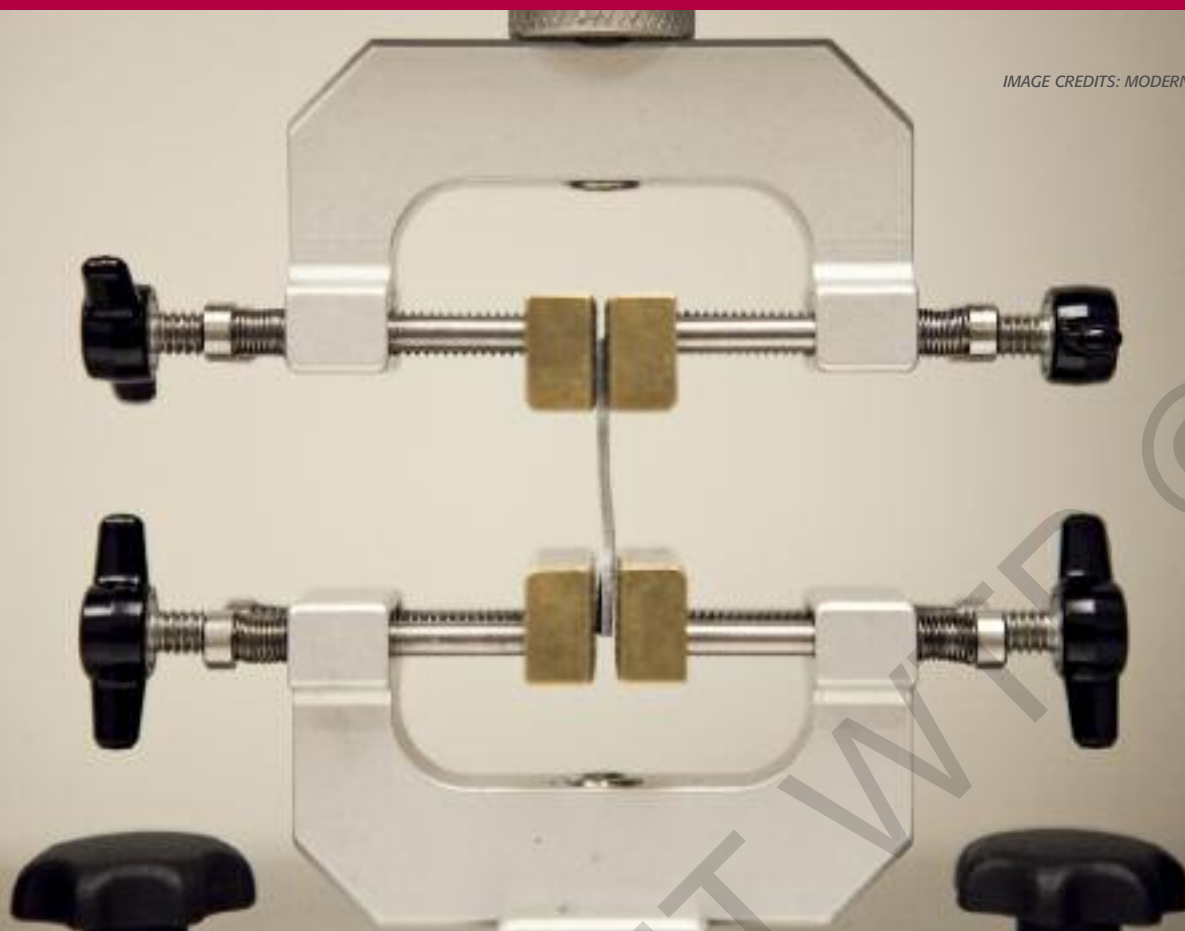




Square cows

There has always been a clear distinction between leather and synthetic materials as far as shoemakers are concerned, when it comes to their use in footwear. Leather is made from animal hides that are a by-product of the meat industry and is therefore derived from a renewable resource. If these hides were not turned into leather, the great majority would have to go to landfill as other uses for them are limited. Synthetics, on the other hand, have been developed by the oil-based chemical industry and are totally man-made. They also consume fossil fuels which are most definitely not a renewable resource. They are entirely different despite the habit of some synthetic producers referring to their products as being synthetic 'leather'.

The environmentally concerned consumer is thus faced with a dilemma: should they buy shoes made from leather which, although a natural material, does involve the slaughter of animals which many are becoming increasingly uneasy about? Or, should they go for shoes made from

synthetics which consume valuable non-renewable raw materials and energy resources? The time may be coming when this problem could be resolved for them by a new source of material, one which is claimed to be the same as leather but has its origins in a laboratory rather than on a farm or ranch.

LEATHER

Expressed in the simplest terms, animal skin is mainly comprised of collagen chains, plus water, keratin and various proteins. Its strength comes from the collagen-based fibre structure which is in turn lubricated by molecules of 'free' water to provide the degree of flexibility and elasticity necessary for the animal to be able to move around freely. In addition, there is also 'bound' water present which forms part of the protein structure itself. If this is removed by excessive drying of the hide, the whole structure begins to harden due to cross-linking of the collagen chains.

Tanning involves replacing this bound water with tanning agents to

provide the lubricant needed to maintain the essential physical qualities of the original hide while at the same time preserving it. Unwanted products are removed and replaced by ones that prevent bonding between the chains of collagen so that the overall structure remains soft and flexible. This is how leather has essentially been produced from time immemorial.

BIOFABRICATION

Modern Meadow, an American start-up company founded in 2011, has been quietly developing what it refers to as a 'biofabricated leather material' called Zoa which it launched last October as a revolutionary alternative to natural leather. It says it has successfully produced prototype material and raised more than \$50 million from investors that has enabled it to open a new and larger laboratory, add to its original 60 staff and begin production trials. In an age of genome therapy and DNA sequencing it would increasingly appear that nothing is beyond the scope of science to achieve and DNA manipulation lies at the heart of what

Modern Meadow has done with Zoa.

DNA is the molecule that carries instructions on how an organism functions in the same way that a software code determines how a computer program works. Modern Meadow takes base pairs of DNA, cuts them and replaces them with new base pairs to create new, unique strands of DNA. The sequence of bases determines the information available for building an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences. This DNA can be edited to instruct cells to produce the type and quantity of collagen needed.

But where does the DNA come from in the first place? It would appear that up until a couple years ago, Modern Meadow was using tissue engineering to produce lab-scale volumes of collagen. Now, using a proprietary biofabrication process, it is able to produce animal-free, recombinant collagen that it claims can rival any collagen currently on the market. The technology uses the latest DNA editing tools to engineer specialised collagen-producing yeast cells which are optimised to manufacture the type and quantity of collagen required.

The new DNA is put into cells and multiplied. Cells are the basic building blocks of all living things. They feed on the nutrients supplied and convert those nutrients into energy, making copies of themselves and rapidly multiplying tens of cells into billions of cells. These cells produce collagen and other proteins essential for manufacturing leather. The collagen groups together to form a triple helix collagen molecule. The triple helix structure of collagen then forms a network of nanofibres that in turn join to form bundles of fibres which are assembled to create the actual material structure.

These protein structures are then further processed to create the final base material which is tanned and finished in a much simplified manner. This is possible because the base material is not taken from an animal, so there is no need for the beam house operations of liming to remove hair, fleshing to remove unwanted membrane-like tissue, de-liming, degreasing and splitting as the material is already of an even substance and completely flat.



Zoa is created using a process called biofabrication.

PRACTICAL ADVANTAGES

This is clearly a simplified overview of a most complex process and there is much detail that the company prefers not to reveal. Nevertheless, the practical advantages of such a material are obvious. It would be made in regular size sheets which would be consistent over their entire area and from sheet to sheet compared to genuine natural leather which varies from hide to hide. It would also not have any wire or growth marks, so it could be cut like any synthetic with all the advantages and savings that implies.

According to chief operating officer Dave Williamson, the process has been designed so that it is easy to scale up and to be carried out in existing industrial facilities. As he used to be at DuPont, one imagines his assertion ought to be well founded. He also says that it would be possible to produce the collagen in large, centralised facilities and then transport it to local factories and tanneries for final processing and

finishing. One particularly remarkable feature is that different parts of a sheet of this material can apparently be given different properties so that, for example, the look and feel could be changed in a controlled way from one part of the sheet to another and so make it theoretically possible to produce material tailored for specific designs.

With regard to cost, Williamson says the new material will be competitive with natural leather. Having said that, he also says that Modern Meadow is not actually seeking to replace leather but to produce a new material in its own right, complete with its own brand name. Shoes made from such a material could appeal to vegans, vegetarians and those uneasy with animal slaughter, all of whom form a relevant segment of the footwear market. It could also have an appeal to shoemakers for whom the old saying "If only we could have square cows," could become a reality. 🐮