The Business Side of German Science—VIII

Making Money With the Aid of Technically Trained Men

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[*THIS is the eighth of a series of articles, written by the Managing Editor of the* SCIENTIFIC AMERICAN, *on German industrial conditions. The author was sent abroad by the publishers for the express purpose of gathering the material on which the articles are based. In this and the article to follow, the part played by the technically trained man in German business is pictured.*

The amazing industrial development of modern Germany is to be attributed in large part to technical education and to the application of science to business. Capital and science work hand in hand. Every one of the great chemical discoveries of our times, most of them made in Germany, are the result not of haphazard experimenting, but of systematic research that has meant the expenditure of princely sums. All German manufacturing is so thoroughly saturated with science, that even the small producer practises on a miniature scale the methods of his larger rivals.]

The Story of Indigo.

The pertinacity with which a German chemical company will carry on investigations for years, fully convinced that ultimately the goal will be reached, finds no more brilliant example than the development of a commercial process for the manufacture of artificial indigo. In the eighties Prof. von Baeyer of Munich succeeded in producing synthetic indigo—a great achievement. Two of the most powerful chemical firms of the day took up the invention almost immediately. They set chemists and engineers at work. After much time, money, labor and thought had been spent in endeavoring to base an industry on von Baeyer's discovery, it was found impossible to produce indigo in commercial quantities by the means that he had indicated. The firms who backed the invention were discouraged perhaps, but not beaten. When Heumann discovered a method of obtaining synthetic indigo from the phenylglycins, a commercial future for artificial indigo seemed to have dawned. Heumann was practically taken into partnership with capitalists who recognized the immense possibilities that lay in his discovery. Without them he would have been able to do nothing. Seven years of hard work elapsed before the first indigo could be manufactured by Heumann's process for the market.

It pays to spend money and time so lavishly. The amount of indigo manufactured to-day would require the cultivation on an area of more than one-quarter of a million of acres of land in the home of the indigo plant. As late as 1897 thirteen million pounds of indigo were grown, valued at twenty million dollars. Not more than one-sixth of this quantity of natural indigo is now marketed. The Calcutta harvest for example, in 1896 amounted to 158,922 maunds and in 1909 to only 31,200 maunds, a maund being 82.14 pounds. In Java, in 1898, there were 122 indigo plantations; in a few years they were reduced to 28. A harvest which in Java amounted to 12.580 boxes in 1898 was reduced to 2,015 in 1908. In 1897 Germany imported $3,200,000 worth of natural indigo; in 1909 only $160,000 worth. On the other hand the export of synthetic indigo in Germany amounted to nearly $2,000,000.

The same story is repeated in the history of alizarin. In 1868 France exported about $600,000 worth of madder. To-day madder is almost unused. Instead, millions of pounds of artificial alizarin are manufactured, seven-eighths of the entire output in Germany. In 1892, 320,000 pounds of cochineal were used in Germany. In 1897 the use of cochineal had dropped to about 34,000 pounds.

Reducing the Cost of Old Processes.

The men in the research laboratories of German manufacturing companies are concerned not only with the discovery of new compounds and the inventing of new apparatus, but also with the simplification and the cheapening of old and long established processes. There has been a vast improvement, for example, in the manufacture of salicylic acid, of which one hundred and twenty-nine tons were exported from the German Empire in 1882, and five hundred and two tons in 1905. Although in twenty years the amount exported increased four times, the price of the acid dropped to one-sixth of what it was originally. In 1900, again, anti-febrin was worth about seven and one-half times what it brought in 1905. Vanillin, which has taken the place of vanilla extract, and which has been produced artificially for the last thirty years, was worth about $1,800 a pound in 1876; in 1902 it was worth about $8 a pound. These remarkable reductions in the selling price are to be attributed entirely to simplified methods of manufacture. The result of the cheapening has been the opening of a much larger market than could otherwise be supplied.

In the dyestuff industry the advances which have been made in the last decade in thus improving original processes is perhaps more marked than in any other phase of German manufacturing. Most of the improvements have resulted in securing a greater degree of fastness to washing, light and similar agencies. Thus, in dyeing cotton the want of fastness of the earlier "salt" dyestuffs soon led to attempts to fix the colors after dyeing. One result of these many attempts was the introduction in 1894 of Vidal black. Immediately a wonderful development of "sulphide" dyestuffs followed. The cotton dyer obtained cheap dyes of much greater fastness than those of the old "salt" class, which, therefore, were gradually displaced. Sooner or later the sulphide dyestuffs will have to give way to the newer vat dyes of the anthracene and indigoid classes when they have been cheapened sufficiently.

Sometimes the discovery of a new process may lead a rival manufacturer to begin a systematic study of an old process in order to improve and cheapen it to such an extent that it will not be crowded out of existence. An example is to be found in the making of sulphuric acid. When the Badische Company devised a method of making sulphuric acid commercially by the contact process it seemed as if the old lead-chamber was doomed. But the story of the competition between the electric light and the gas light was repeated; a method was found of improving the old lead-chamber process and increasing its efficiency, so that it is still worked side by side with the contact process.

Testing New Products Before Marketing Them.

The introduction of a new dye, a new drug, a new explosive, and new fabric is not conducted in a haphazard way. Business men the world over realize that there is an ethical side to the selling of goods. The old days when a salesman was simply a hired liar who stopped at nothing in selling his goods are over. A modern manufacturer not only refuses to misrepresent his products, but he will not even market them if they are not at least as good as the old.

In connection with every research department in Germany will be found a testing laboratory—a place where a newly discovered product must prove its worth. A new dyestuff is subjected to hundreds of practical tests before the public ever hears of it. It is tested for fastness by exposing it to the sunlight by ascertaining how it withstands ordinary alkalis and much washing, and by noting its effect on leather, paper and fabrics in general. As a result of hundreds of tests it may be revealed that a new chemical product is not as good as an old one, or that it is injurious in some way. Despite the fortune that may have been spent in devising a process for its manufacture, it is cast aside immediately.

The introduction of new drugs and medicaments imposes this moral obligation to a high degree. At Hoechst will be found perhaps the largest works in the world for the production of medicines and chemicals that are used in the ordinary physician's practice. Here will be found remarkable laboratories for testing the qualifications of a new virus, serum, drug, or narcotic which is to be used in curing human ills. The laboratory physician works hand in hand with the chemist; the physiologist with the physicist. No bacteriological laboratory, no hospital is conducted with more scrupulous care. A fine stud of thoroughbred horses, from three to eight years old, are an indispensable aid in supplying sera and anti-toxins. The therapeutic agents discovered are rigidly controlled partly in the Institute for Experimental Therapeutics of Frankfurt, partly at Hoechst itself. Diphtheria serum, anti-dysentery serum, anti-pneumococci serum, anti-streptococci serum, scarlet streptococci serum, tetanus serum, Robert Koch's tuberculin preparation. as well as Ehrlch's salvarsan are here prepared and carefully tested before they are sent out.

Analysis of Raw Material.

No longer is raw material bought simply by quantity and with only the most superficial regard for quality. Mass production is the reason. When the output of a steel mill or a sugar factory is millions of tons a year, it pays to save a cent a ton on raw material; it pays to determine beforehand and exactly how much of the raw material can be utilized to produce a certain amount of goods. The old-fashioned miller for example used to thrust his hands into the grain that he bought in order to feel its moisture; or he would grind it between his teeth. It is perfectly obvious that by such crude methods he could not determine differences in moisture of one or two per cent; yet such extremely slight differences may be of untold importance in modern milling. Grain is sold by weight. If it contains a large percentage of water, the miller is simply buying moisture which easily evaporates. Hence, we find that the modern miller—and particularly the modern German miller—scientifically analyzes the grain that is offered to him. Not only does that analysis govern the price to be paid for the grain, but it determines its keeping qualities. When grain is to be stored for a long time, it is not a matter of indifference whether it contains fourteen per cent or sixteen per cent of water. Experience has shown that wheat containing as much as fifteen per cent will keep for a long time, whereas wheat containing only sixteen per cent—only one per cent more—may suffer.

Only a very wealthy firm, it may be argued, can afford to pay a scientifically trained man to test raw materials in this way. That is true enough. But the small firm in Germany proceeds scientifically nevertheless. Much valuable technical assistance is given by manufacturing firms to small consumers of their products who are not able to engage a chemist or a technically trained man regularly. Thus the firm of Simon, Bühler und Baumann of Frankfurt employs a chemist whose chief duty it is to assist breweries and millers to reduce their cost of manufacture by analyzing raw material and waste products, and submitting the results of his examination. Moreover, there are dozens of consulting technologists whose services may be engaged for no very large sum.

The Sociological Side of German Industry.

There is a sociological aspect to German industrial science which is obscured by a national prosperity expressed in exports that amount to millions and millions of marks a year. Each new coal tar drug that is unearthed, each new method that is discovered for the utilization of waste material, means work. It is no small task to provide places for one-third of a million human beings who annually demand a chance to earn their living. The fact that there is so little poverty in Germany, that a task is provided for every able-bodied man, is due in large measure to the laboratory scientists in the employ of the huge manufacturing companies.

Macquarie Island

PUBLIC attention has recently been directed to Macquarie Island, owing to the fact that the Mawson Antarctic expedition, on its way south, established a wireless telegraph station here, so that the island is now in daily communication with Hobart, Tasmania. It was hoped that this station would be able to relay messages to a wireless station at Adelie Land, the base of the expedition on the Antarctic continent, but this plan has proved impracticable. It is said that magnetic disturbances due to the proximity of the south magnetic pole make communication between these two points impossible. However, the Macquarie Island station has proved of some value to shipping in Australian waters by giving timely notice of storms coming up from the south.

Macquarie Island, which belongs to Tasmania, is about 750 miles southeast of Hobart, and is, therefore, a halfway point for expeditions proceeding to the Antarctic on the Australian side. It was visited by the expeditions of Scott and Shackleton, as well as by Dr. Mawson's party. The island is about 22 miles long by 5 broad, and has a rugged coastline, rising sheer out of the water to a height of 1,500 feet in places.

According to a recent consular report this island has been leased by the Tasmanian government to Mr. Joseph Hatch, who has established here the lucrative business of catching penguins for their oil; probably the most southerly industry of the world, except certain fisheries. It is said that there are 80,000,000 penguins on the island. The oil is obtained by boiling the carcasses in digesters capable of dealing with 800 birds at a time. The product is barreled and sold to binder-twine makers in Australia and New Zealand. The chief obstacle to the success of this enterprise is the fact that the island has no harbor. Vessels have to lie about half a mile offshore, and all material is conveyed to and fro on rafts made of casks. Several ships have been wrecked in attempting to visit the island.