When we undertake a piece of research work, nobody can tell how long it is going to take because we fail so many times. The one time we must not fail, however, is the last time we try. Our succeeding on the first attempt is not very good either because then we may overestimate our ability, or greatly underestimate the problem.

A young Englishman, Henry Bessemer, is a good example of the trouble one can get into when things go too well at the start.

A little more than a hundred years ago, steel was very hard to get and its use was limited to making swords, needles, springs and so on. The need for guns in the Crimean War brought steel to Bessemer's attention - the countries at war wanted stronger cannons than could be made from cast iron.

Bessemer was a practical metallurgist and inventor. His process for making bronze powder provided him with enough money to do experiments. He knew steel would make much better guns but there was no cheap method known for making it.

After studying the subject thoroughly, he learned how steel was made by the old methods; ultimately he revolutionized the steel business and opened the way for many new industries.

Now to give you a little background of the problem. Iron, as you know, is one of the elements - like gold, silver, copper and tin. Steel is an alloy of iron with relatively small amounts of such material as carbon, nickel and manganese, just as bronze is an alloy of copper and tin. Bessemer's idea was this. Since steel is an alloy of iron and other materials, why not start with pure iron and then add measured amounts of the alloying materials?

Now pure iron is hard to get because when the ore is reduced to pig iron, some of the original impurities remain, together with the carbon from the smelting process.

The new experiment which Bessemer tried was a method of getting pure iron. He melted pig iron in a crucible and blew air through the molten metal to burn out the carbon and the other impurities.

When the air was turned on, a great shower of sparks arose for several minutes and then stopped. Bessemer found this process gave almost pure iron. Success the first time!

For a second test, he used a crucible which would hold half a ton of molten pig iron, and with the aid of a very powerful engine-driven blower the air was forced through. With a tremendous roar, the sparks poured out as in the first test. Now, just as the sparks
stopped, Bessemer added a calculated amount of the alloying material and, as a result, he had a good quality of steel. Success again!

Bessemer now took out patents on his process and sold licenses to many ironmakers. After he had gone to great expense to fit up crucibles and blowers, the process would not work. He had to return the license money and almost went broke. For months he was in disgrace, criticized and ridiculed on every hand. Bessemer knew his process had worked. What was wrong now?

After a great deal of experimental work, he found there was phosphorus in all the iron used by his licensees. Purely by accident, in his first experiment, he had used iron without phosphorus. With his new knowledge, he was able to repeat his results every time. Now the process was a success.

But the iron masters felt that they had been fooled before and no one would try the process again. However, a few of Bessemer's friends helped him build a steel works at Sheffield.

Soon he was selling a high quality of steel for $100 per ton less than his competitors. Now the very men who had criticized and ridiculed him asked for a renewal of their licenses. Whatever Bessemer received as royalties, the world at large profited 10,000 times more, for at this time the world was on the threshold of a vast industrial expansion.

While steelmaking has undergone many changes since Bessemer's process was first developed, his accomplishments started great industries which, in peacetime, have made possible our skyscrapers, our networks of railroads, our millions of motor cars and the thousands of everyday articles which we use. And it is this peacetime skill and "know-how" that made it possible for us to build ships, like the new 45-thousand ton Missouri, the latest armor-plate, and, in addition, merchant ships, tanks and guns.

The development of steel is a fine example of what the persistence of man can do to help build up a great country like ours - as well as to defend it under attack.