MATERIALS

Materials for Design

Chris Lefteri

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Dedication: For my mum and dad, Androulla and Stasi.
I owe it all to you

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361–373 City Road
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Tel +44 20 7841 6900
Fax +44 20 7841 6910
E enquiries@laurenceking.com
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INTRODUCTION

This book is for anyone interested in or involved in designing with physical materials. It is not a scientific or historical analysis of materials, but instead serves as an aid to understanding the current state of materials – which are the most commonly used and which are potentially the materials of the future. It embraces all areas of design and production, from products made as one offs to those mass-produced in the scale of millions of units per year, from highly desirable design pieces to some of the everyday objects that we take for granted. I first started writing about materials in 1999 and I stated then that we were only at the beginning of our exploration into this area: fourteen years later this still remains true, and a significant development is that material innovations are not just coming from the science community but increasingly from designers themselves. This book is a celebration of the range of established materials that designers are innovating with and materials that they are creating from scratch.

'Like trying to capture a family photograph when all the family members are moving', is how Ezio Manzini described materials in 1989 in his book *The Material of Invention*. As time accelerates the introduction of new types of materials, so the classification of materials families continually needs to be redefined. The established descriptions that have been used to define materials families such as plastics, metals and woods seem to become less and less relevant. With the blurring of the boundaries between these materials families, it's getting harder to work with the old definitions. For example, plastics are more and more often encroaching on the territories of other materials, such as innovations in bioplastics made from cellulose fibres or plastics that are taking the place of metals for lightweight, corrosion-resistant applications.

Alongside the evolution of new technologies and grades of materials, something else is happening that is changing the value they have in our lives. This is not linked to the science of new materials but concerns the role they play in contemporary life. Materials are increasingly becoming central characters in consumer focused stories: anti-bacterial surfaces to improve hygiene; advanced composites that define luxury in consumer electronics; authentic 'real' materials in interiors like stone, glass and stainless steel; the use of 'eco' materials to alleviate our guilt and make us feel like more caring consumers.

These material stories not only help brands differentiate themselves from each other, but facilitate designs that drive a desire in consumers to buy into these stories. However, beyond this desire, there is also a genuine initiative to find alternative, sustainable sources of materials. This area is being driven as much by science as it is by ever-curious designers like Suzanne Lee, with her marvellous innovation of a material grown from bacterial cellulose (see page 60), who are increasingly developing the actual materials themselves rather

than merely just applying materials in designs as an afterthought.

So, as innovations in materials continues to take place unabated, why is this a good moment to take a breath and consider the role of materials and how they might be applied in design? Partly because looking at design through the lens of materials is always an interesting place to see updates and new innovations, but also because the world and the connection we have with materials is going through an incredible change, driven by the two main themes of desire for materials stories and a need to find sustainable solutions. As a result, the use of materials is becoming much more important for designers, not just through developing new materials but also by having a better understanding of their properties and values. This book takes a snapshot of over one hundred raw materials and presents key information that that designers should know about when considering materials for design.

Unlike the materials revolution of the last hundred years, the next materials age won't be as visible. It won't lead to the kind of visions of the future that we had in the 1950s, with a Jetson's-style future of pastel-coloured, aerodynamic vehicles flying about our heads. The themes will be many, but for sure they will be driven by low-energy production and applications, materials scarcity and new interactions with materials. Some materials innovations are, unlike plastics, metals or ceramics, invisible: for example, the information that you receive on your phone, laptop, TV, or the increasing number of other screen-based electronic devices will change the physical interaction you have with materials rather than change the way they look; our need to explore new sources of energy might mean that the road you drive down won't just be a path for cars, but a surface to generate electricity; the walls of a room won't simply be a place to decorate with your favourite colour but where you choose the functions that best suit your home – noise reduction, smell neutralisation, pollution killing. This book would be doubled in size if it were to include all of these types of materials technologies, and perhaps they will form a second instalment.

The three sections in this book are not based on the traditional definitions of materials but instead are categorized through the provenance of these materials. As our focus on the need to reduce resources continues, then where materials originate – whether grown, mined or oil based – becomes more important. The selection of materials within each of these sections is not exhaustive but instead attempts to capture those materials that are the most useable, used, important or just downright inspiring for designers. For some materials the case-studies that accompany them are from specific designers, such as the lightweight aluminium 2012 Olympic torch by Barber Osgerby (see page 174), and in some cases they are from everyday products that are typified by their use of the particular material, such as the crafting of willow for cricket bats (see page 42). The selection is based on raw materials – steel, oak, polystyrene, soda-lime glass for example – and not semi-formed materials that have been transformed into sheets (such as well known brands like Corian® or Lycra®). The information given for all the materials is kept consistent, allowing for cross-referencing across the properties of different types of materials. Where costs have been included, it should be noted that prices fluctuate and those given are estimates that should be used for comparative purposes only.

I hope that this book will make you ever more curious about the materials of today, tomorrow and the not-so-distant future. Please dig in and enjoy!

Chris Lefteri
London, 2013


GROWN

Welcome to the wondrous world of grown materials: fish leather, textiles created from bacteria and horsehair, plastic made from chicken feathers, and the more usual grown materials such as plant fibres and wood. This section is one of the major emerging materials families, an area that encompasses both the big chemical industries – who are looking into extracting proteins from starch to make new types of plastic – as well as research projects from individuals like Fiorenzo Omenetto, a scientist who is developing an incredible array of uses for silk.

This section includes experimental projects based on byproducts of natural waste which are deconstructed to make new types of materials. The urgent need to find rapidly renewable materials is driving designers to experiment with waste materials, for example Erik De Laurens is making a new composite from fish scales, and the rapidly renewable and biodegradable mycelium (grown from the roots of mushrooms in a matter of days) is being used to replace expanded polystyrene.

If, as the introduction to this book points out, one of the key drivers for materials development is the need to find more sustainable materials, then most of these innovations can be found in this section. The last century will be remembered as a time when classical notions of production were blown apart by plastics derived from oil. The next century might see a time when our plastics and products don't come from machines but are grown. Graze across the crunchy textures, playful interactions, natural patterns and interesting surfaces of materials that are currently being developed.

Red Cedar *(Juniperus spp.)*

As a schoolboy lacking in concentration, I found something incredibly therapeutic about sharpening a pencil. Whether it's with an old fashioned magnesium sharpener or a razor-edged steel craft knife, there is no mistaking the peppery smell of that sharpened pencil and, for some, the irresistible urge to gnaw on the end of one. As an object made of wood it is one that has a direct immediacy with its user. You hold it, digging your nail into its plastic-painted surface, smell it, carve it into a needle sharp point, and chew it. Through its built-in obsolescence it goes from being an object of satisfying proportions to a redundant little stump. For this once young schoolboy it also evokes memories of a material and product that empowered me to express my early designs for intergalactic space ships.

One of the reasons that the pencil provokes such strong associations is due to its aromatic smell, which comes from the use of red cedar, a timber with a reddish-brown heartwood and a smooth, fine grain. Since the first mass-produced pencils were developed in Germany in the seventeenth century they have continued to evolve into a product of high mass production. One of the curious facts about pencils is that 75 per cent of pencils sold in the US are yellow, which apparently is due to an old standard established in the nineteenth century, where yellow was used as a symbol of prestige.

Image: Cedar pencil

Production
Pencil cedar can be worked easily with both hand and machine tools with little blunting effect on blades. It will tend to split if nailed and has poor steam-bending properties.

Sustainability issues
According to the IUCN (International Union for Conservation of Nature) red cedar is one of the least threatened trees.

+	−
–Easy to work	–Prone to splitting
–Aromatic scent	–Poor steam bending
–Straight, even grain	
–Sustainable	

Key features

- Medium density: 380 kg/m^3 (23 lbs/ft^3)
- Straight, fine, even grain
- Aromatic scent
- Low stiffness
- Not suited to steam bending

Cost

The most common type of cedar is the western red variety. It is moderately priced and can easily be found on the market.

Sources

Mainly Eastern USA and Canada, Uganda, Kenya and Tanzania.

Typical applications

The aroma of cedar has been put to use for products such as cigar boxes, wardrobes and chests – to ward away moths – coffins and furniture veneers. Waste shavings from production are often distilled for use in essential oils.

Pine *(Pinus sylvestris)*

The name pine suggests scented temperate forest, but it's impossible to describe pine as a specific wood, because it's actually a family of woods, which includes trees with evocative names such as sugar pine and Table Mountain pine, as well as the perhaps more well known Scots pine, spruce pine and yellow pine. Its timber ranges from a gummy, resinous wood to a warm toasted blonde pine, with a white sapwood and a heartwood varying from light yellow-brown to reddish brown, often with a faint scent of resin.

Pines are one of the most widely recognized and used timbers, chosen mainly for their good range of structural properties, including strength, stiffness, good workability, excellent stability and low shrinkage. Due to the fact that its growth range varies from hot to cold climates, the weight of pines greatly varies. Although pine is itself a family it is also part of a larger group that, together with spruce and larch, is known under the collective name of 'deal', a term used to describe coniferous softwoods.

Apart from scented forests, the other association of pine is its 'country kitchen' aesthetic, which seemed to dominate European kitchen design for a large part of the late twentieth century. In contrast, what I like about the Favela armchair by Fernando and Humberto Campana is the adhoc nature of the design and construction, something that seems appropriate for a timber with so many diverse applications.

Image: Favela chair, Fernando + Humberto Campana

Production
Pines are generally easy to work; however, the sticky resin in some pines can be problematic. Dead knots can also give problems by dropping out. They glue well unless the piece of wood is particularly resinous. They also accept stains, paints, oil and lacquers well.

Sustainability issues
Pines are a fast growing tree and so can be seen as renewable under the correct forestry stewardship. One of the interesting aspects of pine trees in relation to their growth is that they are often planted next to 'nurse' oak trees, which protect the pine saplings from wind while allowing sunlight to penetrate.

+	−
–Easy to work	–Not especially strong
–Good dimensional stability	–Dead knots can drop out of the wood
–Accepts finishes well	
–Sustainable	