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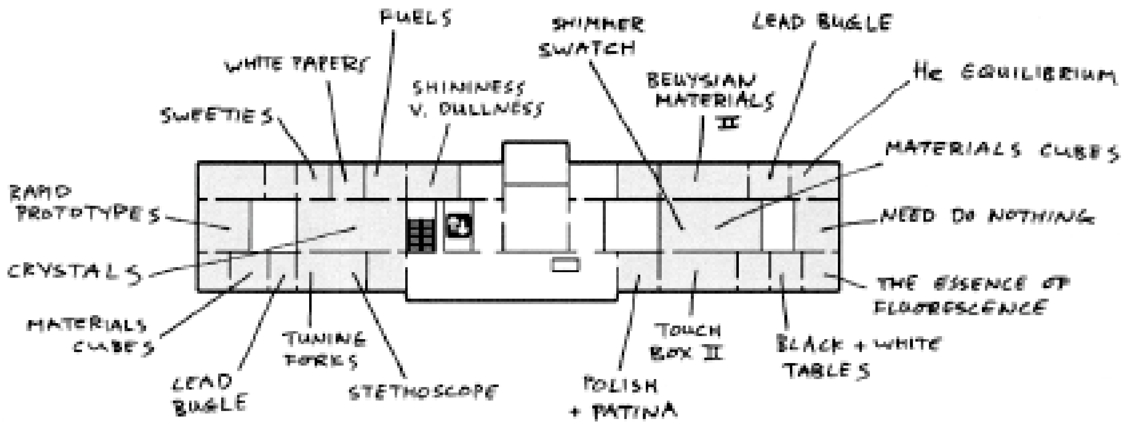
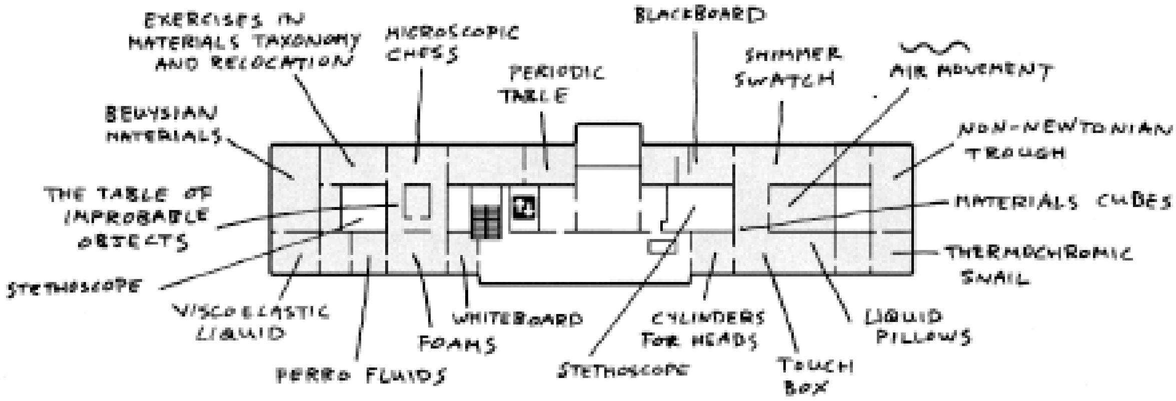
Materials Library Presents
Tate Modern

Conreen, Laughlin, Miodownik

November 2006

States of Flux **Idea and Object**





Poetry and Dream **Material Gestures**

Aim

Materials Library presents a series of events that explore the art and science of four new themes in the Tate Modern's Collection Displays: *Material Gestures*, *Poetry and Dream*, *States of Flux* and *Idea and Object*. For these events we have created a collection of Materials Conjectures that form part of a material conversation with the art. This takes the form of an exploration of artefacts and creations that bring a scientific understanding of matter to art.

Approach

Our approach is to use materials as a tactile language with which to explore the scientific, cultural and sensual aspects of art. Our hypothesis is that technical details enhance aesthetic experience and that generating physical encounters with matter, provides an often forgotten way into this technical knowledge. This approach is reflected in the events and the essays included in this catalogue.

Format

Each event takes place in one of the four new Tate Modern Collection Displays as follows:

Materials Library Presents

Act 1 - 6th November 2006

Material Gestures

1.1 = Scene 1: Gathering and Introduction
1.2 = Scene 2: Materials Conjectures within the gallery
1.3 = Scene 3: Drinks and materials conversations

Act 2 – 13th November 2006

Poetry and Dream

2.1 = Scene 1: Gathering and Introduction
2.2 = Scene 2: Materials Conjectures within the gallery
2.3 = Scene 3: Drinks and materials conversations

Act 3 – 20th November 2006

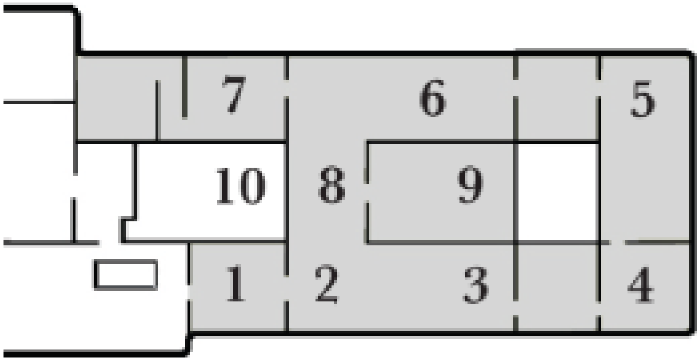
States of Flux

3.1 = Scene 1: Gathering and Introduction
3.2 = Scene 2: Materials Conjectures within the gallery
3.3 = Scene 3: Drinks and materials conversations

Act 4 – 27th November 2006

Idea and Object

4.1 = Scene 1: Gathering and Introduction
4.2 = Scene 2: Materials Conjectures within the gallery
4.3 = Scene 3: Drinks and materials conversations



Materials Conjectures

Cylinders for Heads .1
Touch Box .2
Liquid Pillows .3
Thermochromic Snail .4
Non-Newtonian Trough .5
Shimmer Swatch .6
Blackboard .7
Materials Cubes .8
Air Movement .9
Stethoscope .10

A Touchy Subject

Touch is the first sense to develop in the womb. By ten weeks a foetus responds to a touch on its cheek and starts building a tactile model of its world. Childhood toys are full of shapes and textures, which stimulate the haptic regions of the brain. Kissing, sucking, eating, chewing, breaking and throwing, are all methods of haptic investigation that enable us to create an understanding of the world around us. Actions like crawling and walking, all require our sense of touch to develop to a high level of sophistication. However, after childhood, unless afflicted by blindness, our haptic sense becomes dormant and the visual becomes the primary method of interrogating the world. This is obviously not just in the hierarchy of our cultural and intellectual institutions but also of day-to-day life. Supermarkets have discovered that it is the look, rather than the feel or taste of produce that determines their popularity. Design shops are full of chairs that look cool and stylish but are insanely uncomfortable. Fashionable clothing is designed to look good but very rarely to feel good. Ditto shoes. The epitome of this trend is lingerie, where a lacy thong or tight corsets create a physical discomfort that is endured for the visual pleasures they stimulate.

In adult life, our direct sense of the world is abstracted to, and mediated by, buttons and switches. Buttons on a keyboard, buttons on a phone, buttons in a car, buttons in the kitchen and buttons on remote controls. Even the buttons themselves are highly uniform, either being easy-to-clean minimalist affairs or spongy keyboard trampolines. Rarely does one come across the fluffy button, the sharp button or the button that requires at least two people to push it. We understand that to touch a button is to activate something but it is often forgotten that it is not only buttons that do this.

The button-orientated digital community are coming to grips with our need, desire and ability to sense our environments through touch. With this in mind they are developing virtual reality (VR) haptics. Touch is a notoriously difficult sense to simulate because it involves a complex mix of many different types of sensation: roughness, elasticity, thermal conductivity, electrical properties and chemical properties to name just a few. SensAble Technology's PHANToM, which allows a single point of force feedback to be simulated, is a basic first step towards VR touch: it has the form of a pen, but with an inverse functionality, it takes information and turns it into a force. The development of this VR technology and other ‘glove’ based approaches is vital to those developing virtual surgery as a technique to allow specialists to perform remote surgical operations all over the world. In this case, reliable mechanical feedback is a critical part of the ability to remotely manipulate objects such as scalpels and produce faithful haptic experiences. Museums are also interested in using this technology in order to allow the virtual handling of rare and delicate objects.

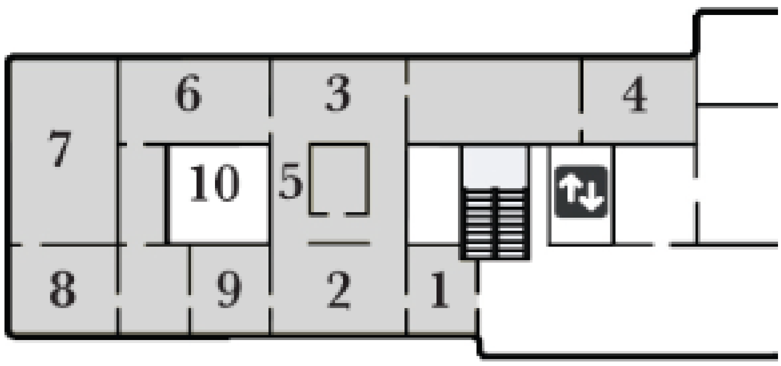
But of course, if VR touch technology follows the pattern of the internet, its expansion will almost certainly not be driven by these worthy aims but by the pornography industry's desire to offer the virtual touching of a different kind.

Both the haptic design of new materials and the development of VR touch require both a fundamental understanding of the science of materials as well as an understanding of the human sense of touch. Thus the advantages of multi-disciplinary teams are being recognised by industry. The first international workshop on Materials and Sensations was held in 2004 in Pau, France, and featured physicists, psychologists, materials scientists, designers and representatives from the fashion and cosmetics industries (www.2psm.fr). In 2005 the Victoria and Albert museum in London put on *Touch Me: design and sensation,* an exhibition that explored the pleasures, sensations and future of touch.

Lectures given without accompanying PowerPoint slides are in the minority and many people reach for a piece of paper to explain their point, but the communal engagement with objects and the tactile encountering of materials is rarely used as a learning aide. It seems odd that one can attend a lecture on the properties and uses of aluminium, for example, and not get a chance to manually manipulate a specimen. Equality one can read descriptions of the density and resultant heaviness of tungsten but it is not until one attempts to pick up a block of it that one begins to *know* the nature of the material. The idea of presenting data as a feeling, perhaps in the form of an object, is nonexistent in the sciences. Yet for many complex data sets this may be a far superior way to promote understanding, especially of forces and complex geometries. Architects and sculptors have been doing this for years, expressing information through form, but it is a pity that the 'please do not touch' culture of modern society prohibits us from accessing this information.

Picture Caption: Finger dipped in liquid latex during Materials Library's *Impermanent Materials* demonstration session at Tate Modern, November 2005. Photograph courtesy of Iona Ramsey.

Materials Library Presents… **Poetry and Dream**
Monday 13th November 2006



Materials Conjectures

Whiteboard .1
Foams .2
Microscopic Chess .3
Periodic Table .4
The Table of Improbable Objects .5
Exercises in Materials Taxonomy and Relocation .6
Beuysian Materials .7
Viscoelastic Liquid .8
Ferro Fluids .9
Stethoscope .10

Blue Sky Material

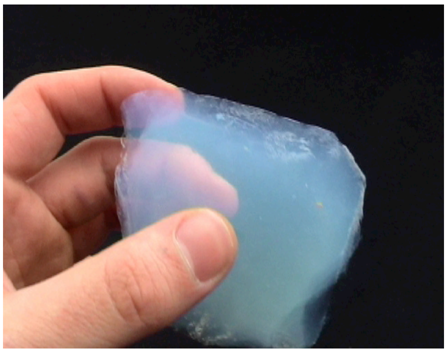
In the 1930s a chemist called Samuel Kistler, conjured into existence a new type of material solely to satisfy his curiosity on a purely academic question. The scientific community applauded briefly, and then forgot all about it. This is how one of the most beautiful materials in the universe was almost lost forever.

Silica aerogel is essentially a transparent form of sand, whose nano-structure contains up to 99.8% air, making it the world's lightest solid. Kirstler had been interested in understanding the structure of gels and in proving whether a gel contained a continuous solid network of material. He chose to do this by finding a method to remove the liquid from a gel without collapsing the solid pores, and in succeeding, created the most highly porous material in the world. First he did it with silica and then went on in a virtuoso performance to make alumina, tungsten oxide, and nickel tartrate aerogels. As an encore, he created what must now be regarded as the fluffiest omelette that has ever existed, egg aerogel.

But applications of aerogels did not take off. Their properties of extreme low density and thermal insulation were ahead of their time and so more than fifty years went by without aerogels really finding a place in the world. Then in the 1980s NASA started playing around with them and decided that perhaps aerogels were not really suited for planet Earth. The result was the Stardust mission to send an aerogel capsule on a close approach to the comet Wild 2, collect space dust, and return to Earth. What made aerogel ideal for the mission was that this ultra fine foam can gradually decelerate and capture dust particles in pristine condition. Since the dust particles impact the aerogel at six times the speed of a rifle bullet, this is no mean feat. Imagine jumping from a jet plane and landing on a foam mattress that breaks your fall so gently that you emerge on the ground perfectly unruffled; this is how aerogel handles space dust, and by doing so, prevents its microstructure and chemistry from being changed through heating. The returning capsule containing the stardust successfully re-entered the Earth's atmosphere and landed on the 15th January 2006. Now the process of sifting through the aerogel, micron by micron, to identify and collect the space-dust has started. This is set to be the world's largest collaborative microscopy activity: it is has been shared out, to anyone willing to help and with access to the Internet (see http://stardust.jpl.nasa.gov).

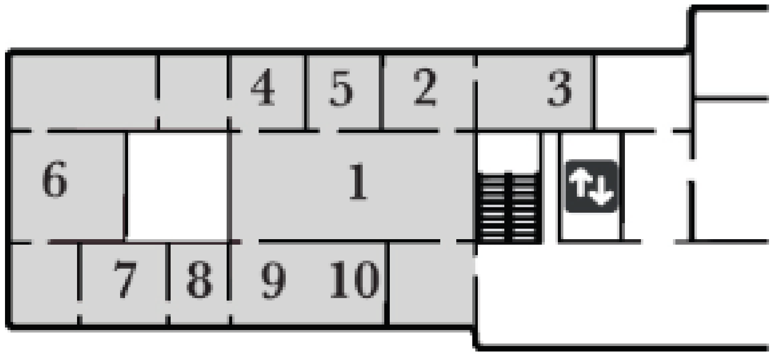
In the mean time environmental concerns have finally become a high enough priority that aerogel's extraordinary thermal insulation properties can be commercially exploited. The big problem is how to deal with the brittleness of aerogels. The solution of the company Aspen Aerogel is to incorporate aerogels into a fabric and thus make them much easier to handle and install. The applications are as various as insulation for oil pipelines, Arctic expedition footwear and NASA space suits. Another solution, by a company named Cabot, is to produce aerogel in a granular form so that it can be pumped into building cavities. This has also allowed the development of transparent aerogel skylights; now much beloved by architects for the quality of light they cast into a space, combined with ultra-insulating credentials.

The seventy year journey of aerogels from their birth as a result of curiosity-driven chemistry, to being the centre piece of NASA space missions, and then hailed as a miracle design material, appears haphazard because the material was written off so many times. However, anyone who has ever held a piece of aerogel in his or her hand will understand why it was never forgotten. Aerogels do not look like anything else you have ever seen. If someone told you that they had been discovered in a crashed space ship, you would believe them; everything about them is alien. The material has the ability, like no other, to compel you to search your brain for some excuse to be involved with it. Like an enigmatic party guest, you just want to be near it, even if you cant think of anything to say.



Its allure is difficult to describe. The material appears to be much more invisible than glass despite being less transparent. This is because there is no hint of reflection on its surfaces giving it the appearance of not being fully solid. Its azure colour is not due to any pigmentation, but is caused by the same phenomenon that gives colour to our Earth's atmosphere, namely Raleigh scattering of light. For this, and many other reasons, aerogel really is the ultimate blue sky material.

Picture Caption: Silica Aerogel produced by Steven M. Jones of the NASA Jet Propulsion Laboratory. Demonstrated by Zoe Laughlin at the Materials Library's *Impermanent Materials* event at Tate Modern, November 2005.



Materials Conjectures

Crystals .1
Fuels .2
Shininess v Dullness .3
Sweeties .4
White Papers .5
Rapid Prototype .6
Materials Cubes .7
Lead Bugle .8
Tuning Forks .9
Stethoscope .10

The Sound of Materials

We live in a visually orientated culture in which sight is foregrounded as the primary sense. It is no surprise that when talking about the world around us we allude to its visual qualities: a dazzling vista, an eye-catching jumper or a mesmerizing sunset. We describe people similarly, with reference to radiant beauties, luminescent complexions and eye-popping hunks: reinforcing the primacy of the visual. However, our sensual relationships with people are not based solely on looks; we care how they smell, how they feel, how they warm us, and how they sound. The same is true of our relationship with our environment in general.

We know the sounds of individual doors in our houses and can distinguish between someone leaving or entering from the delicate variations of keys rattling and hinges squeaking. You can identify any member of the family coming up the stairs from the subtle differences in rhythms and the pitch of the creaks produced. These acoustic qualities of a home are important but often overlooked. Carpeting over the tiles in the hall for example makes for a cozier surface under foot but at the same time the house loses its ability to announce a visitors choice of footwear: the squeak of rubber tennis soles, the tip-tap of stilettos and the solid thump of work boots are banished from the acoustic landscape of the home. Carpet acts on a home as a kind of auditory gag that mutes the sonic signatures of its inhabitants.

Whilst some sounds make us feel comfortable, relaxed and 'at home', others can unsettle and disturb us. An absence of sound can indeed be one of the most disquieting of acoustic effects. Each time the lock of a hotel room is replaced with silent swipe card access, we lose the reassuring sound of metal clunking into place in announcement of security. The token electronic beep that is sometimes inserted as a sonic cue to signal a successful swipe, evokes a wholly different set of audio connotations; those of the supermarket checkout or high street cash machine. Automotive engineers understand the importance of sound to signal security, reliability, safety and quality. It would be possible to totally insulate the inside of a car from engine noise but there is a degree to which the hum of the engine is a comfort to those within, as well as an aide to the driver when selecting a gear change. Good architects also know the value of acoustics and sonic signatures, putting as much attention into how a building will sound as to how it will look. Specific spaces require specific understandings of how sound is deflected and absorbed, allowing concert halls to reverberate the sinews of the audience (be they sat in the back or the front row) or people to have intimate conversations at a comfortable volume whilst having dinner in a crowded restaurant.

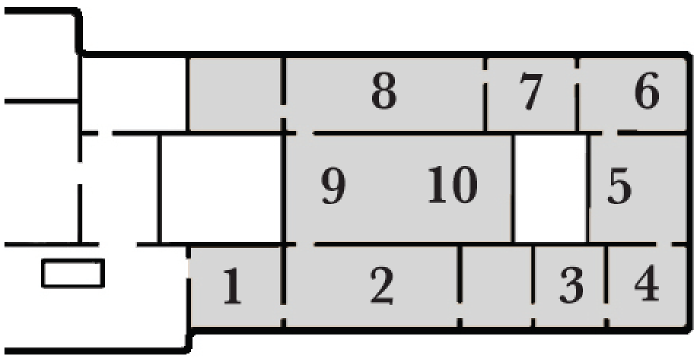
Sounds and their cultural resonances are built upon material relationships that produce specific acoustic effects. Imagine the sound of a prisoner running a polystyrene cup along the iron bars of the cell, as apposed to the archetypal enameled steel cup. We can all call to mind the sound of a stick running along railings but can we imagine how this sound would change if the railings were glass and the stick carbon fiber?

The materials science of acoustic properties has a long and interesting history starting from the early design of musical instruments. Brass trumpets range from very hard nickel-silver through to softer red and yellow brass and onto to an extremely soft am-bronze alloy. The pitch of instruments is linked to the material's modulus and density, whereas the 'brightness' of an instrument is linked to its loss coefficient, allowing higher overtones in the musical spectrum. Softer alloys tend to sound warmer and duller – lead being an extreme case.

Picture Caption: Lead Bugle created for Materials Library by Rex Garrod

Designing the acoustic properties of materials for instruments is thus a strange combination of art and science: it must take into account musicians cultural sensibilities and musical tastes, as well as the fundamental materials science of manipulating density, hardness and modulus while producing an alloy that can be formed or cast into the instrument's shape. The sophistication of church bell design is a good example of this, with artists, musicians and metallurgists all involved in designing powerful and unique sounds for civic buildings. The sound of Big Ben in the Houses Parliament in London is a good example of a bronze auditory signature of democracy; it is measured, grave and earnest. Sets of bells with unique peals have been culturally important throughout history, not only signaling time, but ringing out declarations of love on wedding days, tolling at death and warning of danger in times of war.

Materials Library Presents**… Idea and Object**
Monday 27th November



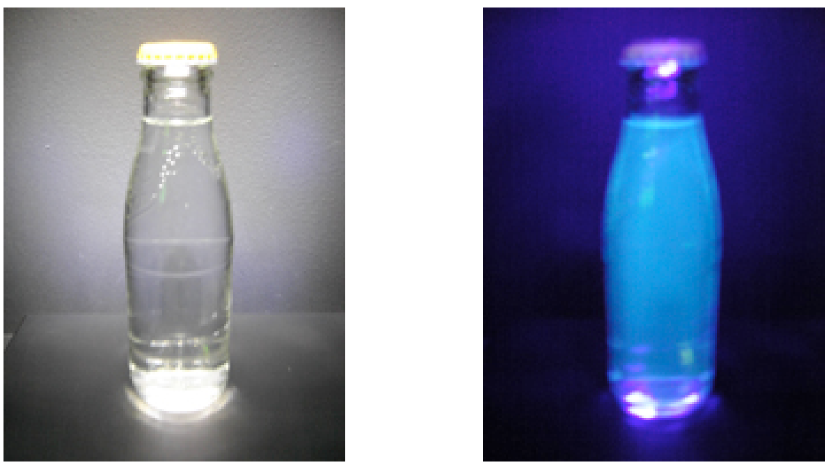
Materials Conjectures

Polish and Patina .1
Touch Box II .2
Black and White Tables .3
The Essence of Fluorescence .4
Need Do Nothing .5
He Equilibrium .6
Lead Bugle .7
Beuysian Materials II .8
Shimmer Swatch .9
Materials Cubes .10

The Essence of Fluorescence

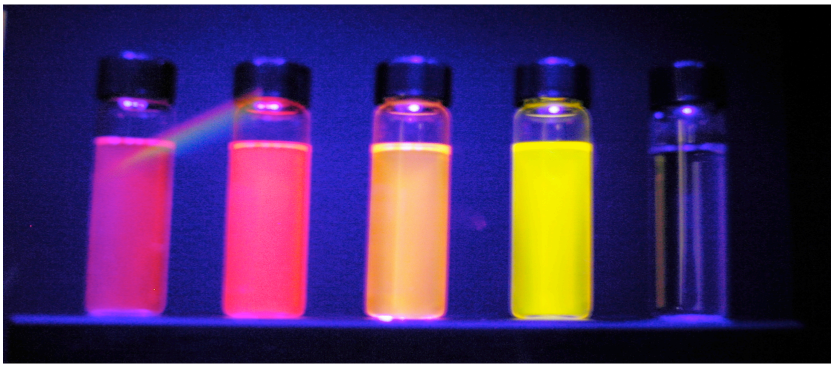
Like a hammer, fluorescent pigments are very rarely used with subtlety. High visibility jackets and garish nightclub interiors are, on the face of it, their sole purpose. The colours hit you like a smack in the face and that is, in essence, the point. But there is another side to fluorescence, a distinctly darker side.

Fluorescent agents convert invisible ultraviolet (UV) light into visible light: a wavelength we cannot perceive is transformed into one we can. Since UV light is invisible, a dark room bathed in UV light, remains dark. Unless, that is, there is something fluorescent in the room, where upon the fluorescent object springs into view, appearing to glow as if lit from within. Trawling around a pitch-black house with a UV portable light is like scuba diving without getting wet. Opening a desk draw reveals that some seemingly mundane pens and papers have a hidden life; they fluoresce mysteriously, as if members of a disco stationary cult. An occasional postage stamp also lights up. Whole shoals of books and magazines loom into view. This latter effect is due to the blue fluorescent pigment in modern paper designed to make it appear whiter than white. More of this pigment is to be found in the bedroom, where in the darkness you encounter squids and eels, which are really shirts and socks glowing blue-white, again due to fluorescent pigment imparted by washing powder as an artificial whitening/brightening agent. A trip to the bathroom becomes a dreadful shock; those clean tiled surfaces are suddenly, like in some ghastly TV advert for bleach, full of yellow and blue stains. But these fluorescent infestations are as much due to the cleaning agents used as the bacteria present. If you need a drink at this stage, a gin and tonic will do little to calm you down, it glows bright blue in UV light, due to the quinine in the tonic water which also fluoresces.



Picture Caption: Tonic water viewed under white then UV light

Such an ultraviolet swim requires a portable ultraviolet light. These are easy to obtain precisely because so many professionals rely on them. Gemmologists tell a good diamond from a dud using a UV light: fluorescent diamonds appearing to be milky due to the internal production of light, which reduces their value. In contrast, finding fluorescence in bank notes ensures value, since it is there as an anti-fraud device, as it is on passports, credit cards and all manner of formal ID. Recently fluorescent millimetre sized micro-dots have been produced which can be sprayed onto any object and are invisible except under UV light. These dots, produced by DataDot technology, uniquely identify an object and are being used successfully by BMW and other auto manufacturers to prevent the theft of automobiles for their parts. If this becomes standard practice, UV lights and magnifying glasses are likely to become essential kit for mechanics in the near future.



Picture Caption: Nile Red under UV light (produced by Dr Klaus Suhling)

The discovery of the naturally accruing green florescent protein (GFP) in the *Aequorea victoria* jellyfish has turned fluorescence into a vital biological tool. The cells of plants and animals can now be genetically engineered to contain GFP and so fluoresce under certain environmental conditions or in the presence of certain proteins. This means that the inner working of cells and tissues can be interrogated using a microscope attached to a UV light. Another fluorescent molecule beloved of biologists and materials scientists is Nile Red. This molecule will fluoresce a different colour depending on the polarity of its environment. Such behaviour qualifies it for 'smart material' status and means that the evolution of functionality and disease in biological tissues can be mapped in colour.

Whether it be from a stamp on a postcard from Canada, or a piece of seemingly nondescript rock, or a fungi growing slowly on the bark of tree; fluorescence is everywhere. It is capable of producing the exuberant brightness of a fluorescent tube as well as exquisite subtleties of phosphorescent algae. Its aesthetic charm derives not just from its colour and brightness but also from its role as a secret chemical agent. This is the essence of fluorescence.

There are materials libraries in New York, Amsterdam, Berlin, Paris, and London. Apart from a commonality of purpose, these materials libraries share very little else. Unlike libraries of books, which have had hundreds of years in which to refine and agree on standards, formats and taxonomy, the materials library as a formal concept is barely ten years old. Some libraries exist primarily as a searchable database, with a much smaller physical archive of samples. Others exist as a specialised reference library on a particular topic for a particular type of practitioner.

Our approach is different. We believe that materials are a language that we all use to communicate not only with each other, but also with the past and the future. The arts are expert in this language of the senses and so it is clear that they need materials libraries as creative tools, much as a novelist needs a traditional library. But here the similarity ends. It makes no sense to talk about the science of words, but the science of a material is vital knowledge that underpins the art, craft and mastery of all materials. So to our mind, a materials library without an interface with the science is like a library without an index, fun but frustrating.

A chunk of Aerogel from the Jet Propulsion Laboratory of NASA that, at 99.8% air, is the worlds lightest solid; a tile of aluminium nitride that conducts the heat from one's hand efficiently enough to cut ice as if it were butter; a Lead Bugle: in the Materials Library these materials are gathered together not only for scientific interest, but for their ability to fire the imagination and advance conceptualisation. Our hypothesis is that not only are technical details essential for makers, they also enhance aesthetic experience and that in generating physical encounters with matter, one provides an often forgotten way into this technical knowledge.

Picture Caption: Materials Library Group performing Wax Lyrical, a piece composed for wax instruments, at The Cheltenham Science Festival, June 2006.

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