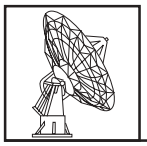
to use modern methods to spread the gospel (seminars, web pages, newspaper and radio advertising, etc.), we must always ensure that due reverence is accorded to God and Christ. We must also ensure that our worship is acceptable to God, that we have not turned our ears away from the Truth to fables, as Paul warned Timothy that some would (2 Tim. 4:4).

The world treats its religious beliefs like styles in dress or etiquette or diets, constantly changing from generation to generation. "I am the LORD, I change not", was the message Malachi gave to Israel (3:6), and the writer to the Hebrews refers to "Jesus Christ the same yesterday, and to day, and for ever", and therefore urges believers: "Be not carried about with divers and strange doctrines" (13:8,9).

It is an awesome responsibility to bring men and women to a knowledge of the great Creator and Sustainer of the universe, to reveal His great and precious promises made sure in the Lord Jesus Christ: "Wherefore we receiving a kingdom which cannot be moved, let us have grace, whereby we may serve God acceptably with reverence and godly fear: for our God is a consuming fire" (12:28,29).



Science

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Science and the Creator

Silk and the silkworm

David Burges

THERE ARE many cases in nature of plants and animals which in the normal course of their lives produce excesses of materials that are useful to mankind for food or other purposes. Whilst these would seem to offer no obvious benefit to the producer and hence no survival advantage for natural selection, they can certainly be viewed as the gracious provision of the Creator, Who has provided a wonderful environment on the earth, and everything in it that is necessary and good for man. Typical examples of products that are produced in abundance, above that required by species for their own reproduction and survival, are milk and eggs, fruits, cereals and seeds of all kinds, providing for human consumption. Similarly, examples of naturally produced materials useful to man include both wool and silk.

An ancient textile

From antiquity, silk has been considered one of the finest and most luxurious of clothing fabrics, and it remains so, even in this age of synthetic fibres. Silk threads are produced by the larvae of butterflies and moths to spin the cocoons in which metamorphosis occurs.[1] But commercial silk is produced only by the Chinese silkworm, which is actually the caterpillar of the moth *Bombyx mori*. The silkworms' natural food plant is the mulberry tree, although artificial diets have been developed. Today they live only in captivity, all wild populations having become extinct.

The practice of making silk from the silkworm reportedly first began in China about 2,600 B.C. The Chinese kept the secret of producing silk for thousands of years, trading the product to Europe and the Middle East. Silk (Heb. *meshi*)[2] was known in Israel, and is employed in Ezekiel's prophecy against faithless Jerusalem to symbolise the blessings that God had showered upon her (16:10,13). It is further referred to in the list of commerce of Great Babylon in Revelation 18:12 (Gk. *sērikon*, from *Sēr*, the Greek name for China). During the eleventh century, European traders stole several eggs, and seeds of the mulberry

1. Of course, spiders also produce remarkable silk threads to form their webs: see "The spider . . . is in kings' palaces", Aug. 1999, p. 319.
2. Other references to silk (Prov. 31:22; Gen. 41:42, mg.; Ex. 25:4, mg.) translate the word *shesh*, which is everywhere else rendered as 'fine linen'.

tree, the silkworms' food plant, and began rearing silkworms in Europe. Today silk is cultivated mainly in China, Japan and India, annual world production being in excess of 60,000 tons. Although it has been replaced by artificial fibres in much of the textile industry, it is still greatly prized for its superior feel and appearance.

Amazing workers

The silkworm moth has a hairy body with creamy white wings about five centimetres (two inches) across. The somewhat larger females lay their eggs after mating, and, having hatched, the larvae pass through a series of moults. After feeding for about six weeks they eventually reach six to eight centimetres (two to three inches) long. When ready to pupate, the silkworms climb to the top of a branch and begin spinning their cocoon. A pair of large glands on the two sides of the stomach secretes a viscous fluid which is conveyed by ducts to an orifice under the mouth. On reaching the air, the fine liquid stream hardens into the silk fibre. This the caterpillar spins into the cocoon, within which it is transformed into a pupa or chrysalis.

The silkworm is an amazing worker and takes only a few days to produce the cocoon, which is formed, astonishingly, from a single thread over 600 metres long! On silkworm farms, only enough pupae are allowed to hatch to maintain the stock of adult moths. The rest are killed by heat because the cocoon silk is otherwise damaged when the moths emerge. The silk is then drawn off and woven into fabric. It takes many thousands of cocoons to make a kilogram of silk.

A biochemical factory

As in the case of spider silk, the ability of an insect to produce such a remarkable material at will attracts the keen interest of researchers, anxious to discover the secrets of the biochemical processes involved. The production of artificial fibres usually involves the use of high temperatures and pressures, and strongly acid solutions, yet the insect is able to produce a superior product from water solution at body temperature. Here is clear evidence of intelligent design which far exceeds the achievements of man.

Silk is produced from proteins that are able instantly to change their configuration on exposure to the air so that the fluid solution hardens into the silk thread, stronger than steel. For sheer resilience, silk is rivalled by only a few artificial materials, such as Kevlar, which is used in bullet-proof clothing, aircraft components and tethers for oil rigs. But Kevlar is stiff, whereas silk is highly elastic, meaning that it can absorb a lot of energy before snapping.

Two recent research projects describe attempts by scientists to use genetic engineering in an effort to harness the properties of silk. In one,[3] genes responsible for silk production have been inserted by German scientists into potato and tobacco plants so that they produce silk proteins in their tissue. It is hoped that these can be extracted and spun into fibres. In a second project,[4] Japanese researchers have inserted genes for a protein from human skin into silkworms. The resulting silk thread then contains the human protein collagen which, it is hoped, could be harvested and used for many applications, including artificial skin and wound dressings.

Marvellous things

The silkworm is just one of a multitude of examples from the natural world of a humble creature which nevertheless uses highly complex biochemistry to produce a material that is of significant worth to mankind. It is beyond reason that such a remarkable system could have arisen by chance, or that the end product would be produced in such quantities as to have commercial value.

We are wise to shun the godless, 'natural' explanations of evolutionists and to see in these marvels the genius of the Creator. With Eliphaz we should say: "I would seek unto God, and unto God would I commit my cause: Which doeth great things and unsearchable; marvellous things without number" (Job 5:8,9).

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3. *Nature Science Update*, 31 May 2001, reporting work first published in *Nature Biotechnology*.
4. *Nature Science Update*, 16 Dec. 2002, reporting work first published in *Nature Biotechnology*.

Daily readings for 29 February 2004

A reader has written to suggest that brethren and sisters make the following arrangements for the daily readings over the weekend 28 February–1 March: Saturday, first and second readings for the day; Sunday, third reading for Saturday and first reading for Monday; Monday, second and third readings for the day.—*T.B.*