The dematerialisation of colour: On the creative and ecological consequences of expanded colour spaces

Dr. Jonas Leysieffer[1], Tina Tomovic[2]

[1] *Research Group Products & Textiles, Lucerne University of Applied Sciences and Arts, Emmenbrücke, Switzerland. jonas.leysieffer@hslu.ch*

[2] *National Institute of Design - NID, Ahmedabad, India. tina.tomovic@hslu.ch*

Corresponding author: Tina Tomovic (tina.tomovic@hslu.ch)

ABSTRACT

By the end of the 19th century, advances in textile colour chemistry had made colours accessible to large sections of society. Colour became the most obvious characteristic of textile objects and the first that could be changed seasonally, if not more frequently. A highly specialised industry emerged, creating new professional disciplines such as colour management, colour control and colour forecasting, along with new, highly specialised tools. Colour charts bear evidence of the developments in this field, as they act as interface objects in a multidisciplinary and now globally active value chain.

The text discusses how colour decisions are made in design, using colour charts as an example. The text argues from a historical perspective. Colour charts have always been used for communication purposes. However, as the colour spectrum has expanded, the appearance of colour charts has also changed. While they used to be primarily a sales tool and marketing tool for innovations, today they represent the self-evident nature of colour in design culture. The authors argue that colour became increasingly dematerialised over the course of the 20th century. Whereas colour was once considered a physical substance that determined specific work processes, today it appears as something immaterial that can be adapted at will.

At the same time, the text illustrates how throughout the past century technical possibilities and with them accustomed design practices go hand in hand with environmental damage. It becomes clear that the current approach to colour in design systematically ignores the significant environmental damage that occurs, mostly outside of the global north. Taking into account the ecological consequences of these developments, the contemporary use of colour will be criticised. Colourants must be considered in terms of their physical substance, enabling well-founded colouring decisions to be made in comparison with eco-design strategies. Assuming that the design process can significantly contribute to avoiding environmental damage, this text will reflect upon past colour-related design practices and the potential of changing these for the future.

KEYWORDS Colour Chart; Design; Textiles; Textile Colour Chemistry

RECEIVED 27/06/2025; **REVISED** 22/08/2025; **ACCEPTED** 29/09/2025

1. Colour charts as contemporary witnesses of technical innovation and colour culture

The second half of the 19th century characterises the textile industry forever. For the first time in history, it became possible to produce practically every conceivable colour and shade (Blaszczyk and Spiekermann, 2017). Previously, people had been dependent on the possibilities and limitations of vegetable dyes. They not only determined which colours were available at all, but also how homogeneous, colourfast and durable they were. The properties of plants also determined which materials could be coloured at all. The development of chemical colourants not only made these boundaries practically irrelevant. They were also accompanied by a significant reduction in price, which rendered the old evaluation standards for colours obsolete. With the expansion of producible colour spaces and the already perfected bleaching processes of the textile industry, the textile medium finally became a blank sheet of paper that could be freely used by designers (Wolff, 1974). The now omnipresent richness of colour changed the public image, altered the rhythm of fashion as well as the industry and its professions in the background. The colour revolution opens up access to colour for a broad, if not the whole of society (Engel, 2009, p. 113).

At the same time, the establishment of dye chemistry is bringing the ecological and toxicological problematisation of the textile industry into the public discourse. Time and again, newly discovered colouring substances led to harmful effects on health and the first bans (David, 2017). The environmental challenges of industrialised chemical dyeing also became apparent in the course of the 20th century and were accompanied by the development of new legislation, for example in water protection (Walter, 2014). However, the globalised textile industry still manages to keep the ecological problems associated with textile chemistry out of the view of Western societies. As both production and waste-related environmental impacts are mainly felt in the global South (Cobbing, 2022).

Also the design process, is largely separated from the ecological impact of textile chemistry. This raises the question of how colors are applied today and whether a way of dealing with the negative ecological impact can be found from a design perspective. Color charts serve as tangible links between the color selection process and color chemistry. Dye producers, dyers and other actors used colour charts as a means of communication to present and sell colours. However, these colour charts and the samples they contained were also an important material basis for colour decisions. Originally intended as a sales tool, the colour samples also played a decisive role in the actual design process. The colour chart underwent considerable change over the course of the 20th century (Varichon and Deimling, 2024). They not only changed the way in which colour was handled and how colour was communicated. The transformation of a tool that was crucial to the design process also had an impact on the practice of design itself.

This article will explore the question of how colour charts were used as a means of communication, as a design tool and as an instrument of market observation. The aim is to trace how colour charts changed over the course of the 20th century. Looking at this development allows conclusions to be drawn about the change in colour as a cultural phenomenon and makes it possible to gain insights into the associated expectations and changes in design processes. In particular, the ecological change associated with technical development will be reflected upon.

The time frame under consideration attempts to map the development of color charts from the establishment of chemical dyes onwards. To this end, objects from the literature were examined, as well as two objects in particular from the collection of the Lucerne University of Applied Sciences and Arts, which illustrate the development of a changed color culture.

2. Colour charts as a multifunctional tool for marketing, production and design

At the beginnings of color chemistry, the dye producers primary concern was to convince the textile industry of the merits of their new colours and secure their custom. Initially, the Leporello was established as an ideal sales tool by manufacturers of dyes from the chemical industry for the then new dyes (Varichon and Deimling, 2024, pp. 66–84). These collections showcased all the colours that could be produced using the new technical capabilities. The aim was to demonstrate to potential customers — the dyers — the variety of colours that could be produced using these products. Rather than being arranged according to the classic colour wheel, the colours in these objects were arranged according to the underlying chemical dyes (Varichon and Deimling, 2024, pp. 68–70). This approach was also reflected in the names given to the colours, such as 'methyl violet' or 'naphthol yellow' (Varichon and Deimling, 2024, pp. 66–84). In this context, colour is closely associated with the production process and is understood and communicated in terms of its chemical composition.

Dye works adopted the form of the fanfold. However, as well as showcasing the variety of colours, they also placed importance on the texture of the dyed material. This led to the use of loosely and sometimes skilfully attached yarn and fabric samples. These made it possible to feel the material between the fingers. One example are the colour charts of the Weidmann S.A. dye works in Thalwil from 1913 (Fig. 1). The colour patterns consist of yarn windings that are grouped in tone-on-tone sequences of the same colour in six gradations from dark to light. Each of these tone-on-tone sequences was given a fantasy name such as *Mikado*, *Titanic* or *Van-Dyck*. These sequences are in turn part of an ensemble consisting of five such colour groups. Each colour was also assigned a specific ascending number, presumably to make the colours clearly identifiable for the ordering process.

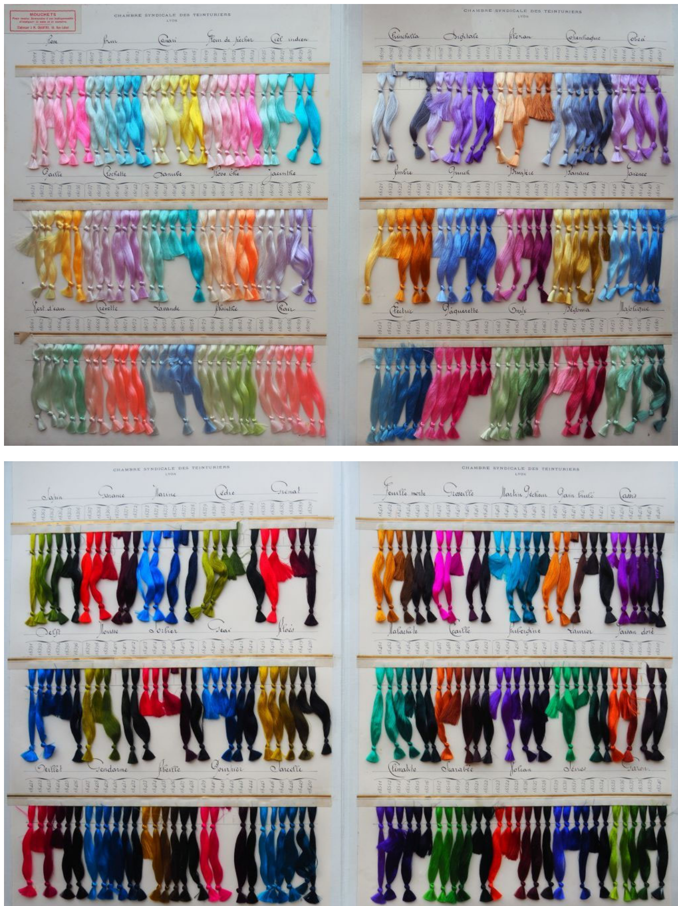

Fig. 1. Insights into the colour chart of the Weidmann S.A. dye works in Thalwil from 1913. © HSLU Silk Memory

Overall, the ensembles presented appear to be very similar. It is also particularly striking that individual colour samples appear several times. The aim of the colour chart to present all theoretically available shades can therefore be ruled out. The placement of the colour samples also does not appear to follow any logical (or colour-theoretical) concept. It was obviously important that individual colours could be presented in different colour combinations. It is likely that possible arrangements for ombré weaving were presented here, which is characterised by a tone-on-tone sequence of colours and achieves subtle colour gradients. The colour charts could therefore have served as a means of communication between the Weidmann S.A. dye works in Thalwil and the subsequent weavers. On the other hand, it could also have been a kind of source of inspiration for the colour selection and thus for the designers. The naming of the colours can also be interpreted accordingly, which linguistically opens up a field of associations for each colour, offering the designers an approach for usage scenarios. The practice of using the colour charts also points to their use as a design tool: Bundles of yarn have been cut out here and there. They were probably used as colour samples to check or pass on, or fell victim to the inspiration process as colour accents.

The impact on the design process was that the dyers defined the decision-making space within which the weavers operated. This somewhat contained and made manageable the theoretically infinite scope of the colour industry for the weavers. The pre-selection of colours can be understood as curation. This may have been a relief for the weaving mills. After all, being provided with a virtually unrestricted repertoire did not make it easier for them to find designs; it made the process more complex and risky.

3. Attempts to control colour decisions

The expansion of the colour palette created new challenges for designers. The availability of competing product ranges had created fashion as a new space for discourse. In this space - based on the availability of differently designed products - it was decided which designs were accepted by consumers and which were not. Colour was particularly central to the design discourse, as changing the colour of a product is significantly easier and cheaper than changing other design elements, such as the shape. Colour became the most obvious feature of the textile object and the first feature that could be changed seasonally, if not more often. A trend that has continued to grow stronger to the present day. A look at the present shows that the clothing industry has maintained this pace of acceleration to this day. Since the end of the 20th century, between 12 and 52 collections have been offered each year. Each time, new color trends are both adapted and fueled. The terms “fast fashion” and “super fast fashion” summarize the main characteristics of an unsustainable textile industry. Looking back again, the availability of colour nuances thus also became a market-driving factor and a matter of course for users. For manufacturers, however, this increased the risk of being left with their own colours due to a poor design decision. As a result, there was a growing need to put colour decisions on a more reliable footing.

Companies that produced textiles and were therefore subject to the trends of fashion discourse initially attempted to control the consumption of their own customers through education (Blaszczyk, 2012, p. 40-46). In a sense, they tried to counter the colour revolution by conveying idealistic notions of chromatic aesthetics in order to counteract the so-called punch colours. Such campaigns are also documented in the shoe industry, for example (Wild, 2019, p. 359-361). Like the textile industry, the shoe industry also had to contend with the problem of being left with unsold goods due to unforeseen fashion changes. Research has clearly shown that fashion discourse was not yet welcomed as a sales-promoting phenomenon at that time, but was instead regarded as a business risk.

The intensified discussion of design rules that attempted to develop orders according to which colourfulness could be guided should probably also be seen in this context. Colour rules would have served the goal of minimising the risk of unsold goods due to incorrect colouring decisions. The debates between Henry Munsell and Johannes Itten and their efforts to better understand and classify colours and colour contrasts can be placed in this context (Gage, 1993, p. 259–268). The idea of rationalising design processes, which were previously considered creative and individualistic, coincided with the trend towards the

scientific approach to design. It therefore seemed a logical step to transfer Taylorist strategies from industry to design (Wild, 2019, pp. 309–361). At a time when the fashion system had not yet become a tangible cultural phenomenon, applying scientific and technical knowledge seemed like an obvious step.

Ultimately, however, it became clear that consumer behaviour cannot be controlled either by establishing academic theories or by conducting educational campaigns. Colour appeared to be one of the most difficult factors to calculate in product design. Market observation was therefore the only option left for reducing business risk. After all, findings from these disciplines had already been applied to consumer goods production and distribution with enormous success. The developments in the USA between 1914 and 1940 are a prime example of this. Due to restrictive measures imposed by French fashion houses, a new method of colour forecasting based on the principles of scientific management developed in America (Blasczyk and Wubs, 2018, p. 16). In order not to be dependent on French forecasts during the First World War, a new association was founded in America, the Textile Colour Card Association. Colour charts took on the specific function of colour forecasting. As the majority of market participants used the colour charts as a guide, they took on a market-regulating function. Their role as a colour forecasting tool subsequently became established as another central function of colour charts.

Until then, colour charts had combined several functions: they were a means of communication, a design aid and a tool for market observation. As design became more professional, these functions began to evolve into independent products and services.

4. The objectification and dematerialisation of the colour chart

From the 1960s, producer-independent colour charts were developed to meet the need for flawless communication regarding colour: colour systems that transformed colour charts into tools for communication and selection. The Scotdic 2468 colour library, for example, has been marketed since 1983 as a tool to support the design process (Fig. 2). It consists of small coloured and removable colour chips on paper that are stored in cardboard folders in a file folder. These allow colour nuances to be compared with each other or small arrangements to be put together. In this type of colour chart system, the colour samples are shown in various tonal shades in relation to each other. They attempt to reproduce the most complete colour space possible. The colour chart becomes a colour library.

These colour libraries do without the fantasy names that were once used. Names were replaced by numbers, which goes hand in hand with the loss of a "humorous" or "artistic" quality. Instead, more specialised information that is specifically intended for experts is being integrated (Varichon and Deimling, 2024, pp. 215-222).

Fig. 2. Scotdic 2468 folder from 1983.

As a result, the interpretative framework that used to be provided by the use of imaginative terms is lost. Colour becomes a purely physical phenomenon with neutral content, without the framework of interpretation that has been attached to it for centuries. Instead, each colour sample is given a unique number, which clearly locates it within the library and allows the samples to be returned to their original place after the design process. At the same time, the number allows colour strips to be reordered. However, as the colour library is developed and offered independently of a dyeing company, it is not possible to order the colour directly. To do this, it is necessary to hand over the colour samples to a producer who transfers them to a dyed product, such as a fabric.

Surprisingly, the carrier material plays a subordinate role in this type of colour chart or library. Overall, it can be observed that in the course of the 20th century the further development of colour charts went hand in hand with the loss of material colour samples (Varichon and Deimling, 2024, p. 121). In the case of *Scotdic 2468*, small colour samples are applied flat on paper or cardboard. There is no haptic assessment of the sample. The colour samples can be purchased in few types of material, such as cotton, polyester or polyamide. The samples act as substitutes and their haptic assessment becomes obsolete. *Pantone*,

the world's most common colour chart system, often manages without any textile carriers at all.

This is a crucial difference for the design process, especially in the textile sector as the carrier fabric is of paramount importance for the colour effect. Colours look completely different on silk or satin than on cotton or knitted fabrics. But it is precisely for the assessment of these aspects that the new products, which are actually specialised for the design process, leave the designers alone. It is left to their individual experience to critically reflect on colour decisions, also with regard to the subsequent materialisation. The abandonment of the former fantasy names also shows that colour in these new design tools is understood as a physical parameter rather than an artistic quality.

The colour charts of this period thus reflect the limitless possibilities that could now be realised. Even if the colour effect was more difficult to assess than before, as the production of colour charts in various materials had practically been completely discontinued. The industry's demand for this spectrum was all the greater as colour was seen as an inexpensive tool for diversifying the product range in the second half of the 20th century. Once the sales-promoting aspect of the fashion industry had been understood, colour appeared to be the perfect instrument for offering the widest possible range of constantly updated products. Changing the colour of a product is considerably cheaper than changing its shape. Colour made it possible to offer an advanced product design that changed with the seasons. The new colour charts met this need and gave this development an additional boost. Colour had now finally become a dematerialised product feature - dematerialised on a level that even the representation of colour in various material samples was dispensed with and left to the imagination and experience of the designers.

Today, designers have a wide range of digital and analogue tools at their disposal. Digital colour databases, programs and plug-ins as well as AI-based offerings are supplemented by analogue tools. Purely digital tools such as *Coolors* or *Colormind* are playing an increasingly important role today and make it possible, for example, to compile colour palettes by searching through digital libraries or extracting automated colour selections from mood images. To a certain extent, the dematerialisation of colour is completed in these digital tools.

The best-known example of the change from the classic colour chart to various independent products is the *Pantone* company. Since the company was founded in the 1960s and the market launch of textile-specific colour standards in the 1980s, its own product range has been further diversified. In addition to the colour libraries, which function as design tools, services such as the documentation of colour trends, the integration of standard colours in industry-specific digital programs and proprietary software solutions for improved colour management are now also included. As a result, colour charts are designed as sub-products with accompanying services and digital applications that are used as colour trend and inspiration tools, serve as colour palette and management software and are designed for colour profiling and colour matching on fabric and print. For the latter, highly specialised software and hardware solutions are available to players along the textile value chain. These include products from *Datacolor* like spectrometers for measuring colour values, colour formula software that calculates faster and more accurate colour chemistry compositions, digital colour management software for communication, daylight technologies (light booth) or lab dyeing equipment. The continuously controlled accompaniment of precisely defined colour tones and their communication are at the heart of this. Analogue colour charts, on the other hand, are of little importance today as a means of communicating colour diversity. Every conceivable colour tone can be implemented. Instead, the focus is on colour selection and, in particular, the communication of precise colour data.

5. Call for eco-friendly colour choices in design

Today, the ecological challenges caused by textile chemistry have increased. The textile industry uses around 8’000 different chemicals today, including 3,600 dyes (Kant, 2012, p. 23). Chemists themselves are calling for standardisation and simplification of the chemical industry in view of this difficult-to-manage landscape (Kümmerer et al., 2020, p. 370). Finishing substances can account for up to 8% of the weight of a textile end product, but science is still in its infancy when it comes to the extent to which they affect human health during use (Wicker, 2024). What is certain is that the global, non-transparent used textile industry causes considerable damage through uncontrolled incineration and illegal landfills, due to chemicals from finishing processes (Cobbing, 2022, p. 11).

These environmental consequences of textile industries colour usage stand in stark contrast to designers abstract perception and handling of colour. It is easy to see how the detachment of colour to it’s physical nature makes it difficult to consider the ecological impact in the design process. In view of this, we need to critically consider our current colour culture and related design practices, which apply colour without ecological reflection or connection to materials. The development and use of colour charts as a means of communication, a design tool and an instrument of market observation is an example of how design culture has changed from more simple and straightforward to complex and ultimately unsustainable. It is becoming clear that technical innovations do not necessarily represent progress; they can change things without improving them.

In order to make colour choices more ecologically reflective, new to develop colour charts must mirror on the ecological impact when making decisions. Maybe colour charts would have a smaller colour palette than today. But given the ecological consequences, there may be no alternative to this. A look at the past shows that it was once possible to achieve outstanding design results even with limited colour palettes. This again might require the subject to be reinforced in teaching. For design schools, this means that the teaching of colour as an elementary aspect

of design needs to be given greater emphasis again. A subject that slowly, quietly and silently came to an end in the golden age of colour theory after Itten.

7. Conflict of interest declaration

The authors declare that there are no conflicts of interest and that no financial/personal interests have affected the author's objectivity for the present text.

8. Funding source declaration

There was no funding received for this study. The study is part of the PhD program Eco-Social Innovation by Design, a joint program by the HSLU and NID.

9. Short biography of the author(s)

Jonas Leysieffer - Dr. Jonas Leysieffer is an art and cultural historian. He has been teaching and researching at the Lucerne University of Applied Sciences and Arts since 2018. His teaching and research activities are focused on material culture and are dedicated to questions about the relationship between design and cultural history. In his previous work, he has focused on tapestries and their significance for diplomacy and court culture in the early modern period, for which he reconstructed the tapestry collection of the Bavarian Wittelsbach dynasty. Another focus of his research is the 19th century. He is concerned with the change from handcrafted to industrialized production methods and examines the consequences for the product design of mass consumer goods.

Tina Tomovic - Tina Tomovic is a Senior Research Associate and Lecturer at the Lucerne University of Applied Sciences and Arts. She is also a PhD candidate at the National Institute of Design in India (NID), where she is investigating the role of colours in textile recycling processes. Her research projects are practice-oriented and take place in close cooperation with stakeholders along the textile value chain and in a transdisciplinary framework.

Licensing terms

Articles published in the “Cultura e Scienza del Colore -Color Culture and Science" journal are open access articles, distributed under the terms and conditions of the Creative Commons Attribution License (CC BY). You are free to share (copy and redistribute the material in any medium or format) and adapt (remix, transform, and build upon the material for any purpose, even commercially, under the following terms: you must give appropriate credit to authors, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use, you may not apply legal terms or technological measures that legally restrict othersfrom doing anything the license permits.

Copyright: The authors keep the rights to further publish their contents where they want and can archive pre-print and post-print (submitted version and accepted version) and the published version of the PDF of their article with no embargo period.

References

Blaszczyk, R. L. (2012) *The color revolution*. Cambridge, Mass., Washington, DC: MIT Press ; in association with Lemelson Center, Smithsonian Institution.

Blaszczyk, R. L. and Spiekermann, U. (eds) (2017) *Bright Modernity*. Cham: Springer International Publishing. doi: 10.1007/978-3-319-50745-3.

Blaszczyk, R. L. and Wubs, B. (eds) (2018) *The Fashion Forecasters: A Hidden History of Color and Trend Prediction*. 1st edn. Bloomsbury Publishing Plc. doi: 10.5040/9781350017191.

Cobbing, M. *et al.* (2022) ‘Poisoned gifts from donations to the dumpsite: Textiles waste disguised as second-hand clothes exported to East Africa’.

David, A. M. (2017) *Fashion victims: the dangers of dress past and present*. First published in paperback. London New York Oxford New Delhi Sydney: Bloomsbury Visual Arts.

Engel, A. (2009) *Farben der Globalisierung: die Entstehung moderner Märkte für Farbstoffe 1500-1900*. Campus.

Gage, J. *et al.* (2013) *Kulturgeschichte der Farbe: von der Antike bis zur Gegenwart*. Leipzig: Seemann (Kunstpraxis).

Varichon, A. and Deimling, K. (2024) *Color charts: a history*. Princeton: Princeton University Press.

Walter, F. (2014) ‘Umwelt’, 14 January. Available at: https://hls-dhs-dss.ch/articles/024598/2014-01-14/#:~:text=Der%20Verfassungsartikel%20zum%20Umweltschutz%2C%20Artikel,oder%20l%C3%A4stigen%20Einwirkungen%20gesch%C3%BCtzt%20werden (Accessed: 20 June 2025).

Wild, R. (2019) *Auf Schritt und Tritt: der schweizerische Schuhmarkt 1918-1948*. Basel: NZZ Libro ein Imprint der Schwabe AG.

Wolff, K. H. (1974) ‘Textile Bleaching and the Birth of the Chemical Industry’, *Business History Review*, 48(2), pp. 143–163. doi: 10.2307/3112839.