

DISCUSSION ON "THE ART OF INVENTING," AT MILWAUKEE, WIS.,  
MAY 30, 1906.

**C. P. Steinmetz:** I do not quite agree with the author of this paper, or rather, I do not believe that there is such a thing as an art of inventing. I consider inventing as a part of the regular work of the engineer. The engineer has before him a problem to solve, whether it be a problem of design, installation, or operation. He has at his disposition a vast amount of experience, his own and others, and if he is successful he solves the problem in a number of successive steps. Some of these steps are old, and have been taken by others under similar conditions. One, or several, may be new, have never been taken by anybody before; that is, are invention, and as such are covered by patent. These new steps may not necessarily be the most important, the most difficult or ingenious ones, but they are new and as such are invention. But without being put in the position where the problem calls for just such a step, without having at his disposition the vast amount of preceding experience, the engineer would never have made that invention—perhaps he may have invented something else.

For the engineer, originality is essential to enable him successfully to solve problems or parts of problems by new ways, or ways partly new. But this part of an engineer's work is so inextricably joined with the rest of his work, that I see no reason to separate it as a special art called the art of inventing. Intellectually, it is neither higher nor lower than the rest of an engineer's work: the application of known facts and selection of appropriate known methods to the solution of a problem. Indeed, frequently the engineer finds a new way, and considers it inventing, though investigation afterwards shows that he is not the first, but that somebody else before him has made the invention, and he merely re-invented it. Nobody can know everything. So, in many cases, inventing is merely the incidental feature that that particular engineering step has not been taken by any one else in exactly the same manner; and similarly, other steps, though they may be more difficult, more creditable to the engineer, yet they are not invention.

As to the question of giving the credit to the inventor—I speak not of those broad and radical inventions, which are rare and far between, but of by far the largest number of patents—it must be considered that in most cases the problem was put before the inventor by some one else, or as part of his professional work; it was solved by the use of a vast amount of experience gathered by others, without which he could not proceed a single step, and very frequently that step which constitutes invention would be of no value whatever, except in connection with the rest of the work, and even then a great amount of development work may be needed to reduce the invention to practical value. That is, the new idea, while it is an invention, requires a great deal more, before it is of commercial utility, and to claim for the

inventor all the credit for the advance in the art resulting from the invention, is as unjust as it would be not to give any credit for inventive originality.

I repeat, most inventions are engineering steps, part of the regular work of the successful engineer, who must possess not only the knowledge to use old ways and methods, but also the originality to find new ways when required to solve the problem before him.

There are but few pioneer inventions. It occasionally happens that inventions are made which open up an entirely new field, establish a new industry, as the invention of the incandescent lamp, of the wireless telegraph, of the polyphase system. And frequently it is difficult to state the exact feature of which the invention consists, especially when after the lapse of years the inventor's work has become commonplace to the world. Take for instance the case of the Edison incandescent lamp. This is one of the most useful, important, and radical inventions. It perhaps can be said to be the foundation of the electrical engineering industry. Before that, electrical engineering was only the art of telegraphy; after that electric power became a quantity to consider. But before Edison people had run filaments in a vacuum. Carbon filaments had been proposed. The high-resistance-feature of the filament is difficult to consider as an essential distinction, since it is merely a quantitative difference: as long as the source of electric power was a primary battery of low voltage, a high-resistance filament would have been decidedly disadvantageous—low resistance wanted. With the source of power of high voltage high resistance was wanted; that was self-evident, especially after Edison had done it. To lead the current into a bulb, platinum wires had probably been used before Edison. So you may ask: What is meant by the invention of the incandescent lamp? That is a question for lawyers to discuss; and since the patents have expired, the details are of no further interest. But before Edison, incandescent lighting did not exist. As the result of Edison's work on the incandescent lamp, an industry of vast importance has been created, and a revolution brought about in the methods of illumination. The importance of the problem was realized before Edison. But whatever may be the details of the work, nobody did it before, and to the one who made the incandescent lamp what it is to-day, the historian gives the credit.

Again we see the same thing in the matter of polyphase transmission. Polyphase currents had been used before Tesla; investigations had been made by Ferraris. Motion had been transmitted synchronously, by polyphase currents, many years before Tesla. All the engineering world was striving for an alternating-current motor; and still all the world waited until Tesla showed how by polyphase currents *power* could be transmitted and distributed, not merely a laboratory toy set in rotation, but power transmitted over distances to do the world's work.

It is characteristic of most pioneer inventions that at first people do not believe that it has been done; do not believe it can be done; pay no attention to it; laugh at it. Next, a host of claimants crop up, all of whom have solved the problem, made the invention long ago, and they claim the credit—only nobody knew of their work until the inventor showed the way. Next, people claim that the thing is as old as the hills, is no invention at all; it was long known before the inventor used it, but somehow nobody had used it before. Ultimately, history records that the art did not exist before, that the work of the inventor brought it into existence, and that to him belongs the credit. Usually he gets the credit long after his death.

This applies to men that produce radical inventions. The reverse of this is the professional inventor, the man who hunts around to pick up and combine ideas created by others, whether useful or not, merely for luck, because sometime something similar may be made useful by the inventions of others. Him I consider as just a step above the professional promoter. But between the two, the pioneer and the freebooter, stands the vast majority of legitimate engineering inventions, representing steps in useful engineering work done for useful purposes.

**President Wheeler:** I quite agree with what Dr. Steinmetz has said, and at the risk of making an anticlimax I will go back for a moment to the subject of the paper, because I want to mention another example of a much needed invention. The author of the paper says that the first requisite is to select a problem. In nearly all work and all businesses a great deal of time is spent in multiplying a unit price by a quantity, and writing the result on a ticket, either a time ticket, a material ticket, or a cash ticket. I think it is hardly realized how much routine labor is spent in writing these tickets, and, as a bookkeeper would say, in making the extensions. In these days when adding machines and multiplying machines are coming into use, the tendency to use mechanical devices in all bookkeeping operations is getting stronger all the time.

I wanted a machine to do the operations I have just referred to, and I asked the people who make the calculating machines to make one for me, but they were not able to do so. I call it a multiplying printer. It might consist of three dials, or equivalents—if you set one at 13 cents and the other at 109 lb., the third dial would tell how much this comes to. If you put a regular form of ticket under it and strike it, it will print the product, and also print the unit price and the number of pounds. The object of printing all three is so that you may go back and see where the mistake was when some one makes out a ticket wrong. That sounds quite simple, and yet nobody has turned out such a device. I thought I would invent one to order, three or four years ago. I consulted a mechanical expert and asked him to get it up for me. After a few days he called on me and laid on my desk what he called the literature of the

subject—a bundle containing about 500 patents of similar devices, and told me he would be glad to get up the machine at \$50 per day, but could not tell how many months it would take.

**Edwin J. Prindle:** Mr. Steinmetz's report of his remarks at the convention, concerning my paper on the "Art of Inventing" has been modified so that my oral reply to it does not appear to have complete connection with the matter, but as those who were present at the convention and who remember the matter will retain the impression of his remarks as they were actually delivered, I desire to make the following more complete reply to Mr. Steinmetz's remarks.

Mr. Steinmetz' position was that inventing is a mere incident of engineering, and that inventing, considered by itself, is one of the forms of activity which is least worthy of respect. The engineer is doing engineering *per se* when he is designing structures and apparatuses for new situations and conditions without changing their principles. When, however, he is introducing new principles of operation, he is inventing, as distinguished from practicing engineering proper. Mr. Steinmetz seems to think that it is the same grade of work to select from among known apparatuses that apparatus best suited for a given condition, and to determine its size and proportion by the use of mathematics and engineering rules already in existence, than it is to invent an apparatus working upon a new principle and doing work at perhaps a greater economy than any apparatus previously invented or serving a purpose which no apparatus previously known can serve. To state Mr. Steinmetz' position, seems almost to answer it.

Sir Francis Bacon considered inventing as one of the highest forms of effort. He said:

The introduction of great inventions appears one of the most distinguished of human actions, and the ancients so considered it; for they assigned divine honors to the authors of inventions, but only heroic honors to those who displayed civil merit; such as the founders of cities and empires, legislators, the deliverers of their country from lasting misfortunes, the quellers of tyrants, and the like. And if anyone rightly compare them, he will find the judgment of antiquity to be correct; for the benefits derived from inventions may extend to mankind in general, but civil benefits to particular lands alone; the latter, moreover, last but for a time, the former forever. Civil reformation seldom is carried on without violence and confusion, while inventions are a blessing and a benefit without injuring or afflicting any.—*Novum Organum*, Book 1, Section CXXIX.

To take the view of a man of to-day, Judge Grosscup, a distinguished Federal Judge in Chicago, has said;

Inventive genius has given to mankind most of its present material civilization. The magnificent flower of civilization, everywhere surrounding us, has opened from germs that were fructified from the brains of inventors.

The founders of the Constitution of the United States thought inventing so important that they introduced a provision into

the Constitution for the enactment of laws for the protection of inventions.

George Washington was sufficiently interested in the stimulation of invention to urge in his first annual message to Congress the expediency of giving effectual encouragement to the introduction of new and useful inventions. In fact he took the trouble to sign the first patent ever issued by the United States, and other subsequent patents.

Photographs of a patent signed by George Washington will be found in an article by the writer in the *Scientific American*, May 13, 1899, page 300. Not only was the patent signed by George Washington, but it was signed by the Secretary of State, and the Attorney General of the United States.

The inventor is one of the greatest benefactors of mankind, and there is eminent authority for belief that, as a class, the benefit which inventors confer upon humanity is a powerful incentive to the production of inventions, as well as the profit that may come to them. Senator O. H. Platt of Connecticut, in an address delivered before the Patent Centennial Celebration, 1891, said:

I deny, however, that the hope of pecuniary gain is the only motive of invention, or indeed the most powerful motive. Two others, at least, are more potent: The insatiable desire to man to see the invisible, to touch the intangible, to know the unknown, to conquer the unconquered, is one; to benefit the human race is the other. The prospect of money reward alone would never absorb and concentrate and intensify the faculties of the inventor. \* \* \* If they can but discover the germs of new inventions which are to cheapen production, which are to minister to the present and prospective wants of mankind, they will be satisfied with their life-work and feel that they are entitled to a place among the world's great doers, though others shall enter in and reap more abundantly the money reward. There never yet was a true invention from which the public did not reap infinitely greater pecuniary reward than the inventor. However selfish his purpose may be, it is an inevitable law of invention that it holds greater benefits in store for the masses than for the inventor.

Every physical contrivance that is substantially different from things previously known, is the result of invention. The comfort in which we live, the ease with which we communicate with each other, the labor-saving devices which make it possible to maintain physical life without ceaseless effort—these are the result of invention, and they give the opportunities necessary for the building up of our present civilization, so that fundamentally inventing is the most important of industrial activities. Inventing creates that which did not exist before, and does not consist in merely repeating actions which others have shown how to perform or in participating in the activities of others as a mere agent or assistant, and, therefore, inventing is, as is almost universally recognized, one of the forms of activity worthy of the highest respect.

That which is easy for us to do, we are apt to hold in light regard. When we thoroughly understand a difficult subject so that it holds no mystery for us, it is apt to suffer in our esti-

mation. It requires an effort to withdraw one's self to a sufficiently distant point of perspective to restore a true estimate. It is probably for this reason that Mr. Steinmetz so lightly regards the dignity of inventing. Inventing comes so easy to him, that he forgets its tremendous importance, and it seems to him but a mere incident in his engineering. Because of the facility with which he invents, he is probably one of those least qualified properly to estimate the dignity of inventing.