appeared in 2002

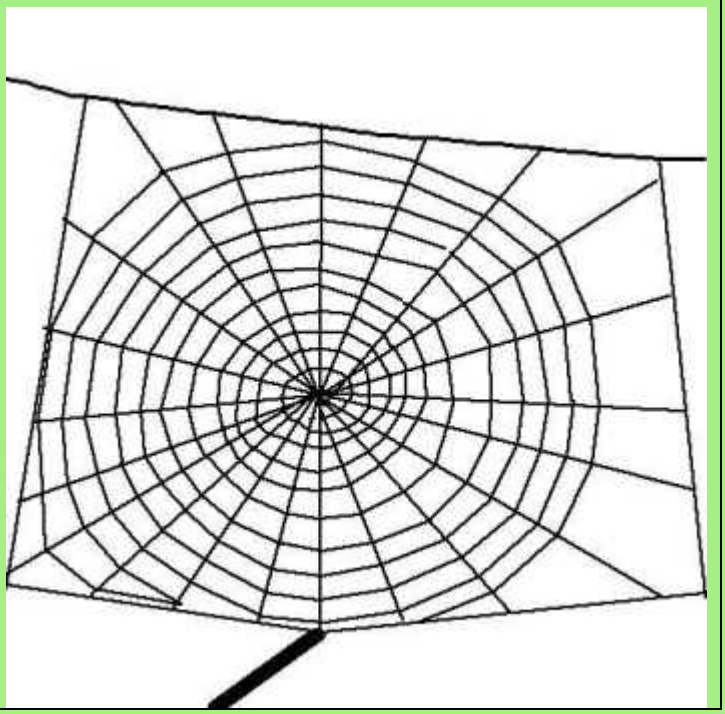
# Technology, bio-tech and the spider's web

Sometimes sticky, sometimes strong is a yarn about the spider's web, says **S.Ananthanarayanan.**

The threads of the lowly spider's web are many times stronger than steel, at a fraction of the weight, they are bio-degradable and now it looks like they can be produced by livestock. A kind of dream come true?

## Structure of the web

The intricate web of the spider consists of many different kinds of silks, each one produced by a different gland in the spider's body. The web is supported by sturdy, radial 'spokes', made of 'dragline' silk This is the silk that serves as 'lifeline' for the spiders to hang from the ceiling and pull it back to the web in case of danger. On these 'spokes' is woven the great 'spiral', of a different and very 'sticky' kind of silk. Then there is bridgeline silk which suspends the web from its support.



## Materials that go in

The different kinds of silk need to combine strength, toughness and elasticity in different ways. Dragline silk is the strongest, and weight for weight, it is many times stronger than steel. This silk is composed of a combination of materials – one forms a framework, which supports another two materials, one rigid and one that

bends, which combine to fill the spaces in the framework. A web within the strands of the web, as it were.

**Nanotechnology**

The result is a marvel of structural engineering, a fretwork of different strands, each with an internal structure, which give immense strength, with optimum use of material. This last feature, of everything consisting of nets within nets results in there being very little real material in there, which makes things very light. Something like Howrah bridge or the Eiffel tower, in miniature.

Each strand is thus several times thinner than a human hair. And as for strength, the movie, ‘Spiderman’ greatly underestimates the toughness of spider silk. It has been suggested that a pencil-thick strand of this silk could stop a Boeing 747 in flight!

The ‘net’ framework also helps the structure ‘deform’, with the material within ‘folding and unfolding’, which makes the material elastic, or ‘stretchy’.

**Biotechnology to the rescue?**

With such strength, lightweight and elasticity, the great dream of engineers and surgeons has been to make spider-web available in quantity. Attempts at farming spiders, like silk worms, met with no success because spiders are fiercely territorial and would fight if another spider were too near!

But the recent advances in genetics seem to have come up with an answer. Scientists at a Canadian biotechnologies company have introduced spider silk genes into mammalian cells and got the cells to produce spinnable proteins similar to real spider web material. After harvesting the proteins, the scientists have spun

them into fine, silken threads. These strands possess the strength and toughness—although not quite the tenacity—of spider-made dragline silks.

The company now hopes to produce large quantities of the recombinant spider silk, trade-named BioSteelR, using goats engineered to produce the spider silk proteins in their milk. If successful, future applications of harvested silk could include medical sutures, high-strength composites and soft body armor.