World Will Feed on Converted Wood

Chemistry

By Friedrich Bergius

Dr. Bergius, now visiting this country, is the inventor of the process being used in Germany to produce annually 100,000 tons of synthetic gasoline from lignite or coal. He is now developing a method for making wood edible. Turning waste cornstalks into glucose sugar is another possibility his work suggests.

Carbohydrates, taken directly or indirectly, whether by human beings or animals, are essential for nutrition. They represent a concentrated product of the energy of the sun. After undergoing certain changes they serve, as fuel, to produce the various kinds of energy which sustain life. In plant-life nature produces carbohydrates in different forms, some of them being directly serviceable for digestion on the part of most animals, others fit for use only by innumerable sorts of so-called lower organisms, especially by microbes.

The various carbohydrates differ only very little among themselves as regards their elementary composition, but these small differences divide them into two classes, by reason of their vastly different mercantile value.

Agriculture, by gradual development in the course of thousands of years, has produced in very large quantities a rather small number of species containing carbohydrates in such form as makes them available for use as food for human beings or for cattle. Nature produces still larger quantities of carbohydrates which are digestible as such only in small part in the stomachs of men and beasts. Their main representative is the woodpulp which is contained to a very large percentage in the waste products of agriculture, especially in wood. Immense quantities of such waste products are at disposal, in this country especially, in form of corn stalks. A considerable part of such waste wood, as we know, is not used in an economical way. In producing lumber, at least 40 per cent of the wood falls off as waste, being used either not at all or, at best, as fuel. Burning up wood means destruction of cellulose, that inner chemical substance of wood, so valuable commercially.

FRIEDRICH BERGIUS turned coal into oil; now he is getting food out of wood

The present enormous request for print paper steadily diminishes our stock of wood in the present, while seriously endangering our future supply. A possibility of turning the forest waste into human nutriment or fodder for cattle might considerably influence agricultural and forest policies in vast territories of the world.

In the course of such reflections the question arises whether it might not be possible for chemistry slightly to alter the cellulose molecule so as to bring it into (*Turn to next page*)

Chemistry Alters International Relations

Chemistry

By Edwin E. Slosson

When I speak of the new field of chemical industry as the Synthetic Kingdom I have in mind something more than the mere fact that it consists in making new combinations of the chemical elements. It also makes new combinations of industries and brings together different countries as well as chemical elements. As the Synthetic Kingdom over-rides the traditional dividing lines between animal, mineral and vegetable, so also it overrides the traditional lines between the nations. It brings international competition which naturally results in the end in international cooperation. This modern development of chemistry has strong political consequences. It promotes national independence and at the same time breaks down natural monopoly.

Twenty years ago it could be said that Chile had a natural monopoly of the world supply of nitrates but the monopoly has been broken in two ways; by the utilization of the nitrogen from coal through the preservation of its by-products, and by the utilization of the nitrogen of the air through fixation. An impartial Providence has endowed every nation with a supply of nitrogen exactly proportional to its area. Whether this free nitrogen is utilized or not in any particular country depends not upon natural resources but the ability of its people. Brain power, like water power and coal power, is very unevenly distributed among the nations.

The effect of the synthetic regime in short circuiting natural processes and multiplying the resources of raw materials has brought industries and countries into unexpected competition. The chemist has upset the geography that we learned in school. For when we were children the natural products were duly distributed among various countries by what was assumed to be the immutable law of nature. To impress this upon our youthful minds we had pictorial maps showing the sources of the substances that were consumed in our daily life; a rubber tree in Brazil; an indigo plant in India; a cotton plant in Carolina; a camphor shrub in Japan; and a silkworm in China. The chemist has ruthlessly uprooted these neat emblematic labels. The United States may ship indigo to India. If the motion picture magnate finds that Japan is charging him too much for the camphor for his films he may buy it from Germany where it is made from American turpentine. The silk worm of Japan and the cotton plant of Carolina are hard pushed by the competition of the wood pulp of Sweden.

The new synthetic kingdom of which the chemist is king and founder already overlaps and may ultimately embrace the three traditional kingdoms of Nature. In the present transition state, while the new regime is being established, the attempt to classify products according to the old divisions is causing considerable confusion. Does a given sample of butter come from (*Turn to next page*)

World Will Feed on Converted Wood—*Continued*

such form that it may act in the stomach just like digestible carbohydrates of starch or of sugar. This can indeed be accomplished by merely adding one molecule of water to one molecule of cellulose —a simple chemical reaction which has been known for more than a century. Nevertheless, well known insignificant chemical reactions, easily produced in the laboratory, sometimes involve enormous difficulties when it comes to putting them to test on a technical scale and at the same time on an economic basis.

A number of processes to realize chemically the reactions of hydrolysing woodpulp have been developed in the course of time, the first practical application having been carried through many years ago, right here in this country, near Chicago. The aim of all these processes has been to transform woodpulp into a fermentable product, to be used in the manufacture of alcohol. All these methods have failed economically until now, because they have not yielded enough fermentable stuff.

While the production of alcohol has been the ultimate goal of all these processes of hydrolysing woodpulp at high temperature, the transformation of woodpulp into foodstuffs has become the aim of a new technical method developed during the last twelve years under my supervision.

In Germany some fifteen years ago Willstätter found by the action of highly concentrated hydrochloric acid that woodpulp could be almost quantitively transformed into soluble carbohydrates and finally into glucose. On the basis of these laboratory results we worked out my process allowing a yield from every hundred parts of any dry wood about 75 parts of crude foodstuffs, containing 80 per cent. of pure carbohydrates. That means 60 per cent. of pure carbohydrates is obtained from the dry wood. This product proved to be of high nutritive value and equal to any other foodstuff of like starch concentration and particularly adaptable to the raising of pigs. Successful experiments have been made to transform the primary product, glucose, for nourishing human beings. We have succeeded in evolving a simple cleansing process for this purpose and have produced pure glucose.

Considerable difficulties had to be overcome during the twelve years of development of the technical methods and apparatus. The most difficult problem has been the separation and recovery of the highly concentrated hydrochloric acid, while no less serious and hard work on the part of a rather large staff of chemists, engineers and workmen had to be done to find the most practicable way of handling the wood, preventing leakages of hydrochloric acid vapors, constructing acid-proof vessels and attending to many other details. Rather large amounts of capital had to be invested before an initial technical plant could be operated without difficulties.

In Germany, which is not producing sufficient agricultural carbohydrates for cattle food and which has a rather large supply of waste wood, this new industry may become an important factor in its economics. But it may also prove useful to the United States where the problem of disposing of the waste material in the cornfields, for instance, begins to be a serious question on account of the increasingly destructive activity of the cornborer.

Obviously, the particularly technical problems in every country have to be studied separately and there is no denying the fact that it takes perseverance, faith and a good deal of optimism, not to speak of time, for preparing and developing a new industry of that kind.

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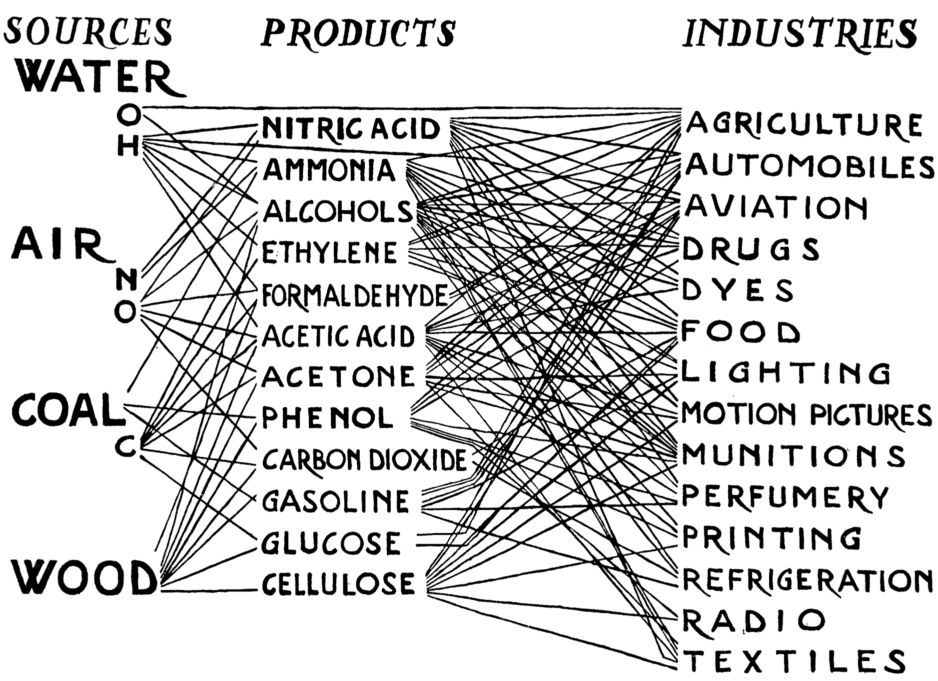
Chemistry Alters International Relations—*Continued*



HOW THE RAW MATERIALS for our industries come from unexpected sources

a cow or a cocoanut? Does a given sample of sugar come from beet or cane? Does a given sample of alcohol come from grain or wine? Does a given sample of acetic acid come from cider or malt? Does a given sample of rubber come from forest or plantation? Does a given sample of musk come from seeds of hibiscus or glands of deer? Perhaps neither; for, perchance the butter and sugar, the alcohol and the vinegar, and the rubber and the perfume may have come from coal. Nobody knows but the chemist who made it and maybe he won't tell. Anyhow, it's nobody's business if the chemist has done his business well enough so the product is correct. After a compound has come under the domain of the chemist, it has renounced all allegiance to the kingdom of its natural origin.

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There are about 500 species of fleas, but less than a dozen seriously pester men and domestic animals.