

# No more prickles!

Ever climbed out of a hot bath, put your winter woollies on, and felt an uncomfortable prickling sensation? If so, recent research at CSIRO's Division of Textile Industry and the Physiology Department of Monash University should prove interesting.

Dr Russell Garnsworthy, Dr Bob Mayfield, and Mr Ray Gully, from the Division, collaborated with two sensory physiologists from Monash — Dr Rod Westerman and Dr Paul Kenins — to find out why it is that some fabrics, when worn against the skin, cause prickling. The degree of discomfort experienced varies from one individual to another; in some cases inflammation of the skin can ensue.

Physiologists have long known that sensations of pinprick and itch are due to pain receptors in the skin, but it was thought unlikely that fabrics could stimulate these receptors, and 'wool prickle' was attributed to wool allergy.

However, when the scientists tested for allergic reactions by scratching wool extracts onto the skin of volunteers, they found no correlation between responses to the test and subjects' reactions to wool fabric.

To determine whether the prickly sensation was in fact mediated by pain receptors, the scientists first blocked the nerves responsible for carrying messages of touch in volunteers' arms by means of pressure exerted by an inflatable cuff. The intrepid volunteers continued to feel the prickle sensation, suggesting that it was being sent via the pain nerves, which had not been inhibited.

Then, while prickly fabric rested on the skin of a forearm, the scientists made an electrical recording from a single pain nerve fibre in the



**Wool fibres such as this (viewed with a scanning electron microscope) may cause prickle if they are large enough, and if they are incorporated into garments — such as these stylish ones — which may be worn next to the skin.**

area. This showed clear activity, which stopped when the fabric was removed.

Earlier work at Monash University had shown that the pain receptors in the uppermost part of our skin could be triggered into low-level activity by loads as small as 75 mg. If this was occurring in 'prickle sensation', what was it in the detailed structure of some of our warmest clothes that was responsible?

To help find out, 80 subjects were asked to rank the degree of 'prickliness' of a range of fabrics draped across their

inside forearms. The same fabrics were also placed against a 'model' of human skin — in fact, a thin layer of teflon mounted on a glass slide. They were applied at a pressure of 4 g per sq. cm, which is similar to that exerted by heavy clothing on the skin.

Like our skin, teflon film is pliable. When the test film was subsequently viewed under low magnification, small craters were revealed. From the size of these, the researchers concluded that they had been made by wool fibres of between 20 and 30  $\mu\text{m}$

in diameter. The textile experts knew that fibres of that size could support loads of more than 120 mg before bending or collapsing. (Thinner fibres, which can support less weight, are crushed by the clothing.)

As in the teflon, the thick fibres evidently make pits in the skin, and forces around the edges of these stimulate the superficial pain receptors to fire.

The number of high-load-bearing fibres in a sample of fabric correlated well with the volunteers' assessments of prickliness. Why individuals differ in their sensitivity is explained by the variability in thickness of the outer skin layer, and hence in the depth of the pain receptors.

Hands, although good at detecting the texture of fabric, are not sensitive to its prickly qualities because of their greater thickness of skin. If skin is moist, from sweat or after a bath, prickly sensations may be all the more uncomfortable because the outer layer of skin is softer and more pliable, making it easier for the large fibres to trigger the pain receptors.

Now we know the cause of this problem, we can predict which types of fibre will be the best for reducing prickliness. For garments that are designed to be worn next to the skin — such as light sweaters — the manufacturers should use wool with lower-diameter fibres. Very fine Australian wool would be ideal.

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Mechanisms in cutaneous sensations of prickle and itch evoked by fabrics. R. Garnsworthy, R. Mayfield, R. Gully, R. Westerman, and P. Kenins. *Proceedings of the 7th International Wool Textile Research Conference, Tokyo, 1985*, 3.