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CHEMISTRY ALTERS INTERNATIONAL RELATIONS[1]

By Dr. Edwin E. Slosson

Director, Science Service

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 overrides the traditional dividing lines between animal, mineral and vegetable, so also it overrides the traditional boundary 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 that 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 régime 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 silkworm 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 régime 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 a cow or a coconut? 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.

[1] Address given before the Second International Conference on Bituminous Coal, Pittsburgh, Pennsylvania.

THE COMMERCIAL PRODUCTS OF COAL

Soap fats, edible fatty foods, lubricating oils, gasoline, kerosene, light and heavy oils, and anti-knock motor fuel of high value are among the commercial products that coal has been made to yield through the skill of the chemists of the German Dye Trust in their research laboratories and immense plants at Leuna, Ludwigshafen and Oppau in Germany.

Seldom does information concerning their new chemical achievements emerge from the carefully guarded walls of this great industry, but before the Second International Conference on Bituminous Coal, Dr. Carl Krauch, director of the I. G. Farbenindustrie Aktiengesellschaft, discussed the mechanism of catalysis and hydrogenation, the chemical processes that have allowed the production of such diverse and valuable materials from coal as raw material.

The synthetic chemical production of basic materials from coal is of utmost importance to Germany's economic future. That country is made practically independent of parts of the world that have prospered from monopolies of rich natural resources. But the German research has immediate application to American conditions. The president of the Standard Oil Company of New Jersey, Walter C. Teagle, introduced Dr. Krauch and in his address the German chemist revealed that the dye trust processes, controlled in America by the Standard Oil Company, can be used effectively in the refining of crude oil.

Refined by the catalytic process, crude Mexican oil, containing 5 per cent. of sulphur, produces gasoline with only a small amount of this undesirable element. Catalysis and hydrogenation also allow the refinery to make from crude oil the material bringing the highest market price. Gasoline, kerosene, gas oil, lubricants and other

products can be produced in quantities varying with the catalysts used. Research applying these new German developments to American refinery practice is understood to be under way in Baton Rouge, Louisiana.

At the Leuna chemical plant in Germany, an annual production of 70,000 tons of synthetic gasoline has been achieved and by the end of 1929 it will equal 250,000 tons. The processes used in this and the other synthetic productions are combinations of catalytic methods developed by the I. G. chemists and the hydrogenation methods developed by Dr. Friedrich Bergius, the German chemist, whose patents were acquired last year by the German Dye Trust.

The close resemblance that synthetic gasoline and other products obtained in the hydrogenation of coal bear to their natural counterparts suggests to Dr. Krauch a new theory of the origin of crude oil.

"Peat and coal layers, after getting into greater depths, combine with hydrogen under pressure, thereby being partially converted in liquid hydrocarbons," said Dr. Krauch. "The presence of hydrogen in the interior of the earth is deduced from the fact that both rocks and volcanic gases contain it. Apart from the generally accepted views of its formation, its origin might be attributable also to the action of water vapors at high temperature upon coal."

The basis of catalysis, the chemical phenomenon that causes two substances to react more effectively in the presence of another that does not undergo chemical change, is believed by Dr. Krauch to be electromagnetic. He conceives the molecules and atoms as having two poles like a bar magnet. The catalytic agent places them under an electric spell and makes them more receptive to chemical action.

Credit was given by Dr. Krauch to American chemists for the fundamental theoretical research upon catalysis. Discoveries by chemists of this country were often used in making the industrial application in Germany.

LIQUID FUEL

SETTING the Thames afire is one of the proverbial impossibilities; yet the householders and factory owners of the future will be doing exactly that when they light up the fluid fuel in their furnaces.

This, in effect, was the prophecy of A. T. Stuart, consulting engineer of Toronto, made to the conference. He based his look ahead on the ever-increasing use of liquid and gas fuels in industrial and domestic power and heating plants, and on the increasingly practicable processes for converting coal and other solid fuels into fluid forms.

The essential of making coal into a liquid or gas fuel without waste is the adding of hydrogen to its carbon. Hydrogen is obtained commercially by breaking up water with electricity. "Hence," said Mr. Stuart, "it is not unlikely that more water than coal will be used as raw material and that perhaps half of the energy of future fuel will come from the combustion of hydrogen obtained originally from water."

Water yields oxygen as well as hydrogen when it is broken up, and the disposal of the surplus of oxygen will present considerable engineering problems. Some oxygen can be combined in the fuel-making process, but a great deal will be left over. The best disposal of this will be to find some place in the process where it can be separated out, and dispose of it as a commercial gas.

Water-power sites and coal mines will not be looked upon as rivals when the fluid fuel economy of the future has been worked out. The most efficient means for breaking up the water to get its combustible hydrogen is to be found in the electricity generated by hydroelectric plants, which already have far higher capacity than the market justifies. This is because their market at present makes use of their maximum production during only a part of each day—the so-called "peak load" period. But if the power can be used for the generation of hydrogen and oxygen from water during the slack periods, the plants can be run at full efficiency continuously; and what was originally water-power will appear, sometimes at long distances, as fuel-power.

POWER FROM THE SEA

AN engineer working on an invention that will not be any good until a couple of centuries after he is dead, but will be urgently needed then—such was the phenomenon which was presented by M. Georges Claude. And M. Claude was not directly concerned with coal at all, but with what the world will do for power after the coal is all burned.

He proposes to harness the potential power involved in the difference between surface and bottom temperatures in the sea. The array of eminent chemists, engineers, inventors and industrialists who heard his address listened with respect, because the speaker's record was not that of a mere visionary. M. Claude invented the first successful process for making liquid air and liquefying other gases; he pioneered in the field of making ammonia out of the atmosphere; he is the inventor of the glowing neon lights that shine on our street signs at night.

The difference between surface and bottom temperatures in the sea, which M. Claude proposes to turn into kinetic energy, is not great. Bottom temperatures hover near the freezing point of water; surface temperatures are only thirty or forty degrees above them. This is only a fraction of the temperature difference utilized in the ordinary steam plant, where the degrees are counted by hundreds instead of by tens. M. Claude proposes, however, to get around this by exhausting the air from his boiler. In the vacuum thus created water will boil at very low temperatures, provided the vapor thus generated is removed fast enough and condensed after being passed through a turbine. A working model of such a hydrothermal plant has been built by M. Claude and his associates, which has been successfully demonstrated before a number of scientific bodies in both Europe and America.

LAVA FLOWS AND VINEYARDS

Now that the eruption of Etna shows signs of subsiding, we may expect the inhabitants of the evacuated region to move back to their devastated farms and vine-

yards, and to begin the slow reconquest of the land inundated by rivers of stone.

We need not exclaim in surprise over the Sicilian peasant's tenacious determination to stick to his ancestral acres, said Dr. Henry S. Washington, of the Carnegie Institution, in an interview with *Science Service*. He goes back into what looks like a danger zone for the same reasons that southern farmers went back to the lands flooded by the Mississippi as soon as the waters subsided: partly because it is his home and he has nowhere else to go, and partly because the land is very rich and repays cultivation in spite of occasional violences of nature.

The slopes of volcanoes afford the best vineyard lands the world knows. Not only in Italy, where grapes are cultivated on the flanks of still active volcanoes, but also in the famous grape areas of northern France and southern Germany, do we find vines on lava soils. The French and German vineyard districts are in very ancient volcanic areas where the earth-fires have long since gone out.

Lava flows sometimes play very strange tricks. The inhabitants of Catania, the largest town in the immediate vicinity of Etna, still firmly believe that their city was saved from the great flow of 1669 by a miracle. When the fiery river was sweeping down, they went to meet it in a solemn procession, bearing with them their most precious religious relic, the veil of St. Veronica. The lava turned aside and poured into the sea, and the town stood safe.

At another place, the owner of a villa about to be overwhelmed in despair sold the place to a bystander, who must have been a born gambler, for a trifling sum. No sooner had the bargain been made than the lava stream divided into two parts, cutting off a corner of the garden but sparing the house.

During an eruption of one of the Hawaiian volcanoes the owner of a sugar mill saved his building by a desperate resource. He had watched the flow, which at that place was very thick and viscous, slowly creeping closer and closer to his plant, thrusting out blunt, fiery "toes" of lava. In a gesture of impotent rage, he dashed a pail of water on one of the "toes," and to his astonishment it instantly "froze." Immediately he set all his hands to work with pails of water, freezing each new "toe" as it formed, and finally built up a protecting dike out of the lava front itself, turning the main stream aside down a gully.

Dr. Washington has spent a lifetime studying volcanoes in all parts of the world, but he has made the Mediterranean region, and especially Italy, his particular field. In recognition of his work he has been decorated by King Victor Emmanuel with the Order of the Crown of Italy.

ITEMS

INSECTS that combine certain characteristics of both sexes have been produced by Professor James W. Mavor, of Union College, Schenectady, N. Y. Professor Mavor exposed fruitflies to the action of X-rays, and among the other evolutionary changes appearing in their offspring were these strange "sex intergrades." He was one of the first biologists to obtain genetic changes in living organisms by treating their germ cells with X-rays. These are brought about, he says, by shifting the positions of the chromosomes, which are the specialized bits of protoplasm believed to be the bearers of hereditary characters. He expresses some doubt as to whether it is possible to produce changes by dislodging or rearranging individual "genes," or hereditary units, without also affecting the whole chromosomes. The idea of delicate control over the course of evolution is not accepted by Dr. Mavor. He believes that the X-rays hit the germ cells too indiscriminately. "There is no question of X-rays controlling the processes of heredity any more than a train-wrecker controls transportation."

SCARLET FEVER is at the top of the list of communicable diseases reported to the U. S. Public Health Service this week. Telegraphic reports for the week ending November 10 from all but four states show that there are 2,841 cases of this disease in the country, an increase of nearly 700 cases over last week. Diphtheria, influenza and measles follow in the order given, with 2,181, 1,442 and 1,373 cases, respectively. Infantile paralysis, which threatened to become epidemic a few weeks ago, is now at a safe low level. Only 98 cases were reported. The rise in scarlet fever, diphtheria and influenza is about what is expected at this season of the year.

A TRITON, one of the lower vertebrates related to frogs and salamanders, has been induced to grow a new foot on an unmutilated leg already provided with a foot. At a recent meeting of the Russian Academy of Sciences, Dr. N. N. Nassenow described his experiments. It is nothing new for a triton to grow a new foot, or even a whole new leg. Tritons seem to be able to regenerate very considerable parts of their anatomy, even including such complex organs as eyes. But hitherto they have done so only when through accident or surgical operation something was cut or bitten away. In Dr. Nassenow's experiment no cutting took place. He merely put a bandage around the creature's leg, tight enough to put pressure on the tissues but not tight enough to injure them severely. Some time thereafter, a swelling was noted on the triton's leg, which subsequently grew out into a normally formed foot, alongside the one already normally present.

THE new British Embassy being constructed at Washington, D. C., will contain a new heating system which eliminates all radiators. The rooms are heated by small hot water pipes buried in the walls, ceilings and floors. The system is in use in England but never before has been installed in an entire building in this country. In some of the rooms the entire walls and ceilings will be heated by the pipes, and in others the floors will be warmed. This system was finally decided upon by the British officials in order to do away with all visible radiators and other heating devices.