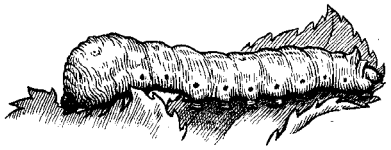


Silk and Silkworms

If you follow the legendary Chinese version, it all started in 2640 BCE with *Xi Ling Shi*, the wife of the Yellow Emperor. Enjoying her tea in the garden one afternoon, she was surprised when a small white shape fell into her teacup – as she fished it out, it released strands of very fine thread, and she realized that it could be made into fabric.

The Chinese started ***sericulture***, or the science of raising silkworms, millennia ago; some historical finds put it even further back than the legendary empress. Originally, silk was reserved for the clothes of the Emperor, and then its use was widened to many dignitaries in the Court. The secrets of silk culture were so closely guarded in China that the worms themselves could not be removed on pain of death – an elaborate series of trade routes, called the Silk Road, was set up to transport this elegant fabric to the West. Finally, the secret was spread to the West in the first century AD, when Byzantine monks smuggled silkworm eggs out of China in hollow walking staffs.

China silkworms are the caterpillar, or larval stage, of a moth called *Bombyx mori*. This moth has no population in the wild, and will not survive being released. The caterpillars require hand-feeding up to five times per day, and have no resistance to predators or parasites. The adult moths have been bred to the point that they are flightless and nearly pure white, and have no mouths or working digestive systems. *Bombyx mori* was most likely bred from an original wild type called *Bombyx mandarina* through a centuries-long process of selective culture. *Bombyx mori* silkworms only eat the leaves of one kind of tree – the mulberry (*Morus, various species*), which have been planted around the globe to provide raw material for sericulture. *Bombyx mori* eggs go into diapause, similar to hibernation, and can be kept in cold storage during the winter. The caterpillars hatch about ten to fifteen days after removal from cold storage. The baby caterpillars, also called *Kego* (in Japan) and *chawki* silkworms (in India) are tiny – about the size of a typewriter dash – and covered in little black hairs. They are kept in large trays and fed constantly for about a month, during which time they change their skins four times as they grow, winding up the size of an adult's little finger and nearly pure white. Spinning of the cocoons takes three to four days, and after that, another two to three weeks for the larva to pupate, turn into a moth and emerge from the cocoon. The adults only live a few days, during which they breed and lay eggs. Adult moths do not eat or drink.

Cocoons used for reeled silk must be stifled, or killed – the emerging moth makes a hole in one end, making the cocoons unreelable. Stifling is usually done with heat, steam, or sunshine. Emerged cocoons can be used to make spun silk, however – they are degummed and fluffed out and carded, or can be stretched into mawatas, hankies, or caps.

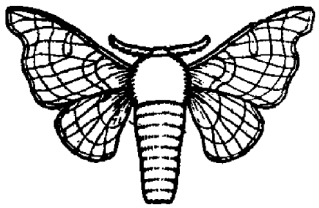
There are several other species of moths used for silk; most of these are referred to as "wild" silk, although some exist in a domesticated or semi-domesticated state. The most common type of wild silk is Tussah, also called Tasar or Tussar silk. *Antherea pernyi* and *Antherea mylitta* are both referred to as tussah silkmoths; *pernyi* is called "temperate tussah" or "oak tussah" and *mylitta* is called "tropical tussah." They are both raised in a semi-domesticated situation, where the worms are grown on plantations of small trees, and the cocoons are collected from the branches after they are spun. *Mylitta* eats mostly Indian trees called Arjun and Asan, and is raised primarily in India; *pernyi* eats oak, and is raised primarily in China. A

relative of the Tussah moths, the Muga silkmoth, *Antherea assamensis,* is raised only in the Assam region of India and famous for its golden silk. The Eri silkworm, *Samia ricini*, is another human-bred type; it is raised primarily in India, and eats castor bean or cassava leaves. Like the *Bombyx* moths, Eri moths often have useless wings due to inbreeding for silk, and will not survive in the wild. Other types, such as fagara silk (*Attacus atlas,* Taiwan) and Tensan silk (*Antherea yamamai,* Japan) are locally important, but not significant in the world market and typically unavailable outside their local regions. All of the wild giant silkmoths belong to a family called Saturniidae; these are typically large and showy moths with bright and often beautiful wings. Some of the wild silk cocoons (particularly the *Antherea* species) can be reeled. There are several of the wild silkmoths native to North America, including the Polyphemus (*Antherea polyphemus*, related to the Tussah moths – I call it "*Texas Tussah"*), Cecropia (*Hyalophora cecropia*), Promethea (*Callosamia promethea*), Calleta (*Eupackardia calleta*) and Luna (*Actias luna*) among others. These all make varying amounts of silk, and are fascinating to raise in captivity.

Silk is a pretty amazing fiber. The original purpose of it in the wild was to keep the pupa protected from the elements during its metamorphosis into a moth. The silk fiber is composed of two proteins: fibroin, and sericin. Fibroin is a long-chain protein which makes up the length of the silk filament. The sericin is a sticky gum, which binds the cocoon together. Some cultivated silk cocoons are bright yellow, or even pink or orange; these colors are usually just in the sericin, and are removed when the silk is degummed. Each cultivated silk cocoon can have up to 1,500 meters of silk filament – nearly a mile – although the average number is more like half that amount. The silk is produced in a gland in the caterpillar's head, and laid down by the caterpillar in a figure-eight pattern which is repeated thousands of times throughout the cocoon. In cultivated Bombyx silk, as well as the *Antherea* species, the caterpillar does not break the filament through the entire three-day process of spinning. This allows the cocoon to be unwound, or reeled, into a fine even thread. Some species silks, like Eri (*Samia ricini*) are not spun with a continuous filament, and are not suited to reeling. The fiber as laid down is referred to as a "bave," and is composed of two even finer parts, called "brins."

Some properties of silk:

Silk is stronger *per weight* than steel wire. It is washable (depending on the dye treatment and finishing), takes dye well, and depending on the preparation, can be soft or stiff, translucent or opaque. Silk does not stand up well to sunshine, and some dye preparations can cause the material to weaken or degrade. Silk makes very comfortable clothing, and "silky" is one of the most desirable characteristics for fabric to touch the skin. Silk is highly absorbent per weight. Silk is a good insulator, although it can create static in handling. Silk thread is typically measured in deniers, each of which represents a gram per 9,000 meters length – nine to twelve denier silk is good for hosiery, buttonhole twist is often a thousand deniers.



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