of transcontinental railroads would have been almost impossible. Had the rails been made in the old way out of puddled iron, with the increased traffic on the Atlantic ends of the lines, they would have been worn out before the Pacific coast could have been reached. The credit does not end here. The reduction of freight rates, owing to the general use of steel rails, is so enormous that it was said by one of our most distinguished public men, the late Hon. Abram S. Hewitt, that the saving alone on the cost of transportation due to the use of steel in the place of iron would, if available, amount to a sum sufficient to pay our national debt in a comparatively short time.

In addition to the use of steel for rails, the Great West is being fenced with steel at a cost that seems almost fabulously cheap, and this product is being used largely for many other purposes. It was formerly iron that was used for structural work, now it is steel; and it has practically superseded the use of wrought iron. Steel is largely used in the construction of all grades of machinery employed in the manufacturing arts. It is the base of our immense inland system of transportation. It is this imperial metal that has enabled the engineer to perform the daring and remarkable engineering feats which he has accomplished during the last half of the century; without it they would have been practically impossible. It is the material used in the construction of the monster floating palaces that cross the vast ocean with the regularity of a railroad train.

Fifty years ago steel was a luxury to the engineer. Modern practice of steel making in the hands of the mechanical engineer, the metallurgist, and the chemist has wrought wonders in producing a material which is used alike in the manufacture of articles of the most weighty, the rudest, and cheapest grades, and in the construction of the most intricate, the finest and most delicate implements and machinery. And it is boldly asserting its value and importance everywhere.

It is to the invention, introduction, and perfection of the modern system of steel making in this country that we are indebted for the education of our people in the scientific, mechanical, and metallurgical arts, which has enabled us to build a navy respected by the nations of the world.

We find steel asserting its value through every walk of life and extending through every clime, linking hands in bonds which grow broader and stronger with the years, till even now we can see dimly on the horizon the promise of the universal brotherhood of man, the longed-for era of Eternal Peace.

AFTERWORD.

The foreword of my friend and colleague, Robert W. Hunt, contains one word which I would fain emphasize in this afterword as the keynote and moral of the life hereinbefore narrated. It is quite needless to point out that the story has been given from the standpoint, and in the words, of John Fritz himself, and that he has told it in characteristic unconsciousness of either keynote or moral. He, who never preached a sermon before, is not preaching a sermon now. But I may venture to do what he has not dreamed of doing; and my text shall be the word "integrity," as designating a dominant feature unwittingly exhibited by these reminiscences.

In endorsing Mr. Hunt's ascription of integrity to John Fritz, I am not merely saying that he never stole money or told lies or accepted bribes. Praise for such negative virtues would be almost insult. I would give to "integrity" its original meaning of complete and invulnerable manhood. In this sense, it includes not only the self-respect which scorns dishonesty, but also the courage which asserts conviction, the ambition which accepts responsibility, the loyalty which ignores self-interest, and the energy which despises ignoble rest. In a word, it is noble, ardent *individualism.*

No man achieves success by virtue of his individual qualities only; and the life of John Fritz shows plainly enough that he won advancement by impressing upon other men his fitness for their needs. In other words, he made friends, who became his sponsors or employers, and whose verdict upon his work now constitutes the basis of his fame. This is the normal career of merit under the system of individual liberty and responsibility. We have heard much, in these later days, of proposed reconstructions of society in which masses and classes are to be substituted as units for *integral* men. Yet no one denies the immense value to society of great achievements and inspiring examples; and it is fair to ask of any new sociological philosophy whether, if put into operation, it could produce a man like John Fritz.

ROSSITER W. RAYMOND.

HONORS.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

CONGRATULATORY.

IN honor and respect of our esteemed member and ex-Vice President

JOHN FRITZ

who, after long years of active duty as a Mechanical Engineer and as a noted Captain of Industry, seeks a rest well-earned, whose ever busy life began almost co-temporary with the manufacture of iron in our Country, who through all its advancing stages imprinted upon it the marks of his thoughtful labors, who with his friend Holley stood beside the cradle of the newly born industry of steel making in the United States by the Bessemer and kindred processes, promoting its growth by his wide and varied experience, and crowning its highest achievements with the versatility of his genius and his rare good judgment, the Council of the

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

desire to make this minute. Endeared as he is to us individually, and to the Society we represent, we cannot permit this eventful occasion to pass without tendering him our love and respect, and without joining in a hearty wish for his future health and happiness, and without expressing the earnest hope that for years to come we may be aided by his counsel and encouraged by his genial good fellowship.

Believing that his great warm heart will receive this slight tribute in the spirit in which it is tendered, we have the honor to subscribe ourselves the loving friends of

JOHN FRITZ OF BETHLEHEM.

On behalf of the Council.	On behalf of the Honorary Committee.
STEPHEN W. BALDWIN	J. F. HOLLOWAY
CARLETON W. NASON	GEORGE H. BABCOCK
ANDREW FLETCHER	ROBERT W. HUNT
W. A. PERRY	HORACE SEE
J. E. DENTON	
JOHN THOMSON	

CHAS. H. LORING, *President*
F. R. HUTTON, *Secretary*
WM. H. WILEY, *Treasurer*

NEW YORK CITY, *August* 21, 1892.

THE IRON AND STEEL INSTITUTE.

VICTORIA MANSIONS, VICTORIA STREET.
LONDON, S. W., *July* 29th, 1893.

DEAR SIR:

I am instructed to inform you that at a meeting of the Council of the Iron and Steel Institute held yesterday, you were unanimously elected an honorary member of the institute.

The honorary members of the Institute now comprise:

The Prince of Wales,
The King of the Belgians,
Professor Åckerman of Stockholm,
The Hon. A. S. Hewitt,
The Ritter von Tunner,

and yourself.

Journal No. 1–1893 of the Institute will be sent you directly it is published, early next month.

I have the honor to be,

Sir,

Your obedient servant,

BENNETT H. BROUGH,
Secretary.

JOHN FRITZ, ESQ.,
BETHLEHEM, PA., U. S. A.

THE IRON AND STEEL INSTITUTE.

28 VICTORIA STREET,
LONDON, S. W., *November* 19, 1909.

MY DEAR SIR:

Under the new Bye-laws of this Institute, it is within the province of the Council to elect Honorary Vice-Presidents from among the distinguished Members of the Institute who, by reason of residence outside Great Britain or other restraining cause, are precluded from taking an active part in the management of the affairs of the Institute. Accordingly, I have the honour to inform you that, by a unanimous vote, the Council yesterday elected you an Honorary Vice-President, for life, of the Iron & Steel Institute, with the right to attend all Council Meetings whenever it may suit your convenience to do so.

I hope to be able to send on to you shortly a card giving a list of all meetings in the year 1910.

I have the honour to remain,

Yours faithfully,
G. C. LLOYD,
Secretary.

JOHN FRITZ, ESQ., M. A., D. Sc.,
BETHLEHEM, PENNSYLVANIA, U. S. A.

THE BESSEMER GOLD MEDAL.

IRON AND STEEL INSTITUTE.

ESTABLISHED 1869.

UNDER THE PRESIDENCY OF HIS GRACE THE DUKE OF DEVONSHIRE.

This is to certify that John Fritz, a member of the Institute, was by the unanimous votes of the President and Council awarded the Bessemer Gold Medal for valuable services in connection with the manufacture of steel.

WITNESS OUR HANDS AND SEAL this 24th day of May, 1893.

E. WINDSOR RICHARDS, *President.*
BENNETT H. BROUGH, *Secretary.*

ENGINEERING SOCIETIES.

Member American Institute of Mining Engineers	1872
President American Institute of Mining Engineers	1894
Member American Society of Mechanical Engineers	1882
Vice-President American Society of Mechanical Engineers	1882–1884
Hon. Member American Society of Mechanical Engineers	1892
President American Society of Mechanical Engineers	1895–1896
Member American Society of Civil Engineers	1893
Hon. Member American Society of Civil Engineers	1899
Hon. Member Iron and Steel Institute of Great Britain	1893
Hon. Vice-President Iron and Steel Institute of Great Britain	1909
Hon. Member American Iron and Steel Institute	1910

COLLEGE DEGREES.

Columbia University: A. M.	1895
University of Pennsylvania: D. Sc.	1906
Stevens Institute of Technology: D. Eng.	1907
Temple University: D. Sc.	1911

MEDALS.

Centennial Exposition Bronze Medal	1879
Bessemer Gold Medal: Iron and Steel Institute of Great Britain	1893
John Fritz Gold Medal: United Engineering Societies	1902
Louisiana Purchase Exposition Bronze Medal	1904
Ellicott Cresson Gold Medal: Franklin Institute	1910

COMMITTEES.

Member of Group 1, Centennial Exposition	1876
Presidential Elector for Pennsylvania	1896
Hon. Expert on Iron and Steel, Louisiana Purchase Exposition	1902

THE FRITZ ENGINEERING LABORATORY.

A CHAPTER in the long and active life of Mr. Fritz would remain unwritten if no reference were made to his relationship to Lehigh University. When that institution was established in 1866, the Founder, the Hon. Asa Packer, of Mauch Chunk, Pennsylvania, selected Mr. Fritz as one of the original trustees, well knowing that his practical experience would be of great value in directing the policy of the new college, which was to be devoted largely to instruction in the arts of Mechanical and Metallurgical Engineering.

Mr. Fritz has maintained his trusteeship from the founding of the University up to the present time, with the exception of a few years, during which, at his request, he was relieved of active participation in the affairs of the University. He has always discharged the duties of his trusteeship with the fidelity and devotion that are so characteristic of him, and he has contributed liberally to the support of the institution.

One day in the spring of 1909, in talking with Dr. Henry S. Drinker, President of the University, he said: "I want to tell you something. In my will I have left Lehigh University a certain sum of money, to be expended in your discretion. I now intend to revoke that bequest. Yes, I'm going to revoke that bequest, and instead of leaving money for you to spend after I am gone, I'm going to have the fun of spending it with you and Charley Taylor. I have long watched the careers of a number of Lehigh graduates, and I have been impressed by the value of the training

FIG. 13. — THE FRITZ ENGINEERING LABORATORY, LEHIGH UNIVERSITY, SOUTH BETHLEHEM, PA.

they have received at Lehigh. But you need an up-to-date engineering laboratory and I intend to build one for you."

No sooner had Mr. Fritz announced his intention than with characteristic activity, in spite of his eighty-seven years, he set about making the plans for the new laboratory. Various suggestions and ideas as to the most suitable plans and arrangements of the building were considered, architects were consulted, but finally Mr. Fritz concluded that, for the purpose in view, he would be his own architect, and that the most appropriate structure would be a large oblong building with a high center and somewhat lower sides, substantially on the lines of the large shop he had some years before built at the Bethlehem Steel Works. The outline of the building can be seen in the accompanying picture. Such a building would provide the necessary essentials: adequate space, sufficient light, and the logical arrangement of having the larger machines for heavy work in the center of the building and the lighter and smaller machines at the sides.

Not only did Mr. Fritz furnish the design of the new laboratory, but whenever possible he was on the University campus to superintend its erection. He also personally selected the greater part of the equipment.

The Fritz Engineering Laboratory is of modern steel-frame mill construction, 94 feet wide and 115 feet long, with the main center section 65 feet in height and the two side sections of lesser height. The external walls which inclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, operated by electricity and of 10 tons' capacity, commands the entire central portion of the building, in which the testing of large specimens is carried on. Ample light has been provided for by numerous windows in the side and end walls, in the clerestory, and by a skylight 84 feet long and

9 feet wide in the north roof. The main aisle of the building is 49 feet 2 inches between centers of crane columns, and has a clear height of 40 feet. The remainder of the width is taken up by two sides aisles, 20 feet in height.

The laboratory consists of four sections: (*a*) a general testing section containing the testing machinery, a small machine shop, and the office; (*b*) a cement testing room; (*c*) a room for making and storing concrete test specimens; (*d*) a hydraulic section.

The testing section occupies the larger part of the western end of the building and contains all of the testing machines except the briquette machines, which are in the cement section. For facility in handling the test specimens, a 10-ton crane, 47 feet 2 inches center to center of runway beams, operated by three direct-current motors, has been installed. A small machine shop, containing a drill press, lathe, milling machine, shaper, etc., operated by a 7.5 H.P. motor, is available for general repair work.

The principal equipment of the testing section proper is as follows:

Type of Machine.	Capacity in Pounds.
Universal	800,000
"	300,000
"	100,000
"	50,000
"	50,000
"	50,000
"	50,000
"	50,000
Tension and compression	20,000
Wire tester	20,000
Cold bend	1.5 inch diameter bar
Torsion	24,000 inch pounds

The cement testing section occupies a separate room on the main-floor level. The equipment consists of tables for making cement specimens, storage tanks, briquette testing

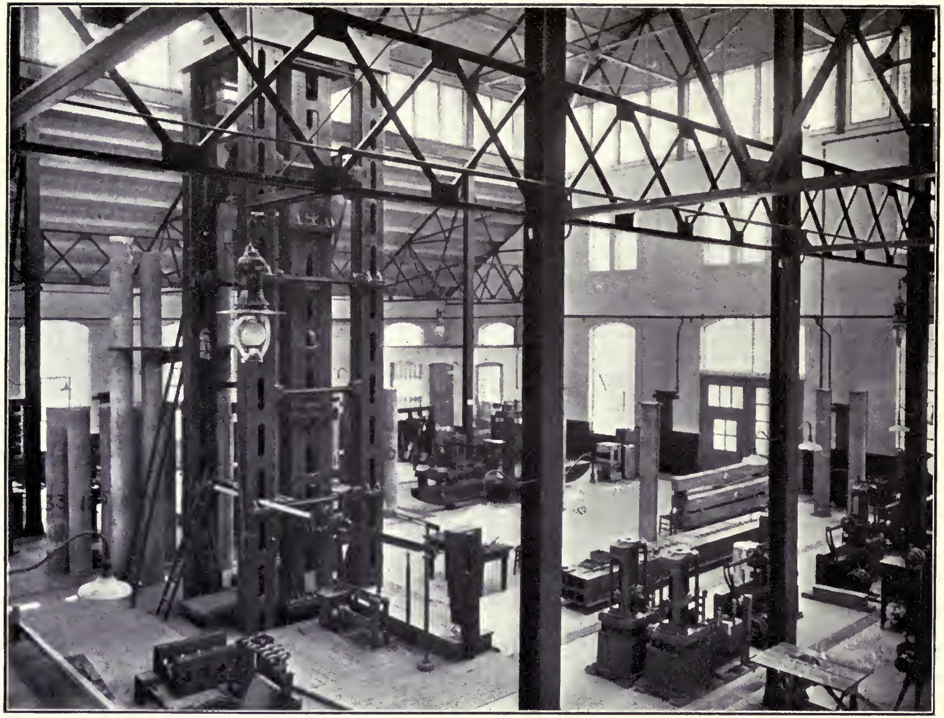


Fig. 14.—The Fritz Engineering Laboratory, Interior. General Testing Section.

machines, and apparatus for making standard cement tests.

The concrete room is under the cement room and is used by the students for the construction of cubes, beams, and cylinders for testing; also for the construction of concrete columns, plain and reënforced, and concrete beams, of commercial size, which are tested for strength by the students. It is connected with the main testing room by a hatchway through which the heavy specimens may be hoisted into the main room by the crane. The equipment consists of bins for sand and stone, mixer, and moulds.

The hydraulic section occupies the northeastern portion of the building. The lower floor is 10 feet below the level of the testing room, the second floor or elevated platform is 10 feet above the testing-room level, giving 20 feet of clear height.

The equipment on the lower floor consists of:

1 DeLaval centrifugal pump, 2000 gallons per minute against 60 feet head.

1 Atlantic Hydraulic Machinery Co. centrifugal pump, 200 gallons per minute against 255 feet head.

1 steel pressure tank, 65¼ inches in diameter by 34 feet 6 inches high.

2 steel calibrating tanks, 8 feet in diameter by 12 feet high.

3 steel weighing tanks, 4 feet in diameter by 3 feet high.

1 steel weir tank, 4 feet by 4 feet by 21 feet long.

1 Trump turbine.

1 Pelton water wheel.

1 Rife hydraulic ram.

The upper platform carries:

1 steel weir tank, 3 feet by 3 feet by 18 feet long.

1 steel tank, 6½ feet wide, 3 feet deep, 17½ feet long.

The equipment also includes pressure, mercury, oil, and hook gauges, meters, scales, and so on.

All electricity for lighting and for power for the testing machines and for the pumps is 2-phase 60-cycle alternating current at 110 and 220 volts.

Instruction in testing of materials and hydraulics is given to students of Lehigh University. The equipment is used for thesis work in the Senior year, and is also used for making commercial tests of materials of construction for manufacturers.

FRANK P. MCKIBBEN,
Professor of Civil Engineering,
Lehigh University.

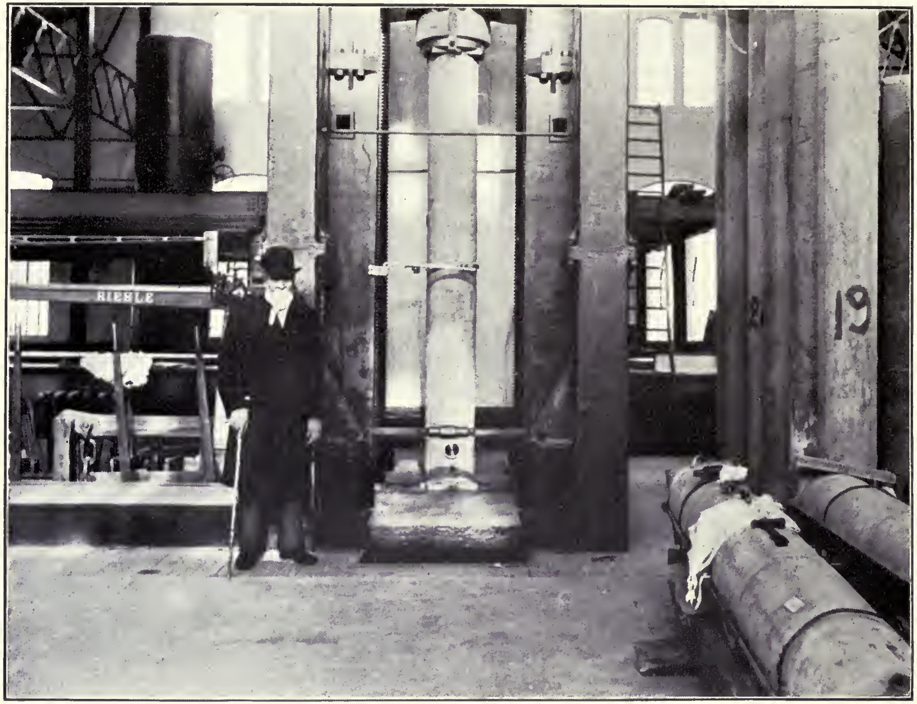


FIG. 15.—THE FRITZ ENGINEERING LABORATORY, INTERIOR. 800,000 POUND RIEHLE TESTING MACHINE.

A SHORT ACCOUNT OF THE ANNIVERSARY DINNER GIVEN TO JOHN FRITZ, THE ENGINEER, AND OF HIS ARREST, TRIAL, AND SENTENCE, AT THE OPERA HOUSE, BETHLEHEM, PA., SEPTEMBER 28, 1892.*

'Twas in the early summer of '92 that two gentlemen, whose families were then in the Adirondacks, but whose business engagements in the city prevented them from being there as well, sat in the parlor of the Engineers' Club, enjoying their cigar. The phrase "enjoying their cigar" was purposely chosen because there were but one smoker and one cigar. The smoker evidently enjoyed the smoking, while the looker-on enjoyed seeing him smoke, and in watching the curling wreaths as they slowly floated upward.

"Do you know," said the smoker, as he came back from dreamland long enough to tip with the end of his little finger the dead ashes from off his cigar, "that Uncle John Fritz will be seventy years old in August?"

"Yes," said the non-smoker; "I had heard of it, and I also heard it hinted that he meant after that date to unload himself of a part of the labors and cares he has so long borne in connection with the great establishment he has been connected with for so many years."

"Well, I don't know about that," said the smoker, who with half-closed eyes seemed to be looking backward into the past; "but I tell you what I think, and that is, that the Engineers and other friends of Mr. Fritz ought not to let such an occasion pass without in some way recognizing the

* *Reprint of a pamphlet compiled and published for private circulation following the dinner to Mr. Fritz at Bethlehem, Pa., September 28, 1892, signalizing the celebration of the seventieth anniversary of his birthday.*

event, and in some way honoring the man, who, by his kindly, loving disposition, his untiring industry, and his rare mechanical genius, has done so much for the company he is connected with, and for the profession of engineering, of which he is so conspicuous a member."

"Well, that's an idea that does you credit," said the non-smoker, as he took a sniff out of the ascending wreath of incense as it took its upward flight, "and I not only agree with you myself, but I am certain that all over this broad land are friends of John Fritz who would do so also, and who, I know, would be glad to join in any scheme that had such an end in view."

So in the gathering twilight of the summer day these two gentlemen at their club talked over a variety of things, which, if they could be brought about, would accomplish, as they thought, the desired purpose. One was to invite Mr. Fritz to come to New York and give him a dinner at the club; but the objection to this was the inviting a gentleman away from his home on his birthday. Another plan was to present him through the means of a committee with a testimonial of some kind. The objection to this was that it would not bring his friends together where they could shake him by the hand and offer him their individual congratulations. Then it was proposed that a few friends should go to Bethlehem and have a dinner at a hotel, to which he should be invited, and this seemed to be the most feasible of all; but it was not forgotten that the person whom it was proposed to honor was extremely modest, and shy of demonstrations of every kind, and that, in view of this fact, it would be best to catch our hare before preparing it for a banquet, and the conclusion arrived at was that in some way the consent of Mr. Fritz must be obtained before anything could be done, and as the cigar had burned to the end the two conspirators went out into the electric-lighted

Broadway and leisurely sauntered homeward, thus ending this, the first chapter.

As Mr. Fritz was not a smoker and could not be influenced by the tender of a cigar, be it never so fragrant, it was decided that the non-smoker should make the trip to Bethlehem and undertake the somewhat difficult task of obtaining his consent to a dinner or a demonstration of some kind. Understanding the difficulties of the mission, and knowing how fruitless the result would be, if it were so awkwardly managed as to elicit the irrevocable "No! I won't have it," the diplomat decided not only to approach Bethlehem by night, but when nearing it he further decided to pass on and land at Catasauqua, there to secure the aid of a renowned citizen of that borough whose persuasive powers had made him famous. The Catasauqua citizen entered into the conspiracy with the ardor and zeal for which he stands in high repute. He offered at once to "hitch up" and drive over to Bethlehem and aid in the assault upon that peaceful hamlet. Under cover of the darkness the journey was begun, and as the lively team sped over the smooth country road, the various methods of making the assault were talked over, and, as now remembered, at the beginning of the journey there was no doubt whatever on the part of anyone but that the consent could be obtained without the least difficulty; but the nearer they came to Bethlehem the less certain this seemed to be, until at the last, as the clattering hoofs of the team awakened echoes in those quiet streets, these doubts had grown to such an extent that it was deemed best not to approach the home of the victim until further assistance could be had from near neighbors and personal friends. So driving about for a time, a home was found which it was said was the residence of an influential friend, but the premises looked suspiciously dark. However, the Catasauqua ally jumped out of the carriage, rang the door bell, and after a long wait was told that the family were all away at the seashore. Coming back to the carriage, a further council was held, and, while there were other houses where other friends lived, it was doubtful if they were at home, so it was suggested, why not go at once to Mr. Fritz's house and have it out with him? "Why not?" "Why! yes; of course," said the other. And the corner was turned, and soon the team was tied up in front of that most hospitable mansion, where, under the shelter of the wide and pleasant veranda, Mr. and Mrs. Fritz, in the calm quiet of the summer evening, were found sitting, looking out upon the same twinkling stars that had shone out upon their pathway long years before, when a seventieth birthday seemed ever so far away. After the hearty greetings that always come to the visitor at that home were over, after the merry jests were tossed and parried back and forward, there came a time when the business of the hour claimed its place, and for its success it was necessary that the victim should be separated from his better half. This was accomplished by the Catasauquian being suddenly attacked by a raging thirst that could not be resisted, and, as the hostess rose to give the necessary order, the thirsty conspirator followed her into the house, and the coast was clear. The non-smoker having no bribe to offer in the shape of a cigar with which to pave the way, saw no way before him other than to tell in a simple, straightforward manner what the friends of the listener would like to do, and that they would like to do these things for several reasons: First, of course, as a mark of respect and esteem for the listener as an acquaintance and friend, to show their regard for him for what he had accomplished as an engineer, and in elevating the profession of engineering higher in the estimation of all; and lastly, they would like to have a good time themselves, and they thought the coming birthday would be a good excuse for it.

To all this the victim listened attentively, and, as it seemed to the speaker, revolving in his mind the memory of the past and the varied experiences of a long and busy life. After something of a pause he said: "You know I don't take much to blowing my horn, and I don't exactly like to be prominent in any affair like what you have been telling me about. What I have done has not been much, and it is not worth making a fuss about. I only did the best I knew how, and" — "But your friends," interrupted the first speaker. "Yes," he said, "that's another thing; now, if my friends (and I have a great many warm ones) — if my friends think they can come to Bethlehem and have a dinner on my seventieth birthday, and can have a good time in so doing, I ought not and will not stand in the way. So I give my consent; but, remember, I am not to be called upon to say anything." "Oh, no; of course not," was the reply, as the hostess and her guest returned to their chairs.

The neighborhood talk went on again until the drive to Catasauqua was remembered, and, as the carriage rolled away, hearty good-nights were exchanged, for the conspirators had won, and the second chapter was ended.

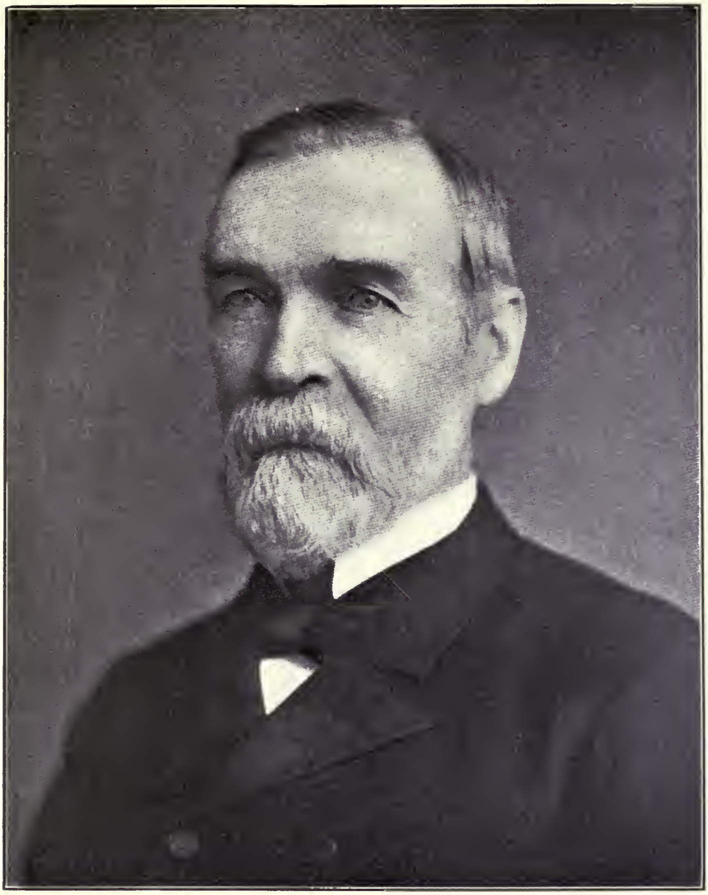
Were you present at the dinner given to John Fritz, the engineer, at the Opera House in Bethlehem, September 28, 1892? Oh! you were? Ah! well, then, you need not read anything beyond this, for what is hereinafter written is for the man who kindly contributed to aid that affair, but who could not himself be present, and also for a number of other persons, both in this country and Europe, who were honored with invitations as guests, and who would most gladly have been there to assist in honoring their friend, but who could not come.

The inception of the affair having been thus briefly explained and the preliminary steps described, it only remains to relate as briefly as possible what was said and done, and who were there.

The next step taken was the selection of a General Committee, that should be representative as to position and character, and so widely located as that it might be considered National rather than local, all of which was accomplished when the following gentlemen consented to serve:

ECKLEY B. COXE, Coxe Bros. & Co., Drifton, Pa.
S. W. BALDWIN, New York Sales Agent Pennsylvania Steel Co., New York City.
R. P. LINDERMAN, President Bethlehem Iron Co., Bethlehem, Pa.
E. D. LEAVITT, Consulting Engineer Calumet & Hecla Mining Co., Boston, Mass.
OLIVER WILLIAMS, President Catasauqua Mfg. Co., Catasauqua, Pa.
S. T. WELLMAN, President Wellman Steel and Iron Co., Thurlow, Pa.
JAMES MOORE, Bush Hill Iron Works, Philadelphia, Pa.
ROBT. W. HUNT, President R. W. H. Inspection Co., Chicago, Ill.
J. F. HOLLOWAY, President Engineers' Club, New York City.
W. H. WILEY, Treasurer, New York City.
CHAS. KIRCHHOFF, Secretary, 96 Reade St., New York City.

On August 8th a circular-letter was sent out by the General Committee to such friends of Mr. Fritz as it was thought could avail themselves of the opportunity offered, and in which was briefly stated the purpose of the proposed gathering, and the reason why the 25th of August had been selected. The first responses that came to the Committee were protests against the date selected, for the reason that so many were either away on their vacation or had planned to be away, all wishing so much to be present and to take a part in the exercises. So, in deference to such a general request, the date of the dinner was changed to September 28, and later on another circular was sent out requesting the person to whom it was addressed to indicate if he would or would not be present.



John Fritz

FIG. 16.—JOHN FRITZ, 1892.

It had been the expectation of the Committee that enough people would respond favorably to make quite a little dinner party at some one of the hotels in Bethlehem, and the smoker, who had burned quite a number of cigars " thinking it over," was so confident of success that he was willing to wager on at least twenty-five. Scarce twenty-four hours had elapsed before the returns began to come in, and but a few days passed before it became evident that no hotel could accommodate the party, and inquiries were set on foot to see if the large hall in the University building could be had, and, while a prompt and favorable reply came, it soon became evident no hall there was large enough to hold the friends of John Fritz, and so at last it was apparent that nothing of less dimensions than the Opera House would answer the purpose.

The magnitude of the affair having outgrown the expectations of the Committee (and the wildest dreams of the smoker), it became necessary to select a local committee, to whom should be intrusted the preparation of what now promised to be a large gathering.

The committee selected for this purpose consisted of Robt. P. Linderman, President of the Bethlehem Iron Co., chairman, and W. H. Jaques, Garrett B. Linderman, W. A. Wilbur, Rollin H. Wilbur, and E. H. McIlvaine, and it was to their good judgment and careful attention to the details of preparation that much of the success of the affair was due. The date of the dinner having been definitely fixed, the local committee proceeded to have the parquet of the Opera House floored over level with the stage, and to having the entire house properly decorated. This was done in admirably good taste, with flags and banners, waving palm trees, floral designs, and grouped and scattered electric lights of various hues, until, taken as a whole, it was fairy-like and beautiful to a degree rarely excelled.

At the rear of the stage an arch of immortelles intertwined with white rosettes of flowers and glowing electric lamps hung above the inscription "Anniversary to John Fritz," while along the long lines of tables huge banks of flowers lent perfume to the air and brightness to the scene.

At the center of the head cross table and immediately in front of the honored guest of the evening stood a huge columbiad mounted on wheels, the whole composed of beautiful flowers and loaded to the muzzle with good things and trained towards the assembled guests, as emblematic of the kind of guns and projectiles "Uncle John" would always be glad to fire off against friend or foe. Special cars kindly tendered by officers of the Reading Railway System for the occasion brought the invited guests from New York and Philadelphia, and, as both trains rolled up to the station, carriages in waiting distributed them among the various hotels and the numerous private residences that so generously had opened their doors to receive them.

By 7 P. M. the parlors and halls of the Hotel Wyandotte, and the vestibule of the Opera House, which had been specially connected for the occasion, were filled with as notable an assembly of men of affairs as it is possible to conceive. Here were men long known as the foremost iron and steel masters of the country. Mine owners stood sandwiched in between managers of blast furnaces and superintendents of steel plants, while engineers, famous for what they had accomplished at home and abroad, stood side by side with capitalists and bankers whose invested means had made possible the building of the famous industrial works that are dotted all over our country, and which serve to make the United States the foremost nation of the world in industrial pursuits. Here and there, meeting, perhaps, for the first time after a lapse of years, were men identified with the building and operating of the first mills to roll rails, or the first plants to make Bessemer steel, in this country. Presidents of colleges and professors of engineering in technical institutions were there, and, as well, proprietors and editors of journals devoted to science and art. Ministers of various creeds vied with each other to do honor to the engineer, while lawyers and laymen talked of what he had done. In the midst of all stood the man they had come to honor, grasping as best he could the hands that were stretched out from all sides, and answering as opportunity would allow the hearty greetings and congratulations that were showered upon him by everyone. Soon the opening doors of the Opera House revealed a scene of beauty none who were there that night will soon forget, as, keeping step to music whose strains were not unlike an "Anvil Chorus," they marched in to take their appointed places at one of the many well-decorated tables that greeted their vision. Standing with bowed heads, they listened to the invocation of a blessing upon the occasion, and all that it meant, and upon all that participated therein.

The banquet, served by the Hotel Wyandotte, and under the special supervision of the steward of the Reading Railway Company, who, with his assistants, came up from Philadelphia for the occasion, left nothing to be wished for. Mingling with the mellow strains of music that floated in the air were the tales of the guest told to the neighbor by his side or across the table; many a merry jest was tossed to and fro as friends were recognized up or down the tables, who, perhaps, had not met before for years; and so, amid a babel of sounds mingled with bursts of uncontrollable laughter, the hours sped on, until with the arrival of coffee and cigars came the reminder that the feast of edibles was over, and, if there was to be a flow of soul, the hour had come.

In view of the fact that the idea of the dinner had originated at the Engineers' Club of New York, and that many of its members were the friends of Mr. Fritz, the compliment of presiding over the occasion was tendered to the President of that club, Mr. J. F. Holloway. Fortunately the duties of the Chairman were greatly lightened by the fact that, in deference to the wish of Mr. Fritz that the usual custom of proposing and answering toasts should not be followed, there was left but little for him to do. In order that the "subsequent proceedings" should not be entirely devoid of interest, a scheme had been quietly arranged among a few of those present, which, while it would be a surprise to nearly everyone, would permit a few to indulge in "talk" which by no means could be construed into speech-making. The scheme proposed was to turn the after-dinner procedure into a Mock Court, with all the paraphernalia of judges, court officers, attorneys, and witnesses, while the criminal was to be the honored guest of the evening. So well had been the plan arranged, so admirably was it carried out in the arranging of the tables and the seating of those selected for the court proceedings, that, without the slightest hitch and without any change except in a few instances the turning of one's chair, the court was speedily arranged and organized ready for business.

In opening the legal proceedings, the Chairman, who, as he said, "By reason of powers conferred upon him by the Vice-Chancellor of New Jersey and a lot of fellows in New York, had assumed the duties of Attorney-General," now proceeded briefly to outline the situation and explain the occasion that had served to bring all present together. He said the remarkable feature of the whole was the hearty interest and coöperation of everyone who had been seen or written to in regard to the affair. This was not only true of this country, but also of those who, living in foreign lands, had been tendered invitations as guests of the Committee, and friends and acquaintances of Mr. Fritz; and one of the pleasurable features, which, unfortunately, all could not for want of time participate in, was the letters that had been received by Mr. Fritz and the Committee, brief extracts of which only could be read. These letters and cables, brimful as they were of kindly regards and warm appreciation of the host as a man, spoke in the highest terms of what he had done in bringing about a better understanding among engineers and in building up ties of kindly brotherhood and good will.

Short extracts were then read from letters received from such eminent foreign engineers as Sir I. Lowthian Bell, E. Windsor Richards, E. P. Martin, C. P. Sandberg, J. Hoecher, Professor Herman Wedding, Adolph Grainer, Sir James Kitson, Richard Akerman, James Dredge, and others, leaving a mass of other letters which could only be referred to. As well were there letters (some of which were read) from friends in this country, who, by reason of absence from home or otherwise, could not be present, much to their regret. These various letters, which of themselves would make quite a volume, would, if published, be of much interest to engineers of all professions; for outside of the personal good will they contain, they show a high regard for the "American engineer" and for what in so short a time he has accomplished.

When the Chairman announced that one John Fritz, of Bethlehem, Pa., was to be arrested and brought to trial then and there on the charge of pretending to be an "engineer," and for pretending to know something about making steel, the absurdity of the charge and the novelty of the procedure instantly caught the fancy of his assembled friends, and such a shout and such a cheer as there arose that Opera House had never before heard. The Attorney-General (in view of the authority which he said had been conferred upon him) proceeded in the most arbitrary and despotic manner to select judges, sheriff, clerk, bailiffs, and officers of the court in general. The selections he made, as it turned out, proved so exceedingly judicious that no one ventured either to object or decline. The names of those selected were as follows:

CHIEF JUSTICE.

R. A. Lamberton, Prest. Lehigh University.

ASSOCIATE JUDGES.

Charles H. Loring, Prest. American Society Mechanical Engineers.
G. W. Melville, Engineer-in-chief United States Navy.
William Sellers, Prest. William Sellers & Co.
Henry Morton, Prest. Stevens Institute.
Charles E. Emery, Consulting Engineer.
John M. Hartman, of Hartman & Taws.

ATTORNEY-GENERAL.

J. F. Holloway, Prest. Engineers' Club, New York.

DISTRICT ATTORNEYS.

John Birkinbine, Prest. American Institute Mining Engineers.
Oliver Williams, Prest. Catasauqua Manufacturing Co.
Jos. D. Weeks, Editor "American Manufacturer and Iron World."

COUNSEL FOR PRISONER.

R. W. Raymond, Sec. American Institute Mining Engineers.
General W. Emil Doster.
J. Davis Brodhead, Esq.

HIGH SHERIFF.

William F. Durfee, Supt. C. W. Hunt Co.

CLERK OF THE COURT.

Charles Kirchhoff, Editor "Iron Age."

COURT REPORTER.

E. G. Spilsbury, Managing Director, Cooper, Hewitt & Co.

WITNESSES.

R. W. Hunt, Prest. R. W. Hunt Inspection Co.
E. D. Leavitt, Consulting Engineer Calumet & Hecla Mining Co.
John Thomas, Gen. Supt. Thomas Iron Co.
And others.

PRISONER.

Uncle John Fritz.

The judges being in place on the bench, the court was opened by a comprehensive and bombastic proclamation by the sheriff, partly in English, somewhat in Latin, with a sprinkling of Pennsylvania Dutch, in which the case of the Commonwealth vs. John Fritz was announced, and the prisoner placed in the dock. Next came the reading by the Clerk of the Court of an indictment purporting to have come from some mythical Grand Jury, which proceeded to give a comprehensive outline of the life of the prisoner, beginning with his boyhood on the farm, and his early training in riding bareback (the "bareback" objected to by the counsel for the prisoner, but objection overruled by the Court) to mill, and in plowing corn, all of which, while of value to a farmer, was by no means a suitable training for an engineer, at least not as engineers are now trained at Stevens Institute, Cornell, and other famous training schools. The indictment showed how the prisoner, growing up, turned his back (same objection by counsel, and overruled) on the old farm, and sought out a country blacksmith and machine shop, where he thumped his fingers, greased his clothes, and grew black in the face, thinking he was becoming an engineer. The indictment said (and it was proved by old citizens called upon the stand) that later on this man came to Bethlehem, where, selecting a fine wheatfield, he threw down the fence and built thereon furnaces and rolling mills, covering the entire field with ashes and cinders, buildings and railway tracks, until it was not now worth a cent an acre (for farming).

Notwithstanding the care and minuteness with which the indictment had been prepared, it was no sooner read than the senior counsel for the prisoner, Sergeant Raymond, arose and moved that "the indictment be quashed." Thereupon the associate counsel, Solicitor J. Davis Brodhead, proceeded, in a manner that will not soon be forgotten by those who listened to him, to show the court how illegal was the indictment in every respect, how loosely drawn; how deficient in definite statement, and how no court of any grade — not to say a court of such high distinction as was this — could for a moment permit such an indictment to have a standing. But it did stand, the Court overruling the motion and directing that the trial should proceed.

At this moment the doors of the balcony were opened, and the ladies of Bethlehem, preceded by Mrs. Fritz, filed in, taking the seats that had been reserved for them. As they came in, a Catasauquian, rising to his feet, said that, while he was there to prosecute the prisoner to the bitter end, he would say that he was blessed with a good wife: "Let us give her three cheers!" They were given, all rising, and he could have had more just for the asking for them.

No attempt will be made to describe the scene of that famous trial. Witnesses were called on behalf of the prosecution that promised well at the start, but under the cross fire of counsel weakened, until, at last, all they had said against the prisoner was turned in his favor. Interjection of witticisms between opposing counsel, mingled with unheard-of rulings by the Court, were wont to set the tables in a roar; "quips and quirks and paper bullets of the brain" were shot forth on all sides, rebounding to and fro, until court, judges, attorneys, prisoner, and all held their sides as they bent backwards and forwards in uncontrollable shouts of laughter. The gravest men there were swept into the wild whirl, while the jolliest simply shouted as they wiped the tears from off their cheeks. At last, the speeches of the counsel on either side having been made, the Chief Justice, summing up the evidence in a most masterly manner, proceeded, after a conference with his associates, to announce the decision of the court, which was, the acquittal of the prisoner; and, as the statute made no provision for hanging the prosecution, the decision of the court was that they should pay all the costs.

In conveying to the prisoner at the bar the decision of the bench, the Chief Justice availed himself of the opportunity to pay him such a tribute of love and esteem as was well warranted by their long friendship for each other as neighbors, and also by reason of what he (the prisoner) had so well done in aiding by his presence and counsel at the board meetings of the institution of learning over which he (the Judge) had the honor to preside. It was a loving tribute from one old friend to another, the recital of which touched the heart of everyone who in that quiet house listened to catch each word. As the Doctor wound up he said to the prisoner, who, with bowed head, stood before him: " And now, John, we could not let you go without receiving, if not a penalty sentence, at least something," and turning toward the stage box at his right, as he waved his hand, the slowly parting portières revealed standing therein a splendid Hall tubular chime clock, of Tiffany's best, which, as the prisoner raised his wondering eyes towards it, rang out sweet and clear the famous chimes which long years ago had pealed out over London's air from the ringing " Bow Bells," and which, like the bells of old, as they smote upon the ear of Whittington, thrice Lord Mayor, seemed to say, " Turn back, turn back." They were the midnight chimes, although the midnight had long since passed. As the sounds died out and the cheering that followed was over, the Doctor proceeded to say, " That clock is yours, John. It will be taken to your home, there, as we hope, to ring out its hourly chimes for years to come, and our wish is that, when by day or night its sweet music shall fall upon your ear and that of your loving wife, it will awaken memories as sweet of this night, and memories not only of the host of friends that are gathered here, but of the larger host of your friends elsewhere who could not be here as well." Then, turning to the listening throng, he added: "Dear friends, let us pray that these moving hands will measure off many hours of peace and happiness in that quiet home to which they will be sent, and, when its last chimes have been rung out in the hearing of our dear friends on earth, may they hear them anew in that peaceful state that passes all understanding. I hope you all will join with me in saying, 'We love John Fritz! God bless John and Ellen B. Fritz!'" And as the deeply felt amen died out, joining hands, all sang "Should Auld Acquaintance be Forgot." And so ends this chapter.

THIS IS THE INDICTMENT PRESENTED BY THE GRAND JURY, AND ON WHICH HE WAS TRIED.

May it please the Court, the Grand Jury, composed of hangers-on about the Court, shoemakers, tinsmiths, carpenters and joiners, members of Congress, briefless lawyers and clergymen on call, being duly sworn, and all (except a few from New Jersey) being citizens of the United States, and good men and true, having been informed that one, John Fritz, of the Borough of Bethlehem, County of Northampton, State of Pennsylvania, had said in the presence of reliable witnesses, that he believed that he could make a rail train, and that if he had a chance he thought he could build a blast furnace, blowing engines and all; that he had been known to aver, that if he had given him the right kind of stuff he could make steel; that at sundry times and places he has been known to attend gatherings of iron and steel makers, had gone to meetings of engineers, and had then and there talked about tensile strength, carbon, phosphorus, etc., and about three-high rail trains, about expansion, and on one occasion was heard to say that he knew about pumps, but he afterwards retracted and said he thought he knew about them, but had since learned that he was mistaken; that in this and many other ways he had endeavored to mislead the public into the belief that he was an engineer, and an iron and steel maker. The Grand Jury hearing that many persons calling themselves engineers, and iron and steel makers, were going up and down through the land persuading men to put money into works for making iron and steel by all kinds of processes, but mostly by short-cut processes, and into building machinery which, if it worked at all, worked directly the opposite way from what it was intended and promised, the Grand Jury felt it their duty to investigate as to the antecedents of this man Fritz, and to ascertain, if possible, whether, by reason of his education or practice, he had any right to call himself an engineer, so that if he had no such right he might be prevented from inflicting injury and bringing serious loss upon the honest but too confiding citizens of this Commonwealth.

The jury find that this aforesaid Fritz, who now sets himself up as an engineer, was, and ought now to be, a farmer; that he was born and raised on a farm, in the township of Londonderry, county of Chester, State of Pennsylvania, near Doe Creek; that, when he was large enough, he split wood to heat up his mother's brick oven, and was paid for so doing with a "turnover," baked after the bread came out.

Then later on he rode the old white horse bareback, while his father held the plow through the rows of the waving corn. That later still he rode the same horse over to the grist mill, where he waited for his grist to be ground. The jury have ascertained, from sources entirely reliable, that in the summer time and while waiting for his grist it was the practice of this pretending engineer to roll up his low pants and wade in the tail-race and watch the big water-wheel go round.

It was not clearly proven to the jury whether it was in watching the movement of the big water-wheel or listening to the merry rattle of the damsel as it fed the corn into the eye of the millstone, or in gazing at the wooden cog wheels as they rolled together, or listening to the knocking of the revolving reels, that the idea first came to him to wish to be an engineer; but there is no doubt it was then and there he was first filled with ambition to the extent that he said to himself, "If I ever grow up to be a man, I will make the wheels go round too." The jury being well informed as to the education of engineers, as they are annually being turned out in great numbers from our colleges, each one having a long roll of parchment paper, tied up with blue ribbon, they investigated as to the college from which this man graduated, and they found that his entire education had been obtained in his attendance at a red schoolhouse on the hill, about two miles away from his home. That he spent there several winters in terms of three months' schooling, for the reason that at that time of the year the business of plowing was rather dull. In addition to this splendid opportunity for procuring an education, he also attended several evening spelling bees, and was assessed, as all the rest were, to occasionally bring a candle. While it is possible that he may have graduated from this institution with high honors, he cannot now prove it, because the master he once helped to "lock out" is dead, and his diploma (if he ever had one) has been mislaid. It was also ascertained that the education of this pretending engineer received some extra polishing touches at a "night school" which he attended (whenever he could get a chance), which was situated at the cross-roads down near the creek.

It was known as the Blacksmith Shop. Here on winter nights he would perch himself on an empty keg at the back of the forge, with his head in the smoke and his toes in the warm ashes; he by the hour watched the blacksmith heat and pound, bend and weld, the iron as he formed it into shoes for horses or irons for the wagon, listening the meanwhile to tales of spooks and Indians told by the old settlers as they sat around the smithy and smoked, until his creeping hair almost raised his cap while he waited in patience for someone going his way to start for home. While the jury (at least some of them) recognized the country school and the blacksmith shop as valuable aids to an education, as a whole they do not believe they would at this time warrant anyone in calling himself a " mechanical engineer " or an expert in making steel. The jury further found that this man in his younger days left the farm and the profession of agriculture, of which he would no doubt have been a shining ornament had he continued in the way he began, and went up to Parkesburg and took the position of " cub " in a country machine shop, having as well a foundry attachment. Here he, so to speak, let himself out in repairing and renewing lame and spavined horse-powers, and in bracing up worn and unbalanced threshing machines, varying his labors by occasionally turning a gudgeon in a hand lathe. As an example of the pushing, pretentious ways this man has, the jury learned that he soon after left the allurements of the country machine shop, going up to Norristown, and, by representations as yet unknown to the jury, there obtained a job in a bar, plate, and nail mill. While in Norristown he claimed that he served an apprenticeship at the "dentistry business;" this bold claim was not believed by many of the jury, and witnesses were examined and cross-questioned, when it came out in evidence that the " dentistry business " consisted in repairing the broken teeth of the gear wheels at night that had dropped off during the day; and he was reported to have said that, if at any time he had any fears of being out of a job, he went and looked in the wheel pits and was sure to find work. It was further reported that this man Fritz claimed to be very expert in setting " single teeth," but that he did not pretend to know much about " plate work " at that time, but later on in his life it is said that he did some very creditable work in that line as well, for his Uncle Sam.

It is hardly worth while to further occupy the time of the Court in showing how preposterous it is for a man with such an education and experience to pretend to be an " engineer " or a steel maker.

The second count of the indictment is, that the aforesaid John Fritz is a disturber of the peace.

Several years ago this man, now at the bar of this Court, came to the borough of Bethlehem, and, as it is supposed, for the purpose of attending a horse race; at least that was the ostensible object of his visit. The race course was a large, level field on the banks of the Lehigh, below the town, and away from any settlement. Sitting on the top rail of the fence, watching the boys trot their blooded steeds, the notion came into his head that the land about there would be a pretty good place on which to build a blast furnace, and perhaps a rolling mill or two. It is one of the known peculiarities of this man that when he gets a notion in his head all creation cannot change him, and there are witnesses here in court who can testify to this. So, having conceived the notion of covering this race course with furnaces and mills, the people who knew him best said it would be of no use opposing him, and that they might as well come down with the dust first as last, and they did, and he not only covered the race track with blast furnaces, rail mills, workshops, etc., but he covered the farms adjoining, and this can also be proved if necessary. By a careful search of the records and by examining recently published documents, the Grand Jury learned that many years ago a body of peace-loving, mild, and unassuming persons came from over the sea to find, if possible, in the New World a spot where they could live a quiet life and be assured of an undisturbed rest afterwards. They found, as they believed, such a spot in the wilderness, here on the banks of the Lehigh. Purchasing the land from the native Americans (upon terms not made public), they founded the peaceful hamlet long known as Bethlehem. It was the belief of many witnesses who appeared before the Grand Jury that, had it not been for the man now at the bar of this Court coming here, Bethlehem would have remained to this day the quiet place it was previously noted for being; that the waving grain would still be bending to the summer breeze over lands now occupied by streets and lanes or covered with comfortable and costly homes; that no noises would have been heard, other than the shrill cry of the blue jay or the warning note of the kingfisher as he dropped from the swinging bough into the river beneath, the cooing of the turtle-dove in the wooded heights above, or the pleading song of the whippoorwill as the sun went down behind the western hills. That all this has been changed by the advent of this alleged engineer can be proven to the satisfaction of this Court. The rumbling of huge wheels, the throbbing pulsations of mighty blowing engines, the shriek of steam whistles, the angry roar of burdened engines, the clanging noise of falling beams and bars, the snorting puffs of the impetuous and bustling locomotives that ply to and fro over the clanking rails and rattling switches, have changed beyond all recognition the old-time peaceful hamlet of Bethlehem. Disturbing and distracting as all this noise and confusion now is, the prisoner has recently built and set in operation other and new steam hammers of a size and weight hitherto unknown, whose descending blows make all the surrounding country to shiver and to shake; in short, the evidence has been so overwhelming against the prisoner as a disturber of the peace and quiet that once reigned along the banks of the Lehigh before he came that the Grand Jury, mindful of their oaths, deemed it their duty to the commonwealth to present him to this Court, and to demand that he be tried by a jury of his peers, if such a one can be found.

(Signed) JOHN OLDBOY,
Foreman.

THE POEM WHICH DR. R. W. RAYMOND, SENIOR COUNSEL FOR THE DEFENSE, RECITED IN COURT, AND WHICH, NO DOUBT, HAD MUCH TO DO WITH THE SENTENCE IMPOSED ON THE PRISONER.

Whom shall we choose the flag to hold
In our vast contests, yet untold,
Which to the New World adds the Old?
    Donner und Blitz!
    John Fritz!

Leaders unseen are with us yet:
Nor they nor we the past forget,
The fate that took them early, yet,
    Thank God, omits
    John Fritz!

When doubters doubted whether we
Could beat our brethren over sea
In rolling-mill machinery,
    Who gave 'em fits?
    John Fritz!

Who stands before us to combine
A level head, an upright spine,
With nowhere any crooked line?
    Most clearly it's
    John Fritz!

Whose heart is warmer than his blast?
Whose faith more steadfast to the last
Than any steel he ever cast?
    That figure hits
    John Fritz!

Whose fame commands our homage, such
As bears of envy not a touch,
Because we love the man so much?
    Why, there he sits —
    John Fritz!

THIS IS WHAT THE ATTORNEY-GENERAL SAID IN HIS CLOSING SPEECH, AND WHICH SHOWS THAT HE KNEW VERY LITTLE ABOUT THE DUTIES OF THAT OFFICE.

May it please the Court, while it was my imperative duty to present the charges on which the prisoner has been tried, I would like to add a few words to what has already been so well said by the distinguished attorneys on both sides. I hope that whatever sentence you have in mind to inflict upon the prisoner at the bar, it will be tempered with mercy; that you will bear in mind that through all these long years he has spent, burdened by the cares, anxieties, and perplexities that ever surround the life of an engineer and the ironmaster, he has always had a kind word for all about him. Did sickness and death come to the homes of any, he brought to them words of consolation and hope; did any have heavy burdens to bear, his hand helped to lighten them; were any despondent, his cheering words gave them new life; and in many to us unknown ways he has done what he could to make this world the better for having lived in it.

I am somewhat of a privileged person to-night, having borne a somewhat confidential relation to all concerned in arranging what has been done here, and with your Honor's permission, I would like to impart a portion of the inner history connected with the preparations made for this event.

It is known to a few present that originally it was intended to have this a small dinner given at a hotel, but when the announcement was made that a dinner was to be given John Fritz by his friends, so numerous were the persons who wished to have a part in it that the hotel had to be given up, and even a large hall was found too small, and this Opera House was the only available place to be had, and, had the dinner been postponed a week longer, we would have been obliged to build a special auditorium.

A few days ago, as you all know, Pennsylvania Avenue was filled with old and battle-scarred veterans, who were marching under waving banners of red, white, and blue, along that historic avenue, many of them for the last time. Among them was the remnant of a regiment known as the Twenty-ninth Ohio, and in the ranks and beside the old soldiers, sorely wounded as many of them were by the arrows of misfortune and poverty, there walked a man who was once their colonel, and once the President of the United States; and, in the time to come, when Rutherford B. Hayes comes to be better known and better appreciated, one of the grandest tributes paid to his memory will be the story that on that last march of the old veterans through the capital of the nation, he took his place in the ranks, and alongside of what Abraham Lincoln was pleased to call "the plain people." And now for the secret I have to tell you. When it was announced that this anniversary dinner was to be given in this large Opera House, the prisoner at the bar, who had asked nothing for himself, came to us and said that, "if there was plenty of room, and no one would be discommoded in the least, he would so much like to have some of his reliable workmen who had been with him for so many years, and on whom he had so much relied, to have a place at the table and a part in the exercises." I need not tell you how promptly he was told that there was a place at the table, and a part in all that was to be seen and heard, and a warm welcome for all he chose to bring; and here to-night there are none more glad and proud at the honors shown to their chief than are John Fritz's old guard; and when the story of his life shall be told, no page will shine brighter, no incident will more truly illustrate his kindness of heart, his modesty, and his thoughtful regard for others, than will the one that relates that, in the hour of his greatest success, when praise and honors came to him from all sides, he turned his thoughts backward to a review of his past life, to a remembrance of the hours of trial and difficulties, and in that retrospective view he did not forget the faithful men who so long had stood by him and helped him; and his happiness to-night would have been incomplete had they not been here to share his pleasure.

AND THIS IS THE "BLUE-PRINT" SPEECH MADE BY THE PRISONER IN HIS DEFENSE, AFTER LISTENING TO WHICH THE CHIEF-JUSTICE AT ONCE GAVE HIM A "TIME SENTENCE."

Judge, they say I am not much of an engineer, and at times I have had doubts about it myself, but there is one thing I never had any doubt about, and that is, that I could not make a speech in public.

When I began to try to become an engineer, we used to whittle out a wooden model of anything we wanted to make, or else we would draw it on a chalked board with a square and a pair of compasses; but the times are changed, and every engineer who begins a job now has to have a blue print before him to work from, and so for this job I have mine.

Under ordinary circumstances I would have preferred to remain silent, but on account of the grand reception you have given me, and the many hearty congratulations that

I have had on the occurrence of my seventieth birthday from friends at home and abroad, I cannot do so. I only wish I could fitly express to you how highly I appreciate the compliment you bestow upon me by such a gathering of friends as are here to-night. Be assured I shall ever remember it as one of the happiest events of my life.

Years ago, when as a barefooted boy I followed the plow from early morn till late at night, I little dreamed that the time would ever come when I would be the recipient of such an honor, and would be surrounded by so many kind and thoughtful friends. Often during my life, when burdened with trials and anxieties, coupled as they sometimes were with bitter disappointments, I had almost concluded that life was not worth the struggle I was engaged in; and had it not been unmanly to do so, I would have been tempted to step down and out; but, gathering new courage, I struggled on; and now, at the end of threescore and ten years, to receive such a royal welcome from so many warm friends touches me beyond what words can express.

As to my past life and its results, I can only say I tried to do the best I could.

When as a young man I began work in the line in which all my after years were spent, we had none of the aids to progress that the young men of to-day have. There were no technical schools where we could learn the theory and science of engineering; there were no papers or books out of which we could learn the practice and experience of others; whatever a boy then got in the way of knowledge came to him by hard knocks and often bitter experience; and so, when you are pleased to commend what I may have accomplished, I esteem it doubly, for you know the school in which I was taught, and you are men fully competent to sit in judgment on such matters. Proud and grateful as I am for all the kind things you have been pleased to say about me and of my life work, it would be ungenerous in me not to say that whatever good I have accomplished has been largely due to the faithful and able assistants that I have had the good fortune ever to have had about me, and also to the true and loyal workmen in the various departments, to whom, by their skill, energy, and the faithful manner in which they have performed their duty, I am much indebted; and much as I would like to thank them individually for their loyalty to me, and the interest I represented, time will not permit me to do so.

As I look backward over my life, I am reminded how one and another of my associates have passed over to the other side, and on my lips and in my heart are the names of your friends and mine who I wish might look on this scene to-night.

It would be vain in me to assume that this large assemblage of engineers, metallurgists, capitalists, and professional men from all parts of the country are here wholly on account of their personal regards for me; so far as it is so, none can be more grateful than I; but I assume it is in part in honor of the profession of engineering, which we so dearly love, and which in its various branches has done so much for our country and for humanity the world over. Time will not permit me to enlarge on this point as I might, but as engineers we all know how important it is to our success to have behind us the men who not only have the money, but have as well the faith and confidence so necessary in pushing forward great undertakings. Such men it has been my good fortune to be associated with, and I want to thank them, not only for their personal friendship so often expressed, but for their confidence in me, which has so much helped me in my labors.

But, Judge, you have asked me if I had anything to say why sentence should not be pronounced upon me. I can only say that my attorneys have said all and more than could rightfully be said in my defense, and so I can only rely on the mercy of the Court. But, Judge, remember, at the least, I was grateful and thankful for all the kind words that have been spoken about me; that my aim in life has been to always do the best I knew how, and make no fuss about it

JOHN FRITZ.

The "time sentence" was an elegant tubular chiming hall clock, on which was inscribed:

O TIME! DEAL GENTLY WITH OUR LOVING FRIENDS,
JOHN AND ELLEN B. FRITZ.

THE CURTAIN FALLS.

The day has come and gone, and the night has waned; the lights have gone out, and the musicians, unjointing their horns and packing them away, have vanished from the scene; the flowers have faded and the wreaths have shriveled to dust; the decorations stowed away in the garret even now are gathering the grime that ere long will change them beyond recognition. All is over save memory, and even that is being dimmed by more recent events. To those who have patiently followed what has been herein written, there will come, perchance, the thought that it was unwise to attempt, as it certainly was impossible, to revive in full the pleasure and ecstasy of this bygone event, and possibly you are right in so thinking; but take this leaflet, and bind it to the menu card you brought home from Bethlehem, and on which is written the autograph of the friends that were about you at the table that September night, and possibly, in after years, — years that have brought whiteness to your hair and a yellow tinge to these leaves, — in some idle moment, you may come across both, stowed away among your papers, and, glancing over what is here written, and over the names attached, there may, perchance, for a moment, come to you a remembrance of the faces you there saw and may never see again, and of words spoken but well-nigh forgotten; and as you lay it down again, may you say, as did the smoker first mentioned, as long afterwards he threw into the ashes of the grate the remnant of his well-smoked cigar: "Well, it was a great success, and I am glad I was there."

THE GUESTS INVITED, MOST OF WHOM WERE PRESENT.

Stephen B. Elkins, Secretary of War,	Washington, D. C.
Benj. F. Tracy, Secretary of the Navy,	" "
Brig.-Gen. D. W. Flagler, Chief of Ordnance, War Dept.,	" "
Com. W. M. Folger, Chief of Ordnance, Navy Dept.,	" "
Chas. H. Loring, Pres. American Society Mechanical Engineers, 239 Clermont Ave.,	Brooklyn, N. Y.
Eckley B. Coxe, Coxe Bros. & Co.,	Drifton, Pa.
B. F. Jones, Jones & Laughlin, Ltd.,	Pittsburg, Pa.
John Chalfant,	" "
James Hemphill, Mackintosh, Hemphill & Co.,	" "
James McMillan,	Johnstown, Pa.
David Reeves, Pres. Phœnix Iron Co.,	Phœnixville, Pa.
Joel Cook, *Philadelphia Ledger*,	Philadelphia Pa.
Percival Roberts, Pencoyd Iron Works, 261 South 4th St.,	" "
John Sellers, Wm. Sellers & Co., Incorp.,	" "
Wm. B. Bement, Bement, Miles & Co.,	" "
Frederick B. Miles,	" "
David Clark,	Hazleton, Pa.
John Kinsey,	Easton, Pa.
A. A. McLeod, Pres. and Gen. Mgr. Reading Railroad System,	Philadelphia, Pa.
Robert P. Linderman, Pres. Bethlehem Iron Co.,	Bethlehem, Pa.
Robert H. Sayre, Vice-Pres. and Mgr. Bethlehem Iron Co.,	" "
Jos. Wharton, Director, Bethlehem Iron Co.,	" "
E. P. Wilbur, Director, Bethlehem Iron Co.,	" "
Geo. H. Myers, Director, Bethlehem Iron Co.,	South Bethlehem, Pa.
Beauveau Borie, Director, Bethlehem Iron Co.,	Philadelphia, Pa.
R. W. Davenport, Assist. Supt. Bethlehem Iron Co.,	Bethlehem, Pa.
W. H. Jaques, Ordnance Engineer, Bethlehem Iron Co.,	" "

C. O. Brunner, Treas. Bethlehem Iron Co., ...Bethlehem, Pa.
Abraham S. Schropp, Sec. Bethlehem Iron Co., ... " "
Sam Adams, ... " "
Owen Leibert, ... " "
Hon. Chas. Brodhead, ... " "
C. M. Dodson, Pres. Morea Coal Co., ... " "
Truman Dodson, Vice-Pres. Morea Coal Co., ... " "
W. H. Sayre, ... " "
E. B. Ely, Coxe Bros. & Co., ...New York, N. Y.
Chas. Otis, Pres. Otis Steel Co., ...Cleveland, Ohio.
Oliver Williams, Pres. Catasauqua Mfg. Co.,...........Castasauqua, Pa.
Samuel Thomas, Pres. Pioneer Mining and Mfg. Co., ... " "
C. B. Dudley, Chemist Pennsylvania R. R. Co., ...Altoona, Pa.
Edward S. Moffat, Gen. Mgr. Lackawanna Iron and Coal Co.,..Scranton, Pa.
Albert Lewis, ...Bear Gap, Pa.
Henry M. Boies, 530 Clay Ave., ...Scranton, Pa.
John Thomas, Gen. Supt. Thomas Iron Co., ...Hokendauqua, Pa.
Joseph Morgan, Chief Engineer Cambria Iron Works,......Johnstown, Pa.
Major L. S. Bent, Pres. Pennsylvania Steel Co.,.........Philadelphia, Pa.
Frank Firmstone, ...Easton, Pa.
B. F. Fackenthal, Durham Iron Co., ...Riegelsville, Pa.
C. F. Mattes, Sec. Vice-Pres. Lackawanna Iron and Coal Co.,..Scranton, Pa.
Maunsel White, Bethlehem Iron Co., ...Bethlehem, Pa.
Sydney Broadbent, Supt. Dickson Mfg. Co., ...Scranton, Pa.
Theo. N. Ely, Gen. Supt. Motive Power, Pennsylvania R. R., .Altoona, Pa.
Robert Lockhart, ...Bethlehem, Pa.
Clark Fisher, Pres. Fisher Rail Joint Works, ...Trenton, N. J.
Joseph D. Weeks, Editor *American Manufacturer*,..........Pittsburg, Pa.
E. G. Spilsbury, Gen. Mgr. Trenton Iron Co., ...Trenton, N. J.
Henry Morton, Pres. Stevens Institute of Technology, ...Hoboken, N. J.
R. H. Thurston, Director, Sibley College, ...Ithaca, N. Y.
Robt. Forsyth, Chief Engineer Illinois Steel Co., ...Chicago, Ill.
R. W. Hunt, Past Pres. American Society Mechanical Engineers, " "
Henry M. Howe, Vice-Pres. American Institute Mining Engineers, ...Boston, Mass.
Henry R. Towne, Pres. Yale & Towne Mfg. Co.,.........Stamford, Conn.
Wm. F. Durfee, Supt. C. W. Hunt & Co., ...West New Brighton, N. Y.
Geo. W. McNulty, Chief Engineer Broadway Cable Railway, ...New York, N. Y.
Chas. Kirchhoff, Editor *The Iron Age*, 96 Reade St., ... " "
Geo. H. Babcock, Pres. Babcock & Wilcox Co., 30 Cortlandt St., ... " "
S. W. Baldwin, New York Agent Pennsylvania Steel Co.,. " "
Prof. James E. Denton, Stevens Institute of Technology, ...Hoboken, N. J.

J. H. Harris, Vice-Pres. Worthington Pumping Engine Co., . . . London, Eng.
J. F. Holloway, Pres. Engineers' Club, 10 West 29th St., ... New York, N. Y.
Prof. F. R. Hutton, Sec. American Society Mechanical Engineers, ... " "
James F. Lewis, Rand Drill Co., 23 Park Place, ... " "
Chas. Macdonald, Union Bridge Co., 247 Fifth Ave., ... " "
John Birkinbine, Pres. American Institute Mining Engineers, 26 North Juniper St., ... Philadelphia, Pa.
James Moore, Bush Hill Iron Works, ... " "
Percival Roberts, Jr., 261 South 4th St., ... " "
Wm. Sellers, Pres. Wm. Sellers & Co., Incorp., ... " "
Coleman Sellers, Past Pres. American Society Mechanical Engineers, 3301 Baring St., ... " "
Washington Jones, 1632 North 15th St., ... " "
H. G. Morris, Mechanical Engineer, Drexel Building, ... " "
W. A. Perry, Pres. Henry R. Worthington, 86 Liberty St., . . New York, N. Y.
C. C. Worthington, Chairman Henry R. Worthington, 86 Liberty St., ... " "
T. F. Miller, Sec. Henry R. Worthington, 86 Liberty St., . . " "
John Stanton, Treas. Atlantic Copper Mining Co., 70 Wall St., ... " "
Horace See, Engineer and Naval Architect, 1 Broadway, . . " "
John Thomson, Civil Engineer, Temple Court, ... " "
R. W. Raymond, Sec. American Institute Mining Engineers, 13 Burling Slip, ... " "
Geo. W. Maynard, Consulting Engineer, 31 Nassau St., . . . " "
James C. Bayles, Engineers' Club, 10 West 29th St., ... " "
John Bogart, Civil Engineer, 71 Broadway, ... " "
Geo. W. Bramwell, 59 Wall St., ... " "
Frank S. Witherbee, Witherbee, Sherman & Co., ... Port Henry, N. Y.
W. H. Wiley, Treas. A. S. M. E., 53 East 10th St., ... New York, N. Y.
Edward Cooper, Cooper, Hewitt & Co., 17 Burling Slip, . . . " "
Abram S. Hewitt, Cooper, Hewitt & Co., 17 Burling Slip, . . " "
Chas. A. Hague, Hydraulic Engineer, 86 Liberty St., ... " "
E. D. Leavitt, Consulting Engineer Calumet and Hecla Mining Co., ... Boston, Mass.
S. B. Whiting, Gen. Mgr., 11 Ware St., ... Cambridge, Mass.
C. J. H. Woodbury, Vice-Pres. Manufacturers' Mutual Ins. Co., ... Lynn, Mass.
Oberlin Smith, Pres. Ferracute Machine Co., ... Bridgeton, N. J.
Horace S. Smith, Sec. Vice-Pres. Illinois Steel Co., ... Chicago, Ill.
F. W. Wood, Pres. Maryland Steel Co., ... Sparrows Point, Md.
Capt. H. G. H. Tarr, 86 Liberty St., ... New York, N. Y.
Walter Wood, Mgr. R. D. Wood & Co., ... Philadelphia, Pa.

W. B. Cogswell, Gen. Mgr. Solvay Process Co., ... Syracuse, N. Y.
A. C. Rand, Rand Drill Co., 23 Park Place, ... New York, N. Y.
John F. Wilcox, Pittsburg Engineering Co., ... Pittsburg, Pa.
William Thaw, Fifth Ave. Hotel, ... New York, N. Y.
Geo. W. Melville, Engineer-in-chief, United States Navy, Washington, D. C.
Wm. Metcalf, Crescent Steel Works, ... Pittsburg, Pa.
Chas. E. Emery, Consulting Engineer, 915 Bennett Building, ... New York, N. Y.
W. H. Bailey, American Tube Works, 20 Gold St., ... " "
David Williams, Publisher, 96 Reade St., ... " "
J. C. Kafer, Morgan Iron Works, 814 East 9th St., ... " "
Jos. Leon Gobeille, Gen. Mgr. Gobeille Pattern Co., ... Cleveland, Ohio.
H. S. Haines, Vice-Pres. and Gen. Mgr. Plant Investment Co., 12 West 23rd St., ... New York, N. Y.
W. H. Adams, Virginia Sulphur Mining Co., 71 Wall St., . . " "
W. A. Sweet, Pres. Onondaga Steel Works, ... Syracuse, N. Y.
Lieut. J. F. Meigs, ... South Bethlehem, Pa.
E. C. Felton, Supt. Pennsylvania Steel Co., ... Steelton, Pa.
A. Mitchell, Supt. Motive Power, ... Wilkes-Barre, Pa.
Capt. Frank Hobbs, Watervliet Arsenal, ... West Troy, N. Y.
Stanley H. Goodwin, Gen. Supt. Lehigh Valley Division, Reading R. R., ... Bethlehem, Pa.
R. H. Wilbur, Asst. to Gen. Mgr. Reading R. R. System, ... " "
W. A. Wilbur, Vice Pres. E. P. Wilbur Trust Co., ... " "
Hon. J. Davis Brodhead, ... " "
R. A. Lamberton, LL.D., ... " "
G. B. Linderman, ... " "
Jos. Wharton, ... Jamestown, R. I.
C. H. Cramp, Pres. Wm. Cramp Shipbuilding Co., ... Philadelphia, Pa.
Edwin S. Cramp, cor. Beach and Ball Sts., ... " "
Stackhouse Powell, Pres. Cambria Iron Co., ... " "
Jay C. Morse, Pres. Illinois Steel Co., ... Chicago, Ill.
H. C. Frick, Chairman Carnegie Companies, ... Pittsburg, Pa.
E. M. McIlvaine, Assist. to Pres. Bethlehem Iron Co., ... Bethlehem, Pa.
J. Tatnall Lea, 4th and Chestnut Sts., ... Philadelphia, Pa.
Alfred Earnshaw, 203 Walnut Place, ... " "
W. J. Taylor, Pres. Taylor Iron and Steel Co., ... High Bridge, N. J.
A. L. Colby, Chemist, ... Bethlehem, Pa.
Chas. Hartshorne, Vice-Pres. Philadelphia & Reading R. R., ... Philadelphia, Pa.
John M. Hartman, 1233 North Front St., ... " "
John Hughes, Delaware Rolling Mills, ... " "
Horace L. Brooks, ... Baltimore, Md.
Harry Moore, James Moore & Son, ... Philadelphia, Pa.

Andrew Wheeler, Pres. Morris Tasker & Co., ... Philadelphia, Pa.
Thos. A Edison, ... Orange, N. J.
W. L. Conynghan, ... Wilkes-Barre, Pa.
E. H. Jones, Pres. Vulcan Iron Works, ... " "
Chas. Ziegenfuss, Gen. Supt. Juragua Mines, ... South Bethlehem, Pa.
Calvin Pardee, Drexel Building, ... Philadelphia, Pa.
Hon. Robt. E. Wright, Pres. Lehigh Valley Car Co., ... Allentown, Pa.
Hon. W. H. Allison, Treas. Allentown Rolling Mills,...... " "
J. K. Mosser, ... " "
J. Rogers Maxwell, Pres. Central R. R. of New Jersey, ... New York, N. Y.
John Taylor, Gen. Traffic Mgr., ... Bethlehem, Pa.
J. Raymond Claghorn, Pres., 204 Walnut St., ... Philadelphia, Pa.
W. A. Lathrop, ... Wilkes-Barre, Pa.
A. N. Cleaver, Esq., ... South Bethlehem, Pa.
Henry Coppee, LL.D., ... " "
W. L. Estes, M.D., Director St. Luke's Hospital, ... Bethlehem, Pa.
Prof. C. L. Doolittle, Lehigh University, ... " "
Prof. Mansfield Merriman, Lehigh University, ... " "
J. H. Dudley, Consulting Engineer, Grand Central Station, . New York, N. Y.
Anthony Victorin, Consulting Engineer, Ordnance Dept., . . West Troy, N. Y.
Wm. Kent, Consulting Engineer, Times Building, ... New York, N. Y.
James M. Doherty, Esq., 2212 Green St., ... Philadelphia, Pa.
Jos. C. Herr, Esq., 224 South 3d St., ... " "
S. H. Chauvenet, Vice-Pres. Wellman Iron and Steel Co., ... Thurlow, Pa.
Richard Peters, Jr., Wellman Iron and Steel Co., ... " "
P. W. Moen, Gen. Mgr. Washburn & Moen, ... Worcester, Mass.
S. T. Wellman, Pres. Wellman Iron and Steel Co., ... Thurlow, Pa.
Carleton W. Nason, Pres. Nason Mfg. Co., ... New York, N. Y.
Andrew Fletcher, Pres. W. & A. F. Fletcher Co., 157 West
73d St., ... " "
Geo. D. McCreary, City Treasurer, ... Philadelphia, Pa.
Edwin Thomas, Gen. Mgr. Pioneer Iron and Mining Co., . . Catasauqua, Pa.
Theo. D. Wilson, Chief Constructor, U. S. N., ... Washington, D. C.
Geo. E. Weed, Pres. Morgan Iron Works, ... New York, N. Y.
John E. Sweet, Pres. Straight Line Engineer Co., ... Syracuse, N. Y.
Alfred Longsdon, 9 New Broad St., ... London, Eng.
C. P. Sandberg, 19 Great George St., ... Westminster, London, S. W., Eng.
R. Gladhill, Mgr. Sir Joseph Whitworth & Co.,.......... Manchester, Eng.
H. S. Carrington, Sec. Sir Joseph Whitworth & Co., ... " "
Sir I. Lowthian Bell, ... Middlesborough, Eng.
E. Windsor Richards, ... " "
E. P. Martin, ... Dowlais, Glamorgan, Wales.
James Dredge, 36 Bedford St., ... Strand, London, Eng.
J. Hoecher, Chief Engineer, Fred. Krupp, ... Essen-on-Ruhr, Germany.

Prof. Herman Wedding, ... Berlin, Germany.
I. Kraft, Chief Engineer Cockerill Iron Works, ... Seraing, Belgium.
Adolphe Grainer, Director Cockerill Iron Works, ... " "
Jos. C. Platt, Consulting Engineer, ... Waterford, N. Y.
Gen. Ario Pardee, ... Hazleton, Pa.
James M. Swank, Sec., ... Philadelphia, Pa.
Gen. Doster, ... Bethlehem, Pa.
J. A. Sweigard, Assist. Gen. Mgr. Reading R. R., ... Philadelphia, Pa.
James A. Burden, ... Woodside, Troy, N. Y.
Prof. Thos. Egleston, School of Mines, Columbia College, . . New York, N. Y.
Capt. James Jenkins, ... Harrisburg, Pa.
Sir Henry Bessemer, Denmark Hall, ... Surrey, Eng.
Percy C. Gilhurst, Finchley, New Road, Hampstead, ... London, Eng.
Sir James Kitson, Monkbridge Iron Works, ... Leeds, Eng.
Wm. Keyser, ... Baltimore, Md.
Richard Akerman, Royal School of Mines, ... Stockholm, Sweden.
John Gjeirs, ... Middlesbro-on-Tees, Eng.
Hugh Bell, ... " "
P. Boward, care Schneider, ... Creusot, France.
J. Barba, care Schneider, ... " "
Wm. C. Whitney, ex-Secretary U. S. Navy, ... New York, N. Y.
Gen. Joseph R. Hawley, U. S. Senator, ... Hartford, Conn.
F. A. Pratt, Pres. Pratt & Whitney Co., ... " "
L. Hernsheim, 29 Broadway, ... New York, N. Y.
Chas. H. Morgan, Engineer and Contractor, 25 Lincoln St., . Worcester, Mass.
Geo. Pierce, Supervisor, Fall River Line, ... Newport, R. I.
E. B. Leisenring, ... Mauch Chunk, Pa.
W. R. Tucker, Sec. Board of Trade, Drexel Building, ... Philadelphia, Pa.
Judge Henry Green, ... Easton, Pa.
Edmund C. Pechin, ... Roanoke, Va.
Senator Wm. E. Chandler, ... Waterloo, N. H.
Archibald Johnston, ... Bethlehem, Pa.
Mathew Addy, ... Cincinnati, Ohio.
Joseph Johnston, ... Bethlehem, Pa.
George Chandler, ... " "
Harry Leibert, ... Bethlehem, Pa.
J. S. Jeans, Victoria Mansions, ... London, Eng.
Alexander Hamilton, ... Johnstown, Pa.
Lieut. Kossuth Niles, Ordnance Office, U. S. N., ... Washington, D. C.
Captain O'Neal, Navy Dept., ... " "
Lieut. Karl Rahror, ... Bethlehem, Pa.
Capt. Ira McNutt . . . . " "
Senator John L. Morgan, ... Washington, D. C.
Senator H. M. Teller, ... " "

Capt. W. T. Sampson, Navy Yard, ... Washington, D. C.
Irving M. Scott, Union Iron Works, ... San Francisco, Cal.
Clarence S. Bement, ... Philadelphia, Pa.
Marriott Smyth, ... Latrobe, Pa.
Andrew Carnegie, 5 West 51st St., ... New York, N. Y.
C. P. Goss, Scoville Mfg. Co., ... Waterbury, Conn.
Senator W. B. Allison, ... Washington, D. C.
Congressman Chas. A. Boutelle, ... " "
Dr. W. H. Chandler, Lehigh University, ... South Bethlehem, Pa.
George Brooke, ... Birdsboro, Pa.
A. S. Patterson, 330 Walnut St., ... Philadelphia, Pa.
Chas. L. Bailey, ... " "
A. J. Dull, ... Harrisburg, Pa.
G. C. Wilkins, Gen. Mgr. Pennsylvania R. R. Co., ... Baltimore, Md.
J. M. Gledhill, Sir Joseph Whitworth Co., ... Manchester, Eng.
James Fuller, ... Catasauqua, Pa.
Capt. Montgomery Sicard, Navy Yard, U. S. S. Miantonomoh, ... Brooklyn, N. Y.
C. Y. Wheeler, Stirling Steel Co., ... Pittsburg, Pa.
G. E. Taintor, ... New York, N. Y.
Chas. A. Hewitt, ... Trenton, N. J.
Henry McCormick, ... Harrisburg, Pa.
Arthur Brock, ... Lebanon, Pa.
R. H. Sayre, Jr., ... South Bethlehem, Pa.
R. E. Jennings, ... West Bergen, N. J.
David H. Thomas, ... Hokendauqua, Pa.
Samuel R. Thomas, ... " "
Stevenson Taylor, Vice-Pres. North River Iron Works, ... Hoboken, N. J.
Wm. Fletcher, North River Iron Works, ... " "
Chas. Wales, Engineers' Club, 10 West 29th St., ... New York, N. Y.
A. J. Haws, ... Johnstown, Pa.
R. B. Keyser, ... Baltimore, Md.
Frank L. Neale, International Navigation Co., 305 Walnut St., ... Philadelphia, Pa.
Prof. J. Harvard Biles, care Chas. H. Camp, ... " "
Owen J. Conley, Ogden Mine, ... Ogden, N. J.
Joseph Stokes, ... Trenton, N. J.
Wm. H. Morris, Pottstown Iron Co., ... Pottstown, Pa.
E. H. Austin, ... Philadelphia, Pa.
David Townsend, ... " "
Wm. B. Schiller, Monongahela Furnace Co., ... Pittsburg, Pa.
C. W. Roepper, Solid Steel Co., ... Alliance, Ohio.
Albert Brodhead, ... Bethlehem, Pa.
Dr. R. I. Bailey, Normandie Hotel, ... New York, N. Y.

Horace G. Lash, Carbon Iron Co., ... Pittsburg, Pa.
Chas. G. Roebling, J. Roebling's Sons Co., ... Trenton, N. J.
James Riley, ... Glasgow, Scotland.
Benjamin Riegel, ... Riegelsville, N. J.
Geo. T. Barnes, ... Philadelphia, Pa.
Rev. P. McEnroe, ... Bethlehem, Pa.
Edwin Menner, ... " "
Tinsley Jeter, ... South Bethlehem, Pa.
W. T. Walters, ... Baltimore, Md.
Josiah Monroe, 208 South 4th St., ... Philadelphia, Pa.
Robert F. Kennedy, 216 South 4th St., ... " "
F. G. Gorham, N. Y. Sales Agent Bethlehem Iron Co., ... New York, N. Y.
Col. H. G. Prout, 73 Broadway, ... " "
William Canam, ... Bethlehem, Pa.
William Stubblebine, ... " "
Patrick Briody, ... South Bethlehem, Pa.
Ensign F. R. Brainard, ... Bethlehem, Pa.
Capt. H. L. Jewett, ... " "
Lieut. Com. Wm. Swift, U. S. N., ... " "
Lieut. S. E. Stuart, ... South Bethlehem, Pa.
Rev. Gilbert H. Sterling, ... " "
Isaac H. Chandler, ... Johnstown, Pa.
George Crocker, 32 Cliff St., ... New York, N. Y.
Chas. Parrish, ... Wilkes-Barre, Pa.
Wm. Chapman, ... Bethlehem, Pa.
Capt. R. A. Abbott, ... " "
Price Wetherill, ... South Bethlehem, Pa.
E. O. C. Acker, ... Bethlehem, Pa.
Merritt Halliday, ... South Bethlehem, Pa.
James E. Tatnall, ... " "
A. M. Mattice, 2 Central Square, ... Cambridgeport, Mass.
Chas. H. Manning, Supt. Amoskeag Mfg. Co., ... Manchester, N. H.
W. R. McIlvain, ... Reading, Pa.
Henry S. Drinker, 227 South 4th St., ... Philadelphia, Pa.
Prof. Jos. F. Klein, ... Bethlehem, Pa.
Harry Jones, ... " "
Clemens Jones, ... Hokendauqua, Pa.
Frank Johnston, ... South Bethlehem, Pa.
Henry Smith, Bethlehem Iron Co., ... " "
William Strawn, " " .... " "
Harry Hart, " " .... " "
Chas. Anthony, " " .... " "
Henry Trumbower, " " .... " "
J. B. Archer, " " .... " "

John Horn,	Bethlehem	Iron Co.,	....	South Bethlehem, Pa.
Edward Murphy,	"	"	....	" "
John Opp,	"	"	....	" "
Hartley Wolle,	"	"	....	" "
Michael Bitler,	"	"	....	" "
Wilson Weaver,	"	"	....	" "
George Sherer,	"	"	....	" "
Ed. Welden,	"	"	....	" "
John Leibert,	"	"	....	" "
Henry Stahlneeker,	"	"	....	" "
Horatio Yeager,	"	"	....	" "
Isaac Deremer,	"	"	....	" "
George Jenkins,	"	"	....	" "
Jos. Brodhead,	"	"	....	" "
Martin Hackman,	"	"	....	" "

C. W. Buchhotz, 21 Cortlandt St., ...New York, N. Y.
Joseph Hartshorn, ...Pottstown, Pa.
Chas. H. Wellman, ...Thurlow, Pa.
James Christie,.........................Pencoyd and Philadelphia, Pa.
B. W. Grist, 113 West 38th St., ...New York, N. Y.
W. L. Elkins, Jr., ... " "
J. T. Knight, Sec. and Treas. Thomas Iron Co.,..............Easton, Pa.
R. Morris Gummere,............................South Bethlehem, Pa.
Geo. F. Kunz, Tiffany & Co., 11 Union Square, ...New York, N. Y.
Geo. B. Roberts, Pres. Pennsylvania R. R. Co., ...Philadelphia, Pa.
James Walters, Bethlehem Iron Co., ...South Bethlehem, Pa.
C. Miner Dodson,.....................................Bethlehem, Pa.
James Watters, ... " "

The John Fritz Banquet to Celebrate the Foundation of the John Fritz Gold Medal, Waldorf–Astoria, New York, October 31, 1902.*

THE JOHN FRITZ MEDAL.

Early in the spring of 1902, at the call of Mr. S. T. Wellman, of Cleveland, a number of prominent engineers and manufacturers met in New York to discuss the question of a suitable celebration of Mr. Fritz's eightieth birthday, the outcome of these meetings being the appointment of the following committee, which decided to invite subscriptions to a John Fritz gold-medal fund:

President, S. T. Wellman; treasurer, John Thomson; secretary, C. Kirchhoff; S. W. Baldwin, R. W. Hunt, F. R. Hutton, C. Warren Hunt, J. C. Kafer, T. C. Martin, E. E. Olcott, R. W. Pope, H. G. Prout, E. G. Spilsbury, Jesse M. Smith, Ambrose Swasey, Oliver Williams, Calvin W. Rice, Wm. Maver, Jr.

The organization was effected by the appointment of four sub-committees, as follows:

Medal Committee. — C. Warren Hunt, chairman; F. R. Hutton, R. W. Pope, C. Kirchhoff.

Finance Committee. — John Thomson, chairman; Ambrose Swasey, Jesse M. Smith, E. E. Olcott.

Dinner Committee. — T. C. Martin, chairman; J. C. Kafer, H. G. Prout, E. G. Spilsbury.

Invitation Committee. — S. W. Baldwin, chairman; R. W. Hunt, Oliver Williams.

The task of designing a gold medal and cutting the dies was intrusted to Victor D. Brenner, of New York City. There was contributed by about 500 persons a sum which,

* *Reprint of a pamphlet issued at the time by the subscribers to the banquet.*

after providing for the artist's fees and other expenditures, left a balance of about $4,000 as a permanent fund, the interest on which is adequate for the annual purchase of the gold medal. A brief memorandum by the treasurer will be found in this pamphlet.

The general scope of the memorial is indicated by the following rules adopted for the award of the medal:

Fig. 17. — The John Fritz Medal.

PROPOSED RULES FOR THE AWARD OF THE JOHN FRITZ MEDAL.

1. — The John Fritz Medal was established by the professional associates and friends of John Fritz of Bethlehem, Pa., U. S. A., August 21, 1902, his eightieth birthday, to perpetuate the memory of his achievements in industrial progress.

2. — The medal shall be awarded for notable scientific or industrial achievement. There shall be no restriction on account of nationality or sex.

3. — The medal shall be of gold and shall be accompanied by an engraved certificate, which shall recite the origin of the medal and the specific achievement for which the award

is made. Such certificate shall be signed by the chairman and secretary of the Board of Award.

4. — The medal may be awarded annually, but not oftener.

5. — No award of the medal shall be made to anyone whose eligibility to the distinction has not been under consideration by the Board of Award for at least one year.

6. — Awards shall be made by a board of sixteen, appointed or chosen in equal numbers from the membership of the four national societies, the American Society of Civil Engineers; the American Institute of Mining Engineers; the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. The governing bodies of each of these societies shall be requested to appoint from its membership one representative who shall hold office for one year, one for two years, one for three years, and one for four years; and each succeeding year to appoint one member to serve for four years.

7. — In case of failure of any of the national societies to make the original appointments as requested, the selection of representatives from its members shall be made by those appointed from the other societies, and should any future vacancy occur by reason of the failure of any of the said societies to act, or otherwise, such vacancy shall be filled by the Board of Award from the membership of the society so failing.

8. — Should one or more of the four national societies go out of existence, its representation on the board shall cease and determine, and future awards shall be made by the representatives of the remaining societies.

All of the four societies have selected representatives and the council of award has now been duly constituted in accordance with the above terms.

The preliminaries for the medal having been duly settled, the successful foundation of the fund was signalized by a banquet at the Waldorf-Astoria, October 31, 1902, a report of which is given in the following pages.

The models of iron and steel making processes that adorned the banquet room were loaned by the Stevens Institute of Technology. The Elbright Company of America, Russell Spaulding, manager, made and loaned to the Dinner Committee without charge, a beautiful sign in frosted incandescent lamps, several feet in length, reading, "John Fritz, 1822–1902," which was hung at the back of the speakers' table, and which was illuminated as soon as the guest of the evening took his place beneath it. Facilities for committee meetings, etc., were furnished courteously by the American Society of Mechanical Engineers and by the Engineers' Club. No small share of the success of the banquet was due to the kindly help and suggestions of "Oscar," of the Waldorf-Astoria, who prepared specially a number of trophies in candy to be borne around the hall in procession, illustrative of the triumphs of American steel production. Before the banquet began, the Dinner Committee sent to Mrs. John Fritz, who occupied with friends the central box in the balcony, a handsome birthday bouquet. The balcony was occupied by over 150 ladies, to whom light refreshments were served while the dinner was in progress below, and whose presence in full evening dress added greatly to the brilliancy of a memorable occasion.

BRIEF FINANCIAL STATEMENT OF THE JOHN FRITZ MEDAL FUND, AS OF JANUARY 23, 1903.

Total receipts, including accrued interest	$6,039.32
Total disbursements	1,930.00
Balance on hand	$4,109.32

Now deposited in the Mercantile Trust Company, drawing interest at the yearly rate of 3 per cent.

NOTE. — The cost of designing and constructing the medal, the dies, and the album was $1,700; the incidental expenses, such as circulars, stationery and postage, making up the remainder, $230. It is practically certain that the net amount available for fixed investment will not be less than, say, $3,700; which will be ample to carry out the purpose of the founders in an appropriate and satisfactory manner.

While the subscriptions were purposely limited to the small sum of $10, in order to give the large circle of Mr. Fritz's friends and admirers an opportunity to become identified with the foundation of the medal, the Committee felt justified in yielding to the insistence of Mr. Andrew Carnegie, who contributed $1,000, and Mr. A. J. Moxham, who contributed $100.

SPEECHES AT THE DINNER TO JOHN FRITZ, AT THE WALDORF-ASTORIA OCTOBER 31, 1902.

SALUTATORY.

THE TOASTMASTER (Col. Henry G. Prout): — Gentlemen: This afternoon a lady came into this room to look at the decorations and she looked at this design and she read it, "John Fritz, 1822–1902," and she said, "What a shame to drag an old man like that out of his bed!" (Laughter.) Obviously, she had not seen the "old man." We are met here for two principal purposes — first, to celebrate the eightieth birthday of our friend, John Fritz. (Applause.) And second, to celebrate the successful founding of the John Fritz Medal. (Applause.) If I might venture to follow for a moment the thought of the immortal Gettysburg speech, I should say that Mr. Fritz himself had anticipated this celebration and made it superfluous by his great and lasting gifts to the happiness and prosperity of mankind and by his simple and dignified and sincere life. (Applause.) It is little that we can add to the estimation in which he is held by those who have known him long and well. It is little that we can add to the glory of his name throughout the civilized world. It is little that we can add to the endurance of that monument which he has built for himself. But we can find pleasure for ourselves in expressing to him here in this public way our admiration and our affection. We can find inspiration and the glow of enthusiasm for own lives in listening to the words of those who know his worth and his character and are qualified to appreciate them. These, I take it, are the real reasons why we are here.

The General Committee has directed me to say to you a few words about the John Fritz Medal, its origin, its purpose, and its present state. The story is short. Last spring, a few friends of John Fritz met to organize a celebration of his eightieth birthday, and then the further thought came that they would establish a memorial in order that future generations might know that the men who had lived in the time of John Fritz had had the sense to appreciate his worth. (Applause.) It was natural that that memorial should take the form of a medal, and then the committee decided that this medal should be given to anyone in the world who might have proved his title to it by achievements in research or in applied science, and then it was decided that this medal should be given by a committee of sixteen to be chosen from the four great national engineering societies of our country. The General Committee believe that this medal, considering its scope, considering the method of award, will be even a more distinguished honor than the Bessemer Medal which Mr. Fritz himself is proud to hold. (Applause.) It was decided that the fund for the medal should be raised by a subscription, and that each individual subscription should be strictly limited to a small sum in order that many men might share in the honor of contributing to the fund. The Committee believes that the John Fritz Medal thus established will be, like the olive wreath of the Olympian games, in itself a little thing of trifling cost, but representing such distinguished achievement that it will always be amongst the most precious trophies of the man or the woman who is successful in getting it. (Applause.) The medal is now secure. The fund is established. The design has been made. The die is made, and the album containing the signatures of the subscribers to the fund will be presented now to Mr. Fritz, as will the master cast from the artist's model, by Mr. John Thomson, to whom, more than any other one man, we are indebted for the idea of this medal. Mr. John Thomson. (Applause.)

PRESENTATION OF THE MEDAL — JOHN THOMSON, C.E.

Mr. Thomson: — We have thought, Mr. Fritz, that it would please you to have a permanent record in respect to the founding of the medal which is to bear your name. I have here an album. It is entitled, "The John Fritz Medal." It is dedicated to "John Fritz, Engineer, One of the Principal Founders of America's Iron and Steel Industry." It contains a photograph of yourself, Mr. Fritz, also photographs of the obverse and reverse of the medal, under which is inscribed "To Perpetuate the Memory of John Fritz and His Achievements in Industrial Progress." In addition to the historical data and the rules for the award of the medal, it also contains the names and addresses of the founders and their autographs, some four hundred and eighty-four in all.

In the name of and in behalf of the founders of the John Fritz Medal, I have the great pleasure to ask you to accept this album, Mr. Fritz, as a slight testimonial of our admiration and regard, and we would have you believe that we desire no greater honor than to be known as the friends of John Fritz, of Bethlehem. (Applause.)

We have also thought, Mr. Fritz, that it would add to your pleasure to announce, especially on this occasion, the name of the recipient of the first medal. The rules adopted relative thereto seem to indicate at this time one name, in that the stipulation is expressly set forth that the award shall be made to commemorate the most notable scientific and industrial achievement. These plaster plaques were reproduced from the original medal made by the artist, and from these one set of castings in bronze has been made,

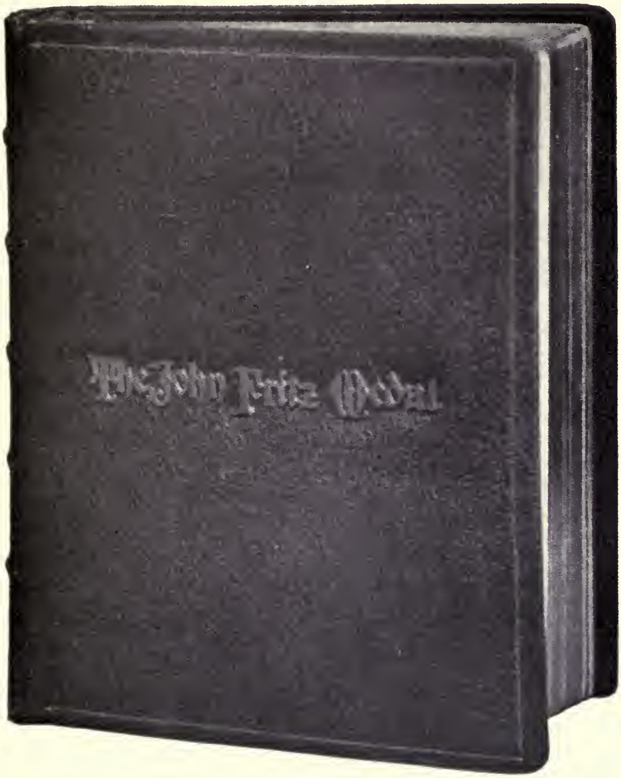


FIG. 18. — EXTERIOR OF ALBUM.

but no more shall ever be made therefrom, for I shall now destroy these original master patterns. (Applause.) (Mr. Thomson here smashed the plaster plaques.)

Mr. Fritz, I am duly authorized and directed by the founders of the John Fritz Medal to make the following official announcement of the award. We ask that you, John Fritz, accept these bronze plaques, the only ones of the kind that will ever be presented as an award, made by and coming directly from the founders, our unanimous finding being that of all the Captains of Industry this medal may most worthily be awarded to you. (Applause.) And we beg to assure you of our abiding faith that the crowning reward of your splendid achievements and character will be the perpetuation of your name, than which there can be no higher ideal for the engineering and industrial captains of the future. (Applause.)

Now, Mr. Fritz, for each and all of the founders, I wish you many happy years and growing honors, and the love of friends. (Cheers.)

The guests, on the proposal of Colonel Prout, here drank to the health of John Fritz. There were loud cheers and long calls for "Fritz."

SPEECH OF MR. JOHN FRITZ.

Mr. President, Dear Friends: I do not know what to say in response to this reception that I am given here to-night. It is utterly beyond my power to express the things that are in my mind. The only thing that I can say is that I accept this in the name of the four great engineering societies. I am not going to detain you long, as you can see.

Standing here, my mind is carried back to the days of my youth, when I worked on a farm, from sunrise to sunset, barefooted. Then my wildest imagination could not have foreseen this honor.

I appreciate this greeting, and accept it as a token of your esteem; and am truly sensible of the great honor you have thus conferred upon me, which gives rise to sincere joy in my heart, that takes precedence of all other emotions, and I can only say that I thank you from the depths of my heart.

But what have I done to earn this reception! What little I have done has been much overrated, and I am the recipient of honor beyond what I deserve; but I hope that my kind friends will continue to overlook my shortcomings, as I have ever tried to do my best.

FIG. 19. — FRONTISPIECE OF ALBUM.

I do not now forget the laboring man, and especially the able, brave, and noble men who loyally stood by me in times of the severest trials that were encountered during my long connection with the iron and steel industries, and who were ever ready to face any hardship or danger that would in any way tend to prevent success. To these kind and loyal men much credit is due for such success as I have attained.

But, alas, the majority of them have gone, the grave has closed over them, but they are not forgotten, and they will ever have a green spot in my memory.

It was my misfortune to start in the world with a meager education. I was born of exemplary parents; my father being a man of high moral character, he fully impressed upon my mind the importance of energy, economy, and absolute integrity. My mother was a true, Christian woman, and early taught me to read and revere the Holy Bible and to trust in the Supreme Being, and that to respect and obey His laws was a duty which mankind should not disregard.

At this distant day, to my mind, the moral and religious training received from my parents, and their noble example, was the most important training I could possibly have received; and I have ever thought the highest honor I could pay to their memory was to endeavor to follow their noble example. In after years, when overburdened with grave responsibilities which were ever recurring and had to be met, it was then I sorely felt the want of a better education; but on reflection, I knew my parents had done the best they could, and I was content.

It has always been my good fortune to be blest with many kind and loving friends, who have stood by me in the darkest days and were ever ready to give assistance by their wise and sympathetic counsel.

There are times when it is an agreeable servitude to be under obligation to those whom you esteem, and I am deeply sensible of the honor conferred upon me on this occasion, and greatly regret that I have not the command of language to make a fitting acknowledgment to my kind friends, who have provided for the "Fritz Medal" and arranged this splendid birthday feast, and to you all for your presence here to-night.

But no words of mine can ever express the full measure of gratitude that I so deeply feel towards you all. And here, my dear friends, I beg to assure you that the uniformly kind and thoughtful attention that you have always shown me will be held in grateful remembrance.

May God, in His infinite mercy, vouchsafe to you all long, useful, and happy lives, surrounded by kind and loving friends, is my most fervent desire.

Three cheers for John Fritz were called for by Mr. Martin and given, and the diners sang, " For he's a jolly good fellow."

The Toastmaster: — Strange thing, isn't it, that John Fritz has so many kind and loving friends?

The next sentiment is " The Fathers of the Art." For at least seven hundred years the Anglo-Saxon people have been carrying on their struggle for liberty regulated by law, and in that struggle we, on this side of the water, have taken the characteristic part. We have gone out and fought our stubborn wars and then we have gone home and sat down and carried on the still more stubborn conflict with ignorance and folly and ignoble ambition and rapacity. The gentleman who was to have spoken for the Fathers of the Art, in the greatest of our wars, contributed of his money, of his wisdom and his energy, and since that war he has continued to give the same devotion to the long civil struggle that has been going on, and all of that time he has walked in parallel lines with Mr. Fritz, for he too is an ironmaster. That is Abram S. Hewitt. (Applause.) Lowell has said that the chief duty of a nation is to produce great men, and I am sure in Fritz and Hewitt we can present fine specimens of the product of our nation. (Applause.) Unfortunately, Mr. Hewitt is too delicate to be here to-night, but he has sent a letter which will now be read by Mr. Martin, the chairman of the Dinner Committee. (Applause.)

Mr. Martin, who was received with cheers, said: "This letter from the Honorable Abram S. Hewitt is addressed to his personal friend, Mr. E. G. Spilsbury, my associate on the Dinner Committee, and runs thus:

"I have been debarred for some time by the limitations of age from assisting at any function which takes place in the evening. I have been trying, however, to make an exception in favor of the complimentary dinner given by his admirers to my old and valued friend, John Fritz; but now that the time has arrived, I find I must deny myself the pleasure of personally congratulating him, in the company of his loving friends, upon the attainment of his eightieth birthday in the full possession of his health and faculties, and with the promise of many honorable years to come.

"We have made the journey of life together and, to some extent, upon the same lines of action. It is pleasant to recall that during the half-century of our association, at times of competitive struggle, the friendship which has existed between us has never in the slightest degree been disturbed. This happy experience is due, doubtless, to the amiable traits of Mr. Fritz's nature, which, with all its masculine energy, is tempered with the sweetness of the gentler sex. 'Once a friend, always a friend,' will be inscribed upon the record of a career which in some respects is unique among the men of our day and generation.

"I do not intend to indulge myself in recounting any of the interesting details of his long and useful life. This pleasant duty will be performed by others, but I do desire to point out that the life work of John Fritz affords a very conspicuous example of the working of American institutions during the century which has just closed, the most remarkable era of progress in the history of the human race.

"That a boy born in humble life, with no advantages of education or opportunities for position, without influential friends or the favoring accidents of fortune, should be able to advance steadily in usefulness, power, and the respect of his fellow men, until by common consent he occupies the first place in the domain of practical industry with which he has been connected, gives conclusive evidence that political institutions which afford free play to individual ambition, industry, ability, and strict integrity are worthy of all loyalty and should be cherished and preserved at all costs and hazards.

"The developments of the twentieth century show that these institutions are in great peril. Their essence is to be found in individual liberty, involving the right of free labor and the acquisition of private property under lawful conditions. When the right of free action shall be suppressed, the possibility of a career like that of John Fritz will be destroyed. Collectivism ending in Socialism, may afford other advantages, but let it not be overlooked that these advantages will be obtained only by the sacrifice of personal freedom, and will arrest the progress of civilization due, during the ages that have passed, to the substitution of freedom for force.

"John Fritz is a living proof of the results of individual and industrial liberty in a country endowed with boundless resources. In vain shall we seek for a like career in nations or in countries where the individual initiative has been suppressed. The stagnation of China, whose men are physically strong and whose resources are abundant, is in marked contrast with our own land, where heretofore every citizen has been free to employ his labor and his energies in his own way, so long as the rights of others were respected.

"John Fritz, therefore, is to us more than a man whom we love and respect, more than a friend to whom we wish many years of health and happiness: he is an example of the free spirit of American institutions, a beacon light warning the present and coming generations against permitting any invasion of the principle of the liberty of the citizen, which alone has made our beloved country great and free."

Mr. Martin, after reading the letter, proposed three cheers for Mr. Hewitt, which were given heartily.

THE TOASTMASTER: — In this wicked world which we inhabit it is very little use to build a nation, such as Mr. Hewitt has suggested, unless we are prepared to keep it with the sword. I am told that in certain newspaper offices war has been abolished, and that armies and navies are now refuges for the idle, and schools of pride and cruelty. (Laughter.) And yet some of my friends of some practical experience assure me that the devil is not yet dead and that the richest man must still be prepared to fight for his own. However that may be, this gentleman on my right whose amiability you have heard expressly dwelt upon has spent some valuable years of his life in making material for the efficient and complete destruction of his brother man. (Applause and laughter.) In 1898 we were very glad to have some of that material in our ships. (Applause.) I spoke a moment ago of the Anglo-Saxon struggle for liberty regulated by law. I ought to have said the struggle of those born to speaking the English language, for the Scotchmen, who I believe are not Anglo-Saxon, have a certain fine aptitude for fighting, and with their broadswords they have helped us in carving out that path toward liberty. I am about to introduce to you a Scotchman. He is, I presume — I am not told so — a descendant of William Wallace himself. (Laughter.) He is a sailor and a warrior. He is an explorer who has written his name across the Arctic Sea and he is an engineer who has written his name across the story of our new navy. I have the honor to introduce Rear-Admiral George Wallace Melville.

SPEECH OF REAR-ADMIRAL MELVILLE.

Rear-Admiral Melville: — Gentlemen: I am called on to respond for the Navy of the United States. (Applause.) The Navy of the United States is no mean institution. It is second to none in the world, except in tonnage. (Applause.) You will rightly understand that I am pleading for more tonnage — more tonnage, more guns, more armor, more speed. I will divert from the Navy, however, for a few minutes and for a very few minutes.

Among us here to-night is our veritable Vulcan, whom we are assembled to honor, the Fire God and Iron King of the great engineering profession, — John Fritz.

> " Those who labor
> The sweaty forge, who edge the crooked scythe,
> Bend stubborn steel, and harden gleaming armor,
> Acknowledge Vulcan's aid."

Who of us all would not doff the hat and bow the head in honor to this our grand brother of the forge and the mill! . . Our guest, by his mechanical ability and resourceful enterprise, has done much to force the recognition of engineering as a profession. But the engineer of the hour is not without honor, and we who are here to-night know full well that the praises of John Fritz have been sung again and again, and that his name is grandly linked with the development of the iron and steel industries in this country. . . . " Good Uncle John," as we call him, was born in a hamlet where everybody worked, and in early youth he acquired the habits of industry. It was a community where every one respected the rights of his neighbor, and he grew up with the love of his fellow man as the cardinal precept of his creed. Living in a State that was rich in natural resources and the center of the infant iron industry, he began to comprehend the possibilities of making the United States the granary of the world, and of so improving the manufacture of iron and steel that the product of the western plain could not only be carried cheaply to the manufacturing districts of the Atlantic coast, but even to the remote countries beyond the sea. When we review the life work of this man, and measure his influence in the moulding of the destinies of the industrial world — no wonder that we account him great. He has seen the crude mill and furnace grow, under his very hands, as it were, into the perfectly equipped modern plant — he having been identified with every important improvement that made for increased production in iron. . . . In the naval world he will be regarded, by reason of the part he played in giving us our first armor plant, as one of the few persons without the service who made it possible for the nation to secure on the seas even a greater prestige and influence than it ever possessed before.

It is because dear old Uncle John, during his long and busy life, has stood for integrity, faithfulness, and application, and everything of good report and right living, that he has, aside from his mechanical genius, been able to make so good a fight. Our hearts go out to this man, who has done more than his duty — more than his share of the work. His open-heartedness and gentleness of soul win our universal good will and esteem. Those who know him best love him most. . . . I know that Uncle John would dispense with these honors that we would show him to-night; but he, good man, must not forget that we are a little selfish in this matter, because we are proud to be associated with him, and to be able to shine just a little bit by his reflected glory.

I can but repeat the only toast of the evening, — Uncle John Fritz, the Fire God and the Iron King, our Vulcan, our great and able leader, and, as well, our kind and gentle-hearted brother. (Loud applause.)

THE TOASTMASTER: — This is a very remarkable occasion in some unexpected ways. We are honored to-night by the presence of the oldest living marine engineer probably in the world, the man who designed and engined the first steamship for the United States Navy, and I ask you to rise and give three cheers for Mr. Charles Haswell. (Cheers.)

MR. HASWELL: — Through a long, varied, and eventful life I have received some compliments, but I know of none equal to the gracious manner in which you have been pleased to receive my name. (Applause.) And I assure you that I shall cherish it, not only in memory, but I shall instruct my children to bear in mind your gracious compliment bestowed upon me. (Applause.)

THE TOASTMASTER: — The engineer and soldier are one type of man, their work is substantially the same. It deals with the properties of matter, with the relations of time, space, and force. It develops the same intellectual and moral qualities, — quick resource, self-reliance, courage, fortitude, and devotion to duty. Joshua, himself a great commander of troops, was a born engineer, and I doubt not that he destroyed the walls of Jericho by much the same means that would have been used to-day by the distinguished engineer and soldier who will now speak for the Army. I have now the honor to introduce Gen. Eugene Griffin. (Applause.)

SPEECH OF GEN. EUGENE GRIFFIN.

GENERAL GRIFFIN: — The force known as the regular army, existing by the will of Congress annually expressed, does not comprise all that should be properly included in the terms of our toast. The history and traditions of the past; the long record of glorious victories which are inscribed on the blood-stained pages of the book of fame, all belong to the army of the United States. Its battle flags adorn our capitols; its trophied guns our parks and public places. The army includes the unfed, unshod, unpaid, tattered veterans of Valley Forge alike with the conquering host which Sherman led through the heart of the Confederacy; it includes the militia of 1812, alike with the grand old Army of the Potomac against whose iron front at Gettysburg were broken and scattered the advancing waves of the rebellion; includes the victorious armies which feasted in the halls of the Montezumas, alike with the heroes of San Juan Hill; it includes the knightly troopers of the West, who in years of savage warfare have written a record of bold adventure, of daring achievements and heroic sacrifices, which are but feebly portrayed by the cold, brief words accompanying the medals of honor so brilliantly won, so sparingly bestowed. Regulars and volunteers alike, in foreign, domestic, and savage warfare, our army has made a record which no criticism can belittle, which no eulogy can enhance. . . . What part have the engineers played in this glorious record? Have our military brothers upheld the reputation of our profession? Let us see. . . . Armistead, the third graduate of the United States Military Academy, commanded an army in the field . . . and Alexander Macombe was called from his high place as Chief of Engineers to take command of the army of the United States as Major-General. But it was in the Civil War that the great opportunity came — after political influence had ceased to be a potent factor and when real merit was pushing men to the front. . . . Here is a list of twelve army commanders all taken from the Corps of Engineers. . . . Twelve corps commanders were taken from the Corps of Engineers. On the Confederate side there were eleven general officers with big commands, and all taken from the Corps of Engineers. And again, as division and brigade commanders, as chiefs of staff and as staff officers, as commanders of engineer and volunteer troops, there were many others whose names would make a much longer list.

Such a glorious record is sufficient evidence that the Corps of Engineers furnished much more than its fair proportion of skillful leaders and able soldiers, and that they well uphold the reputation of the engineering profession. The fact that over 10 per cent of all the officers in the Corps of Engineers were killed in battle during the Civil War is the best possible evidence that they knew how to fight.

And it is not alone in practical demonstration of the art and science of war that the engineers of the army have made so good a record. Their work in civil lines bearing upon social and economic conditions has been most important. There came into my possession to-day the manuscript of a most interesting chapter bearing upon this subject. I quote from it as follows:

" The Baltimore & Ohio was the earliest important railroad enterprise undertaken in the United States. S. H. Long, William Howard, and William Gibbs McNeill, all officers of engineers, . . . were chosen as a board to select the proper route to the Ohio. Upon the rails definitely located by McNeill, for the first time in America, ran a steam locomotive. Before McNeill resigned in 1837 he had surveyed the summit division of the C. & O. canal, and had acted as chief engineer of seven other railroads from New England to Florida and Alabama. After he resigned, for the remaining sixteen years of his life, he acted as chief or consulting engineer upon many railroads and other public enterprises in the United States and Cuba, completing the western railroad of Massachusetts, planning and practically constructing the first large dry docks at the Brooklyn Navy Yard, and acting as president of the Chesapeake & Ohio canal.

"Probably greater than McNeill was his junior, Whistler. . . . In 1835 the Russian government determined to build a line from St. Petersburg to Moscow. A commission of Russian engineers suggested Major Whistler to take charge of this work, and he accepted in 1842. The road and its equipment were planned by him in detail. . . . His report upon the gauge to be selected has been pronounced one of the finest models of any engineering document ever written. . . . In building of engines, all parts were standardized and interchangeable. Whistler died in 1849. Another graduate of West Point, T. S. Brown, was invited to succeed him. . . . In a hasty inspection of the records, I have been able to count 49 graduates who have been chief engineers, and 22 who have been presidents of railroads. Many have acted in these capacities on several railroads, and the list would be long indeed of those who have served as resident or assistant engineers."

Now, as to our honored guest. We are here to-night to testify our respect, our admiration, our affection for that sturdy engineer, that noble man, — John Fritz. He has lived a life which we may well strive to emulate, and made a record we all delight to honor. Longfellow says:

"But age is opportunity no less
Than youth, though in another dress;
And as the evening twilight fades away
The sky is filled with stars, invisible by day."

It is my hope and my prayer, it is the hope and prayer of all of us, that these stars, even though invisible to us, may shine brightly and serenely upon the pathway of John Fritz until the day comes when the great Archangel sounds the last taps and the lamp of life is extinguished. (Hearty and continued applause.)

The Toastmaster: — We will now have a few extracts from letters and other messages that have been received, and first I would like to read something that has been handed to me. The President of the World's Fair to be held at St. Louis, Governor Francis, who regrets his inability to join with us on this occasion, has asked me to announce here the appointment of Mr. John Fritz as Honorary Expert in the Metallurgy of Iron and Steel for the Exposition. (Applause.)

The messages of congratulation and so forth will be read by a gentleman who with characteristic modesty has undertaken to conceal his identity, inasmuch as he had the preparation of this printed list. At the risk of interrupting a friendship of twenty years, I am going to tell you his name presently. I want to tell you that we are all very greatly indebted to him for the tremendous amount of energy and devotion and ingenuity which he has put into the preparation of the details of this dinner; as, for instance, this beautiful menu which you see. It was prepared entirely under his direction, and I would suggest that each one of you carry away his menu with religious care, because it will be extremely difficult for you to replace it if you lose it now, and I am sure you will prize it very greatly. You will observe on the first page the autograph of Mr. John Fritz, which he has put there with a good deal of trouble; I think he signed some six hundred of them, having before him the constant terror of writer's cramp. (Laughter.) To the chairman of the Dinner Committee we owe this, also, which I am told is the revised American Society section of rail (laughter), and we owe to him a great many other things; but I promised to tell you his name, — Mr. Thomas Commerford Martin. (Applause and cheers.)

Mr. Martin: — On behalf of the Dinner Committee, I wish to announce that we did not attempt to revise the standard section of steel rail in America. (Laughter and applause.) You will find this sample in the catalogues; I will not say whose. (Laughter.) I told Mr. Wellman, when he remarked to me in the way of criticism that he was not familiar with that section (laughter), that Oscar said it had to fit the sorbet boxes. Mr. Wellman said that that was something new to him in the way of steel rails. (Laughter.) I have here a bunch of messages, cable dispatches, and letters, and a whole volume more on ice at the Engineers' Club. (Laughter.) I will not inflict many on you, but I believe you will be glad to hear each one of these.

MESSAGES OF CONGRATULATION.

Letters, telegrams, etc., read.

San Francisco.

Regret enforced absence on this occasion, which marks an epoch in American metallurgy by honoring your birthday. " Ithuriel's spear touched a toad, it became a jewel." You touched iron ore and transformed it into armor, guns, shafts, plate, materials, with which American engineers have conquered the whole world by land and sea. All hail Unser Fritz, father of us all. Deem it not a too presumptuous folly, this spray of western pine beside your eastern oak and holly.

Irving M. Scott.

Genoa, Italy.

Though absent and far away, I wish to add my congratulations to Mr. Fritz on his eightieth birthday. He has done more for the steel industry than any man living, and we all acknowledge him as our master and prize him as our friend.

Charles M. Schwab.

London.

Absent in body, present in mind. Thanks for thirty years' friendship.

C. P. Sandberg.

Dufferdingen.

Sincere wishes to your eightieth birthday and respectful homages to one of the pioneers of American iron industry.

Max Meier.

Heartiest congratulations and hopes that we may for a long time still, keep your true friendship.

Greiner,
Chf. Engr. John Cockerill Works,
Seraing, Belgium.

DUSSELDORF.

Happy salutation to the well-deserved chief of Ironmasters.

Verein Deutscher Eisenhuettenleute,
CARL LUEG SCHROEDTER.

Winsor Richards, Edward Martin, and Arthur Keen, London, much regret they are not with you to-day, but join your many friends on the other side of the Atlantic in wishing you very many happy returns of your birthday.

EDWARD MARTIN,
(Mgr. Director, Dowlais Works, England.)

On this day of honor congratulations and heartfelt well-wishes.

AXEL SAHLIN,
G. M., Millom & Askam Furnaces, West Cumberland, England.

THE RECTORY, ST. ANDREWS, SCOTLAND.

Absence deeply regretted. Long life, happiness, health, wealth, and honor to John Fritz, rolling-mill pioneer, friend and counsellor of us all.

CARNEGIE.

SHEFFIELD.

Sheffield's heartiest greetings to John Fritz.

ROBERT HADFIELD,
(Inventor of Manganese Steel.)

Regret my absence. Add my best wishes to all those showered upon John Fritz this evening.

JAMES DREDGE,
Editor, *London Engineering.*

Best wishes for the John Fritz Medal banquet.

P. T. BERG,
(Formerly Chf. Eng. of the Homestead Works.)

As I am obliged to sail for Europe on the morning of October 31st, it is with profound regret that I have to announce my inability to be present at the banquet to be given on that date to Mr. John Fritz, the man who has done so much for this country as a pioneer in its great iron and steel industries.

When we compare the feeble beginnings of this department of metallurgy with its strength to-day, we are astounded and can well understand the consternation of European nations, as they contemplate the giant strides we have made and are still making in this branch of industry. This state of things has been made possible only by the great work of such masters as our honored friend. May his latter days be like those of Moses, "his eye not dim, or his natural force abated."

Sincerely,
E. E. Olcott,
(Pres. Am. Inst. Mining Engrs.)

Mr. Ambrose Swasey also cabled his congratulations from Japan, where he was traveling.

The Toastmaster: — Ever since men quit fighting with clubs, iron has been the great war material, and it is still the real precious metal, because the man who has iron can get coal, and yet the consumption of iron as a material of war is very insignificant as compared with its consumption in the arts of peace. Civilization is well measured by the consumption of iron, and in our own country we consume more per capita than any other nation. You may draw your own inference as to our standing in civilization. Of all the iron and steel that we produce now, it is probable that not more than one-half of one per cent goes into ships of war, guns, shell, and other military material. Practically, all of it is consumed in the tools of peace. The gentleman who will speak for the American Society of Civil Engineers, of which he is an honored past president, has himself, I suppose, consumed about one hundred thousand tons of iron and steel in the bridges which he has built. I have the honor to introduce Mr. George S. Morison. (Applause.)

SPEECH OF MR. GEORGE S. MORISON.

Mr. Morison: — Mr. President, Gentlemen, Ladies: The amount of iron and steel which I have myself consumed is so insignificant in comparison with what is used every day now, that I feel as if your introduction was a puff which I did not deserve. But we are here with especial respect to a great ironmaster, and the ironmaster has done more than anybody else to raise the profession of the civil engineer to the rank which it holds to-day. (Applause.) The civil engineer's profession is less than a century old. The civil engineer's work, dating from the remotest antiquity, was confined to other materials than metal. His works were built of timber and his fine works of stone. The iron master has added iron and steel. The profession is no longer dependent solely on the laws of compression: it has the laws of tension and of elasticity as well. It has been elevated and raised by these increased powers, and it is the ironmaster who has rendered this possible. To no one does our profession owe such a debt of gratitude as to these men who have given us the material of modern construction. But it is not only in this way that we would refer to our guest of the evening. The profession of the civil engineer is new as a profession. It has been built up in the last century. The men who built it up and made it what it is, were men who not only had to build it but to make their own precedents and find their own way. They could not be educated, because no man is educated in that which has not yet been done. They had to do their first work themselves. (Applause.) If we go back through the history of the world, we find in the earliest times that a set of men established the conditions while working with the sword, by personal bravery, by indomitable skill. We find those men classed in all ancient history as heroes. They were the heroes of war, and if they were the right kind of heroes they were the masters in peace. The hero was the man of the earliest times, and after that when we come to a time when intellect rather than prowess began to have its effect, when education was not general but was specialized among a few, we find another set of men of very different order, who led people forward by the force of their minds, and their intellect, and who were known as the prophets of those days. And passing from the time of prophecy to the times which we can almost remember ourselves, because we remember the people who were active then, we come to the very class of men who made our country possible, who did the work which Mr. Hewitt has so graphically described, and who were the patriots of that period. These three classes of men have made the history of the past. Their work was done practically before our profession began, but in the work of the last century, the time that has made the profession of civil engineering what it is, we have had in that profession a set of men who have perhaps done more than any of the others to render the conditions of universal humanity possible which we see to-day. Those have been the men, who, working without precedent, finding their own way, laying the foundation for the education which the profession in the twentieth century will enjoy, have brought up civil engineering to what it is. You may call them heroes, you may call them prophets, you may call them patriots; they have the best qualities of all three. But I think they can in no way be described better than the men who have done the most to utilize the forces and the materials of nature for the best good of our race. They are the pioneers and the best civil engineers, and among them we can place no one in a higher rank than our guest of to-night. (Applause.)

THE TOASTMASTER: — Now we come to the foundation of things. But for the mining engineer we should have no ironmasters. The mining engineer made John Fritz possible. He made Bob Hunt possible. He made Alexander Holley possible. (Applause.) The American Institute of Mining Engineers will be spoken for to-night by a gentleman who for many years has ably served that institution as its secretary and who has made a great mark on its history. I mean Dr. Rossiter W. Raymond. (Applause.)

SPEECH OF DR. ROSSITER W. RAYMOND.

Dr. Raymond: — Mr. Chairman, Ladies and Gentlemen: Nothing less, I think, than the occasion and the subject of to-night could have stimulated a busy and a weary man to come here at this hour. I suppose that very few men now living or who ever have lived, or if they did live, ever lived very long under such a burden of reiterated, monotonous, successive, and onerous occupations as has been for the past few months, particularly, in view of certain extra volumes and so forth, the lot of the secretary of the Institute of Mining Engineers. In fact, when I consider the work of my recent occupation, I can find no parallel to it except the case of the old fellow who kept a lighthouse off the Maine coast, who was left alone, tending his light, coming to the mainland once in a while to buy himself a plug of tobacco and row himself back again to his lonesome habitation. Well, there was a colporteur and tract distributor in Maine who heard of this hermit and resolved to bring him some spiritual benefits. So on one occasion, seizing the opportunity of a calm sea, he rowed himself out of sight of land and reached the distant lighthouse on the outside line of our coast, and he undertook to leave with the lighthouse keeper a package of useful and inspiring tracts, and the old man said: "Take them away; I haven't got any time for them." (Laughter.) "Why," said the other, "you must have a great deal of time; you have nothing to do here but to tend your light. I should think you would be very glad of a little occupation." "Occupation," said the old fellow; "I have got occupation enough. I have got St. Vitus's dance and a Waterbury watch." (Laughter.) That is about the condition of the office of the secretary of the Institute of Mining Engineers. (Laughter.) But if I were weary unto death, methinks I would stir myself to rise and come hither and accept the great privilege of speaking a word to-night for the man and for the society that I love. (Applause.)

You do well, Mr. President, to call upon the Institute of Mining Engineers upon this occasion. The Institute of Mining Engineers was the first technical society in this country to recognize those virtues and merits, that brilliancy, that fidelity, that glorious character in John Fritz which you now at this meeting do again. (Applause.) Our society was organized in 1871 and we elected John Fritz in 1872 a member, in 1875 we made him vice-president. I do not blame the Mechanicals for not doing it so early — they were not born. (Laughter.) In 1894 we made him our president. The Mechanical Engineers, with commendable imitation of us (laughter), elected him a member in 1881 and president in 1895, after we had got through. (Laughter.) The Civil Engineers elected him a member in 1893, and, much to their credit, elected him an honorary member in 1899. In that, gentlemen, as in almost every other important step, the progress of the American Institute of Mining Engineers leads the procession. (Laughter.) But there is another reason why you do well to couple the name of this honored man with the name of the society which honored him first. The American Institute of Mining Engineers belongs to the class of which John Fritz is an example and a type. There are three kinds of people: the men that do things, the men that hinder things, and the men that report and criticize things (laughter); the workers, the shirkers, and the reporters. Now, the American Institute of Mining Engineers is composed of the men that do things. (Laughter.) The chairman of your Dinner Committee has just read a long list, from celebrated sources, of congratulatory telegrams. Every single name in that list except the Japanese name which I could not understand as it was pronounced, is a member of the Institute of Mining Engineers. Last year a collection was made of the so-called Captains of Industry to welcome Prince Henry of Germany. Twenty per cent of the entire list were members of the Institute of Mining Engineers; of those who were eligible for membership, ninety-nine per cent. (Laughter.) The first president of the Institute of Mining Engineers, Father David Thomas, and its twelfth president, John Fritz, alike were practical men, — men who had made their own way, and who, although they had been obliged to triumph without the aid of an early education, were among the most cordial to welcome such an education, its advantages to the next generation, its aid to themselves. We begin at the outside, unlike the other technical societies of this country, and I do not claim that our system is better. I have often said that I could recognize the advantages of others, but I do think that it is different. We have in our membership common miners, laborers, mine foremen, and people that cannot spell — but then, that is nothing, most of you can't spell. (Laughter.) I am an editor and I know. (Laughter.) We have men who understand, and it has been our strength and our glory and our growth that we had from the beginning the men who understood, not merely the intricacies of theory, but the still more devilish intricacies of practical experience. Let me tell you just a little thing that I heard John Fritz once say, and let me sum up the whole matter as to this point with that. Fritz said to me: "When I am going to start a new engine, I want a good draughtsman to make the drawings, and I want the patterns to be well made, and I want the pieces to be assembled and put together in the shop, and then I want them taken to the mill, and I want the machine erected, and then when the boys come to me and say it is all right, I say, Are you sure it is all right? Does everything fit? Is it all according to the drawings? Are all the proportions just right? Yes, yes, yes. Well, then, turn on the steam and let us see why the thing won't go." (Laughter.) That is another matter in which I claim that John Fritz is a worthy member and a typical member of the Institute of Mining Engineers. In the thirty-one volumes of our transactions, over twenty-five thousand pages octavo, you will not find in the transactions of this really national mine workers' union — you will not find one single line about raising the pay of engineers. (Laughter.) You will find a great many pages about raising engineers. You will not find one single plan for shortening a day's work or diminishing the quantity of labor that an honest man gives for his wages. (Applause.) But you will find a great many pages devoted to the problem of increasing and improving the quality of the labor. You will find the spirit of giving more than you get stamped on its pages. You will find that the enemy of that Society is not capital, but ignorance; that the weapon of that Society is not the brutal boycott or the senseless strike or the voluntary idleness, which a certain great authority has recently declared to be the weapon of another society, but industry, knowledge, and light. You will find that Society recognizing individual manhood. You will find that Society rewarding it with its recognition and its praise and not believing in any solidarity of occupation which constitutes a mass without units. (Applause.) You will find that Society entertaining the ideal of manhood that rises not upon the ruined homes and slain bodies of its fellow men, but uplifted on their grateful hands. You will find that Society standing in a solid rank for individual liberty, for individual endeavor, for the man who works over hours, for the man who thinks more of his duties than of his rights, for the man who gives forever and forever more than he gets. (Applause.)

And against the glorified picture of another John which has been set before us in these latter days, we lift the type of our John, — John Fritz (applause); and we match John Fritz's day with John Mitchell's day; that was yesterday; this is to-day, and thank God it is to-morrow and forever. (Applause.)

I pray God that the medal which we have this night installed will stand forever for those who shall win and wear it, as the name upon it stands to-day for such qualities as these. I pray God that He may grant it — nay, He will grant it, for He is not dead, and American manhood and liberty inspired by Him are not dead, and Justice and Truth are the foundations of our national life as they are the foundation of His eternal throne. (Tremendous applause.)

The Toastmaster: — I have here a telegram which has just been received: "Accept my heartiest congratulations. I join with those present in honoring you. Controlling reasons prevent my being with you. George Westinghouse." (Applause.) The stated order of proceeding will now be rudely interrupted by Mr. John C. Kafer, of the Dinner Committee, who has something to say. (Applause.)

Mr. Kafer: — Mr. Chairman, Mr. Fritz, and Gentlemen: I am delegated by Mr. Irving M. Scott of San Francisco, who has sent me this beautiful loving cup, to present it to Mr. John Fritz, in commemoration of what Mr. Fritz has done for him in his work in building the Oregon. On this cup is inscribed the following: "To John Fritz on his eightieth birthday. The builder of the West greets the genius of the East. The Oregon's performance glorifies the steel of Fritz." (Applause.)

We have with us here to-night the designer of the machinery of the Oregon, Rear-Admiral Melville. We have Mr. Lewis Nixon, who was the designer of the hull. Mr. Irving Scott promised to be here but could not get here, and Mr. Henry Scott was unavoidably detained. Mr. Fritz, I present this to you in the name of Mr. Irving M. Scott of San Francisco. (Applause.)

The Toastmaster: — I suppose that no other body of men ever spoiled so much good steel as the mechanical engineers. (Applause.) And I know of no one so well qualified to apologize for them as their honored past president, whom I shall presently introduce. It is especially fitting that he shall speak here, because he was one of the Bessemer boys in the very infancy of the art. He worked under and with John Fritz and George Fritz and Bill Jones, and that soaring genius, that beautiful spirit, that greatest of them all, Alexander Holley. (Applause.) What a privilege it was to begin one's life work building up a great art in such company! It is my privilege now to introduce to you that highly favored gentleman, Capt. Robert W. Hunt. (Applause.)

SPEECH. OF CAPT. ROBERT W. HUNT.

Captain Hunt: — Mr. Toastmaster, Ladies and Gentlemen: My tongue would have to be palsied if I could not respond to such an introduction. The only thing that makes it embarrassing is that my name should be coupled with those greater ones. But it was, thank God, from the inspiration of them, that any success which may have come to me has been my lot to achieve. And serving under John Fritz, could you ask a better pioneer, could you ask a greater, a more inspiring commander? (Applause.) The American Society of Mechanical Engineers probably made one great mistake in their selection of a president; outside of that their roll shows a line of names of most distinguished gentlemen, and among them none tower so high as that of John Fritz. He made our society great, not only in this land but in the lands of the world. Raymond says we took

Fig. 20. — Cup presented to John Fritz on his Eightieth Birthday by Irving M. Scott, Builder of the Oregon.

him second-handed. But we were only waiting to give him the honor which belonged to him. (Applause.) And when he came to us perfected from the crucial fire, he became our president, and it is as *our* president that you will ever know him. (Applause and laughter.)

It happened, gentlemen, to be my fate to commence my active career in the iron and steel business at Cambria in 1860, and I went there just one month after Mr. John Fritz had resigned his position as Chief Engineer and General Manager of that concern to remove to Bethlehem and there establish the Bethlehem Iron Company. When I went to Cambria I found I entered a house of mourning, and I was greeted with tales of the attributes and the loving-kindness and all else that go to make up the character of the "old man" who had gone away. I found there succeeding him his brother George Fritz, and it was my fate to become and to be to the end of his too quickly ended life his most intimate friend. He died in 1873, and it was through him and by him that I knew and became known by John Fritz. You call him "Uncle John"; I have a right and I claim it to get closer, because he is nearer me, and it has been my fortune during these many active years to know that I was one of his boys. (Applause.) I regard George Fritz and always did regard him, and I regard his memory to-day as that of the greatest mechanic that I ever knew. (Applause.) And still he thought, as he called him with the rest — the "old man" was greater than he. (Applause.) But I know that neither of them ever took a step that he did not consult the other, and each bore to the other the greatest respect for his ability. And later Alec Holley was let into the family. (Applause.) John Fritz, George Fritz, Alexander L. Holley. (Applause.) Think of that combination, gentlemen. They were the pioneers of the Bessemer business in America. (Applause.) And with leaders, able assistants had to come. The result — America has led the world. (Applause.)

A peculiarity of Mr. Fritz which you all know is that he has liked hard work, and he also has built better than he really knew. Typically, I remember on one occasion he called in a friend to criticize a piece of machinery which he had designed, and steam had been turned on and it was running. The only comment that this friend could make was, "Mr. Fritz, don't you think that you have made it unnecessarily strong?" John replied, "Well, if I have, it will never be found out." (Applause and laughter.) And I tell you he has loved hard work. There was an occasion when there was a breakdown at the Bethlehem rail mill and the mill was stopped. Impatient at the unsuccessful efforts of those who tried to drive the broken casting off the shaft, he seized a sledge and swinging such blows as only those massive shoulders could deliver, it was soon loosened; but as he put down the sledge at nine o'clock at night, an old employee, a privileged man, who happened to be an Irishman, said: "Now, plaze, Mr. Fritz, go home. Sure you have been here since six o'clock this morning. Let the boys do the rest, but begob, I don't know why I should ask it of you, because during all these years you have worked time and half-time." (Applause.) Looking at him to-night, time and half-time don't seem to have hurt, and I will tell you why. His labor has always been on straight lines, no matter what opposed, no matter how others looked. He has had his troubles, God knows, but his path was the straight one, and he hewed it on those lines to the end. (Applause.) Gentlemen, I think one of the greatest compliments that was ever paid him, and he has been the recipient of many, as you know, and none great enough, was the fact that he could not make a bad thing. His integrity entered into the products of his establishment.

(Applause.) Bethlehem rails, and Bethlehem billets, of special steel, ranked the highest. Commercial conditions became such that there was no profit. Well! The production of rails and billets ceased, but the works were turned on lines where perfection of result was all-important, and so you had introduced into America the manufacture of armor plate and of ordnance. He could not make the armor so perfect but what he could make the ordnance to knock it out, and they had a great time getting the equilibrium. However, here I say, the great compliment came when John W. Gates through his revenge against Andrew Carnegie precipitated the discussion in the Committee of Congress on the affairs of our nation as to whether or no we were paying too much money for the armor for our ships. They turned to Mr. Fritz to give them the figures of proper cost of production, and give them the design of a plant if the Government desired to build one or decided to build one, and the cost of the plant. The then Secretary of the Navy, in introducing him to the Congressional Committee, said: "I present to you Mr. John Fritz, the most honest man I have ever known." (Applause.) And the results of Mr. Fritz's figures and their confidence in them saved our nation from making the great mistake of entering into that manufacture. (Applause.)

Gentlemen, from all you have heard to-night, and from all we know, his talents, his integrity, have conquered the respect of the world. Years ago his loving kindness and himself made him the crowned king of our hearts. Long live the king! (Applause.)

The Toastmaster: — In some sense, John Fritz belongs to the world. That you have heard over and over again to-night. But if you would know the real man, if you would know him in his gentleness and in his strength, if you would know him in his wisdom and in his sympathy, you must go into the valley where he lives, and amongst the neighbors who dwell around him. The Valley and the Neighbors will be spoken for to-night by one of Mr. Fritz's old and trusted friends, Mr. Oliver Williams.

SPEECH OF MR. OLIVER WILLIAMS.

Mr Williams: — Mr. President, Ladies and Gentlemen: Seventy-five years ago the Lehigh Valley was practically an unknown district. At the upper end a few cranks were endeavoring to persuade their neighbors that the black stones that were outcropping all around them could be burned, but with very little success. Thirty years afterward, by the course of evolution, these black stones became black diamonds, and the cranks became coal operators. Twenty years later through the same evolution, the operators became coal barons. I did not know until a few weeks ago how they obtained this name, and it was only when I went to John Markle, Dr. Wentz, and George McCreary, and half a dozen more, with tears in my eyes, to beg for a carload of coal and couldn't get it, that I found out why each one of them was called a coal barren. (Laughter and applause.) It has always been a question where the coal measures ended and the slate measures commenced. John Markle and the rest of them say that the slate measures appear round about Slatington. My wife says they begin up around Hazleton, judging from the coal bin that she has had filled at different times. (Laughter.) The slate district of the valley has been one of tremendous importance to us. The boom in slate has been caused largely by the political bosses of Pennsylvania and the adjoining States. Their demand was very great. There has been, by the order of wise Providence, another measure just below the slate measure, and that is the cement measure, made, apparently, because in the last few years the common people have smashed so many of these slates that our bosses have made for us, that it took all the cement that was in that region to repair, and that has caused a boom in the cement industry. (Laughter.) Another great and helpful influence from the cement industry has been to repair the fortunes of the poor old fellows who owned that ground originally, and could not make a living from it, and that has now enriched so many of the people of that district.

Adjoining the cement district comes the iron district. I will not stop at this late hour to give you any history of the wonderful story of the prosperity of the iron industry in the Lehigh Valley from the day that Father Thomas blew in the first anthracite furnace in '39 up to the present time that these later furnaces have poured out their iron by the millions of tons. It is about forty years ago that John Fritz invaded that valley. He came from the rural districts and took possession of our land. It was a scene of bucolic innocence when he came there. I don't think I am prejudiced, but with determined earnestness I want to tell you that the people of that Valley — and it is a great thing to be known as the Valley, without any prefix to it — the people of that district were distinguished for their amiability, their beauteous persons, their courteous manners, their dignity, their earnestness, their firmness, their generosity, their — well, I can go through the alphabet, but I won't. I don't mean to say that all the people had all these virtues combined in them. There were only two there, really, that had all these virtues. I would say that one was John Fritz, only I have to go back and live with him for the next thirty or forty years, and I do not know what the effect would be if I told him of those virtues that were combined in him.

It is with the deepest feeling that I speak to you to-night for a moment of the love and esteem in which we hold this man in the Valley. We know all about him. We can say that we have eaten with him, we have drunk with him, we have slept with him, and we have gone to Pittsburg with him. (Laughter.) I could a tale unfold, but I won't. (Laughter.) I will only say this, — that our feelings, in reference to this man, can only be expressed by a darky story. A darky wanted to get a divorce from his wife. Going to Lawyer Scott, the lawyer asked him what claim he had — what had she done. What were his reasons for getting a divorce? And the lawyer heard the darky sobbing and looking up he saw the great tears running down from his eyes. He said to him, " You love this woman? " " Love her — love her! Why, I fairly analyze her." (Laughter.) That is the feeling we have toward John Fritz.

In the palmy days of Venice they had a book that was called the Golden Book, and in that book were written the great deeds of those men that had acted worthily toward the Great Republic. The Golden Book of the Lehigh Valley is the hearts of the neighbors of this man, and first and foremost in their hearts is written the name of John Fritz. (Applause.)

The Toastmaster: — A very few years ago there appeared upon this planet a set of men who now threaten to drive us all out of business. They deal with a body of facts of which we who have gray hair know almost nothing. They speak a language to which we listen without understanding. They are changing the mechanic arts and they are changing the whole face of society, and they are doing that by an agency which they themselves cannot explain or define. Of course, I mean the electrical engineers. The Institute of Electrical Engineers, the youngest of our engineering societies and already one of the strongest, is represented here to-night by a pioneer in the art, one of their past presidents, — Prof. Elihu Thomson. (Applause.)

SPEECH OF PROF. ELIHU THOMSON.

PROFESSOR THOMSON: — Mr. Toastmaster, Ladies and Gentlemen: It is certainly a great pleasure on this inspiring occasion to join in the homage to our honored guest, John Fritz. We represent, as your toastmaster has said, the youngest growth or development in engineering. One of the speakers preceding me said that America leads the world in certain directions. In what direction did America lead the world first? Why, in electrical work, in electrical engineering. These successes that have followed were the natural outgrowth of the grand development that was going on among our industries. The American electrical engineer can, however, say that he set the pace for the world, by Franklin, earlier than the others. He is, I hope, to be able to continue setting that pace. It certainly will remain with us electrical engineers to keep up the progress, and the advancement which has been so rapid in the past twenty years. When this electrical engineering industry first began, our honored guest, John Fritz, the man for whom we are gathered here to show our respect and admiration, was an old man, relatively speaking. Less than twenty years ago, electrical engineering did not exist. Not much more than seventeen or eighteen years ago (I think that is the time), a band of a few enthusiasts, as they might be called, gathered together and called themselves the American Institute of Electrical Engineers. As the art grew, the Institute grew. It has kept pace with that enormous growth and development which now keeps us all so busy. And what is that enormous growth based upon? Why, it leads back to the ironmaster. . . .

We have, in the short time of the life of this American Institute which I have the honor to represent, revolutionized lighting, we have revolutionized power, we have revolutionized the chemical industries to a large extent, and are bound to revolutionize metallurgy much more than has yet been done. We can almost see our way clear to the giving a candle power of light for say a quarter of a watt, or 1500 candle power to a horse power perhaps — not the 2000 candle-power arc light that you have all heard of, that only measures three or four or five hundred actually, but 1500 real candle power. We have given you not only one kind of light, but half a dozen different kinds of light, and those half-dozen different kinds of light having their own special field.

We have in these few years revolutionized the street-railway systems and we are bound to revolutionize in time those great systems that extend over the country for hundreds and hundreds of miles. From the electric furnace we have produced the best abrasives, the hardest substances, and we have even produced the diamond. At the same time we have some furnaces that have produced not the grittiest and hardest of substances, but almost the softest of solids, which will flow under pressure like liquid,— an artificial graphite. We have given you aluminum, the lightest of metals, with alloys which make it almost as common as brass and cheaper bulk for bulk. There is even a promise that we may be able to attack on a commercial scale the elements of the atmosphere, nitrogen and oxygen, and unite them commercially and produce nitrates for use in the fertilization of lands. (Applause.)

Now we are, as it were, on the threshold of this development. Within a few years we have had a most surprising development in the way of transmission of signals for long distances. The telephone itself was wonderful enough,— a little piece of sheet metal in front of a magnet with a coil on it through which you could talk over enormous distances — but we have, as it were, seized upon the whole ether surrounding the world; we have seized upon an atmosphere, not of air, but of that something which is within air and which fills all space, and made it the means of communication.

In closing, I would say I know I voice the sentiments of every one of the body of American Electrical Engineers in doing honor — I stand as the representative of each and every one of them in doing honor to the guest, John Fritz, this evening. (Applause.)

The Toastmaster: — Bob Hunt has told us of the fame of Bethlehem rails and billets and armor plate and castings; but to my mind the greatest product of Bethlehem is men. Bethlehem men were bred under John Fritz, and under him they learned not only their business as engineers, but they learned those things which lie at the very foundation of society: they learned thoroughness and justice and loyalty and fidelity and devotion to duty, and wherever they went out, to carry Fritz's ideas over the country. The gentleman who will speak to-night of John Fritz's old boys is one of those old boys, and he carried Fritz's ideas into the building up of the New South. He is not only an engineer, but a business man; he is not only a politician, but a patriotic citizen; and I take uncommon pleasure in introducing to you Mr. Daniel A. Tompkins, of Charlotte, N. C.

SPEECH OF MR. DANIEL A. TOMPKINS.

Mr. Tompkins: — Mr. Chairman, Ladies and Gentlemen: I am handicapped with being a provincial before a metropolitan audience, and perhaps an overfed and sleepy metropolitan audience. I am handicapped in many respects because I came here with a speech prepared to tell how well educated a man John Fritz was, and Abram Hewitt's letter and Mr. Fritz's speech knocked that speech of mine into a cocked hat. Mr. Hewitt said he was not educated at all.

If I had not had time to reflect, I would not be persuaded that Mr. Fritz said he started this life with a scant education. What did we all do? (Laughter.)

About two months ago I happened to be in this city and I learned that there were two ladies here from the South. Their people were good friends of mine and I invited them to dinner. Going through the lobby of this hotel downstairs we came upon the distinguished gentleman who is the guest of honor at this feast. I stopped to speak with him, and he was cordial, as he always is to his friends. Leaving him to rejoin the ladies, one of them asked: "Who is your very rich friend?" (Laughter.) "Why," I said, "I never thought about him as being a rich man before in my life. I think he is pretty well fixed, even as modern riches go. But what made you think he is rich?" "Well," she said, "that beautiful smile that he has and that very cordial manner he has — I think it is just exactly what I would have if I was worth about fifty millions of dollars." (Applause.) I said, "That benignant smile and cordial manner do not come from his money, but they come from what he did." One of them said, "What has he done? Tell us about what he has done!" I said, "He has advanced the material development of this country. He has improved the processes of steel and iron manufacture until these in America surpass what is to be found in any other part of the world. He has improved the manufacture of ordnance forgings and armor plates until the chances of war are materially decreased, and then he and I built the Bethlehem Iron Works." (Laughter.) Well, this lady looked rather quizzically out of the corners of her eyes and said: "How much did he build, and how much did you build?" (Laughter.) "Well," I said, "I see your innuendo; I see you are suspicious. Come back and I will prove by the gentleman himself that what I said is all right." We went back and I introduced these young ladies and told him the claim that I had set up that he and I had built the Bethlehem Iron Works, but I said: "Before you commit yourself, I want to tell about a little incident. There was a town we will call Duttersfield. It was owned absolutely by a nobleman and a Quaker. The nobleman owned every house in town except one and the Quaker owned that one. The nobleman had often endeavored to buy the Quaker out and the Quaker would not sell. One day they met at a little alehouse, and after a glass or two of ale, the nobleman said: "Now, look here, James, I have offered you four times what that old house of yours is worth. I don't care anything about buying it; I don't want to press the sale on you. But you Quakers profess to be particularly honest, and I want you to tell me now the reason why you do not want to sell — just as a matter of curiosity." And the Quaker said, "Well, John, if I tell thee honest, I suppose it is because I could no longer say that thee and I own the whole town of Duttersfield." (Laughter.) Then Mr. Fritz sat down and said, "As long as you tell that story, you are my partner in Bethlehem." (Laughter.) I thought I was all right with the ladies, when he added: "There's about five thousand other fellows that's got exactly just the same right to claim to be partners in the Bethlehem works as Dan Tompkins has." Well, that knocked me into a cocked hat, you know. That gives me a text, — a text that fits the occasion. Five thousand people sent out from the Bethlehem Iron Works to undertake the industrial development of this country! I leave out myself and make it 4,999. (Laughter.) I do not believe that the very greatest works of Mr. John Fritz have been in the improvement of the iron and the steel industry. I do not believe that his greatest work has been accomplished when he has been called into counsel by kings and emperors and foreign countries, to tell them what to do. I do not believe that his greatest work has been in constructing the Bethlehem Iron Works, but rather in training those 4,999 fellows to go out and preach his creed of thrift, economy, industry, and financial integrity and industrial courage throughout these United States, and to make the wheels turn, and to establish pay rolls for the benefit of the population from the St. Lawrence to the Rio Grande. (Applause.)

Now, I will tell you another thing, and I am going to say something disagreeable to the audience, but not to him. I believe he will back me up. You have been praising him too much. He did not do everything you said he did. There is somebody at the other end of this hall that is entitled to half the praise. (Applause.) I have known many a woman who could have kept him from doing anything. (Applause.) I make my obeisance to Mrs. Fritz, and I say that the fruits of her work are here before you. (Applause.) I asked Mrs. Fritz's brother how long Mr. Fritz had been called the old man, and he said: "I don't know. He was about twenty-five years old when he came courting around our house, and he was the old man then." (Laughter.) His life and its development have been parallel with the development of the profession of engineering, and that profession of engineering from the time of George Washington down to the present time has been enlarging, broadening, and widening itself all the time until it has come to comprise almost every one of the arts and sciences that are known. I make my obeisance to the gentleman whom I honor above all others in the engineering profession. I stand always uncovered in his presence. I wish him a long and a happy life, and that the rest of his life may fulfill all the conditions that Mr. Abram S. Hewitt stipulated in his letter, and being yet a young man, that is a great big wish. (Applause.)

THE TOASTMASTER: — It is too bad to break up this beautiful occasion, but I am afraid we will have to do it. Mr. Fritz asks me to express his thanks to you for your attendance, and to express to the speakers his thanks for the many graceful things that they have said about him, and we will part with one toast which needs no spokesman: "Mrs. Fritz and the ladies, God bless them all."

THE BANQUET AS SEEN BY ONE IN THE GALLERY.

That unique caravansary, the incomparable Waldorf-Astoria, never opened its spacious gates to, or harbored within its walls, a more intelligent and all-round refined and high-toned company than graced and dignified its halls on the auspicious thirty-first day of October, 1902. They numbered by the hundreds and had come from the East and from the West, from the North and from the South, neither for business nor profit, enticed by no self-interest; theirs was an errand of pure pleasure, not, as vulgarly understood, in "tripping the light fantastic toe through the mazes of the dizzy dance," not to burn incense at the shrines of wealth, not to worship at the feet of beauty, not to pour libations in the welcome of some conquering hero, or sacrifice hecatombs to celebrate the victory of some political chief, but simply to honor a modest friend, a good man "eighty years young," whom they loved, and whom they long since affectionately christened, "Unser Fritz."

At the appointed hour this distinguished company, 600 strong, was thronging the elegant and brilliantly illuminated lobby of the Banqueting Hall, doing homage and offering hearty congratulations to the hero and the heroine of the hour; for, as in all well-organized and desirable assemblages, this was not for men alone. As the best work since time immemorial has been accomplished by the united efforts and coöperation of good men and women, so should all happy results be shared and enjoyed by both. But,

> "All human history attests
> That happiness for man, the hungry sinner,
> Since Eve ate the apples, much depends on dinner!"

The banquet came next in order. At the entrance to the theater of action, the ladies, being invited "to go up higher," ascended into the regions of music, softer light, and purer air, to the "Angels' Gallery," the men filling the space only a little lower than the angels. Why attempt to describe the magic scene that greeted our eyes after reaching the hemicycle allotted us for observation! It should have been painted then and there with the colors fresh on the palette, under the enchanting spell of the moment, in the warm glow of the lights, the exhilarating music, the presence of friends, and the inspiration of the spirit afloat in the genial atmosphere. Though time brings in quick succession its varied seasonable festive functions, it can never dim from memory the bright and beautiful vision of that delightful night. What with the inviting groups of cosy small round tables, the dazzling linen, the shining silver, and glittering crystal; the myriads of pink-shaded lamps diffusing their soft rosy glow, the bountiful decorations of gorgeous chrysanthemums, and the fine models of steel-making processes, the setting of the picture was perfect, both in itself and in pleasing relief to the somber and monotonous regulation costume of the guests it enframed. What a whimsical fashion that of the guest's dress suit, so nearly resembling the livery of the garçon! An old itinerant preacher illustrating his discourse with panoramic views, called the attention of his audience to the picture of Daniel in the lions' den, adding: "My friends, you will easily distinguish Daniel from the lions, as the former carries a blue cotton umbrella under his arm." The characteristic distinction of the guests this night, though not so original, was even more effective,— a pure white chrysanthemum, *en boutonniere.*

A brilliant overture by the band and the introduction of oysters upon the scene opened the first act of the epicurean melodrama. A full corps of modern Ganymedes began to play their inspiriting part, other ministering spirits appearing and disappearing, bearing in turn green turtle soup, olives, almonds, celery, radishes, *filet de sole* with cucumber salad, then appetizing sweetbreads with Parisian potatoes, followed by lamb flanked with French peas as *pièce de résistance.* All tantalizingly near and aggravatingly far. Feeding time in a menagerie is under certain circumstances amusing and entertaining, but who has not observed the unrest of the smaller animals looking on the greater devouring their lion's share? A cat looking at a king can scarcely find in the privilege the satisfaction of interviewing a mouse. To beguile the fancy and help while away the tedium of hope long deferred and great expectations, exquisite souvenir programs of the entertainment, genuine works of art and triumphs of engineering skill, had been thoughtfully distributed among the feminine denizens of the upper regions; but the dainty and artistically devised French menu only emphasized the fact and added to the regret that on this spicy occasion, what was sauce for the gander should not be sauce for the goose. One of the most exquisitely cruel modes of torture during the Dark Ages was by starvation, the helpless victims bound in narrow cells in full view of the inquisitor's kitchens, being forced witnesses of all the culinary operations and preparations in the result of which they had no share. History but repeats itself. When the promised "light refreshments" reached the altitude of the mouth-watering spectators, however, they had been fit for the gods, and on Olympus had served as nectar and ambrosia.

During these digressions above, things were progressing in regular courses below, fish and flesh had been duly disposed of with accessories galore, and as entre-acte, specimen sections of a new kind of T-rail, skillfully contrived to answer the double purpose of sherbet cups, had been presented to the banqueters as souvenirs of the Fritz Festival. The irrepressible punster naturally pronouncing the *sorbet à l'orange* "raal good." The band in the meantime enlivened the swiftly passing hours with its gayest notes. Years ago, at a popular biblical panoramic exhibition, each scene was ushered in by an organ accompaniment explanatory or prophetic. Thus, as the return of the Prodigal Son unrolled before the audience, the music struck up, "When Johnny comes marching home again," and Christ stood stilling the tempest to the tune of "A home on the ocean wave, a bark on the rolling deep." In the absence of a music program and unfamiliar with the repertory of the modern dinner-band, we infer that the selections were up-to-date, and can certify to the suitableness of "For he is a jolly good fellow," and "We won't go home till morning," as well as the reasonableness of the final "Good-by, ladies, we're going to leave you now."

But the end had not yet come. Roasted squabs and salad were next in order, followed by the delicacies of the daintiest of desserts, fancy ices, various cakes and sweets, luscious fruit, cheese and coffee, that subtle beverage, medium between the material and spiritual life of man, introducing as *grand finale* the happiest idea and greatest surprise of this surprising spread. There entered, to the liveliest notes of the band, a long procession of the entire force of the waiting corps, marching and countermarching through the intricacies of the array of tables, parading before the "beloved John" and his friends huge candied representations of some of the striking results of the steel industry, which, but for the work of the great and venerable chief, had scarcely existed. The modern steel building was exemplified by a beautiful model of the greatest sky-scraping "Flat Iron" in the world, borne aloft in the arms of the head of the cortège. Then followed miniature facsimiles of the latest steel bridge, the steel-clad battleship Oregon, of the biggest steam and electrical engines built, and of the very latest type of American disappearing siege guns, such as are now being mounted along our Atlantic coast, beside which stood some toy cannon balls. Then followed still other mechanical designs, intended to emphasize the triumph of the steel industry which John Fritz has done so much to create.

And now for the feast of reason and flow of soul, since "man should not live by bread alone." Behind an antique-looking tribune, built on a slightly elevated platform overlooking the joyous multitude, sat "Uncle John" in the midst of the orators of the night, their noble and friendly faces framed in by banks of ferns and flowers, against a background of the three colors we love the best, broken midway by mysteriously closed curtains, at the parting of which we had expected some hand to trace writings upon the wall, in letters of steel and words of heaven's fire,

"An honest man, the noblest work of God";

but when the curtains opened, it was to introduce the interesting ceremony of the medal presentation of which the "Honest Man" was the first recipient. Then followed the reading of a noble epistle from Hon. Abram S. Hewitt. One of the veterans of the art, detained by the infirmities of advancing age, he penned his message full of wisdom and good cheer, to which the house responded with heartfelt and enthusiastic applause. The Navy was represented by Rear-Admiral George W. Melville, one of the best and bravest of the nation's heroes, whose exploits and achievements in the Lena Delta astonished the world. Then congratulatory messages were read, coming "from the four corners of the round world." Then the Army was responded to by General Griffin, and able speeches generously savored with Attic salt were enjoyed from representatives of the four great American Societies and Institutes of Civil, Mining, Mechanical, and Electrical Engineers. The facetious manufacturer of "lucky omens" from up-country discoursed on the Lehigh Valley and its neighbors, and last, but not least, one of Uncle John's boys dwelt on the days of his brother old-boys in a speech redundant with wit and humor. And when the last good-by was spoken to the warm pressure of the hand, all went on their various ways, feeling it had been good to be there.

The event was a rare success from beginning to end; thanks to the ingenuity, good taste, and appreciative realization of the eternal fitness of things on the part of the various committees. Kindness and good-will had conceived the idea, talented ability had carried it out, the well-earned laurels of a truly good and great man had been scattered along his upward path to the land of all possibilities, while yet he might gather them up, see the friend's face, and press the kindly hand who brought them. No post-mortem eulogiums, no flower-decked tomb could so well keep fresh the memory of one whom his fellow men loved to honor, while yet he trod the ways of life with them.

J. B. T.

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SUPLEE, HENRY H.
SWAIN, GEO. F.
SWANK, JAS. M.
SWASEY, AMBROSE.
SWEET, JOHN E.
SWEET, WM. A.

TALBOT, BENJ.
TARR, H. G. H.
TAYLOR, KNOX.
TAYLOR, L. H., Jr.
TAYLOR, STEVENSON.
TAYLOR, W. J.
TESLA, NIKOLA.
THOMAS, EDWIN.
THOMAS, SAMUEL.
THOMSON, ELIHU.
THOMSON, JOHN.
THURSTON, ROBT. H.
TOMPKINS, D. A.
TOWNE, HENRY R.
TOWNSEND, DAVID.
TOWNSEND, J. W.
TREXLER, H. C.
TROTZ, J. O. E.
TRUMP, EDWARD N.
TUCKER, W. R.

UEHLING, EDWARD A.
UNDERWOOD, F. D.

VAUCLAIN, S. M.
VORHEES, THEODORE.

WAITT, A. M.
WALES, C. M.
WALKER, W. R.
WALLACE, JOHN F.
WALLACE, H. T.
WARD, WM. L.
WARNER, W. R.
WARREN, B. H.
WEBSTER, GEO. S.
WEBSTER, WM. R.
WEED, GEORGE E.
WEHRUM, HENRY.
WELLMAN, CHAS. H.
WELLMAN, SAMUEL T.
WESTINGHOUSE, HERMAN H.
WESTINGHOUSE, GEO., Jr.
WESTON, FRANCIS E.
WETHERILL, JOHN P.
WETZLER, JOSEPH.
WHARTON, JOSEPH.
WHEELER, S. S.
WHITE, MAUNSEL.
WHITING, S. B.
WILBUR, E. P.
WILBUR, COL. R. H.
WILBUR, WARREN A.
WILEY, CHARLES.
WILEY, MAJOR WM. H.
WILGUS, WM. J.
WILLIAMS, DAVID.
WILLIAMS, GARDNER S.
WILLIAMS, OLIVER.
WILSON, JOSEPH M.
WITHERBEE, FRANK S.
WITTENGENSTEIN, KARL.
WOOD, F. W.
WOOD, HOWARD.
WOOD, WALTER.
WOLLE, HARTLEY C.
WORTHINGTON, C. C.
WYMAN, H. WINFIELD.

ZALINSKI, E. L.
ZEHNDER, C. H.
ZICK, WM. G.

The Following are the Awards of the John Fritz Medal:

No.	*Date*	*To*
1.	1902	John Fritz
2.	1905	Lord Kelvin
3.	1906	George Westinghouse
4.	1907	Alexander Graham Bell
5.	1908	Thomas Alva Edison
6.	1909	Charles T. Porter
7.	1910	Alfred Noble
8.	1911 (to be awarded Sir Wm. H. White in November)	

Testimonial Dinner to John Fritz by the Manufacturers' Club of Philadelphia.

On November 17, 1910 the Manufacturers' Club of Philadelphia tendered John Fritz a reception and dinner at the rooms of the Club. the participants numbering about 175. Col. W. F. Donovan acted as toastmaster. Addresses were made by Nathan B. Folwell, President of the Club, John Birkinbine, John Fritz, James M. Swank, Charles M. Schwab, the Rev. Russell H. Conwell, Joseph E. Thropp, the Hon. Hampton L. Carson, and Robert W. Hunt.

In connection with the exercises of the evening the Elliott Cresson gold medal was awarded Mr. Fritz by the Franklin Institute of Philadelphia "for distinguished leading and directive work in the advancement of the iron and steel industries," and Dr. Russell H. Conwell, President of Temple University, Philadelphia, announced that the Trustees of Temple University conferred on Mr. Fritz the honorary degree of Doctor of Science.

Fig. 21. — The Fritz Memorial Methodist Episcopal Church and Parsonage, South Bethlehem, Pa. Erected by John Fritz as a Memorial to his Father and Mother, 1892.