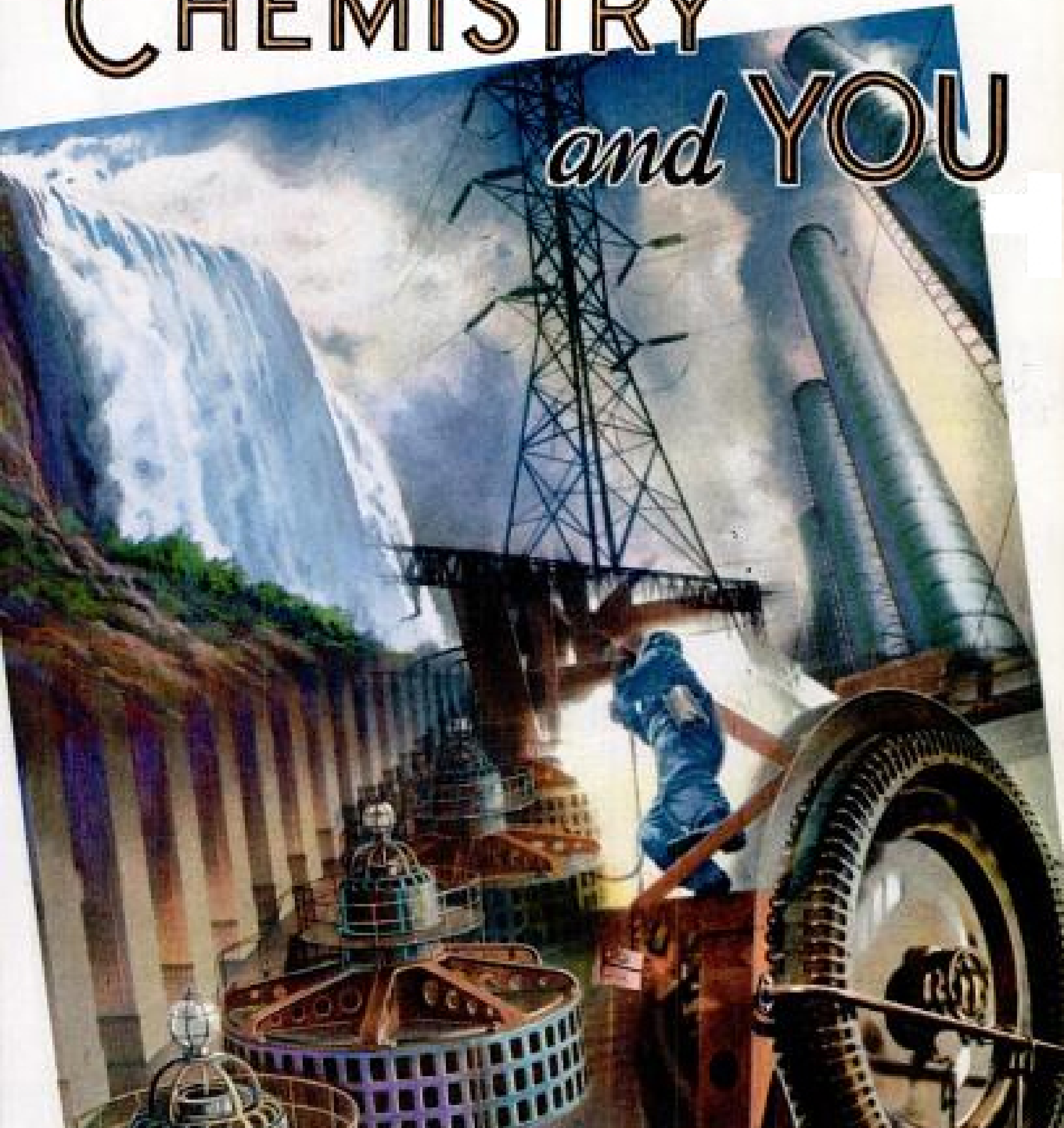
CHEMISTRY *and* YOU

PART I



WITHOUT chemistry's assistance, particularly in the field of metallurgy, we could not produce or transmit the power to turn the wheels of industry.

CHEMISTRY guards motorcar quality. Here a chemist is determining the sulphur content of steel samples in the Chevrolet plant.

By Dr. C. M. A. Stine

Vice-President E. I. du Pont de Nemours and Company

IN the past century there have been three great phases of development so basically revolutionary that much or all of our economic structure has been embraced in the radius of resultant change. These may be described as, first, the introduction of steam power to machinery; second, the utilization of electric power, and third, the application of the relatively new science of chemistry to the whole wide range of man's material problems.

Steam and electric power gave us a new type of existence. Manufacturing passed from the home to the factory, from the hand to the machine. Millions left the farm for the town. Mechanical transport supplanted animal transport. We learned to talk great distances over wires and finally without wires by radio. We learned to fly. The workday was reduced, leisure increased, and our standard of living was raised to a level previously undreamed.

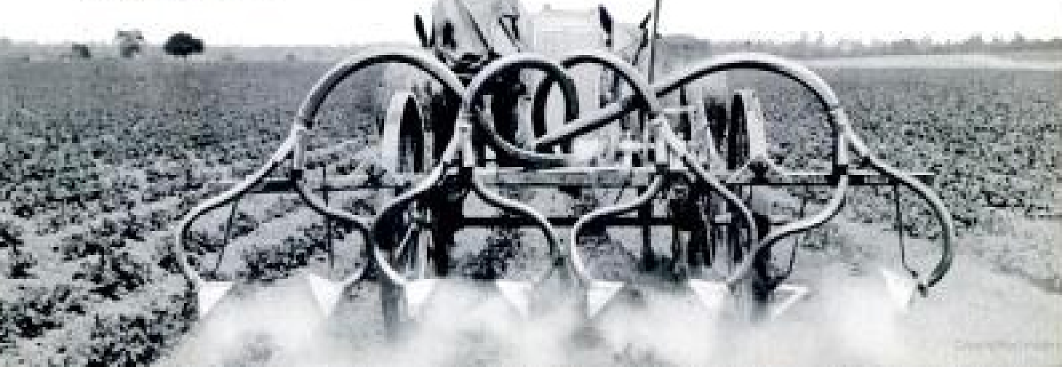
Widely sweeping as they were, however, neither of these first two revolutions was complete by itself. Steam power gave us the locomotive but inventors were unable, despite numerous efforts, to apply steam satisfactorily to a highway vehicle. Success of the automobile had to await perfection of an electrical ignition system that permitted the use of gasoline, a new source of motive power. Too, steam power alone was insufficient to produce the telephone and the radio, or to effect any change in our methods of lighting, but when it was harnessed to a dynamo each of these impossibilities and hundreds of others immediately became possible.

That is, they became possible within limits, but so definite were these limits that they precluded wide use of the more important inventions involved. Since the dawn of time man had been confined to natural materials to fill his needs. By no means were these always satisfactory, or as abundant as he would have liked, or as convenient to his reach, or as cheap. The materials of nature were filled with impurities, they were heavy when man would have preferred them light, soft when he wanted them hard, or solid when they should have been liquid. Progress halted before this barrier set up by a seemingly unchangeable and inscrutable nature.

CHEMICAL research has played an important part in the improvement of the telephone. Here Alexander Graham Bell is opening the New York-Chicago line in 1892.

Photo courtesy Bell Telephone Laboratories

The automobile is a notable example of how formidable this barrier was. To get strength in the car the early builders had to use metals such as went into locomotives and stationary engines. The result was a clumsy, unwieldy and expensive vehicle that no person of mod-



SAFETY glass is the direct result of chemistry. Below, dusting potatoes with calcium arsenate, a chemical.

BEFORE electricity and modern household appliances, many of them the result of chemical research, invaded the home to lighten household drudgery, women worked in kitchens like these.

Photo Courtesy Westinghouse

erate means could afford. This vehicle then was equipped with rubber tires that were more unreliable than the weather and wore out after a few thousand miles of highly uncertain travel. Windshields and windows were of glass that shattered at the least impact. The leather-covered seats rapidly disintegrated, the gasoline and lubricants available soon choked the motor with carbon and gum, the painted surfaces became cracked and dull in six to twelve months, while rust ate into the machine's vitals at a hundred spots.

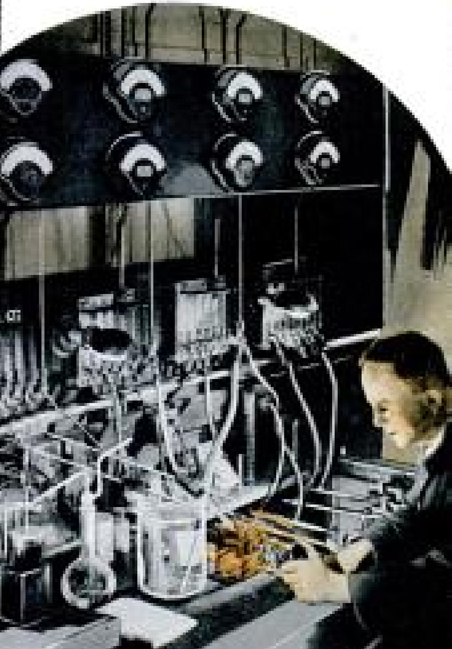
Obviously this car of only a generation ago was little more than an uneconomic plaything. It was faster than a horse but so unreliable in operation and so costly that if the future of the automobile industry had depended on it, that industry would be of small concern to us today. Similar shortcomings were inherent in the telephone, in the electric lamp, and indeed in most of the products of invention. The fault was not in lack of human skill, not in lack of vision, not in lack of money, but in lack of the right kind of materials. Throughout the length and breadth of industry this lack was felt. On every front it checked us—until chemistry broke through the barrier!

The modern foundations of chemistry were being laid in Europe while we were fighting the Revolutionary War. With

peace we were quick to grasp their significance and the chemical industry grew rapidly in America. In the main, however, its function was to supply known chemical materials and only casual thought was given to creating new materials. The period was marked by a wider and more intelligent use of chemicals in bleaching textiles, in papermaking, in tanning, in steel fabrication and other lines, but problems of synthesis interested few outside of college laboratories.

Nevertheless some highly important chemical strides were taken that pointed the enormous potentialities of the science. In 1828 Wohler, a German, synthesized urea, a waste product of animals and humans. This was the first evidence that man

CONTRAST this up-to-date kitchen with the old-fashioned ones on the opposite page. The magic hand of the chemist has reached into the home as well as the factory.

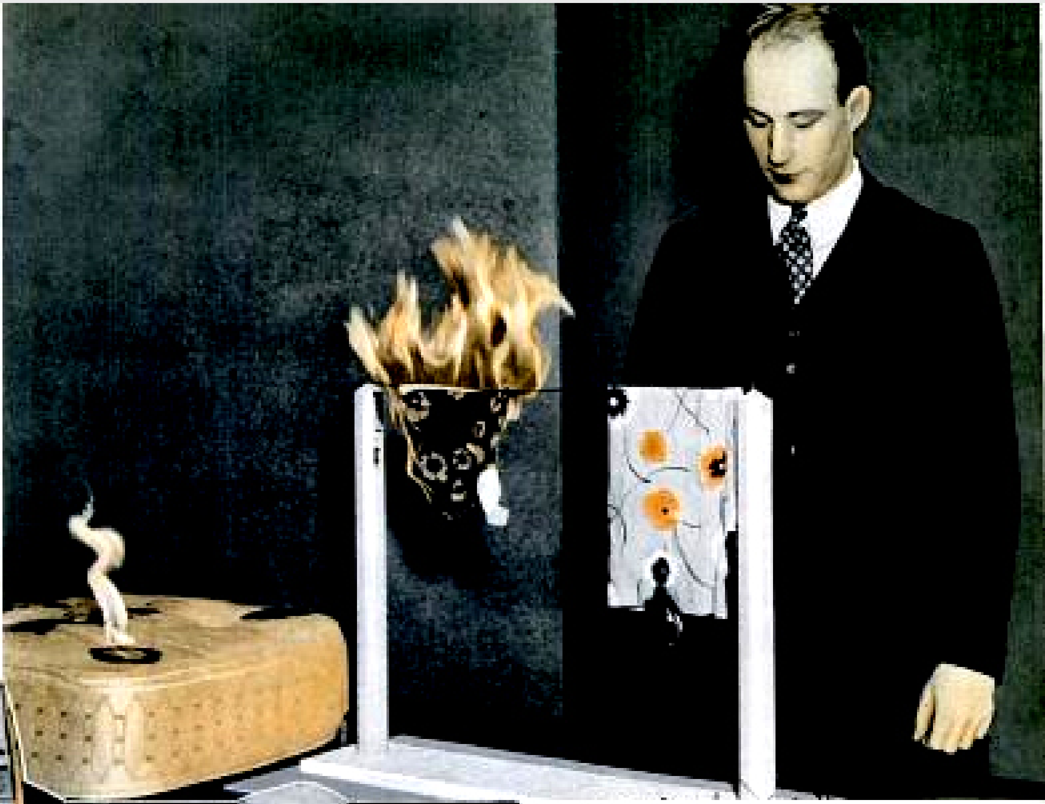


RATS being prepared for vitamin D assay in du Pont laboratory. Right, controlling current into electroplating bath, one step in furthering knowledge of plating.

could make an organic substance, hitherto produced only in a living body, by chemically compounding inorganic substances. Seventeen years later another German, Schoenbein, treated cotton with a mixture of nitric and sulphuric acids and got a highly explosive new material he called guncotton, the technical term for which is nitrocellulose. Cotton, chemically, is almost pure cellulose, a chemical term you should remember, because you handle something made of chemically transformed cellulose almost every waking hour. Cellulose, which means literally "full of cells," is the fibrous material that makes up the structure of most plants and all trees. Therefore it is almost as abundant as the air.

Shortly after Schoenbein's discovery of nitrocellulose it was found that its explosiveness could be reduced simply by using less nitric acid. This gave us still another new material, pyroxylin. In 1869 Hyatt, an American, plasticized pyroxylin with camphor and created "Celluloid," the first of the synthetic plastics, out of which was soon being made a wide variety of things. Then de Chardonnet, a Frenchman, squirted nitrocellulose in solution through a spinnerette and got a fine filament or thread, which he then denitrated to reduce its flammability. This was the first man-made textile fiber, rayon.

These were basic discoveries. In them were the germ cells of a hundred new industries that in



time would consume cellulose by train-loads. Equally important was the isolation of aluminum by electrochemical methods. This achievement by Charles Hall, a twenty-two-year-old chemistry student at Oberlin college, placed in common use a metal that previously had been almost as precious as silver. Then Perkin of England discovered dyes could be derived from coal tar, Goodyear found a way to vulcanize rubber, invention of the electric furnace led, among other things, to new abrasives and high-speed cutting tools, and a wholly new conception of chemistry's relation to medicine was effected by the work of two mighty pioneers of science, Pasteur of France and Ehrlich of Germany.

Many believe the World War led to the establishment of a chemical industry in America. What actually happened is that an already formidable American chemical industry woke at the time of the World War to its own enormous potentialities, and what is equally important, to its own deficiencies. In 1914 the official census did not bother even to list American-made dyes, although on dyes were dependent textiles, leather, paper and other industries employing 1,200,000 workers. Our farmers had to buy potash from Germany and nitrate from Chile. Our

SPRAYING body of car in Pontiac plant. Durable, quick, drying finishes developed by chemistry have made possible the mass production of automobiles. Top, demonstrating a chemical agent for flameproofing fabrics. Untreated fabric is at left, the treated one at right. At far left is treated mattress on which gasoline has been ignited. The gasoline burns, the mattress does not catch fire.

RACKS on roof for making exposure tests of finishes. Above, examining paint and lacquer samples for cracks or other imperfections.

physicians and hospitals had to buy German medicines. In inorganic chemistry we were fairly well fortified, but Germany ruled the organic chemical world — the world of almost infinite promise. All of our coal-tar chemical plants together employed only 528 workers. Hard upon chemistry's awakening, more than $300,000,000 were invested in chemical buildings and equipment by American colleges and schools and an even greater sum was invested by the chemical industry. One company, du Pont, spent $50,000,000 in the development of dyes alone.

Only seventy-one doctorates in chemistry were conferred in 1914. This number multiplied seven times until in 1934 it was a third of all the doctorates conferred. The number of chemists rose from 14,000 to more than 30,000, while the corporal's guard of workers in coal-tar chemicals grew to an army of 11,000. Something of a similar nature took place in all of the leading nations, but nowhere was it

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Chemistry—and You

(Continued from Colorate Section)

on a scale comparable to that in this country. Indeed, the world and particularly America swung into a new era of progress, which may be called either the Chemical Era or the Scientific Era. The change definitely marked the passing of economic leadership from the machine builder to the scientist, with chemistry serving as a common bridge between all of the sciences involved—and most sciences are involved.

The machine did not decline in importance—it is, perhaps, even more important than it was. But we have moved to a higher plane of progress, into a higher air of economic development, that begins where the plane of the Machine Age stopped. The machine is simply a means toward doing better and at less cost what was once done by hand and foot power. It is essentially a labor-saving device. Science is concerned with labor-saving too, but it is far more vitally concerned with creation—the creation of new knowledge, of new materials and new products, of new industries and new employment, and of improved health and material welfare for all of us, from the proudest to the humblest.

The awakening of the chemical industry was the birth of a new viewpoint and of a new idea of responsibility infinitely more daring than man had yet conceived. On the one hand it recognized the imperfections in our progress, while on the other it challenged the complacency which held imperfection to be an inevitable characteristic of human effort, about which little or nothing could be done. Under the old viewpoint we believed man could not possibly improve on nature's materials and deemed successful imitation of them the height of human achievement. Under the new viewpoint we threw attempted imitation to the winds and set out boldly to become creators in our own right of wholly new materials that nature had failed to supply.

Nature is still omnipotent in her own vast sphere. The chemist is seeking neither to paint the lily nor to perfume the rose. However, he is seeking, and finding, colors, perfumes and drugs far more satisfactory for man's purposes than any nature has provided in flowers and plants.

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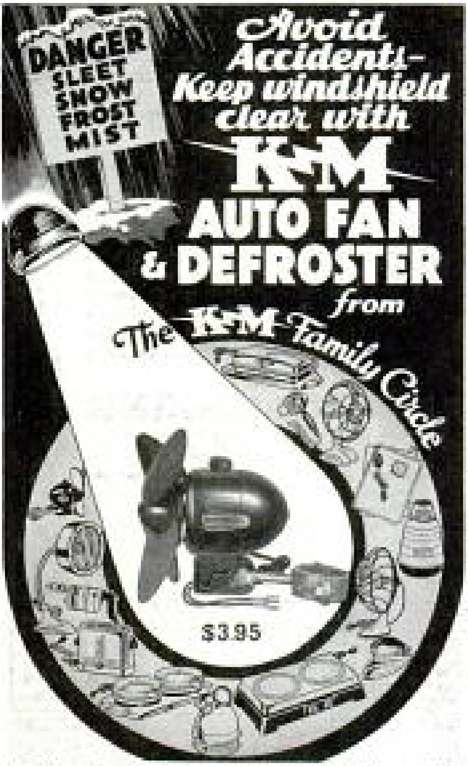

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He is seeking, and finding, ways to improve natural foodstuffs to the end that we will be healthier. He is erecting barriers to protect us against the hazards of disease with which nature has surrounded us under her law that only the fittest should survive. The chemist is taking such common things as air, water, coal, salt, lime and the like and compounding them or their components into a great new category of materials capable of serving us better than any of the natural substitutes to the use of which we have been limited for centuries.

(Continued next month)

Electrical Theater of the Sky Has Rooftop Planetarium

In a nine-story building of modern architecture in Osaka, Japan, is the far east's only museum of electrical science. They call it an electric "theater of the sky," for on the sixth floor is a huge planetarium whose spherical roof is the ninth floor ceiling. The building is beautifully illuminated at night, and its thirteen-story tower has a great lighted star. The roof is a mammoth globe with lands and oceans marked in colored mosaic. The motor for the planetarium was too large for the elevator and had to be hoisted with a crane.