CHEMISTRY

Castor Oil, Coal Newest "Silkworms" For Stockings

Patent on Synthetic Fiber Reveals It as Made From Substance Nature Creates in Death, Chemists from Coaltar

CASTOR OIL and coal appear potentially to be the "silkworm" from which may be made the silk stockings American women will wear tomorrow.

With these basic ingredients chemists are now fashioning, in their test tubes, a viscous fluid which can be drawn into fibers that are finer and stronger than natural silk and have amazing elasticity. While not yet ready for commercial production, chemists studying the new fibers aim at the goal of producing sheerer two-thread stockings that will have the durability of four-thread hose.

In the posthumous patent (No. 2,130,-948) of the brilliant du Pont chemist, Dr. Wallace Hume Carothers, recently granted by the U. S. Patent Office, is revealed this strange fiber that gives promise of being silk's crucial rival in the hosiery field.

For the past month du Pont officials have maintained a complete silence, in the face of many rumors, on the nature and properties of a new fiber which was superior to silk and potentially could battle silk for control of the hosiery field. News of this new fiber, without details, leaked into chemical circles.

In the new patent, fiber experts at the National Bureau of Standards believed they have discovered the long-awaited and very important announcement.

Finer Than Silk

Completely synthetic in their origin, the new fibers can be easily drawn to a size equal to the diameter of a natural silk filament, or in the extreme case, to only one-seventh the diameter. Yet the new fiber shows a tensile strength equal or better than that of silk. In some cases the fibers are 150 per cent. stronger than silk.

"The elastic recovery of these fibers under moderate elongations was very remarkable," states the patent, "and in this respect was much superior to existing artificial silks."

The fibers are "lustrous and silky in appearance" and are almost completely insensitive to moisture. When made into fabrics the synthetic fiber fabric possesses a far better elastic recovery than natural silk.

The Carothers patent, with 56 broad and basic claims, describes the production of fibers from long chain amine compounds. These are prepared by reacting diamines and dibasic acids. Out of this reaction come acid salts which are crystalline solids having fairly definite melting points.

Eight specific ways of creating the new fibers are described. A typical reaction is a mixture of 14.8 parts of pentamethylene-diamine, 29.3 parts of sebacic acid and 44 parts of mixed xylenols.

The new silk is not rayon, for its origin is not from the cellulose of growing plants like cotton or wood, but from coal and its highly important coal tar derivatives.

Coal tar has already produced thousands of organic compounds that range from perfumes which nature never knew, to explosives and dyes and even to organic compounds of the human body itself.

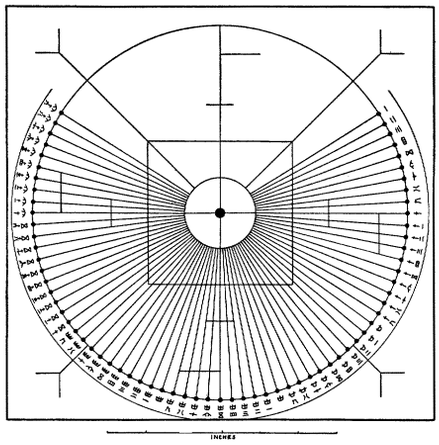
Products of Death

In fact, one of the ways to prepare the new synthetic silk fiber might be to make it out of a human corpse. A basic ingredient of the fiber is the chemical known as cadaverine that is formed in the human body after burial. Cadaverine is formed by nature as a decay product of the lysine which occurs in many of the body proteins, in serum albumin and in the fibrin of clotted blood. After death lysine breaks down and forms the evil-smelling and poisonous cadaverine. Cadaverine is known to chemists as pentamethylene-diamine.

But chemistry, with its ingenuity, does not need to depend on death for its supplies of this material. Out of sticky black tar, formed as coal is heated and its vapor caught by distillation, a long series of steps can duplicate cadaverine. It is by this completely synthetic method that Dr. Carothers prepared his material from which the silk-rivaling fibers come.

Castor oil enters into production of the new fiber because it is used to form an acid which reacts with the cadaverine. This is sebacic acid. To make it, chemists first make a castor oil soap (just as soaps are made out of palm oil and other vegetable oils). Heating this castor oil soap with sodium hydroxide creates sebacic acid.

A remarkable property of the new



ACCURATE

The sundial, of which this is a line drawing, was made about 2300 years ago at a time when the Chinese divided the day into 100 parts. The dial has an accuracy of one part in 2500.

ASTRONOMY

Ancient Chinese Sundial Found Extremely Accurate

ONE of the world's oldest sundials, unearthed in China and dating from the Han Dynasty, about the third century, B.C., impressed astronomers with its accuracy and precision of construction when Dr. Peter M. Millman of David Dunlap Observatory, Richmond Hill, Ont., analyzed it in a report to the American Astronomical Society.

Divided into 69 equal segments each 1/100 of a complete circle, there is a circle inscribed with an accuracy of one part in 2500. The Chinese were known to divide the day into 100 parts in that period. Other lines on the stone were used to determine the solstices. The dial was evidently placed in the plane of the equator and Dr. Millman considers it probable that it was a standard type made for use over a fairly wide range of latitudes.

The dial was brought from China by the Rt. Rev. W. C. White, and it is now in the University of Toronto's Royal Ontario Museum of Archaeology. It is the only one of its kind known in any collection at the present time.

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fibers is the ability to stretch them up to 700 per cent. and thus create permanently an almost complete alignment of the molecules of the material. Under X-ray study sharp diffraction images are obtained which denote a "true fiber."

The new fiber, says the patent, is an outstanding contribution because it is made entirely by synthetic means and has the unusual property of being very strong, flexible, elastic and insensitive to moisture to a high degree.

The excellent recovery of the fiber, after stretching, makes it "especially useful in the preparation of knitted wear, such as stockings, gloves, sweaters, underwear suits, etc." In the light of the fiber's rivalry with natural silk, it is significant that stockings are mentioned first in this list of applications of the fiber.

While extremely fine fibers can easily be drawn by the new process, it is also adapted for the production of larger filaments which are useful as bristles, artificial straw, fishline leaders, musical instrument strings, dental floss, horse hair and mohair substitutes and the like. The bristle filaments have "good snap, toughness and resistance to water." The du Pont Company has already announced a brush containing synthetic bristles which, it may be suspected, are made of the new fibers.

Can Deluster

Although the fibers have a luster like silk, it is easily possible to treat them and reduce or destroy this luster, states the patent. Zinc oxide and carbon black are among the best known of these delusterants.

Textile experts of the National Bureal of Standards believe that it will be some time before the new fiber will be on the market in its most important application, the hosiery field.

It is believed that the cost of materials used in the fiber's preparation will make it more costly than rayon. Whether it can compete with silk in cost, if large scale output is obtained, is a question for the future to decide.

The new patent's implications to a nation like Japan, producing the great bulk of the world's natural silk, are not to be overlooked. When and if the chemists decide to bring the new product out of the laboratory, America, with its vast supplies of coal, will be a step nearer freedom from foreign domination of its silk requirements.

Dr. Carothers' death on April 29, 1937, by suicide, came only 20 days after the application on his important fiber patent was filed. At only 41 years, his passing removed from the chemical stage a brilliant experimentalist who had played a leading role in producing du Pont's synthetic rubber, Neoprene, in 1931. Dr. F. B. Downing and Dr. Ira Williams were other chemists of the group who took Father Julius Nieuwland's original researches with acetylene derivatives and turned them into a product superior to natural rubber for many uses.

Dr. Carothers took his B. S. degree from Tarkio College in Missouri in 1920 and his M. S. and Ph.D. from the University of Illinois in 1921 and 1924 respectively. He was a member of leading scientific societies in America and abroad and in 1936 was elected to membership in the National Academy of Sciences, highest American scientific honor.

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RADIO

Obtain 2,500-Mile Reception On Television Wavelengths

Amateur Reports to Harvard Show Super-Reception on Night of June 5 Due to Behavior of Great E Layer

AMERICAN radio amateurs in 30 states have enabled Harvard scientists to learn new facts about the strange behavior of the electrified "E" layer some 74 miles above the earth.

Transmission on the ultra-high frequency band of 56 to 60 megacycles—a band contemplated for television transmission—has been found to have amazingly long pickup; 2,500 miles in an extreme case.

Over 700 contacts between amateurs on this band on the single night of last June 5 show receptions of these supposed line-of-sight frequencies over distances of 600 miles in many cases. And in exceptional cases reception was obtained over distances of over 1,400 miles, report J. A. Pierce and H. R. Mimno of Cruft Laboratory, Harvard University (*Physical Review,* Sept. 15).

Working with amateur contacts assembled by the American Radio Relay League, amateur radio's coordinating organization, the Harvard scientists have used the data thus gathered from hundreds of "ham" operators to discover that two happenings on June 5 led to the amazing distance, or DX, reception.

They found that high over the eastern United States on this date there was a remarkable coincidence of great E layer ionization with unusual atmospheric bending of the transmission paths a mile or two above the earth. This giant bending area, roughly oval in shape, stretched in an east-west direction from Providence, R. I. to Akron, O., and north-south from Rochester, N. Y., to Gettysburg, Pa. It was this condition which accounted, they believe, for reception up to 300 miles.

The much greater DX reception, reaching up to 1,400 miles in one case, is explained by direct reflection off the E layer. This distance, the Harvard scientists point out, is the maximum which can be secured with a single reflection off this layer.

Still later reports to Science Service show evidence of a double reflection off the E layer and a total transmission distance of 2,500 miles.

The 56 megacycle (56,000,000 cycles a second) band on which these observations were obtained has recently been opened to amateur transmission by the Federal Communications Commission. For many years it has been regarded as a strictly local band of communication for the signals appeared to travel pretty much in line-of-sight and were often blocked out by obstacles and by the horizon.

Parts of this and neighboring bands have been assigned for television transmission and it has been one problem of television to get around, in some fashion, the restricting local characteristics of signals on these frequencies.

Admittedly the night of last June 5 represented a most unusual case of radio transmission for the eastern United States but it represents a condition which might occur again. Perhaps when television comes into regular operation in the homes of the future you may suddenly find your images double. One from your nearby local television station and another from a station operating some 1,000 miles away. You may be seeing double but, in this case, it won't be your own fault.

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