How the Germans Utilize Waste—VI

Wealth That Has Been Earned By the Efficient Use of Raw Material

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[*This is a continuation of an article that was begun in last week's issue. It is the sixth of a series of articles prepared by the Managing Editor of the* Scientific American *on European industrial conditions. The author was sent to Europe by the publishers of the* Scientific American *for the purpose of studying the application of science to business abroad. So much have the Germans done in the application of scientific principles to the utilization of waste, that little more can be done than to give glimpses of a small part of a vast field that they have so admirably covered.*]

Making Precious Stones With Waste Gas.

At Bittersfeld, electrolytic hydrogen is also used for the production of artificial gems. At the beginning of the present century, Verneuil, of Paris, succeeded in devising a process of making synthetic rubies, and another Frenchman, Michaud, in the middle of the nineties, succeeded in making what are known as "reconstructed rubies" out of natural ruby fragments. Almost at the same time a German gem polisher named Herman Wild of Idar, began to make real artificial rubies. Later he collaborated with Prof. Miethe. They developed a process which was eventually adopted by the Bittersfeld works. In that process, hydrogen plays an important part. Not only are real rubies thus made, but genuine sapphires, topaz, and other precious and semi-precious stones. These products must not be regarded as mere imitations of real gems, but as genuine precious stones.

Germany's annual potato crop is somewhere in the neighborhood of 45,000,000 tons. The supply is considerably in excess of both household and industrial demands. New channels had to be found to use up the surplus profitably, and if possible, to save a portion of the 10 per cent of the total crop which annually goes to waste through decay and the lack of proper winter storage. About eleven years ago the German Association of Alcohol Manufacturers, the largest industrial consumers of potatoes, took this task upon themselves. They organized a branch of their association to be known as the German Potato Driers' Association and assigned to it the task of studying methods of using dried potatoes in the various forms in which they could be produced. To increase the general interest in this question, the Alcohol Association succeeded in raising from interested sources, including two subscriptions from the government, the sum of 30,000 marks to be distributed as prizes for the best methods of reducing potatoes to an available stock food. Of the forty entries received, only twenty-two failed to answer the requirements. One of the most successful systems proved to be a method of washing the potatoes, steaming them, and passing them between two rollers, heated to 284 deg. Fahr., then removing the dried and crushed substance from the rollers by knives and passing it through a cooling funnel, after which it is ready for storing. The surplus supply of potatoes is thus worked up into a nourishing animal food.

Generating Power from Sewage.

The city of Berlin affords an excellent illustration of the enormous development to which the pursuit of sewage disposal by sewage farming has led. The city itself covers an area of about 20,000 acres; its sewage farms are no less than 40,000 acres in extent. In a way the Berlin sewage farm is a gigantic real estate speculation. Ultimately the city will sell the sewage farm land at a large profit and turn to modern biological methods.

Our present mode of disposing of sewage by pouring it into streams is exceedingly wasteful. It represents so much nitrogen which has been extracted from the soil, and which ought, by right, to be returned to the soil. If it could be advantageously used, it would represent a value of about $200,000,000 a year to England alone. This, however, is distributed over a quantity of three billion tons. Sewage is so complex in its nature that the recovery of its chemical constituents would be almost a hopeless task. That, however, is no reason why some method should not be devised of utilizing it as a fertilizer. As a general rule, the sludge is dumped on land which has been bought for the purpose, but in many European towns land suitable for that purpose is nearly all filled up. Consequently it is a serious question what shall be done when no more land is available. Farmers have endeavored to use the sludge as a fertilizer; but that is not always practicable, partly because of the chemical character of the sludge and partly because of the farmer's distance from the dumping ground.

Experiments carried out at Bruenn have shown that sewage sludge, after it has been dried until it contains 25 per cent of dried substance, is superior to most animal fertilizers in its content of nitrogen and of phosphoric acid. As the quantity is too great to be disposed of locally, it has been successfully used after complete drying for the production of lighting gas.

Making Clothes Out of Wood.

From Germany we can learn how to make the most out of a tree in an industrial way; for in Germany a tree which as a cord of wood is worth little more than three-fourths of a cent to a cent a pound, is converted into artificial silk worth $2 a pound, and into artificial bristles of cellulose acetate worth $4 a pound. Thanks to the German chemist, trees may now serve to clothe a man. A whole industry has sprung up in the last decade for the express purpose of scientifically converting wood into cloth—wood, moreover, which would otherwise be wasted in fashioning round tree trunks into rectangular boards, and beams. In Saxony, for example, a yarn called "xylolin" is made from paper as well as directly from wood pulp. From that paper, yarn, twine, cord, carpet, imitation canvas, and even whole suits of clothes have been made—all of them proof against the action of both hot and cold water. A large corporation has built a factory not far from Berlin for the purpose of making "silvalin" yarn from spruce, of which there are fairly large tracts in Germany. Like its cousin "xylolin," "silvalin" can be woven in the loom to produce whole pieces of cloth which in their essence are nothing but transformed trees.

The whole German cellulose and nitro-cellulose industry is a brilliant example of what efficiency means in the utilization of wood. The production of artificial silk from wood is alone a triumph of the application of science to industry. The credit for the original discovery belongs to Chardonnet. The process that he devised has not been very radically changed to this day. An ether-alcohol solution of nitro-cellulose is employed. At first the liquid was squirted through a fine opening, the resulting thread congealing in cold water. Each thread was composed of a tube with a liquid interior. As it emerged from the fine opening, it was rather coarse, but it was spun into a thin filament later. Nowadays very fine openings are used, as small as 8/800 of a millimeter.

In the last twenty years, Germany has built up a huge industry on cellulose derivatives. All of them cannot even be mentioned here. In the manufacture of incandescent mantles, both for coating the mantle to enable it to withstand the shock of handling, and in the production of mantles themselves by the ejection of filaments containing the thoria and ceria, to be afterward woven into mantles; in the production of pyroxylin for imitation leathers and the manufacture of continuous film (an improvement which has undoubtedly contributed more than any other discovery to the popularity of photography and especially of the moving picture)—in all these we find that cellulose is nowadays employed as a vital necessity. Little did Schoenbein dream that the gun cotton (nitro-cellulose) which he had invented would find far greater application in the arts of peace than in the art of war. Thanks to his discovery many articles hitherto made from expensive natural products are now made chiefly from wood waste. Between five thousand and six thousand patents on nitro-cellulose and its uses are now to be found on the records. Even the scientist has benefited by the wider application of cellulose. Museum specimens are now prepared with it, particularly sections for the microscope; important documents are preserved by means of it; special tubes for deep sea sounding are made of it, the tubes being coated inside with silver chromate. All these are minor but still important applications of nitro-cellulose solutions.

Artificial Wood.

Many a large building in Germany is floored with a material which is obviously not cement, because it is not hard enough, nor linoleum because it is not quite soft enough despite its elasticity. Ask an architect what that curious material is and you will be told that it is pressed sawdust mixed with magnesium chloride. Wood is too expensive in Germany to be burned under a boiler—the American method of utilizing most sawmill waste. Hence the sawdust floor. We in the United States have not been blind to this new use of what was once a waste; for the German manufacturer will tell you that the American too is beginning to mix his sawdust with magnesium chloride. Like most German industries, however small, the process of making a flooring from sawdust is conducted on strictly scientific principles. Something more than a haphazard mixture of sawdust and magnesium chloride is required. The chloride absorbs water very readily. It is what the chemist calls hygroscopic. Unless some scientific method is adopted to effect the mixture, a perpetually damp floor will be the result. Accordingly, the manufacturers have employed chemists to solve that problem for them. It is the business of the chemist to ascertain the correct proportions of the mixture. The usual process is to add the sawdust in the right quantity to a cement-like mass composed of a solution of magnesium chloride to which powdered magnesia is added. Sometimes the manufacturer delivers tiles of this composition, and sometimes he mixes the composition on the spot, works it in the form of a plastic mass, and allows it to set. The cost is rarely greater than $2 a square yard. The effect of linoleum and parquet flooring is obtained by adding coloring matter. Even wainscoting, stair coverings, and roofing tiles are thus made. One manufacturer supplies the raw material itself and the formula for mixing it, so that you can lay your own floor, and exercise your own ingenuity and good taste. Some of these artificial wood floorings and wainscots are made from bottle corks. Perhaps that explains why the waiters in every German hotel have developed a squirrel-like faculty of treasuring cork stoppers.

The Manufacture of Soda.

There is a rivalry in applied chemistry in Germany that is just as keen as business rivalry. A brilliant example is to be found in the competition between the LeBlanc, the Solvay, and the electrolytic process for the production of soda from waste. A capitalization of $25,000,000 was practically wiped out in the last ten years in Germany when Solvay succeeded in placing the ammonia-soda process on its commercial feet by inventing suitable apparatus to compete with the LeBlanc process. A few factories managed to save themselves by turning to other fields; for example, a factory near Stettin started in to manufacture superphosphates in its sulphuric acid plant. In Aix-la-Chapelle, however, an ingenious chemical engineer succeeded in so far improving the old apparatus, that the LeBlanc process is still worked there with commercial success. The same holds true for Heinrichshall. The struggle between the LeBlanc and the newer processes was even keener in England. Forty-five factories were threatened with extinction. They united together to form the United Alkali Company. By increasing the efficiency of the old LeBlanc process, and by utilizing to the utmost such by-products as hydrochloric acid, chlorine, sulphur and chlorate, for which there was a great demand in England and the United States, they managed to keep their heads above water and to make money. What is more, they also succeeded in assimilating the new processes. A curious change in values of the individual products has taken place. Hydrochloric acid, which at one time was simply driven off into the air, to the intense disgust of the vicinity, or run into the sea, soon became the financial pivot of the entire undertaking. Sulphur, which combined with calcium, accumulated in great heaps or was poured into the sea with the waste dye, was afterward exported by the hundred-weight to America.

Very justly the LeBlanc process has been called the high school of all industrial chemical work. The process was of no use to such young countries as America, Italy, Russia. They had no means of disposing of the by-products which have now become actually main products. For their need the extraordinarily simple and cheap method of the ammonia-soda and the electrolytic processes are wonderfully efficient. Thus, even in Italy, which has begun to develop its water powers of recent years, these processes can be carried out commercially if the chlorine is disposed of in some way. The textile industries have thus far proved the chief consumers of the chlorine. The alkalis, on the other hand, are absorbed in enormous quantities by the textile, soap and candle industries. The result is that a good deal of soda must still be imported. Hence, it is a matter of vital importance to find a new outlet for the chlorine.