Colour agencies, a practice-based research project in search of a contemporary understanding of colour

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Abstract

Finite resources and mass extinction caused by global warming have a deep impact on our current way of understanding the world. Therefore, the need for a practical and theoretical focus on a more sustainable and empathetic gaze towards human and non-human relations, including our relationship with matter, is driving a search for new perspectives and procedures in research and teaching of design processes in academic institutions.

As a result of a long-standing engagement with the matter of colour at the Chair of Visual Arts in Architecture Department at RWTH Aachen University/GER, the ongoing research project 'Living Colour' was conceived in 2020 and implemented as a teaching format.

Living Colour' discusses a theoretical context of contemporary colouring methods and the sustainable production of material and its application. Questions of cultural, ecological and social implications and how specific characteristics of organic sources affect design processes are examined and reflected on.

The focus lies on the processual, performative and transformative qualities of the colouring agents regarding lightfastness, temperature, moisture and carrier material. Practices and outcomes give insight into the impact of intertwining interdisciplinary theory and practice, treating both as equals for the production of knowledge in research and teaching.

Keywords: material agency, design-research, colour research, academic teaching, new materialism, practice-based research, material-science

Fig. left. Joergens, M., 'Haematometer' tool to measure the transformation of bruises, 15 cm diametral, cotton dyed with diverse plant colours, © Neuefeind, A.

Fig. right. Hensel, S., Chlorella vulgaris, © Hensel, S.

Resumen

La limitación de los recursos y la extinción masiva provocada por el calentamientoglobal tienen un profundo impacto en nuestra actual forma de entender el mundo.Por ello, la necesidad de un enfoque práctico y teórico sobre una mirada mássostenible y empática hacia las relaciones humanas y no humanas, incluidanuestra relación con la materia, está impulsando la búsqueda de nuevasperspectivas y procedimientos en la investigación y la enseñanza de losprocesos de diseño en las instituciones académicas.

Como resultado de un largocompromiso con la cuestión del color en la Cátedra de Artes Visuales en elDepartamento de Arquitectura de la RWTH Aachen Universidad/Alemania, elproyecto de investigación en curso "Living Colour" fue concebido en2020 y puesto en práctica como un formato de enseñanza.

En "LivingColour" se discute el contexto teórico de los métodos contemporáneos decoloración y la producción sostenible del material y su aplicación. Se examinany reflexionan las cuestiones relativas a las implicaciones culturales,ecológicas y sociales y cómo las características específicas de las fuentesorgánicas afectan a los procesos de diseño.

La atención se centra en lascualidades procesales, performativas y transformadoras de los colorantes enrelación con la resistencia a la luz, la temperatura, la humedad y el materialde soporte. Las prácticas y los resultados dan cuenta del impacto de entrelazarla teoría y la práctica interdisciplinarias, tratando a ambas como iguales parala producción de conocimiento en la investigación y la enseñanza.

Palabras clave: agencia de materiales, investigación en diseño, investigación del color, enseñanza académica, nuevos materialismos, investigación basada en prácticas, ciencia de los materiales

Context

In short, sustainable access to natural resources has become essential and demands a rethinking of our usual production techniques. Recent perspectives such as poststructuralism (Deleuze, Guattari, 1980), Actor-Network-Theory (Latour, Callon, Law, 1980) and Material-Oriented Ontology (Bennett, 2010) seek to challenge the hegemony of the previously-dominant anthropocentric outlook, aiming to change our perspective towards the agency of the non-human and therefore constitute a perspective of acknowledgment, companionship (Haraway, 2003) and care towards other entities (Neimanis, 2017)[1]. This especially applies to the rising awareness of how the interconnection between human and non-human forces across all disciplines has led to a renewed engagement with the dynamics of material and its entanglement with discursive practices, a perspective which is referred to with the term New Materialism or Material Turn (Yoshihara, 1956, Barad, 2007, Ingold, 2007)[2]. Philosophy, and Social and Cultural Sciences shed new light on material properties and their role in the production of art, design and architecture. The research project 'Living Colour' discusses these theoretical perspectives in order to consider novel accounts of acting forces, processual nature and self-organising capacities of matter, whereby matter is perceived as co-productive in conditioning and enabling social worlds, human life and experience.

This framework, given during the teaching format, requires operating in practice, "the turn to the performative, which revises traded methods and integrated experience and aesthetics, characteristic to arts and design, in a culture of knowledge

[1] Poststructuralism established theories to overcome humanistic human-centred views in philosophy. In visual arts, design and architecture, these ideas had a deep impact in theoretical and practical belongings, because they changed and challenged common conceptions of creativity. Among the many positions we cite are Deleuze and Guattari, establishing the idea of assemblage, and Latour, who developed the Actor-Network-Theory, or ANT, with Callon and Law at the same time, enabling ideas of agency and symmetric relationship.
In parallel to this development, Donna Haraway proposed provocative theses on biotechnological challenges and the conditions of making science. Her border-crossing analyses on science and social relations, and her term 'situated knowledge' (1988) paved the way to trans-disciplinary forms of research as well as marking a fundamental shift in understanding human agency. Her term 'companionship' (2003) suggests an equality of all entities including animals, plants and matter and emphasises relationship, which gave an important impulse to change perspective on scientific and artistic practice, similar to Jane Bennett's political and ecological approach to materiality in her main work "vibrant matter", 2010.
Astrida Neimanis is one of many thinkers and writers who suggests rethinking the dominant Western and humanist understandings of embodiment, where human bodies are figured as fundamentally autonomous from the non-human, and who proposes to cultivate gestures of empathy, stewardship and nourishment towards natural commons in the context of finite resources.

[2] Important aspects in new materialism concerning material agency are the mutual relationship of material and mind, as stated in opposition to western humanistic thinking by 'gutai', a group of Japanese artists in 1956, and stated by Jiro Yoshihara in the "gutai manifesto" as well as the focus on a material-discursive practice by Karen Barad on materiality and performance in her "agential realism" in 2012. Her main influence on practice-based research formats is her conclusion that knowledge is continuously changing in practicing with materiality.
Ingold follows this argumentation when stating "The properties of materials, then, are not fixed attributes of matter but are processual and relational." He also shaped the term "ocean of materiality, in which humans like all other entities, swim." (Ingold, 2007, p.8). In this ocean materials exist on their own terms. "Plants, too, provide an endless source of materials for further processing and transformation. One has only to enumerate, for example, all the different materials that can be derived from trees, including wood, bark, sap, gum, ash, paper, charcoal, tar, resin and turpentine (Ingold, 2007, p.8).

is rising, (and) in which knowledge is experienced in action and process." (Bippus, 2012, p.18)[3]. Research on design-processes reveal that the active qualities of matter are valuable partners in body-material-dialogues, examined and described in Embodied Knowledge (Christensen et.al., 2020, Schmitz, Groninger, 2014)[4], Tacit Knowledge (Palaasmaa, 2009) and Reflection-in-Action (Schon, 1982). Tight relations are stated between scientific and artistic research practices since both are based on intuitive, exploratory aesthetic and experimental approaches to achieve knowledge (Mareis, Windgätter, 2014, Bippus, 2012, Rheinberger, 2001). Seen this way, creating material knowledge in the higher education of art, design and architecture is applied research which again reflects the strong entanglement of theory, method and practice (Borgdorff, 2015). In academic education, architecture is taught as a discipline which intertwines artistic and technical knowledge into a built design. It is also a subject with social responsibility and impact. Social, cultural and economic demands have to be skilfully combined with design processes since the effect, the organisation and the appearance of the built environment concerns all of us as well as the non-human. If architecture is to reflect its time, it has to develop appropriate tools to react to environmental changes including new working methods and concepts. The aim of the exam regulations for the Master of Architecture and Urban Planning degree program which came into force in 2019 is to establish a stronger link between teaching and research and to integrate the students as "science assistants". Here, research-based studying serves to develop not only interdisciplinary and innovative teaching, but also critical awareness and, increasingly, to introduce students to a research culture of their own.

Colour as matter is a fleeting phenomenon that people have been trying to grasp in sciences as well as art, architecture and design for thousands of years by looking, wandering, dreaming, painting or writing (Schmitz, Schröder, Kramer, Neuefeind, 2019)[5]. Yet, living in a contemporary colour world, we tend to forget that most colouring agents once originated from minerals, lichens, insects, and plants. The development and industrial production of synthetic pigments and dyes starting

[3] Performative Turn is a collective term to describe the rising interest in performance and action in epistemological processes, whether artistic or scientific. Practice in general comes into focus in academic research, not only as a subject but also through performative methodologies like re-enactment, re-construction, reflection-in-action and so-called hands-on practices.

[4] Christensen, Drach et.al, (2020) Schmitz, Häußler, Mareis and Groninger (2014) edited publications on practice-based research in an architectural context, and share the thesis that media and materiality in the draft not only depict, but in turn are the basis of further knowledge acts.

[5] "Orte der Farbe": a multidisciplinary approach to colour in spatial situations was published in 2019. Diverse positions on the fleeting phenomena of colour were discussed and assembled in this book after an international conference, held at RWTH Aachen University in 2015.

in the late 19th and early 20th century[6] led to the imitation and replacement of traditional colouring agents. The new dyes and paints were more brilliant, durable and affordable. In just a few decades, the colours that had previously come from all sorts of organisms and mineral sources were cast aside. We find ourselves in an "artificial paradise (…), the ultimate mimetic camouflage that allowed second nature to pose as nature." (Taussig, 2006, p. 49). Furthermore, a long tradition of know-how on the manual production of pigments and dyes, a knowledge which is nowadays referred to as tacit knowledge[7], has been cast into oblivion. In scientific research on colour, especially in material art history and conservation science, there is a growing interest in recovering (and discovering) knowledge involved in the manual practices of 'making' colour, conserved in historical recipes. The re-enactment of these recipes can provide us with artisanal and tacit knowledge that exceeds the language-based notes of a historical journal[8].

Another hands-on approach to the matter of colour is performed by the interdisciplinary institution Haus der Farbe, Zurich/Ch where craftsmen and scientists cooperate on different aspects of colour in architecture. Here, colour as a supply material is handled and examined as a fundamental part of a design practice while it remains strongly connected to a traditional craft knowledge[9].

The research around colouring agents derived from microorganisms is rather new, although research on microorganisms used in various other fields has been ongoing for several years. Increased global warming has paved the way for engaging with microorganisms as they sequester atmospheric CO2 and convert it into biomass, as a source of nutrition, or as a helpful indicator where colour often acts as a signal for environ-

[6] William Henry Perkin wasn't trying to make the colour red in his lab that day. As a research assistant for a famed chemist, he was trying to whip up synthetic quinine, a treatment for malaria. Perkin was interested in the properties of coal tar, an abundant by-product that comes from heating coal. But instead, he ended up with a dark powder. Washing out his flask with alcohol, Perkin was struck by the residue's bright purple colour. He tried using it to dye silk, and it was a success. Perkin had found the world's first synthetic dye. From that moment on, "coal-tar color coated the world as a natural backdrop. Coal-tar color became the light of the world.", M. Taussig, 2006, p. 49.

[7] Tacit knowledge, a term coined by Michael Polanyi, as opposed to explicit knowledge, is a form of knowledge that is difficult to transfer to another person by means of writing it down or verbalizing it. Abilities such as facial recognition, riding a bicycle or kneading dough require all sorts of knowledge which is not always known explicitly, even by expert practitioners, and which is difficult or impossible to explicitly transfer to other people. In design, arts and architecture this concept of implicit knowledge has a deep impact on teaching methodologies.

[8] In contemporary research on colour, performative methods like re-enactment are practiced in art history and conservation studies by Sven Dupré, "Art Techne—making and knowing on arts from the 15th century until today" and Anne-Sophie Lehmann, with the making and knowing project on arts in renaissance, University of Utrecht, Netherlands, as well as in The Straus Conservation Center, Harvard Art Museum, in their colour laboratories, and by Pamela Smith, "the making and knowing project - intersections of craft making and scientific knowledge", Columbia University, NY. https://harvardartmuseums.org/teaching-and-research/research-centers/straus-center-for-conservation-and-technical-studies

[9] Haus der Farbe, Zürich, is a Swiss institution to connect theoretical knowledge with skillful experience in craftsmanship. Applied Research on colour is strongly connected to contemporary practice in workshops and studios. https://hausderfarbe.ch/de/institut/forschung/

mental change. As colorants, their biomass is mostly extracted in the food industry, where they need to be compatible with food flavours, safety, and nutritional value. Microorganisms already produce industrially useful natural colorants such as carotenoid and anthocyanin, while contributing to the sensory attributes of food. However, research into the creative and artistic value of these organisms is only at the starting point. Capable of producing colours in numerous different shades and hues, they could serve as ecological substitutes for the ready-made colouring agents we buy in shops. In recent scientific art and design studies, there have been cooperative efforts to connect design, technical and biological knowledge and expertise on plant-derived colour (Atelier Luma, Arles, Colorlab/Laboratorium, Ghent, Greenlab, Berlin)[10].

How long does it take a dye to be grown and produced by plants or seaweed? How do they influence the choreography of a design? Similarly, how can they direct our daily gaze? Can their characteristics enable new forms of colour appearance or the perception of colour? How does their agency affect and change the design-process? What are the ecological, political and social implications? These are the main questions tackled by the 'Living Colour' research project.

Fig. left. Joergens, M., paper dyed with Arthrospira platensis, © Neuefeind, A.

Fig. right. Hensel, S., pigment extracted from micro-algae Dunaliella salina (left) and Arthrospira platensis (right), © Hensel, S.

[10] The three projects chosen may be representative of the broad range of cooperation:
> Atelier Luma - an interdisciplinary experimental cultural institution based in Arles, southern France, "brings together experts in design, art, biology and technology with regional partners and material resources such as algae to create new and sustainable solutions." https://atelier-luma.org/en/about
> Laboratorium is a biotechnological laboratory based in the KASK School of Arts in Ghent, Belgium. Its "Color Lab was a trans-disciplinary research project approaching the colour field from different perspectives: from sustainable production and application to the use of colour as a common language between art and science." http://www.laboratorium.bio/
> Greenlab Berlin- a laboratory for sustainable design strategies. "Initiated in 2010, the interdisciplinary greenlab laboratory at Weißensee Kunsthochschule Berlin links university projects with practice-oriented research and industry with the aim of inspiring and developing innovative concepts for sustainable and environmentally-friendly products and services. In this research-oriented collaboration, sustainable design methods and strategies are to be applied to develop and implement new concepts and answers to ecological, social and cultural questions." http://greenlab.kunsthochschule-berlin.de/

'Living Colour' research project

As a teaching format, 'Living Colour' took place for the first time in the 2020/21 winter semester with 12 Architecture Masters students in order to discuss the agency of colouring agents sourced from living organisms. With respectful consideration of the historically tactile qualities of colour before the rise of synthetic paint, we explored the sensory and bodily experience of colour in detail. Following Ingold's proposition: "Could not such engagement–-working practically with materials—offer a more powerful procedure of discovery?" (Ingold, 2007, p.3), participants produced and used pigments and dyes derived from different organisms such as plants, micro-algae or cyanobacteria, by following different instructions for experimental settings. Ingold points out that "the knowledge of a skilled practitioner in a world of materials is a knowledge born of sensory perception and practical engagement." (Ingold, 2007, p.11-12).

'Living Colour' started from everyday colour phenomena, such as the industrial dyeing of diverse food products like salmon or oranges. By raising awareness regarding the cultural, ecological and economic dimensions of such quotidian phenomena, a layer was added that shed new light on the usage of colouring agents.

Learning outcomes included the acknowledgement of interdisciplinarity (art/architecture and biotechnology) as a potential for innovation, the reflection on the temporality of materials (growth, fragility and decay as the resulting properties) and its implications for their usage and the investigation of architectural topics such as the interaction of location, weather conditions and time and the resulting implications for the choice of material. Since the colouring agents are fugitive, participants reflected on the capacity to convey the momentary aspects of sensation and how we have lost or even have never learnt an ability to support change and seasonality as part of the characteristics of time.

Practice, process and results were thoroughly documented (photography and video-documentation, handwritten notes and sketches in research journals) and were reviewed at short time intervals in online meetings. The discussion was intersected by theoretical sessions in order to connect the practical experience to an anthropological and philosophical understanding of matter in general. Hence, this research on colouring agents served as a micro-history that can propose a new understanding and perspective of how we now considerately and sustainably refer to matter and consequently, to the environment where this matter originates.

Tacit Knowledge

Madder root and Indigo

One of the aims of 'Living Colour' was for participants to rethink our material production modes. Once a dye is produced from madder root or enough lichens harvested to dye a piece of fabric, the participants carefully used what took seasons to grow, a process similar to what Taussig describes as "slow deliberation of speed, or rather non-speed" (Taussig, 2006, p. 164). Therefore, the research project acknowledged the methods and strategies of pigment and dye production before the rise of synthetic paints, when tacit knowledge was a given for many individuals. Here, historical recipes of plant-based dyes (such as madder lakes and Indigo) served as a guideline[11] with the aim of tracking the affect those manufacturing techniques have on the researcher. The objective was to stress the spatial, bodily and sensory experiences of the participants and to develop or rethink specific choreographies of producing a colouring agent, considering the movements which dyers have performed over hundreds of years before paints were industrially produced.

Fig. left. Hadasch, L., cotton dyed with Rubia tinctorum (madder root), @ Hadasch, L.

Fig. right. Aliskan, A., Isikli, T., following instructions on extracting colour from Indigofera tinctoria (Indigo), video still, @ Aliskan, A.

[11] "Re-enactments of historical techniques bring to the surface ideas that are often latent in strictly theoretical approaches to technique and materiality. By investigating recipes of pre-modern color, we engage with colour as both technique and concept, as the cross-geographical product of nature and artistic experimentalism, and, above all, as an area of study that has increasingly come to move across disciplines and scholarly domains" Dupré, S. (2018) (Blogpost) available online at: https://artechne.wp.hum.uu.nl/re-working-with-makers-part-2/
Sharifa Lookman remarked, regarding the 2019 ROOTHS summer school (Research on the Origin of Historical Techniques):
"As a participant, I found that the summer school's give-and-take between the written word and re-enactment emphasized two fundamental ideas in the study of color technologies: his process, the mutability of language in interpreting recipes and the intellectual merit of touch and sensation in reconstructing them; in other words, the valuable cross-fertilization of both mind and body in materiality studies." Lookman, S. (2019) (Blogpost) available online at: https://artechne.wp.hum.uu.nl/experiencing-historical-techniques-through-the-color-black-at-the-roohts-summer-school/)
"Drawing on techniques from both laboratory and archival research, the Making and Knowing Project crosses the science/humanities divide and explores the relationships between today's labs and the craft workshops of the past, and between pre-industrial conceptions of natural knowledge and our understanding of science and art today." Smith, P. (2015) available online at: https://www.makingandknowing.org/about-the-project/

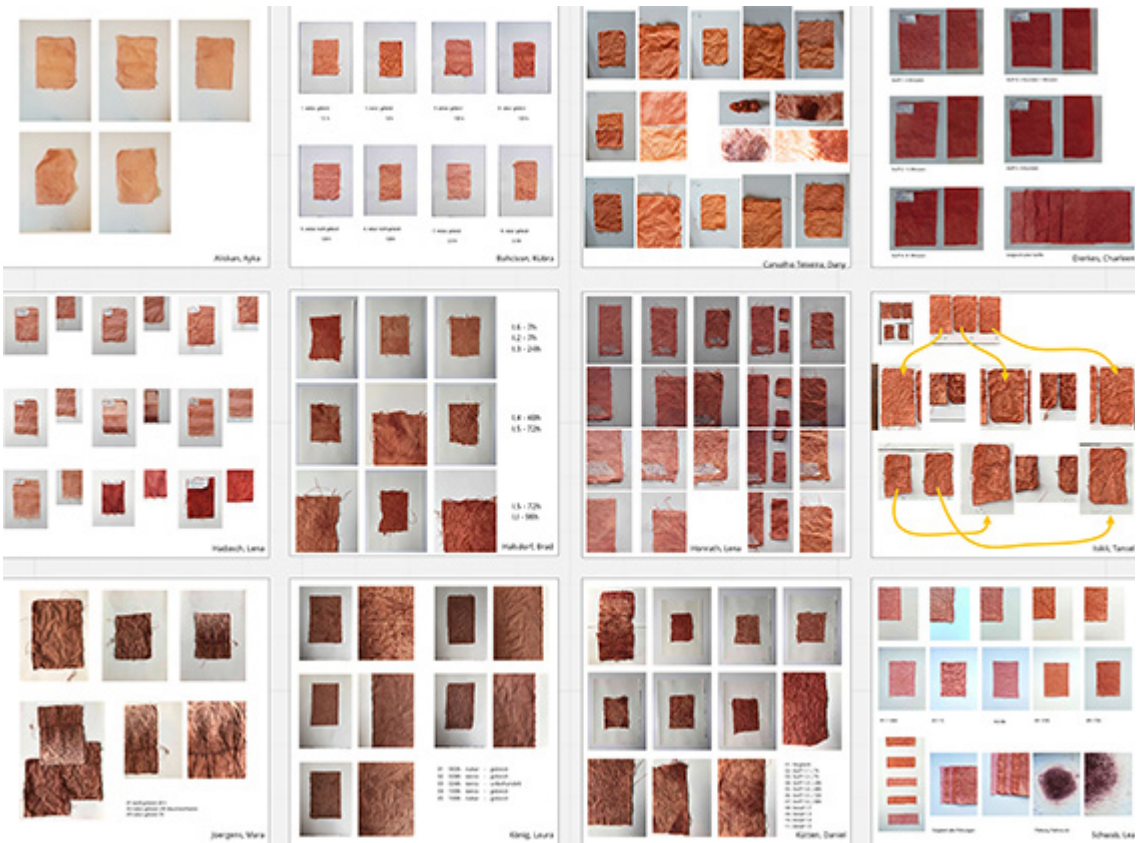

Fig. Presentation and discussion of results, cotton and linen dyed with Rubia tinctorum (madder root), screenshot, © Hensel, S.

Agency

Plants, micro-algae and cyanobacteria

Fig. left. Hadasch, L., paper dyed with chromatography of purple maple leaves, © Neuefeind, A.

Fig. right. Honrath, L., paper and cotton dyed with pale green lichen, © Neuefeind, A.

Following the idea of seasonality and locality, one student task evolved around the investigation of their respective surroundings with regard to potential colouring sources. Inspired by the 'Colour Walks' of William Burroughs, they were invited to stroll around their neighbourhood and engage in observation of organic sources such as plants, mushrooms, algae or lichens. This served as a way to reflect on the specific colour palette of their daily environment and to acknowledge the potentials that lie at their doorstep at this particular moment in time. A Google map documented the respective locations (accessible online). The sources found were surprising, and much more than could be expected in a north European winter, thanks to saturated colours that came from mushrooms, mosses, berries and flowers.

Fig. left. Dierkes, C., documentation of 'Colour Walk' in the centre of Aachen, © Dierkes, C.

Fig. right. Schwab, L., diagram and text observing her own body after consuming beetroot, © Schwab, L.

Another task used an environmental chamber, a UV-light simulation chamber. In general, an environmental chamber, also called a climatic chamber or climate chamber, is an enclosed space used to test and simulate the effects of specified environmental conditions on biological items, industrial products, materials, and electronic devices and components. In this task, students dyed several papers with a strongly saturated blue from Arthrospira platensis and spread them in different locations to observe their transformation over time due to UV-light radiation. This served as field research to gather initial data regarding the disappearance of the fugitive pigment phycocyanin, derived from cyanobacteria.

In order to compare the collected data, the next step involved standardised material tests for lightfastness of media conducted in the UV-light simulation chamber. Next, the colouring agents, applied on the paper and with one part of the sample masked, were exposed to light energy accelerated by a factor of approximately nine. By doing so, the sample was projected into a future scenario and it was possible to gather reliable data regarding the colouring agents' behaviour over time.

A third task involved the participant's body itself. Following instructions from Cooking Sections, a duo of spatial practitioners based in London, published via Serpentine Galleries 2020, the students digested two cooked beetroots which dyed their

bodies from the inside in tones of red, a phenomenon which showed in the form of red- tinted urine after some days. This task served to raise a more profound understanding of a dialogue between body and matter with a focus on the time-based aspect of colouring methods. Students' observations were expressed in the form of a poetic text, as well as a self-designed diagram.

What participants learned from working with organic sources as colouring agents is that although they can have a surprisingly bright and saturated appearance immediately after extraction, their nature can be highly fugitive. Results showed that exposure to UV-light can degrade some of the pigments rather quickly, which raised awareness on how harmful sunlight can actually be to any skin. Furthermore, on paper, applied surfaces appeared matt and dull, but when applied in thicker layers they took on an almost lacquered appearance. Sometimes extraction of pigments led to pale hues of grey or yellow. Experiments with different mordants and supports indicated that the possibilities are endless and that we are only at the starting point of exploring the full potential of the agency of these colouring agents.

Fig. left. Dierkes, C., cotton dyed with mushrooms, © Neuefeind, A.

Fig. right. Aliskan, A., colour samples derived from fresh berries, @ Neuefeind, A.

Empiric cycle

The handwritten journal: a tool to reflect

A fundamental part of the project was the accurate documentation of processes where the epistemological aspects of handwritten notes and sketches could be appreciated. Writing and drawing preserved fugitive aspects and showed the agility of thinking within such a dynamic (Bippus, 2009)[12]. In most scientific experimental settings, handwritten notes and sketches serve as a tool since they enable immediate documentation and expression of the action of body and mind in relation to the setting (Rheinberger, 2019, Bredekamp, 2007)[13]. In 'Living Colour', sketches and handwritten notes functioned as a step-by-step reflection process.

"Astonishing and previously unintelligible aspects are revealed when being able to draw a logical conclusion through accurate documentation. Since research defines the concept of further development, complete, detailed and objective documentation is essential for following experiments. Establishing principles and starting points is important in teamwork in order to achieve usable results and developments instead of a collection of random products without traceability. The use of the research journal in 'Living Colour' made all participants very aware of this aspect of scientific work in the course of the series of experiments."

[12] Elke Bippus explores artistic practices in relation to scientific practices, with a strong focus on manual practice and thinking.

[13] Concerning his research on scientific notes and sketches, Bredekamp also stated a logical relation between hand and mind, and the importance of manual recordings in scientific processes. Rheinberger defines the term "experimental systems": he focusses on science practices as process and defines a setting of knowledge, technologies, instruments and materials as an experimental system, as an assemblage in the meaning of a system or network of actors according to Latour's ANT, and Deleuze, which enable research processes. Handwritten notes then form part of this assemblage.

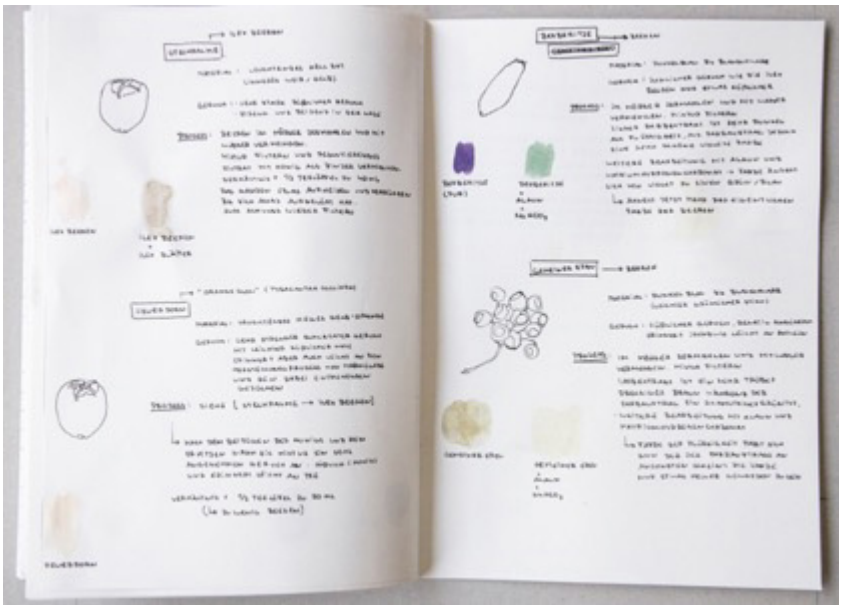

Fig.: Teixieira, D., notes in research journal, @ Neufeind, A.

"Of course, in a fast and complex world, it is not possible for everyone to have "worked out" or manufactured all of the products they use themselves beforehand. But repeated memories with small projects on very different levels (food, clothing, furniture, flora, fauna, etc.) could be enough to broaden the view of the origins and complexity of things. Even a conscious walk, for example, in the format of the Colour Walk by William Burroughs, is a simple, but haunting and transformational experience, contrary to the familiar and what we take for granted. It is like wearing a kind of "focus glasses" that help to concentrate on previously neglected aspects. Exciting discoveries that we never would have thought possible await in our immediate surroundings. In my search for colouring materials in urban areas, I was surprised to find such a large number of very different lichens and mosses in the city centre alone. The structure, colour, spread and habitat were more diverse than I ever would have expected for early February…"

"Improvisation, adaptation and alternatives are tools that are widely used since every design is individual. Its planning and realisation cannot be carried out under laboratory conditions. There are established procedures for design elements which, like the colour recipes, have been tried and tested over decades, but an exact transfer is never possible without adjustments. In this respect, working in our own colour

laboratory was a completely new experience and a useful insight into a different way of working. The detailed documentation of every single step initially seemed unusual, superfluous and sometimes exhausting, but their usefulness was proven as early as the first series of tests in order to understand the processes and differences in the results."

"However, differences can be precisely demonstrated on the basis of the documentation. It helps the understanding enormously. The unconscious seeing and acting become conscious perception and internalisation." Participant Honrath, L., 2021, notes in research journal.

Accurate documentation and structured notes served as a tool to increase an understanding of corporeal and im(material) dimensions of the experiments. Yet, as opposed to structured notes, we also advised the participants to take more personal notes to reflect on sensorial and emotional dimensions of the study. Here, notes relating to a bodily experience such as haptic experiences, smells, sometimes even tastes and what impact they had on the experience of the use of the colouring agent were recorded. "The challenge under discussion is how to develop and account for methodologies that enable cultural researchers to investigate affective processes in relation to a certain empirical study." (Timm Knudsen, Stage, 2016, p.1). Here, "we define an affective method as an innovative strategy for (1) asking research questions and formulating research agendas relating to affective processes, for (2) collecting or producing embodied data and for (3) making sense of these data in order to produce academic knowledge." (Timm Knudsen, Stage, 2016, p.1). Embodied experiences were not only reflected personally in the research journals, they also often became a topic during the weekly discussions with the participants. At first, questions regarding smells, tastes or emotions were viewed with scepticism by the participants, but as the project evolved, they became accustomed to the idea of these dimensions having an impact on the study. In the end, the sensory aspects of encountering material were embraced; many research journal entries were a testament to this. Participants related to their experiences in their reports and conclusions.

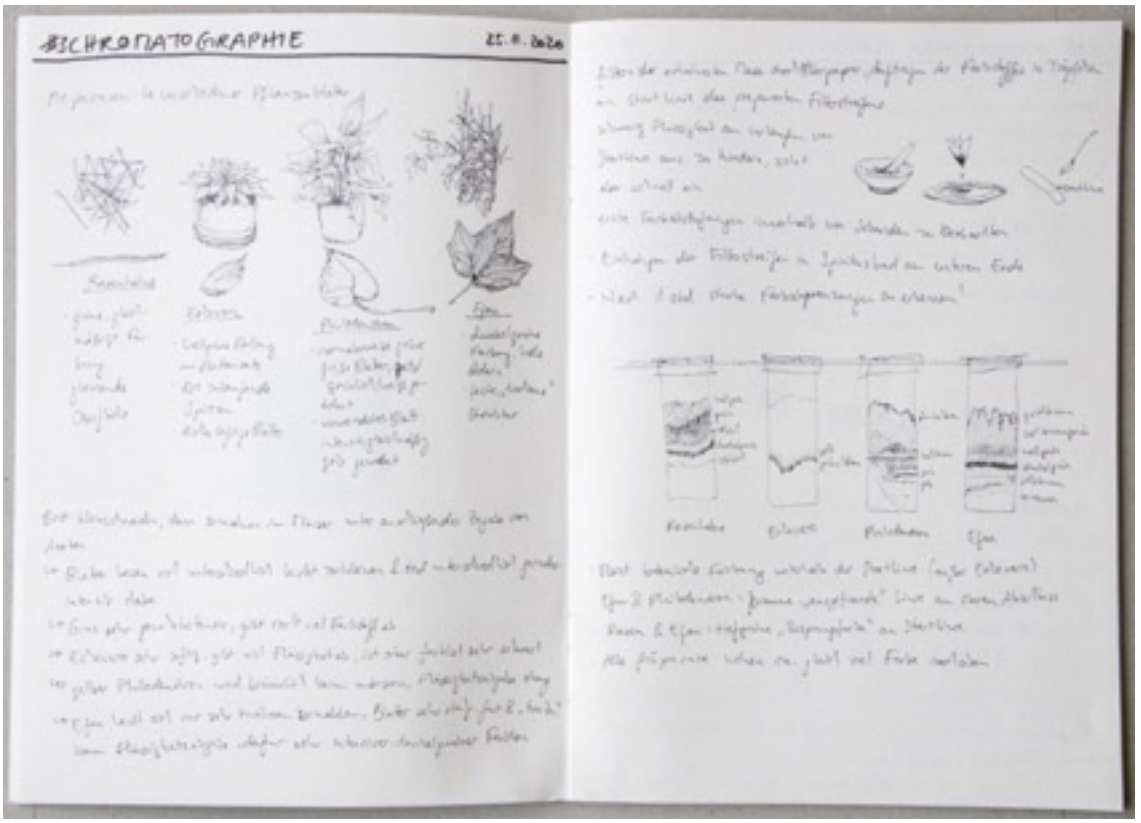

Fig. Honrath, L., notes in research journal, @ Neuefeind, A.

Conclusion

In educational Institutions such as academic faculties of architecture, the model of research-based teaching is a promising format. Since academic research is highly defined by its discipline and the methods belonging to it, developing adequate methods in an interdisciplinary field such as architecture is a multifaceted challenge. Processes are divergent and constantly changing; therefore the attempt to extract a purely systematic structure is equivalent to neglect. Rather, its interdisciplinary character synthesizes influences and methods from different disciplines and therefore develops new entry points and perspectives in order to flexibly respond to contemporary challenges. Design research can offer an open 'toolbox' to a process- and matter-oriented approach that can exceed our current understanding of matter and a built environment.

Starting from everyday phenomena such as the artificial colouring of food products, we observed a rising awareness among the participants towards their surroundings. Participants opened their eyes to previously-unnoticed quotidian events and the complex infrastructure and dynamic of economic and environmental relationships at play behind them. The encounter with the material itself—roots, plants, micro-algae and cyanobacteria—and the fleeting manifestations of colour in (even the participants' own) bodies, strengthened the feel and awareness for materials and for the subtlety of physical changes in an animate and inanimate world. Therefore, the topic of colour served as an entry point for questions that went much further. The constant reorganisation of colour in organisms or matter, both artificial and natural, and the life around it, exposed global entanglements of human forces, cross-examined their bare necessity and sought answers on to what extent we can be held responsible.

The perceptive shift on colour as an agentic material, as a source for design-processes and a fundamentally bodily, haptic and aesthetic experience questioned our human-centred point of view and the resulting expectations towards colouring agents and material in general. To consider colour as an active force marks a possible shift in design practices as well as in teaching, since it neglects the hierarchy of maker and material. To handle the material, to notice its sensual appearance, to get in touch with it, apply it, question it, observe it and to accept its transformation, generated an attitude defined by curiosity and respect. The borders between research and teaching blurred, and facilitated the intertwining of both. The strong link between contemporary theory and a bodily experience opened up new perspectives in a teaching format derived from a research-based approach like the one implemented at RWTH Aachen University.

Note: In this paper, we refer to the research project 'Living Colour' that took place in the 2020/21 winter semester at the Chair of Visual Arts, Architecture Department, RWTH Aachen University/GER, with 12 participants. It is funded by Curriculum 4.0 of the Ministry of Culture and Science Nordrhein-Westfalen in cooperation with Stifterverband NRW and is still under way.

Bibliography

Atelier Luma, https://atelier-luma.org/en/about (accessed 11th April 21)

Barad, K., 2012, *Agentieller Realismus. Über die Bedeutung materiell-diskursiver Praktiken*, transl. by Schröder, Berlin, Suhrkamp

Bennett, J., 2010, *Vibrant Matter: A Political Ecology of Things*. Durham. Duke University Press (pdf) downloaded from: http://film.ncu.edu.tw/word/Vibrant-Matter.pdf on 23rd May 2019 15.45 pm

Biolab/ Colorlab, http://www.laboratorium.bio/ (accessed 11th April 21)

Bippus, E., 2009, Einleitung, p.18, in Bippus, E., ed., 2009, *Kunst des Forschens, Praxis eines ästhetischen Denkens*. Zürich, Diaphanes

Bippus, E. 2009, Skizzen und Gekritzel. Relationen zwischen Denken und Handeln in Kunst und Wissenschaft pp.76-93, in Heßler, M., Mersch, D., eds., 2009, *Logik des Bildlichen*, Bielefeld, Transcript

Borgdorff, H., 2015, Forschungstypen im Vergleich pp. 69-76, in Badura, J., Dubach, S., Haarmann, A., Mersch, D., Rey, A., Schenker, C. and Pérez, G., eds., *Künstlerische Forschung. Ein Handbuch*, Zürich, Diaphanes

Bredekamp, H., 2007, Denkende Hände, Überlegungen zu Bildkunst der Naturwissenschaften pp.12-24 in, Lammert, A., Meister, C., Frühsorge, J. and Schalhorn, A., eds., 2007, *Räume der Zeichnung*, Nürnberg, Verlag für moderne Kunst

Christensen, R., Drach, E. Gasperoni, L., Hallama, D., Hougaard, A., Liptau, R., eds., 2020, *Artefakte des Entwerfens*. Skizzieren, Zeichnen, Skripten, Modellieren. Forum Architekturwissenschaft Edition 4, Berlin, Universitätsverlag der TU Berlin

Deleuze, G., Guattari, F., 1980, *mille plateaux*, transl. Massumi, B., 1987, *A Thousand Plateaus. Capitalism and Schizophrenia*, Minneapolis, University of Minnesota Press, (pdf) downloaded from http://www.kareneliot.de/downloads/Deleuze%20Guattari%20A%20Thousand%20Plateaus.pdf on 8th April 21

Dupré, S., 2018, Re-Working with Makers, Part (II) (Blogpost 11th January 2018. online available at: https://artechne.wp.hum.uu.nl/re-working-with-makers-part-2/ (accessed 8th April 2021)

Haraway, D., 2003, *The Companion Species Manifesto: Dogs, People and Significant Otherness*, Chicago, prickly paradigm press, (pdf) online available at: http://theorytuesdays.com/wp-content/uploads/2018/08/Haraway-Companion-Species-Manifesto.pdf (accessed on 9th April 21)

Ingold, T. 2007, Materials against Materiality, in archaeological dialogues 14, Cambridge University Press (pdf) Downloaded from https://www.cambridge.org/core. Instituto De Biosciencias, on 26 Mar 2019 at 19.07 pm, subject to the Cambridge Core terms of use, available at https://www.cambridge.org/core/terms. https://doi.org/10.1017/S1380203807002127

Greenlab, http://greenlab.kunsthochschule-berlin.de/Kunsthochschule Berlin Weißensee (accessed 11th April 21)

Haus der Farbe, https://hausderfarbe.ch/de/institut/forschung/ (accessed 11th April 21)

Latour, B., 1996, On actor-network theory: A few clarifications, pp. 369-381 in soziale welt, 47. Jahrg., nomos, Baden-Baden (pdf) Stable URL: http://www.jstor.org/stable/40878163 .accessed: 06/02/2015 04:38, Online available at: http://transnationalhistory.net/interconnected/wp-content/uploads/2015/05/Latour-Actor-Network-Clarifications.pdf (accessed on 8th April 21)

Lookman, S., 2019, *Experiencing Historical Techniques through the Color Black at the ROOHTS Summer School* (Blogpost) first of November 2019. webpage online available at: https://artechne.wp.hum.uu.nl/experiencing-historical-techniques-through-the-color-black-at-the-roohts-summer-school/ (accessed 8th April 2021)

Mareis, C., Windgätter, C., 2013, "zu den Wechselbeziehungen zwischen Design-, Medien- und Wissenschaftsforschung", p.9-20, in Mareis, C., Windgätter, C., eds., 2013, Long Lost Friends. Wechselbeziehungen zwischen Design-, Medien- und Wissenschaftsforschung, Zürich, Diaphanes

Neimanis, A., 2017, *Bodies of Water, Post-human Feminist Phenomenology*, London: Bloomsbury Academic

Palasmaa, J. 2009, *The Thinking Hand, Existential and Embodied Wisdom in Architecture*, Hoboken, Wiley

Polanyi, M. 1966, *The Tacit Dimension*, New York, Perseus Press

Rheinberger, H., 2019, *Etwas über Kulturen des Experimentierens*, webdocument, online available at: https://www.researchgate.net/publication/338271174_Etwas_uber_Kulturen_des_Experimentierens (accessed 11th April 21)

Schmitz, T., Häußling, R., Mareis, C. and Groninger, H., eds., 2014, *Manifestationen im Entwurf. Design-Architektur-Ingenieurwesen*, Bielefeld, Transcript

Schmitz, T., Schröder, U., Kramer, F. and Neuefeind, A., eds., 2019, *Orte der Farbe*, Köln, Walther König

Smith, P., ed. 2015, *The Making and Knowing Project*. Webpage, Online Available at: https://www.makingandknowing.org/about-the-project/ (Accessed 9th of April 2021)

Straus Conservation Center, https://harvardartmuseums.org/teaching-and-research/research-centers/straus-center-for-conservation-and-technical-studies (accessed 11th April 21)

Taussig, M., 2006, *What Color Is the Sacred?*, Chicago: University of Chicago Press

Timm Knudsen, B. & Stage, C., 2016, *Affective Methodologies: Developing Cultural Research Strategies for the Study of Affect*, London: Palgrave Macmillan

Windgätter, C., eds., 2013, *Long Lost Friends. Wechselbeziehungen zwischen Design-, Medien- und Wissenschaftsforschung*, Zürich, Diaphanes

Yoshihara, J., 1956, The Gutai Manifest, pp. 261-262, in Rübel, D, Wagner, M. and Wolff, V., eds. 2005, *Materialästhetik*, Berlin, Reimer

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