

MATERIAL INNOVATION

PRODUCT DESIGN

Andrew H. Dent & Leslie Sherr

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has a
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Solution™



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MATERIAL INNOVATION PRODUCT DESIGN

With 355 colour illustrations



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A Note About Material Properties

Each project and material that appears in this volume is described according to its properties. Understanding a material's attributes is fundamental to its selection and to its role in fulfilling the needs of designers. While many material properties exist, this book highlights the following, which are currently at the forefront of innovation in product design: all-weather use, biomimicry, composite, compostable, durable, ergonomic, high strength, lightweight, nanotech, rapidly renewable resource, recycled, simplification, stain-resistant/easy-clean, and sustainable solutions.

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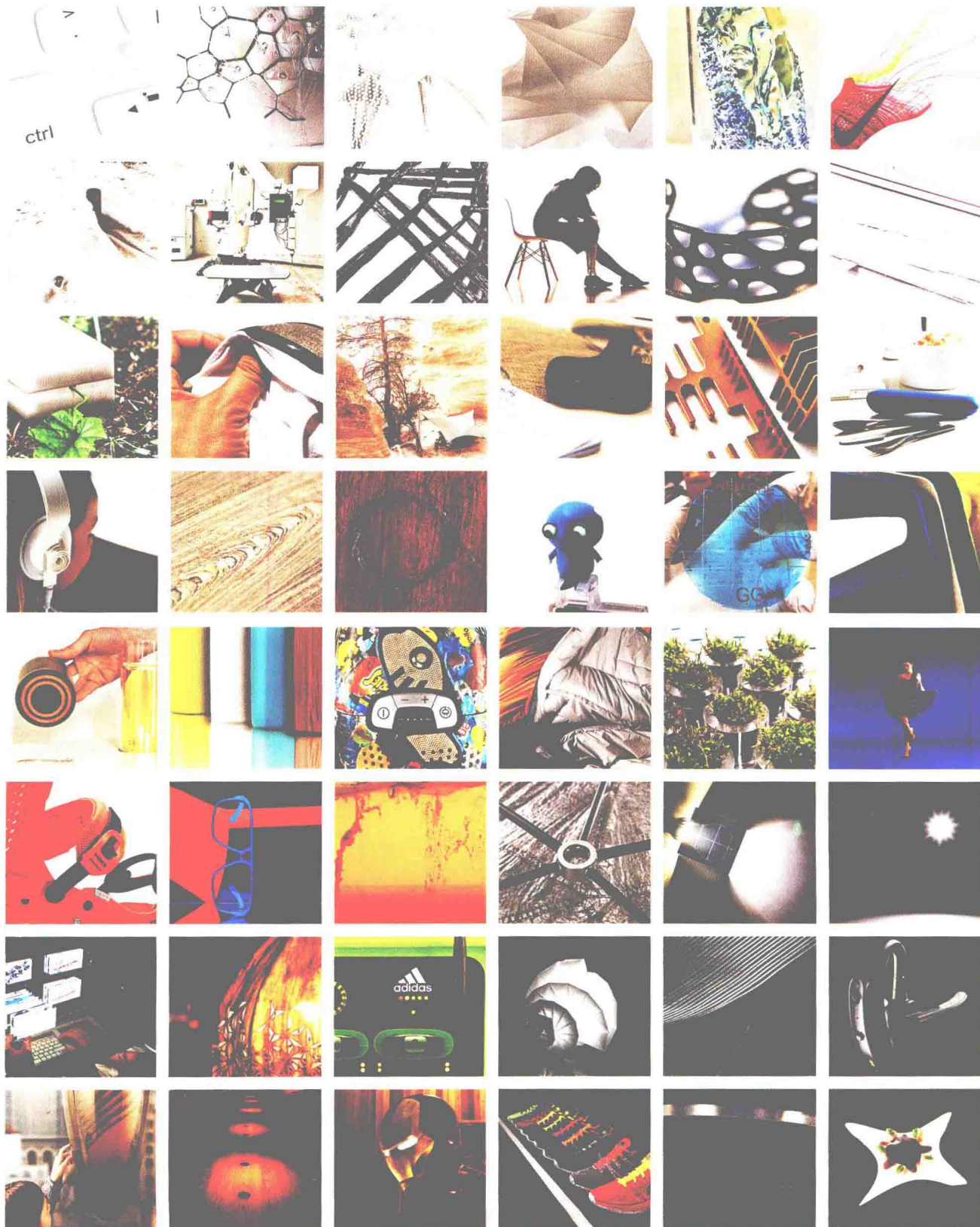
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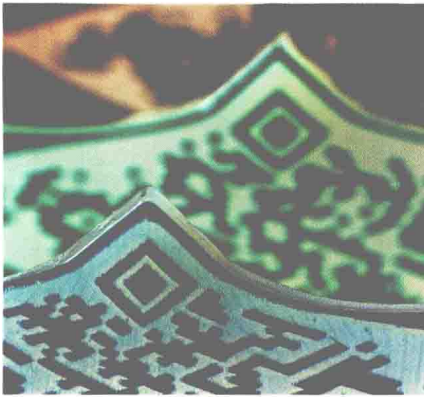
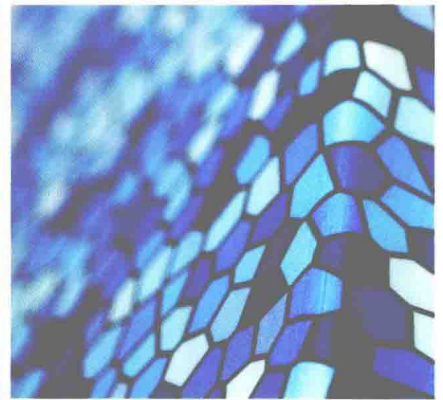
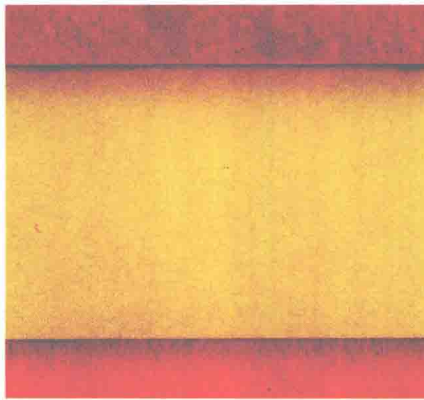
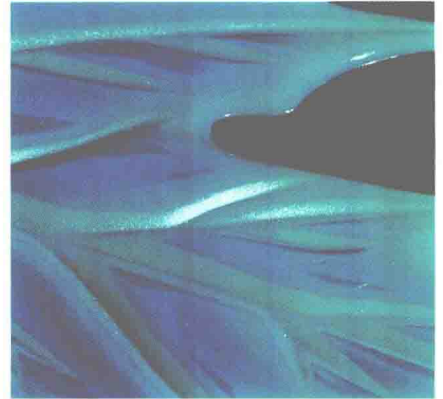
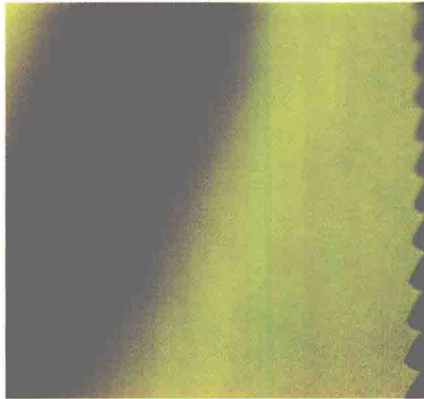
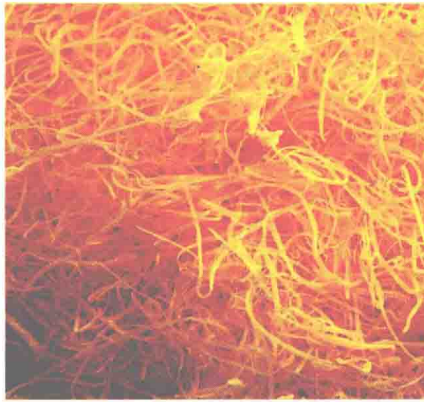


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PREFACE

BY MICHELE CANIATO
PRESIDENT, MATERIAL CONNEXION

Since Material ConneXion was founded in 1997 on the premise that the selection of materials able to give tangible form to a designer's vision is of paramount importance, the world has seen startling social change and scientific development. Technology now enables more products to be made and used than ever before in the history of man, transforming how we communicate with each other and relate to the material world. But many of these products have been of inferior quality and with little regard for their impact on the environment, whether in terms of production, use or disposal. This has triggered urgent questions about sustainability and natural resources. Our desires and concerns are reflected in the objects we make, a fact as true today as it was thousands of years ago. As our population grows and customization becomes commonplace, infinite cultural subtleties can now be reflected in the smallest detail such that design has become both an agent and a mirror of change, able to convey complex messages in the most basic, intuitive terms.

While this book is focused on product design, it is part of a series that encompasses multiple design practices because today modes of professional practice and ideas flow from one area to another and consumers and users do not compartmentalize designed goods and images in the same way as the manufacturing industry. Ideas generated within specialized design fields go on to influence others, with many designers believing that innovation can best be found by looking outside, rather than within, one's chosen creative discipline. Today, there is a fluid and pervasive overlap between architecture, identity, fashion, products, packaging, interiors, automobiles, computer interfaces, and so on. Recognizing this, we have sought to bring insights that come from considering design across a broad range of media and within a forward-looking context that acknowledges the field's shifting parameters.

Today, Material ConneXion offers a worldwide network of libraries and consulting teams that collaborate

with an astonishing range of companies large and small, global and local, heritage brands and visionary entrepreneurs. For all these clients, design is integral to how they operate, facilitating innovation and creativity that allows them to deliver better products, and ultimately a better quality of life, to their customers.

This publication organizes by material type a select set of highly innovative products whose influence extends beyond their category and immediate purpose. While there are many publications about design as either a process or a set of intentions, here we define the attributes and benefits of each object, revealing how they are made, how they are different, and hopefully better, not just from an aesthetic point of view but as a way to inspire new ideas and applications. Some of these products we have been privileged to help develop, giving us a special insight into their unique attributes. For example, a recent collaboration with Logitech, a leading consumer electronics and accessories company, led to the launch of FabricSkin Keyboard Folio, the first iPad case made entirely of fabric (page 64). Designed to advance the consumer experience of digital tablets, the case uses a waterproof, touch-sensitive fabric that is available in six colors and suitable for both iPad 4 and iPad Air. Material ConneXion supported this project as a sourcing entity for the materials involved, working with the design agencies responsible for the style and look of the case to identify how they might best combine technology and familiar fabrics to trigger a warm, tactile, handcrafted feeling.

The act of designing, and the final designed product, make a cultural statement, one that refers to a way of life, how we engage with the world as we move through each day. In this broad sense, design is a dynamic process that reflects and shapes our existence, providing a bridge between creativity and consumption. Hopefully, this book will help readers think differently about designing—inventing around all the many aspects of products themselves from consumer usability to manufacturing to the after-use and, of course, the starting point: the material they are made from.



INTRODUCTION

BY ALLAN CHOCHINOV

EDITOR-IN-CHIEF, CORE77

CHAIR, SCHOOL OF VISUAL ARTS MFA PRODUCTS OF DESIGN

The field of product design is either very old or very new, depending on how you frame things up. If you're talking about ingenuity and invention and creating a better mousetrap, then no doubt its origins are as early as we can measure. (Indeed, the ability to use a tool has been posited as one of the main differentiators between humans and other animals.) If, however, you define product design as "industrial design"—one of the official monikers of its study and practice—then we're only talking several decades. Here, a primary definition of the practice is to innovate, through a repeatable process of design, new and notable objects that marry form, function, engineering, aesthetics, and business viability. When desire enters the picture, industrial designers can cynically be viewed as creating ever more pieces of stuff, feeding market demand and sometimes *creating* that demand through marketing, trends, and conspicuous consumption.

In fact, there are many other ways to characterize design and the products that result. Richard Tyson, systems thinker and design strategist, looks at products as "shadows of systems"; as embodiments that rest on the interconnected shoulders of so many elements of extraction, manufacture,

shipping, usage, behavior, economics, and culture. I myself see products as "props in an experience," mediating interactions in ways as subtle as a couple of coffee cups changing the character of a "meeting" from official to social.

THE FORMS OF PRODUCT DESIGN

But what's particularly fascinating right now is the myriad forms that products can take. (Not *formal* as in shape or form, but rather how they find their way into the world and earn their keep.) From DIY hacks and mods to aeroponic urban farming machines, from shared libraries of digitally fabricated objects to speculative design gestures aimed at provoking dialogue and debate, the instantiations of products and product design are the broadest they've ever been: Bespoke Innovation's custom prosthetic fairings (page 104); Suzanne Lee's "grown" textiles (page 20); Teague's 3D-printed headphones (page 102)... There are just so very many ways to think about what a designed object is and does.

A product can answer a question—*what would we need to create in order to solve this problem?* Or we can think of a product as a kind of delightful pursuit—*what could we furnish to celebrate and ennoble this event?* Or more, we could think of a product as something that enables something else—*what could we create in order to promote this kind of positive behavior?* Products are therefore situated along a continuum of intention: There are products that

opposite Bespoke fairings are made with sophisticated scanning, modeling, and 3D-printing technology to surround the owner's prosthetics and restore the lost contour with a product customized for his or her lifestyle and personality.

serve as a means to an end, and there are products that are an end in themselves. A 3D printer, for example, is a device that creates other items, but those items that result are then products in themselves. If it's the aforementioned bespoke prosthetic fairing that emerges from the 3D printer, that product functions to “dress” an engineered prosthetic leg underneath, “inviting an expression of personality and individuality that has never before been possible” (www.bespokeinnovations.com). At that point, we're talking about fashion and self-identity and dignity and a host of other characteristics that start to blur the line between an object and its purpose. In fact, if we think long enough, it can sometimes be hard to distinguish products from their function...in the same way that a set of Russian nesting dolls can be viewed as both container and contained. One of my favorite books to read to my daughter is *A House is a House* by Mary Ann Hoberman, illustrated by Betty Fraser. A representative passage goes like this:

*A box is a house for a teabag,
A teapot's a house for some tea.
If you pour me a cup and I drink it all up,
Then the teahouse will turn into me!*

And then . . .

*Cartons are houses for crackers.
Castles are houses for kings.
The more that I think about houses,
The more things are houses for things.*

(I thought the idea was so powerful that I started reading the story to my college students—storytime! They loved it as much as I did.) So products can be seen and held, but they can also enable activities. They affect behavior. They affirm life. This is one of the reasons why product design is so exciting: the notion that products are services, and that services are behaviors, and that behaviors are culture, and that culture is what designers seek to influence in the first place—it actually seems facile to think of products as just “products.” They're so much more.

HOW PRODUCTS COME INTO BEING

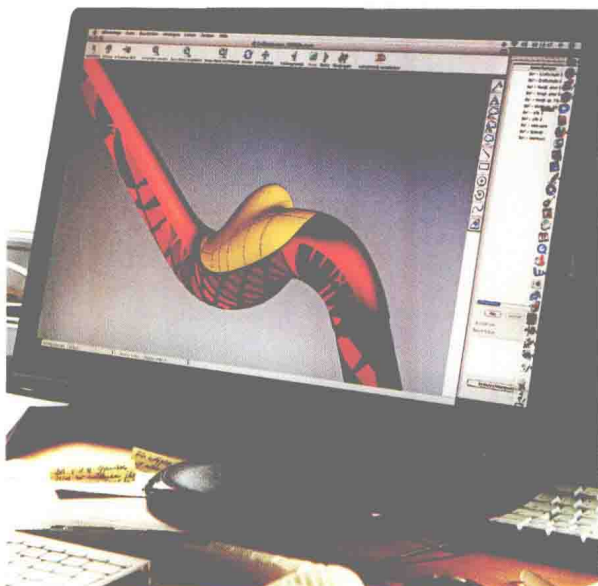
Still, most people would define design as problem solving; as a way of improving the human condition and iteratively making the world a better place. Here, the design process

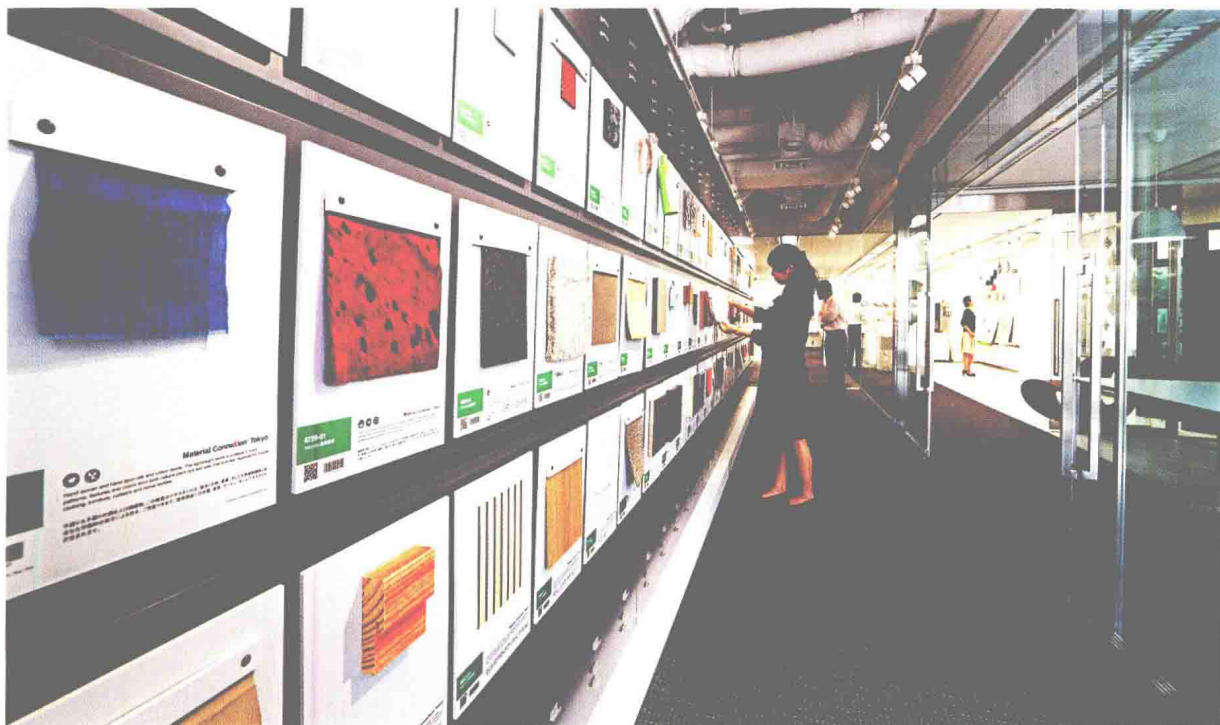
follows a more-or-less agreed-upon methodology: Research and discovery, insight gathering, problem definition, idea development, refinement, and finally production. This process seems linear and repeatable, but it can be much more effective if the phases overlap and feed back into one another, leaving room for a lot of induction and a little bit of serendipity. (Businesspeople don't like processes that aren't predictable, but designers *love* them.) This kind of product creation, then, uses external constraints as guardrails, and serves a concrete taskmaster: The design brief.

But another way of thinking about the creation of products is focusing in on their intrinsic, as opposed to extrinsic, demands. I've long encouraged design students to ask “what does the product want to be?” rather than “what do you want to make it?”—betting that if they can see things from the product's point of view, they would be able to innovate in a way that came from within; that didn't show the hand of the designer, but instead surfaced the unique properties of the product *as it could only be*.

A goal like this is ambitious, of course, but if you look around you, I'll bet that the products you most admire do

The Ganymed Walking Aid (on screen) was built with a novel S-shaped curve and pared down using software that relies on bionic engineering principles, to create a product that is lighter and feels more natural to use than its predecessors.





have a kind of “rightness” to them; that they have a signature characteristic that stands tall and proud, and in many ways *defines* the object. In this book, the combination of materials that results in the Ganymed Walking Aid (page 74) is a good example, or Julia Lohmann’s Kelp Lampshades (page 28). And here I’d argue that materiality can be one of the most powerful drivers in defining a piece of design, determining its “thingness” and telling its story out loud.

THE MATERIAL’S THE THING

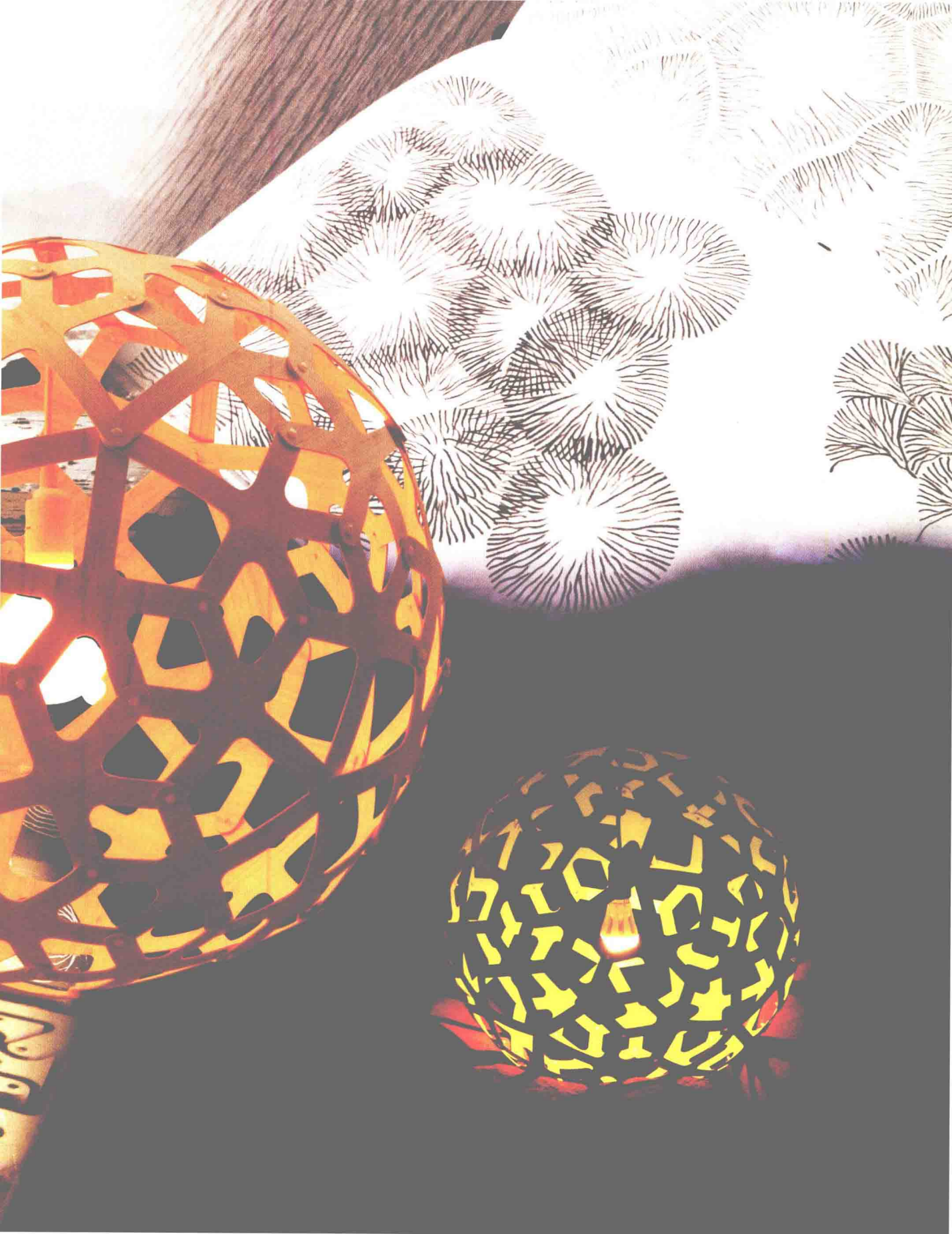
Designers choose materials they believe will best satisfy an object’s requirements. Designers also employ materials to “rethink” and reimagine projects—say, changing a cellphone housing from injection-molded plastic to milled bamboo. Material manipulation can be targeted to save money, to save labor, to reduce ecological impact, or to simply refresh a brand. But perhaps the more ambitious (and even poetic) way to think about material is less ad hoc. Michelangelo famously remarked that his sculptures were already resident in the stone; that all he had to do was carve away everything else. With material choice, you can actually come at things from the inside out. What does this material want to be? What does it want to make? And, of course, what something is actually made of triggers an avalanche of dependencies and consequences: How does the material come into being—is it extracted from the earth or synthesized in a lab?

Material ConneXion’s Tokyo location is part of a global network of libraries where product designers can search for materials alongside architects, engineers, and artists to find the perfect solution for their current project or an inspirational reference for future designs.

How is the material manipulated into its final form—is it the old “heat, beat and treat,” or is it grown in a petri dish? How does the material serve its time in that form—how does it wear, shock-absorb, feel? And, of course, how does that material find its way *out* of the world—is it recycled, reused, composted, or landfilled?

We can even challenge the term “material *choice*,” since often the right material isn’t necessarily chosen, exactly. It chooses *you*. You might be suspicious of such a thought, but as you enjoy the wonder-filled pages ahead, I’ll bet that you vacillate between the notion that a material was selected for such-and-such a purpose, or that a material could not have created anything *but* the product that you are admiring. And what an amazing thing that is; that we are at the point in material science and technology where we can fit the right material to the job, we can fit the right job to the material, and, every so often, we can attain a match so ideal that we cannot imagine them apart. That’s what designers shoot for a lot of the time, and the products in this volume are proof that very often, they succeed beautifully.







CHAPTER 1

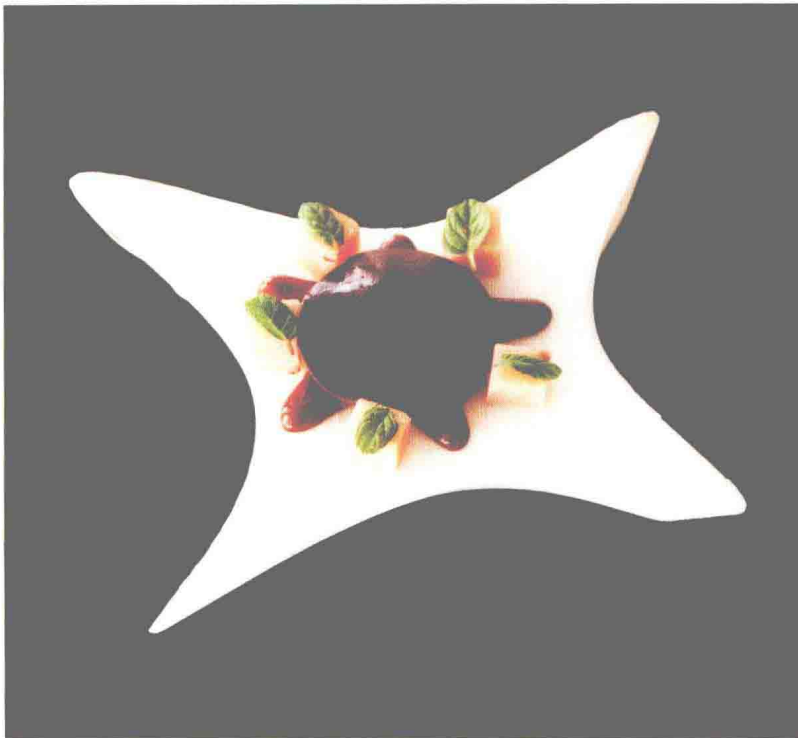
GROWN MATERIALS

We have always grown materials. The majority of the human-manipulated things on this planet are from materials grown from the earth. However, these have been substances that then require more or less human effort to change them into usable materials, whether spun into yarn and woven into fabrics, hewn, cut and planed into lumber, or broken down into fibers and mulched into pulp. The material then needs to be used to create a product, requiring further synthesis, work, and energy. Nature needed to be harnessed, controlled, fought against to achieve these products; needed yet more energy, water, and other resources to do so.

There is a revolution going on in the twenty-first century that has at its forefront the idea that “nature knows best.” There is an increasing belief that to produce more effectively, with fewer resources and less energy and resulting in a better end product, we need to work with nature rather than against it, using its best methods for furthering production not just of materials but of end products. Call it a version of “grow your own produce” that is using the latest advances in biotech as well as our fuller understanding of natural processes to envision a future where growing your own computer, teacup, chair, bike, car, and indeed home are the norm.

To get there, we need to overcome certain preconceptions about what our products should look like. We also need to bring together some newer production methods, and materials that are showing promise as alternatives to our twentieth-century thinking about how to make things and what they should be made of.

opposite Protocells can sense, move, and replicate, but they are not alive. The Amoeba Trainer promotes the concept of bioengineered materials that can be 3D printed protocell by protocell in the shape of a runner's foot, then “turned on” with the user's movement, causing them to flock to areas where the most support is needed.



Robots in Gastronomy is a research group based in Spain, where chef Paco Morales and architects at GGLab have successfully 3D printed crockery and food.

3D PRINTING OF FOOD

There are some similarities between the growing of products and the current revolution in 3D printing. Though this phenomenon will be covered in more detail in the “Additive Manufacturing” chapter of this book, the idea of “growing” a substance through the cumulative adding on of material offers some great ways to manipulate biological materials not possible previously. Indeed, the successful production of 3D-printed food (www.robotsingastronomy.com) suggests that we are not far away from the blurring of the lines between grown and printed things.

CHEMISTRY OF PLASTICS: NATURAL VS PETRO

We know that almost all of the plastics utilized in the products we use in everyday life derive from oil. This oil, as we know, is the combination of many long-dead plant and animal species from prehistoric times. It is possible therefore that we could manufacture all the plastics we need from natural sources—grow them—as is shown by the currently large range of bioplastics we use. We need to move quickly

to a “third stage” of bioplastics, those made from large-scale production of plant species that are neither a food source for humans nor require the displacement of food crops (this topic is examined in the discussion of “Altered Naturals” in the *Architecture* book in this series). This third-stage production is exemplified by such sources as switchgrass (though even this produced on a large scale could affect local ecosystems), algae, bacteria, and to a certain extent, waste streams from the production of food from crops, though care must be taken that these wastes could not be effectively turned into food sources of some kind. Beyond this third stage is the potential to produce plastics from the carbon from CO₂, and there are some companies (for example, Bayer in collaboration with RWE, a power generator, of Germany) that will be bringing this production on line in 2015. Getting this production to the efficiency and cost effectiveness of our current oil-based solutions will take some work, but is possible, and viable.

Thinking beyond the simple replacement of oil-based plastics with those from bio or waste sources, there have been some effective forays into using biological sources to “grow” our products. Suzanne Lee’s BioCouture fabrics and