CHEMISTRY

Fabrics of the Future

Chemistry Now Makes Fabrics for Clothing From Milk, Coal, Metals, and Even Air and Water

By ROBERT D. POTTER

AFTER the Garden of Eden, or its anthropological equivalent, man set out to hide his nakedness in clothing and has been doing it, more or less, ever since. In those countless years probably everything that naturally exists in the world has been used or tried for clothing.

The great advance of the past came when man learned to obtain fibers, group them into threads and yarn, and weave them into cloth that could be fashioned into shapes roughly matching his own figure. Our clothing today is testimony of the ingenuity of the past.

But what has gone before is only a small part of what will appear in the future. The fibers and fabrics of tomorrow stagger the imagination and leave the mind speculating in fantasy that has a good chance of some day coming true, regardless of how crazy it may now seem.

A few years ago who would have suspected that useful fibers and fabrics could be made out of cows milk? Or from trees, or coal, or fish, or sand?

These are but a few of the accomplishments of modern chemistry whose test tubes are fashioning fibers and fabrics from unsuspected sources. More and still stranger ones are in store for the future.

Some Very New

Some of these fibers and fabrics have just entered into their commercial life. Their small beginnings are only a foretaste of the future. Others are just about ready to be presented to the consumer. Still others are yet only products of the laboratory but their amazing properties mark them as potent products of days still to come.

Some of the products were obtained by halting, tedious research of previously obscure inventors. Others are outgrowths of intensified research in great industrial laboratories.

Others are the result of the intensified drive of chemistry, throughout the world, for economic self-sufficiency among nations; each country wishing to develop fibers and fabrics synthetically so that it may be liberated from dependence on foreign imports that might fail in time of war.

This international drive for ersatz materials, as the Germans call them, cannot be overlooked in any study of tomorrow's fibers and fabrics. Under the spur of national defense a country feels justified in expending great amounts of money to produce synthetic materials that will replace others that normally would be imported.

Wool, cotton, flax, and silk just about exhaust the natural materials from which clothing can be made. The drive for synthetic substitutes is particularly intensified in those nations which do not possess sufficient amounts of these raw materials within their own boundaries.

Italy, spurred by the need of economic self-containment and freedom from importing products that would be cut off in time of war, is the land of Lanital—the synthetic wool-like fiber made from cow's milk.

Service and Beauty

Yes, highly serviceable and beautiful fibers and fabrics are now being made out of the casein in milk. And because the casein of American milk is no different from that found in the milk of Italian cows, the day is not far away when a similar material will be produced commercially in the United States. Already scientists at the U. S. Department of Agriculture are doing it experimentally and also the research laboratories of American industry.

Man-made wool fibers are not only highly serviceable but are cheap to produce because only slight modifications of existing rayon machines are needed.

Casein, well-known as the essential ingredient of cheese, is the basic ingredient of this new rival for the fleece off a sheep's back. Moreover, in the process, every other part of milk besides the casein is also used. None is wasted.

The raw milk is skimmed for its cream and fat that goes into butter. The skimmed milk is then treated with acid to coagulate the casein into curds. The whey, that separates off at this stage, is treated to neutralize the acid and is then fed to pigs.

From the casein curds comes the dried casein powder that is the starting point of synthetic wool fibers. Twenty-six gallons of cow's milk will produce about 8.8 pounds of butter and 6.6 pounds of casein. A pound of synthetic wool-like fiber can be made out of each pound of casein.

At current American prices the casein in a three-piece dress ensemble costs only about 50 cents for the raw materials.

Actually it is the protein in the casein which is the chemical building block out of which chemistry has fashioned this new and valuable fiber. Because this is so chemists in America, and in other countries, have succeeded in making fibers out of a variety of proteins.

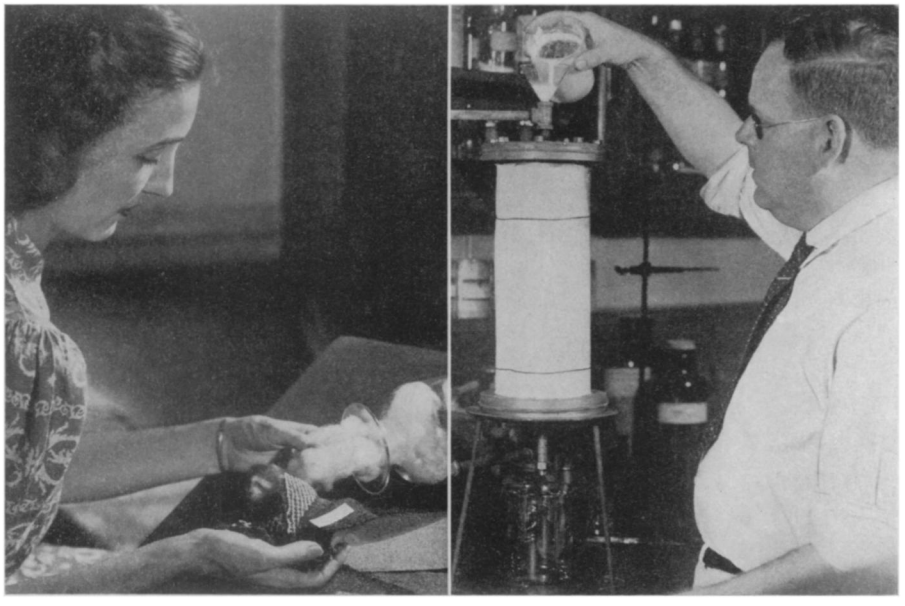
Even From Fish

Thus in America fibers have been made out of soybeans. In Japan and in Germany the protein of fish has been experimentally used as a source for wool-like fibers.

According to chemical analyses of synthetic wool fibers it has been shown that they contain every chemical element found in natural wool in almost identical proportions, except that the sulfur con-

THANKS TO BOSSIE

For the yarn in this attractive sweater our gratitude must go to the cow, not the sheep. It is made from the casein in milk.



RESEARCH IN THE UNITED STATES

America is not neglecting the possibility of making wool from milk. Earl O. Whittier of the U. S. Department of Agriculture is shown here pouring a solution of casein which is to be treated chemically so that it will produce useful fibers. On the left, you see the wool and samples of wool-like fabrics which can be woven from it.

tent in man-made wool is slightly less than in natural wool, and the carbon content a little more.

An analysis of the two "wool" fibers looks like this:

	Synthetic Wool	*Natural Wool*
Carbon	53 per cent	49.25 per cent
Hydrogen	7 per cent	7.57 per cent
Oxygen	23 per cent	23.66 per cent
Nitrogen	15.50 per cent	15.86 per cent
Sulfur	.70 per cent	3.66 per cent

In a process that employs much of the equipment of present-day rayon plants, the casein of milk is dissolved in chemicals and made into a syrupy liquid. When at the proper consistency this liquid is passed through tiny orifices called spinnerettes. As the myriad of fine streams of liquid come out of the spinnerettes they enter a chemical bath of formaldehyde and are hardened into fibers.

In a continuous process these newborn fibers pass on to other tanks containing solutions that will mature them. Finally they are dried and become masses of "wool" looking quite like the cleaned shearings from a sheep's back. This wool is then spun into yarns for weaving and knitting in the usual fashion.

The man-made synthetic wool fibers are solid, can be made in controlled size of diameters and as long as is desired. In their solid nature the fibers compare with the finest merino wool, which likewise is solid. Cheaper grades of wool show a characteristic hollow center space in their fibers.

Ever since wool-from-milk fibers have been produced scientists have been wondering if bacteria—which can so easily attack milk and make it sour—cannot also attack synthetic casein fibers.

Two Dutch scientists have recently tested their problem and found that casein-eating bacteria in the air will, indeed, destroy the synthetic fibers. The bacteria liberate a chemical enzyme which does the job. Heat is found to destroy this enzyme reaction.

But before you humorously picture wearers of synthetic wool clothing boiling their clothes periodically in hot water to prevent their destruction, realize that the criticism is more academic than practical in its importance.

For years the major part of the buttons in the world have been made from casein. These casein buttons, too, can be destroyed by bacteria in special laboratory tests. However, this knowledge has never stopped the use of such buttons. In real life, conditions are so unfavorable for bacterial enzymic action on casein used in clothing that objections on this score are not too important.

Conservative scientists, seeking to weigh the future of synthetic wool-like fibers, are reluctant to picture the complete displacement of natural wool by this new chemical rival.

They see rather the situation as one potentially like the rayon development where rayon has displaced natural silk in some fields but has achieved its greatest usefulness after it stopped trying to be a substitute for silk and became a fiber in its own right with its own valuable uses.

Synthetic fibers, like the amazing artificial wool made from the casein of cow's milk, have not sprung, full-blown out of the minds of chemists; marvelous and ingenious though those minds may be.

All modern synthetic fibers owe their debt to rayon, the granddaddy of them all. And though rayon may be the research parent of the fibers of the future it is no doddering, enfeebled parent which has outlived its usefulness.

The pioneer synthetic fiber and giant of the industry today is widening its circle of achievement and usefulness.

Rayon's rise came swiftly after the World War. In the decade and a half from 1921 to 1935 cotton showed an increased consumption of about 6%. Wool, in the same period, gained 17% and silk increased its production by 47%. But rayon, for the same 15 years, increased

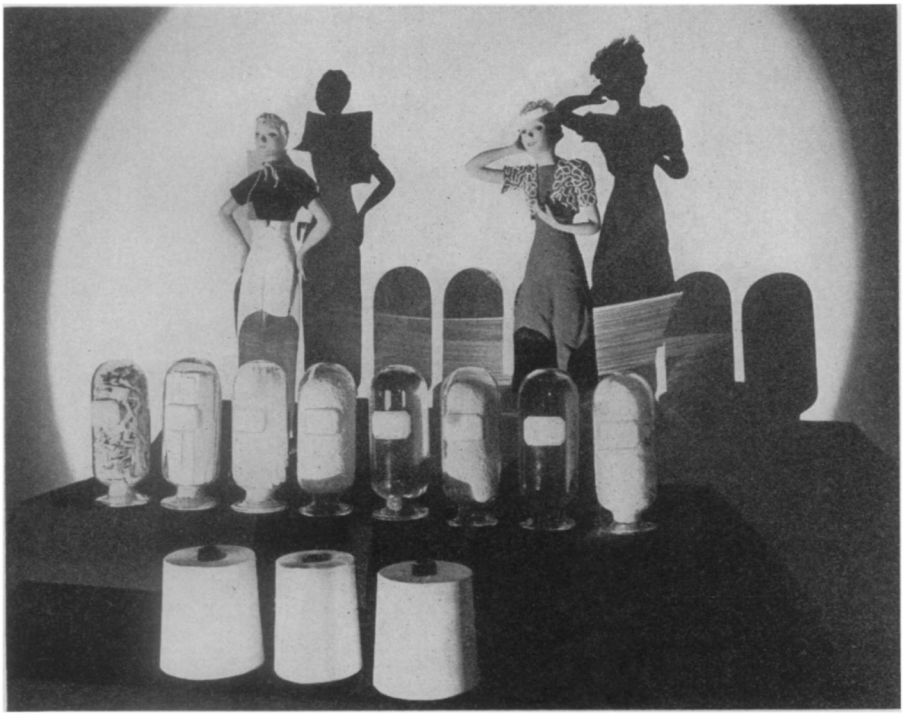


EXHIBIT SHOWS HOW RAYON IS MADE

Eight different chemical steps go into the making of acetate rayon in turning raw wood chips into fine fibers and fabrics.

production 1,000% or ten times the 1921 figures.

This dramatic rise is no freak thing but an economic tribute to a synthetic fiber which has demonstrated that it could stand on its own feet and render its own service, not as a substitute for something else, but as a product which possesses special properties of its own.

It was not always thus. Rayon's origin, in fact, came about in attempts to duplicate natural silk. For centuries man had watched the silkworm chew up mulberry leaves and extrude a tiny thread for its cocoon that man called silk.

If a worm could take plant cellulose and produce such a fiber, reasoned chemists, why could not scientific research do the same thing.

For years no man succeeded in this dream. And then, in the year 1886, the French nobleman, Hilaire de Chardonnet deposited with the French Academy of Sciences a sealed envelope with instructions that it be opened three years later. In 1889, then, the process for making artificial silk was given to the world.

True, the early synthetic filaments were not as strong as silk, they could not stand moisture like natural silk, they could not be made as fine as silk, nor could they do many other things. But the beginnings of the present rayon industry were laid.

The artificial silk industry of those early years struggled on not quite realizing that among its biggest handicaps was that it sought to duplicate silk. The fibers had a shiny luster somewhat like silk. The appearance, however, was far from genuine and the shininess came only to be the mark of an inferior and substitute product.

●RADIO

Dr. Vergil D. Reed, assistant director of the Bureau of the Census, will describe plans for the 1940 national census as guest scientist on "Adventures in Science" with Watson Davis, director of Science Service, over the coast to coast network of the Columbia Broadcasting System, Thursday, February 22, 4:15 p.m., EST, 3:15 CST, 2:15 MST, 1:15 PST.

Listen in on your local station. Listen in each Thursday.

With the World War came a vast expansion in the plants of the rayon industry; an enlargement far out of accord with any consumption of shiny artificial silk. The reason was that it was only a chemical twist of the wrist to convert the fiber plants into factories for producing high explosives of nitrocellulose and for the production of "dope" for airplane wings.

But when peace returned there was temporary dismay. Vast plants lay idle for a time, with enormous production possible, but with no peacetime markets.

But the ingenuity of chemistry solved this problem by taking out the telltale luster of shiny artificial silk and producing a softer appearance. That—together with an international agreement to define the man-made fiber by a generic name, rayon—did much to lift the rayon industry on its upward course which has surged onward so remarkably in the last decade and a half.

The rayon industry had one thing which the natural silk industry could never quite attain, absolute control of production to bring uniformity of product. And out of research came variations of basic rayon fibers which would dye more beautifully than any natural fibers.

The key for uniformity was that you can control a machine but never a silk-

worm. And the key to better dyeing was that the chemists could juggle atoms in the chemical molecules and make them accept bonds with the molecules of dyes which nature never equaled.

The ability to take dyes, in fact, opens the economical and clever process of what the trade calls cross dyeing that is possible with combination fabrics of rayon with wool, cotton or natural silk. In cross dyeing the combination material is run through two different dye vats; one containing dye for the natural fiber and another for the rayon fiber.

In terms of economics this means that a combination fiber of rayon and some natural fiber can be woven in undyed form. Then, after the stylists have decided on the colors for this year's hues, the materials can be dyed. Thus mass production can be obtained with undyed fabrics and the dyeing takes care of itself later with the basic, undyed stock.

The debt all synthetic fibers owe the rayon industry consists not only of the encouragement which one research achievement can bring to scientific workers struggling in another field, but also to the development of manufacturing machines which frequently are readily adaptable for making fibers from other sources.

Rayon's bag of tricks—backed by some of the most clever chemical laboratories of the land—is by no means exhausted. Crush-proof, moisture-resistant rayons are here and other advances are on the way. Rayon's future as a fiber, in fact, is by no means limited solely to the textile field for wearing apparel.

Cords of rayon are now going into longer wearing and stronger motor vehicle tires, especially useful for trucks and busses.

On the sea the marine counterparts of these cords for tires appeared in the sails of the American yacht, *Ranger,* which successfully defended the America's Cup against the British challenger, Endeavor II.

No, don't worry too much about rayon. He may be granddaddy to many a research fiber, but as a parent he will be able to take on the "kids" for many a year to come.

Fabrics from glass, metal, coal, air and water and even paper and rubber will be described in a future issue.

Science News Letter, February 17, 1940

All beekeepers get stung occasionally, says one expert; but the secret of avoiding it is to work with bees on bright sunny days when they are busy, to work deliberately, and protect your face with a good veil.