

and castings. I was shown one machine—I think it was for the rifling of some of the guns, though I am not sure as to this—which contained a screw of only three inches in diameter and thirty-five feet long, which was designed and cut by a Chinaman, and I took a time exposure of a yellow-faced Chinaman, who makes the finest of the improved sights of the Armstrong guns. The work is as delicate and as beautiful as that of a watchmaker, and there is an improvement on the original, which this man has added. The rifling machine for the big guns would have cost \$15,000 to import. These Chinamen were shown the drawings, and they made it for half that sum. It is so in nearly every variety of machinery, and among the things now actually being made in these works are all sorts of modern projectiles, from the revolver bullet up to great shots of steel weighing 1,000 pounds. They make cartridges from those fitted for a revolver to the kind required for a six-inch rifle, and I saw Chinamen drilling steel, cutting our grape shot and making brass cartridge cases from disks of metal and paid a visit to the warehouses, where I was shown the 200 different kinds of shot and shrapnel which are made here. They are now turning out about 30,000 pounds of shot a day, and they have made recent experiments with Chinese iron which demonstrate its superiority in some respects over any other iron of the world.

No one knows much about the mineral resources of China. But coal and iron are said to exist in nearly every one of the eighteen states or provinces of the empire, and there have been some iron mines which have been worked for years. Up to this time, China has been importing the raw material for her arsenals, but she is now experimenting with her own supplies, and the manufacturing China of the future will probably be entirely independent of the rest of the world. The coal and iron formations of the province of Chili are said to be the largest in the world, and the product is unsurpassed. The iron now used here comes from the province of Hunan, in about the center of China, and some idea of its character may be learned from a test which was recently made here. A shot was cast of this iron for a three-inch rifle, and it was fired against a target with the same charge and the same gun in competition with imported shot of steel. The target consisted of three iron plates an inch thick, interleaved with boards of wood. The steel shot penetrated the target, but none of them went through it. The Chinese cast-iron shot passed clear through the target and were lost. The process of manufacture of the iron is not known at the arsenal. It comes here in the shape of iron plates or slabs, from half an inch to two inches thick, and I should say, at a guess, for I did not measure them, fifteen by twenty-five inches in size. I saw a great quantity of the ore lying outside of the foundry. It is of a reddish brown color, and looks much like some which we get from the Lake Superior mines. The pigs or slabs are laid down here at about twenty dollars a ton, or ten dollars a ton in gold, thus costing about half a cent a pound. Mr. Cornish tells me that the Chinese make castings of iron which would be considered impossible in America. They will cast kettles as big as the largest

American apple butter kettle, holding about as much fluid as an old-fashioned wash tub, and only a sixteenth of an inch thick. These kettles are wonderfully strong. You would think they would snap like glass, but they are thrown about as though they were made of copper, and are very hard to break. In the experiment above mentioned Mr. Cornish told me that he had no idea that the shot would go through the target, and he was disappointed in not being able to find it. He says the iron is far superior to the average European iron, and that he is satisfied that it is made with charcoal. It does not melt easily, however, and the foundries do not like it.

There are hundreds of steam engines of all kinds in these works, and they are all managed by the Chinese. I saw one of four-hundred horse-power which was in charge of a boy and a youth of twenty-one, and I noticed that numbers of the Chinese mechanics are under age. Some of them are old men, but it is hard to tell the age of a Chinaman, as they all shave, and there are few gray hairs. I spent some time looking at the men putting up an engine of two thousand horse-power. It is of the most modern variety, and has cost a fortune. The immense furnaces burn gas, and a look into them would scare the religion out of any modern Shadrach, Meshach and Abednego if the Viceroy of Nanking cared to play the part of the cruel Babylonian king of the Scriptures. These furnaces are controlled by two easily-moved levers, and a mistake would blow the whole into atoms. A Chinese engineer about thirty years old has entire charge of them, and he stood for me beside the furnace doors while I took his picture.

The steel works of this arsenal cover about four acres. The men are now experimenting in making ingots for armor plate, such as we turn out at Bethlehem, and they are putting in a steel furnace which will smelt fifteen tons of steel at one time. If it is a success, they will add others. They have made some small ingots, and I saw some steel rails for railroads which they turned out the other day to show the Chinese authorities that they could make them. They do all sorts of forging. They are now putting in a seven-hundred-ton steel press, which will exert a force of two thousand tons on the ore beneath it. I saw great steel hammers forging out immense lumps of steel, and I was surprised at the wonderful way in which these people handle all sorts of metal and machinery. There is never a mistake, and the men are on hand every time.

What I saw today has removed from my mind all doubt as to the ability of the Chinese to construct and manage modern machinery, and I question much whether they have not the germs of a creative ability, which, under proper conditions, might produce as great inventions today as the Chinese mind has done in the past. The compass, gunpowder and printing originated here, and we may have a Chinese Edison in the future. I asked questions of Mr. Cornish concerning this, as we walked through the works, and he told me that several of the mechanics had improved upon the original models which had been imported, and I saw a machine for

cutting steel which a friend of Li Hung Chang had adapted to the making of candle wicks, and which, by his favor, he was running with the arsenal power. Said Mr. Cornish:

"The lack of inventors in China may come from there being no patent law. These men tell me they don't care to work at getting new things, because their neighbors will steal their ideas. Besides, you must remember that the Chinese mind has for years run in other directions. A mechanic is not of much account here, and the man who can write a three line poem or can quote Confucius would be thought more of than any inventor. Tupper, the poet, had he been born in China would have outranked an Edison, and the literati look down on such work as beneath them."

I did not have time yesterday to visit the powder works where the Chinese are making all sorts of powder from the brown cocoanuts which are used for the heavy guns to the small black grains which are made for modern rifles, but I saw samples of the powder and Mr. Cornish says there is a chemist now on his way from Germany to China, who will teach them how to make the smokeless powder which has been recently invented.

I asked as to the hours of work and the wages of the men. Mr. Cornish replied: "It is a curious thing that we have an eight-hour law in existence in these works and our employes work fewer hours perhaps than in any other native establishment in China. The men begin work at 7:30 a. m. and work until 11:30. Then they have an hour for lunch and work on until 4:30. In case of necessity, however, of war or otherwise, we could work them almost twice that long and we could add to the force largely without much trouble. Our mechanics get from three to six Mexican dollars a week, or from a dollar and a half to three dollars a week in your currency. The very best of the foremen receive as high as eighty dollars a month, and under foremen get about thirty-five Mexican dollars a month. Our possible supply of labor is, of course, unlimited."

"By the way," continued Mr. Cornish, "I suppose the eight-hour rule came from the fact that this establishment was originally organized by an American who came here a score and more of years ago and was employed by the Chinese to run it. He ran it so well that he made a fortune out of it, and for this reason it was taken out of his hands. The Chinese don't object to money being made, provided they make it themselves, and they saw that Mr. Falls was getting rich very fast. They now handle the thing themselves and if there are any fat contracts or squeezes to be made it is a Chinaman who has charge of them."

At this moment one of the officers of a Chinese naval vessel came in to see about getting two six-inch guns for his ship, which was lying at the arsenal wharf, and with him we took a trip over a Chinese man-of-war. But of this I will write in another letter.

Frank G. Carpenter