Colour
in environmental
design

AIC Association Internationale de la Couleur
International Colour Association
Internationale Vereinigung für die Farbe

Proceedings
of the
AIC Symposium 1988   7–11 August
Winterthur Polytechnic Switzerland

AIC Symposium 1988
Switzerland

Colour in environmental design

7–11 August 1988
Winterthur Polytechnic

In charge of AIC organized by the
Colour Course Centre   Prof. Werner Spillmann

Sponsored by the
Government of the Canton of Zurich
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The AIC Symposium 1988 will bring together

architects   **environmental**
interior architects   **colour researchers**
designers   **psychologists**
town planners   **physiologists**

The AIC Symposium 1988 will be a forum for experts with a special interest in the question of **how colour can be handled in the human environment** for the sake of the users. The participants are persons eager to see how other professionals have tried to find solutions for practical tasks or have dealt scientifically with problems like the impact of colour on human beings.

Official language
In order to facilitate communication the language will be English.

AIC   Association Internationale de la Couleur
       International Colour Association
       Internationale Vereinigung für die Farbe
AIC is a non-profit organization with the object of encouraging research in colour in all its aspects, of disseminating the knowledge gained from research, and of promoting its application to solutions of problems in the field of science, art, design and industry on an international basis.

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* Text not yet received by June 30

As colour is a visual phenomenon, contributions on the topic of "Colour in environmental design" will be mainly based on colour illustrations which are omitted of course in the following texts and will be presented at the symposium in Winterthur. The texts have been copied as received from the authors. In the interest of an optimal pre-information the proceedings are distributed to the participants before the symposium.

Introduction Lecture
Prof. Tom Porter   **England**
Artist-Designer
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Oxford
Colour in environmental design

Colour in Environmental Design

It would be fascinating to know what motives drove Phideas
when, without an ICI or a Sikken's paint technology, he
painted the Parthenon. The fact that he worked with inferior
pigments and a limited palette did not seem to deter him.

Evidence that the Ancient Greeks painted and gilded their
statuary and temples was to later come as something of a shock
to the more purist aesthetes and artists who had perceived
antiquarian architecture and sculpture as untainted by a
cosmetic colouration. Indeed, such evidence of a Greek
polychromy had caused the sculptor Rodin to strike his breast
and exclaim: "I believe it here that these were never coloured."

A similar culture shock affected British modernist architects
when—even after his death—the more widespread use of colour
reproduction in design journals had revealed Le Corbusier's
buildings in colour; he was an architect they had believed
passionately to have practiced architecture as a "colourless"
science.

Despite these delayed reactions, a fascination with heightened
levels of environmental colour in design circles seems to recur
in a cyclical fashion. In fact it was the Victorian designer
Owen Jones who suggested that "highpoints" in art and culture
seemed to be synonymous with a predilection for pure, bright
hues and that, conversely, dull and muted colours paralleled
periods of decline. However, it does appear, at various points
in time, that architects feel the need to "rediscover" a basic
palette of architectural polychromy and that each rediscovery
triggers experimentation with the three dimensional orchestration
of primary and secondary hues. One such cycle emerged in the
1830's. This was fed by the colour archaeology of Semper and
Hittorff and climaxed in Owen Jones' highly sophisticated
colour system for Joseph Paxton's Crystal Palace. However,
under the influence of John Ruskin this quest for a colourful
livery for the Industrial Revolution became redirected into
an architecture of "coloured stones" as practiced by William
Butterfield and George Edmund Street.

Heralded by the colour evangelism of Bruno Taut, another
colour cycle began at the outset of this century and found
expression particularly in the stereoplastic colour skins of
Gerrit Reitveld and Theo van Doesburg. Remnants of this cycle
crossed the Channel in the 1930's but, as part of an Art Deco
style, it appeared as a derivative and jolly decoration applied
to London's cinema's and factories.

As if to undermine Jones' theory of "highpoints" another
upsurge of interest in bright architectural colour was to

reappear in the mid-seventies. Inspired by the colourful
working parts of agricultural and industrial machinery that
had survived the Industrial Revolution, this cycle saw a high
Victorian revivalism reapplied in a banal fashion to code the
exposed structural components of a high technological
architecture.

Apart from monitoring colour cycles I have, during the last
few years, been monitoring the facade colours of five Liverpool
back-streets. In fact, in 1979, I bought a house in one of these
streets. These are a sequence of terraces of row houses built
on the banks of the River Mersey and began their life as
docker's cottages. Local information has it that their brick
housefronts have always been painted and residents, although
not wealthy, are intensely proud people—this pride being
reflected in the prim facades.

The bright and well-maintained colour of these streets has
attracted film-makers and several television productions—
including Alan Bleasdale's Boys of the Blackstuff and Carla
Lane's Bread—used this immediate area as outdoor sets for their
movies. In 1983, together with Ian Fell of Independent Television,
I made a video for Imperial Chemical Industries PLC entitled
Colouring your Home. The video later won a Special Category prize
in the 1984 UK Video Awards, and at its media reception in
London several of the design press refused to believe that these
streets had not been especially designed and decorated by ICI
for the purpose of filming. Although in reality we had filmed
the colours as we had found them, their disbelief that the
scheme could not have been orchestrated by non-designers reflects,
again, a professional attitude to environmental colour that
refuses to accept more highly chromatic urban systems as more
than "temporary" or "special events."

However, the humble colours of Toxteth represent a form of
public art that speaks a language of time and place. On the one
hand, they identify a specific area in the North-East of England
and, like the facades at Burano, celebrate their proximity
to water. On the other hand, they transform in time. For example,
a decade ago they were more vibrant and variegated. Today they
appear more coordinated and homogeneous—qualities that seem to
have emerged after the infamous Toxteth riots in the early
eighties. However, if we look more closely, we can begin to
understand their language because walls use applied colour to
heighten the diagramming of architectural elements and to signal
individuality and territorial ownership. Within this language
the boundary between one home and another becomes a target area
for a meticulous line of demarcation. This colour change
signposts territorial extent and, when indicated by a shared
downspout, will often carry two colours—each signalling the
emblematic hues of respective households.

Another aspect of decoration at Toxteth is a use of colour
that is as old as painting itself, i.e., a colour application
used to transfigure the nature of form, as in the way a layer
of pigment transformed Greek marble into "flesh" or, even
earlier, in the red ochre daubing of prehistoric human remains

in order to invest a blush of life. At Toxteth another
magical feat is performed when, via a layer of paint,
brickwork is changed into stone, and vice versa. This kind
of "paint magic" has been referred to by Michael Graves. He
sees colour as a representational device and suggests:
"if we paint gypsum board terra cotta in order to allude to
brick, then our first reaction to that surface is of brick."
Graves' use of architectural colour is filled with similar
messages which play a role in a post Modernist memory-nudging
game in which, for instance, stucco is painted the colour of
travertine in order to signal what might have been.

The Toxteth colours are by no means accidental; they have evolved
within a traditional system that is reinforced and extended
each time a resident repaints his house. In his book
Design of Cities, Ed Bacon touches on this chemistry. This
person, like his neighbours, has, "thousands of times since
childhood, experienced the colours and colour relationships
in his town. Because of the size and scale of his town, his
apprehension of it and its colours is complete and simultaneous.
All parts of it and all its details are at one instant a part
of his mental equipment. As he decided what colour to paint his
house it naturally and inevitably fitted in with forms and
colours surrounding him. This phenomenon, often referred to
as "intuitive," actually represents a process so complex that no
computer yet conceived can come close to duplicating it."

My interest in the colours of traditional environments has led
me to the work of Jean Philippe Lenclos in France who, in the
face of the proliferation of synthetic and "imported" building
materials, has attempted to codify the diversity of the French
regional palettes. At the heart of this programme is the need
to reaffirm the experience of traditional colour patterns for
their development to embrace a new architecture and, of course,
to reinforce an all-important sense of place.

The identification of traditional Italian urban "colour maps"
is the preoccupation of Giovanni Brino. His discovery of the
1800 Turin Council of Builder's colour plan for that city
(a plan comprising around 80 colours), and his attempt at its
restoration, has opened the debate as to whether or not we
should "freeze" such systems in time. However, the fact that a
comprehensive city scale colour plan was already in place in
Turin by 1830 predates Fernand Leger's dream and Victor
Vasarely's promotion of the "polychrome city."

It is my belief that laypeople generally seem more prepared to
accept more chromatic levels of colour in their built environment
than a so-called "sophisticated" design taste will allow. This
belief stems from experiences of projects in the Headington area
of Oxford and also from the results of a small survey conducted
with Byron Mikellides at Oxford Polytechnic. A further insight,
this time into a Victorian laypersons attitude to colour, comes
from another aspect of Giovanni Brino's work. It is well known
that a preview of Owen Jones' proposed scheme for the Crystal
Palace caused consternation among potential exhibitors to the
Great Exhibition of 1851. Capitalizing on this situation, the
Illustrated London News sponsored a competition which invited

its readers to design an alternative and acceptable scheme.
This competition attracted 25 entrants whose submissions have
each been reconstructed by Giovanni Brino. Brino found that
that the alternative schemes were just as bright if not more
"outrageous" as the proposed and ultimately installed by
Jones.

Finally, designers (and I am no exception) can still, somehow
impossibly, detach the concept of colour from an understanding
of space. The graphic representation of space in the design
process is usually drawn in black ink on white paper and even
small scale models are constructed with a greater concern for
achromatic plastic qualities than for an articulation of the wider ran
of constituent elements. By comparison, our real understanding
of space is subject to a wholistic process—an integrated
faculty in which each variable is experienced in context
together with all the others. In other words, our perception
of colour, apart from other influences, is constantly and
simultaneously modified by a supplementary experience of light,
texture, and form, etc. Therefore, as we experience each as a
component of all the others, colour is light, texture, and form.

Tom Porter

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Colour, meaning and urban design

COLOUR, MEANING AND URBAN DESIGN
Barry Maitland

Urban design theory has been developed largely as if colour were an irrelevant, or at best marginal, characteristic of urban environments. The essential features of urban structure have been seen almost exclusively in terms of form and activity, with colour considered, if at all, as a decorative aspect of purely local significance. Kevin Lynch's five basic components of the city image, Jane Jacob's four conditions for good city environments and Christopher Alexander's 253 underlying patterns, are all defined in terms of form and activity. For Krier, urban morphology is the governing concept of urban design, and even for Gordon Cullen, the most painterly of urban designers, colour is seen, like texture and graphics, largely as the means to enliven a local set of circumstances.

It is arguable however that colour plays a larger and more independent role in the definition and expression of the structure of the city. The colouring of buildings can be regarded, not just as a series of relatively fortuitous enhancements of local architectural form, but rather as an expression of the underlying rules which govern the way buildings relate to one another in the city as a whole, and to the social and economic patterns which they accommodate. In performing in this way, colour works alongside form as another system of expression which may complement and reinforce the formal readings of the city, but may also act as a counterpoint or even contradict those readings. In this paper I would like to explore some of the ways in which colour, as a systematic expression of buildings in an urban context, may do this. I shall draw most of my illustrations from Australian cities, although I believe the observations would apply, with some translation, to any others.

Of course, the idea that form and colour are complementary and sometimes contradictory expressions of underlying structure is one which has long been explored by painters, and notably in the work of Paul Klee. It seems particularly appropriate to begin with him, not only because of his associations with this region, but also because he discovered himself as a painter through an encounter with a city, Kairouan, and painted numerous images of cities throughout his career. It was at Kairouan in 1914 that Klee made his famous statement "I and colour are one. I am a painter", and then went on to define his goal as being "the synthesis of urban architecture and pictorial architecture".

Klee's paintings of cities illustrate at least three ways in which colour and form can relate to one another.

Firstly, colour is one of the basic characteristics of the city which establish its visual coherence and unity. The range of hue and value which occurs within a city provides one of those 'contributory' aspects of its unique character which also include such features of its form as building height, block form, roof profiles, fenestration patterns and so on. In a work such as 'Mural Painting' of 1924, Klee suggests the way in which colour, and the range within which it can be modulated, is a fundamental aspect of the coherence of the overall city image.

The second role of colour is illustrated in some of Klee's earliest sketches of North African cities. In works like 'Red and White Domes' and 'Hammamet with Mosque', the landmark buildings form a contrast with the remaining fabric of the city, in terms of form by their domed and towered profiles, and in terms of colour by being either white or of more intense hue against the background range. By extension this can apply to all of the components of the city image described by Lynch and others, so that colour becomes a means of articulating the structure of the city, and identifying its districts, edges, nodes, routes and landmarks.

In doing this, colour, alongside form, acts in two roles, as a symbolic system, emphasizing the significance of important public elements of the city, and as a navigational system, helping people to orientate themselves within it. In both roles it gives the city legibility, establishing the hierarchy of its parts and creating within it the sense of place.

The third kind of relationship between urban form and colour explored in Klee's paintings is more ambiguous. As an expression of the coherence of the city image and as a means of articulating its parts, colour can be seen as reinforcing its form. But, as he demonstrates in a work such as 'Italian Town' of 1928, the pattern of form, here represented with a linear perspective, can be contradicted by the pattern of colour, in this case by tonal values which reverse the implied recession. Thus colour and form can work in counterpoint or contrast to overlay multiple meanings upon the city. Different hierarchies can be inferred simultaneously from the contradictory structures of the city's expression in colour and its form, and ambiguity and plurality of meaning may result.

I shall try to use these principles illustrated in Klee's paintings to interpret the use of colour in Australian cities, and to suggest that, even at its most crass and wilfull, and least informed by considerations of good urban design, the use of colour in buildings can nevertheless be interpreted as an attempt to manipulate them to some effect. It is necessary however to preface this with some comments on the present condition of Australian cities, in urban design terms.

With the exception of a handful of smaller cities in the older states of the south-east, and of the capital Canberra which is a unique case, all of the major Australian cities are in the middle of a stage of transformation from the European cities they once were to the North American cities they have been trying for the past twenty years to become. This process, which has been the subject of considerable controversy and debate, means that there now exist within each of them, two contradictory paradigms for the way in which buildings should relate to one another and to the public spaces they address.

On the one hand, the city centres generally maintain the older block pattern in which properties are built up to the street line, address their major frontages and entrances to the main streets with secondary ones to side streets, and with utilitarian elevations to service courts at the rear. This traditional typology then establishes the public street spaces as contained, clearly defined urban 'rooms' whose hierarchy is complemented by the common form of address adopted by what may be dissimilar styles of building. And even where, as in the gold towns of the west, there was no existing context to relate to, the rules by which the future city would be generated were clearly implied in the first tentative steps in their foundation.

On the other hand, all of the major city centres have been invaded by a new typology, in which buildings are seen as essentially free-standing towers, with equally treated elevations, and surrounded by public space which is not contained, but is open and free-flowing.

As a result, each of the cities now contains a mixture of these fundamentally conflicting paradigms, so that traditional streets are broken open by plazas which act as forecourts to new towers. Many now regard the cities as having been compromised by this mixture, with a loss of the integrity of the traditional street form of public spaces. At the same time it has been difficult for the newer type to be fully realised within the confined site boundaries of the city centres, and the public spaces at the foot of the towers are often little more than symbolic references to the generous open spaces implied by the model. They are fitted out with hard and soft landscaping, the visual effect of which is to detach the building from the tight matrix of the surrounding street form.

Colour can be seen to have played a significant part in the representation of the new paradigm, often in a symbolic way in circumstances where it could not be fully physically realised. Though hemmed in by surrounding buildings, the new tower could be visually detached from its neighbours and from the plot line by adopting a pale or neutral colouring, in contrast to the brighter and richer tones from which it would emerge. Even more marked, a cool, recessive hue towards the blue range of the spectrum would distance it from its traditional, and incompatible, surroundings.

These colour choices are complemented by other distancing devices, of texture, reflectivity and pattern for example, which reinforce the sense of separation created by plan geometry, pilotis and other features of the building form. In terms of the first principle gleaned from Klee's paintings, they have the effect of shattering the homogeneity of the former pattern by introducing a new range of values and hues calculated to contrast and detach.

The scale of the new towers inevitably brings them into conflict with the symbolic and navigational structure of the city also, overwhelming its former landmarks and disrupting the setting of its nodes and major routes. We are accustomed to think of this in terms of built form, with images of St Patrick's Cathedral in New York dwarfed by the surrounding towers of mid-town Manhattan. But again, and as Klee reminded us, colour also is a powerful tool with which the relative significance of buildings within the city can be established.

In the traditional Australian city, the focal points were marked out by towers exploiting the colour contrasts of sandstone and copper roofs, or of polychromatic stone and brickwork. Today these effects are dimmed by the more strident colour contrasts of the towers around them, and the dominance over its surroundings of a landmark tower such as that of Sydney Town Hall,for example, or the North Sydney Post Office, is irrevocably lost.

In terms of the legibility of the city image, this might not be a disaster, provided the new landmarks were establishing a new framework as valid as the old. It seems apparent however that their character is not governed by some common scheme, whether as an urban design plan or else an accepted set of conventions as in the former city. Rather the city centre appears to be the setting for a competitive struggle, with towers jostling for position, outlook and visual prominence, and its visual ordering the outcome of free market forces rather than of cooperation and conventional precedence. It seems necessary then to say something of the way in which the forces of competing private interests might express themselves through the use of colour in the city.

As in American cities, it is not uncommon in Australian cities to see the townscape character dominated by large-scale advertising hoardings. In these cases it is the ephemeral but visually compelling panels of primary colour and graphics, rather than the architectural forms beneath them, which provide the key markers of the city image. It is no accident that they often occur at the node points of the visual structure of the city, for they are exploiting the same characteristics of priority and prominence. This feature of advertising in the city can be seen as simply the most explicit use of colour in a competitive way, gaining advantage by being linked to the dominant features of the city image. In Sydney the tops of the tallest towers now command two hundred thousand dollar a year rentals for the space they offer for the corporate logos which advertise their major tenants.

Now, as Klee illustrated in the painting 'Italian Town', colour need not only reinforce the structure implied by form, it can manipulate or even contradict it. Thus the competitive use of colour in the city can attempt to shift the relative prominence of sites and of buildings, and to manipulate the inherent morphological hierarchy in favour of some arbitrary part within it.

We see this in a small way when a new proprietor of a business in a marginal part of town sets out to promote business by giving the store a new coat of paint. The building becomes an advertisement, but it also tells passers-by that this is the key point in the neighbourhood. At the opposite extreme, where not one but all of the properties on the street compete for prominence in this way,the result is as in the night view of Las Vegas, with the architectural form completely dissolved in a riot of competitive colour.

How then do these possibilities influence the use of colour in those more durable components of the city which, though subject to less instant evaluation, are still dependent for their success in terms of rental income upon the way their location is perceived within the overall urban framework? The answer will no doubt depend upon the competitive climate of their particular city, but I would like to offer one hypothesis, based upon the Australian case, and which might be termed 'the inverse square law of competitive urban colouration'.

At the centre of the pale towers of the central business district of Sydney stand the tallest and palest of all, exemplified by the white towers designed by Harry Seidler. These command the highest rentals, partly because of the high quality of their design, but also because they are recognised as the prime buildings on the prime locations. In Sydney, and now also in Brisbane, Seidler's towers[1] rise above the surrounding jumble like the white dome in Klee's watercolour 'Before the gates of Kairouan', or, more likely, the white cathedral of Le Corbusier's image in his book 'When the Cathedrals Were White'.

The white towers are surrounded by others of a variety of pale shades which generally intensify as they move away from the peak land value position. Standing on the southern edge of the area of office towers, one looks in towards the central white tower through a spectrum of lightening tones. At this southern edge, on the frontier of the CBD, the newest tall building, the Carringbush Tower[2], asserts by its distinctive high colouration that its fringe location is in fact a new prime position, a new node in the urban structure.

A similar principle seems to apply to those developments which have leapfrogged out of the CBD to establish outposts beyond its borders. Across the Harbour Bridge, in North Sydney, the towers are generally brasher and more highly coloured than in the main centre. Beyond them, a new family of towers, in the suburban centre of Chatswood[3], uses all of the devices of profile, pattern and colour to establish an identity for a new city node.

Such uses of colour by new developments to establish themselves within the visual structure of the city, set up patterns which, as in Klee's 'Italian Town', invert the expectations of traditional form. A new, more dynamic, and potentially more disruptive relationship between form and colour is initiated.

In such a situation, driven by the competitive stance of individual developments within the private sector, it must seem highly desirable that the public realm expresses itself with equal vigour, asserting the common structure upon which the legibility of the city depends. Two Australian examples, both finished this year, and both highly dependent on the use of colour for their effectiveness, may serve to illustrate some ways in which this can be done.

In some ways the design of the public areas at the Brisbane Expo site provides an exaggerated metaphor for the condition faced by urban designers in many Australian cities. Although located along an attractive water frontage, the site is hemmed in on its other side by low grade buildings. And if an Expo site can be seen as a kind of miniature city, its public spaces here are somewhat formless, and its 'civic' architecture undistinguished. The task for the designers[4] of the public areas then was to find some way to give identity to the elements of the 'urban' structure, its landmarks, nodes, routes, edges and districts, and to do it in the absence of convincing form. The answer lay in the use of colour.

At the approaches to the site, 'gateways' are identified by graphic devices which emerge out of the background of advertising hoardings in the neighbouring district.

Routes are then defined with a graphic use of colour which in places implies a rich street architecture of the kind which ought to be there but is not. At ramps and approaches to pavilions the colours intensify, and are complemented by bright sculptures denoting node places.

Symbolic gateways are formed to 'districts' within the miniature city, and along the river front an edge is formed by highly coloured street sculpture which masks the paucity of the building forms behind.

If this example suggests, even in the highly charged state required by its context, some clues as to how the use of colour in the public realm can retrieve deficiencies of private form, the case of Circular Quay in Sydney provides an utterly convincing illustration of how such intentions can be realised in the real world of the CBD.

Circular Quay is the front doorstep of Sydney. It is the place where immigrants used to arrive by sea at their new homeland, and where commuters arrive by ferry at the foot of the towers of the city centre. It runs between the two structures which symbolise the city - Jorn Utzon's Opera House and the Sydney Harbour Bridge. It was thus the most public and significant of all the edges to the city, but also the most neglected.

In 1984 an urban design competition was held, arising from which a programme of public works was initiated. These have now been completed in a series of projects carried out by a variety of designers under the direction of the Government Architect[5]. They are linked by a common palette of materials and colour which now ties Circular Quay together in a rust-orange ribbon around the base of the pale towers.

At its east end, the project ties the Opera House into a quayside promenade formed in a brown aggregate concrete matching the base material of that building. A pedestrian canopy runs back towards the railway station and ferry terminals, its orange colouring matching the paving and the brick and tile work of the Federation style house remaining on the quay, now as a restaurant.

The treatment of orange steelwork is carried through the ferry piers, the original structures of which have been opened up to give views through to the water from quayside cafes whose canopies adopt the same motif. And finally the theme culminates on the west side of the quay in the Overseas Passenger Terminal, reconstructed by Lawrence Nield as a Constructivist urban sculpture, offering a wonderful variety of public platforms and decks overlooking the activity of the waterfront, while still maintaining its historic role as terminus for the sea-voyage from Europe.

The Australian Bicentennial has provided the opportunity for other public works which provide extended examples of public order inserted into the competitive disorder of the CBD, and notably at Macquarie Street and Darling Harbour in Sydney. To varying degrees they have emulated the combination of formal coherence on the one hand, and vital city activity on the other, which Circular Quay manages to achieve, and which is the mark of the most successful reconciliation of private and public interests in cities such as these. It is significant that colour plays such an important part in giving meaning to that reconciliation.

Notes

1   Harry Seidler's towers in the centre of Sydney are Australia Square (1967), MLC Centre (1978), Grosvenor Place (1988) and in Brisbane, the Riverside Centre (1987).

2   Rice Daubney, architects of the Carringbush Tower.

3   Rice Daubney, architects of the Zenith Centre, Chatswood.

4   James Maccormick & Associates, and Bligh Jessup Robinson, architects for the Brisbane Expo site.

5   Designers working to the coordination of the office of the New South Wales Government Architect, J.W.Thomson, were : Conybeare Morrison & Partners - street furniture; Hall Bowe & Webber - concourse to Opera House; Allen Jack & Cottier - restructuring of ferry wharves and railway station; Lawrence Nield & Partners - restructuring of Overseas Passenger Terminal.

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*Evaluations and emotional loadings
of colour in man-made environment*

<u>Evaluations and emotional loadings of colours in man-made environment</u>
by Sven Hesselgren

When we look at the facade of a building, the visual experience
is so to say "built up" by sensations of light, colour, and form.
This visual experience is combined with a lot of other sensation
modalities to form a "total perception". We react to this in a way
that has been studied scientifically. It has been found that there
are a lot of different factors within this reaction. By means of a
diagram or a "model" I have illustrated this in my book ON ARCHITECTURE
- An Architectural Theory Based on Psychological Research, which is
on sale at this Symposium. You will find this model on page 46; I
1) show a slide of it here.

You see that among the psychological responses you find a lot
of factors of aesthetic evaluations, together with a very complex
emotional loading. If you want to deepen your knowledge about all
this, you have to read the book; I will here only give a brief
summary of all of it.

If we study first of all the form sensation, we find two
important factors. One factor "consists" of the two polar dimensions
unity-disruption, the other is monotony-variation. The facade can,
however, be a unit and at the same time have variation. This is what
"ordinary people" like. If, however, the facade from the form-sensation
point of view is too monotonous, variation can be created by means
2) of colour-combinations. On my slide I demonstrate how an architect
has tried to give variation by means of using blue and red hues,
but the nuances are dull, and this gives a dull total impression.
3) My next slide shows a facade with exactly the same form, but
here the colours are of a slightly reddish yellow hue, with nuances
within the pale register. In spite of the fact that this facade is less
varied, more monotonous, I expect you find it more "beautiful".
Apparently this depends on the fact that the different nuance-realms
in these two cases are emotionally loaded in different ways. It is
necessary for the architect to learn to consciously understand this.

In my book I have described in detail the scientific research
4) about this on pages 226-229, on two slides I will here give some
5) examples of this. If you want to deepen your knowledge about this,
I refer to Sivik's thesis from 1970.

There is, however, also another important phenomenon, namely

the <u>combination</u> between two or several colours, a combination that can be "beautiful" or "ugly". Concerning this very interesting and very important phenomenon I refer to pages 58-67 in my book. But if you want to "understand" what I say there, you will have to glue the colour-samples correctly, and then look at "what you have done". You must understand that experiences of this kind must be experienced in order to be "understood", it is not sufficient to "describe" them by means of words.

Talking about colour combinations, there is a very important phenomenon, namely the "distance" between the two colours, first of all their contrast in "lightness". Most often we - when looking at the exterior of a piece of architecture - prefer great contrast to small contrast. The greatest contrast one can experience is that

6) between black and white. I show on a slide here how this can be done by means of an awning in order to make a facade more interesting.

Even inside a dwelling some people prefer this great contrast when they for instance want a patterned wallpaper. However, if the contrast is that great, it can even be dangerous to someone looking

7) at it. My slide here shows the pattern of a wallpaper that at an exhibition a long time ago I wanted to put up in order to demonstrate this danger. But I got into trouble. The worker who put it up, became so sick by looking at it, that he had to go home and go to bed. This means that the architect has to study carefully this phenomenon, he has always to find the <u>best</u> contrast.

But at the same time as we study the <u>contrast</u> between two (or several) colours, we have also to study if - and how - they are <u>connected</u> with each other. As I have already said, I have discussed this in my book, but Anders Hård and Lars Sivik have studied it in

8) a series of scientific experiments. I show in this slide the result of one of these experiments. It is briefly described in my book, but for details I refer to their own description.

And I want to draw your attention to another colour sensation phenomenon, that has not been studied scientifically in the same way as the NCS.

9) My slide shows two objects, equal in form, similar in colour hue, but different in colour experience. When I asked a friend of mine if she liked one of these blue objects more than the other one, she said: Yes, since these are two toothbrushes I like the one that

is not transparent more than the transparent one.

This means two things. First of all: When she had given a MEANING to the visual form, this meaning became the basis for her aesthetic evaluation. And secondly: The colour was not her greatest interest here, it was something else. What was it?

Apparently one of the objects has a colour that seems to be connected to the surface of the object, the other one a colour connected to the transparent volume. David Katz in his book The World of Colour described the first aspect as a "surface colour", the other one as a "volume colour". There are also, according to him, two other kinds of "colour appearances", namely "film colour" and "luminous colour". I want to mention here that we also ought to observe the difference between two kinds of "surface colours", namely "lustreless" and "lustrous" colours.

The NCS, as it appears today, deals only with the half-mat colours - something between "lustreless" and "lustrous". I know that many architects are asking of a NCS concerning all of these "colour appearances". Why? Because they have often used them. 10) I give an example of this on my slide, showing the Rosetto Window in the York Minster. Volume colours in connection with transparent glass have been used for centuries, first of all in churches.

And we have to understand that there are continuous shifts between all of these colour appearances. To take an example: A colour can continuously move from "surface colour" to "volume colour"; these "half-transparent colours" are of great interest within architecture. And if we examine the "lustrous colours", they also give a glimpse of "luminous colour".

One possibility to study these phenomena is to look upwards. The blue colour of the sky apparently does not "belong to an object", it is definitely a film colour, but if we look at the cloud-scape we find that the white colour there "belongs to the surface" of the clouds, and are thus surface colours, even if we also find light and shade there - phenomena of light sensation that is something other than colour sensation. And sometimes it happens that a cloud can have a golden sun-reflection, that apparently is not a surface colour but a luminous colour.

It is important that these aspects of colour sensation are

studied as scientifically as the now established NCS.

Even if colour in a man-made environment is very important, there is another aspect that I want to draw your attention to.

The most important thing about the NCS is that it clearly demonstrates that there is a structure in the realm of colour sensation that has no parallel whatsoever in the physical stimulus - the electromagnetic radiation, "built up" by photons - that "arouses" this "inherent" mental "wish". The same holds good for all kinds of sensations, but it is most evident in colour sensation.

In order to handle colour in a man-made environment, the architect has to listen to two experts: Listen to what Anders Hård tells about colour sensation, listen to what Gunnar Tonnquist has to say about the physical stimulus; they are today internationally wellknown, from China to Australia.

The fact that colour sensation and its stimulus must be described in quite different terms, has for me given rise to an understanding of the structure of the total psyche - illustrated
11) in a "model", shown on this slide - and the way in which this is not only connected to the physical universe but also how it has been developed in connection with the biological body. This I have described in an article START AND DEVELOPMENT OF EXISTENCE, published in English in the Swedish book TOK:s årsbok (Year Book) 1988, that is available at this Syposium

I hope you have understood that what I have tried to do here, is to give a brief summary of what I have found, namely that the scientific study of colour gives rise to an understanding of our total "mental world", and thus gives us a hint about how we ought to act in order to understand that we have to fulfill not only our material needs, but also our mental needs.

3 Gunnar Tonnquist **Sweden**
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Aspects of colour (percept, valence, stimulus, colorant), what do they mean and how can they be used?

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ASPECTS OF COLOUR
(percept, valence, stimulus, colorant),
what do they mean and how can they be used?

1. Introduction

Showing two blue-green fields, one in a blue, the other in a green surround:

How many colours do you see?

Now, many of you are suspecting that I'm trying to cheat you, and - wanting to stand out as smart - you may argue thus: Well, of course I **see** a bluer blue-green against the green - and a greener blue-green against the blue, but this must be an **illusion**, as the speaker of course is showing us the same stuff in both cases (if we join the two inner fields we will see this!), so there is just the same colour in two surroundings. But now (separating the blue-green fields again) you are denying the testimony of your eyes in favour of what you believe to be the physical **reality**.

But what did Hering say about the purpose of a colour system?
> "... (to give) the reader ... a comprehensible ex-
> pression as precise as possible for every colour,
> so that he can mentally reproduce any colour with
> some exactness, ... we must at first disregard al-
> together the causes and conditions of their arou-
> sal. For a systematic grouping of colours the only
> thing that matters is **colour** itself. Neither the
> qualitative nor quantitative physical properties
> of the radiation are relevant." (1874)

Therefore, as soon as the same kind of blue-green material is seen against two differently coloured surrounds, then we have two different colours. This is not an illusion, it is the normal way our colour sense works. It would be as much of an illusion to say that when two parts of the visual field have identical physical properties, they should always look the same, disregarding the complexity of colour sense.

Let us look at the visual process with the help of a series of schematic diagrams.

2 The colour stimulus

An illuminant (the sun, the sky or an artificial light source) is either viewed directly or illuminates an object. It is a physical concept, specified by the spectral power distribution of the electromagnetic flux. The condition for the flux to be luminous is that at least part of the energy falls within the "visual spectrum", i.e. the wavelength range, where the human eye is sensitive. CIE has recommended three types of illuminant (A, C, D65) to be used in colorimetry.

After being reflected (or transmitted) by the object, the flux enters the eye, where the optics focusses an image on the retina. So far we are within the domain of physics, and the luminous flux acts as a **colour stimulus,** i.e. a radiant flux stimulating the human neural system to a visual response. The word "stimulus" is Latin for the stick which the Roman farmer used to "stimulate" his donkey to move forward. The stimulus is physical and can be measured physically with physical instruments.

Not only the radiant flux entering the eye is referred to as stimulus, but also the object from which the flux is emitted (reflected, transmitted) towards the eye. Therefore all colorants, dyes and pigments also belong here, and all the samples in a colour atlas are colour stimuli. They are physical themselves, even if they illustrate perceptual relationships in colour space.

Possibly induced by the art of three-colour printing (practised by the Chinese in the twelfth century and in the West some five hundred years later), a three-receptor theory for colour vision was first postulated by Palmer 1777, then by Young and Helmholtz. But how the signals are transferred to our mental image of the object remained unknown.

The Grassmann laws (1856) of additive colour stimulus mixture helped to circumvent the problem. They stated that any three primary stimuli may be used in colour reproduction, hence also in a stimulus measurement system, and that physical measures of different sets of primaries may be mathematically transferred into each other. It was thus possible to concentrate research on the phases before and after the neural process, abiding future disclosures of the latter.

3. The colour valence

The Grassmann laws made it possible to establish **colorimetry,** i.e. the technique to measure the physical stimulus by physical methods evaluating its spectral power distribution mathematically to simulate human colour vision, thus assessing the **colour valence** of the stimulus. This evaluation is based on colour matching experiments where a number of observers had to match spectral stimuli against mixtures of three primaries. The average was defined as the CIE standard observer - to be used with a defined illuminant and a specified instrument configuration. The matching is a psychophysical process, made once for all, but then the whole procedure takes place in the domain of physics.

The evaluation of a colour valence is thus based on colour matching. Therefore tristimulus values and chromaticity coordinates are useful to tell if two stimuli will give colour percepts that look alike or not; but they do not tell **what** they look like.

The moment of averaging in determining the standard observer functions implies that an individual observer may deviate noticeably from the average - without being colour deficient.

The term colour valence is new in English. It is a translation from German "Farbvalenz" introduced by Prof. Manfred Richter. The usual English term is "psychophysical colour", used in parallell to "perceived colour". I find both expressions most unfortunate,

as they imply "colour" to be something dual in character and with an existance outside the observer. By "colour valence" we can denote a capacity to evoke a certain perception of colour, not to be confused with the colour itself.

For many physicists, this is all that has to be known about colour. To them the colour we see is "really" a radiant flux with a specified power distribution, and they even believe that CIE coordinates "describe" the colour. But what surprises me even more is that so many artists, architects, designers and teachers believe themselves to be more clever and more sophisticated, if they express themselves about colour in physical and technical terms instead of just telling us what they see.

4. The colour percept

We may then return to Hering, who set out to study the **colour percepts** as already quoted. By studying the colours themselves he developed the "natural system of colour percepts", vigorously fought by Helmholtz and other adherents of a purely trichromatic system, until von Kries, Schrödinger and Müller suggested that the "Helmholtz or Hering?" question could be given a "Helmholtz and Hering" answer with the zone theory of colour vision.

Hering based his theory on the fact that there are six "einfache Farben" (to-day called elementary colours), which have no resemblance to each other and which form a sufficient basis to describe all other colours.

Two elementary colours (black and white) are end points of the bipolar scale of achromatic grays, decreasingly whitish as they are increasingly blackish. The other four elementary colours are chromatic (yellow, red, blue, green), dividing the hue circle in four quadrants, and forming a bipolar hue scale for each such quadrant (e.g. yellow - red with a decreasing yellowness balancing an increasing redness). The non-adjacent elementary colours are opponent in the sense, that no colour can be simultaneously yellowish and bluish, nor reddish and greenish. Hence, the Hering system was called the opponent-colour theory.

The resemblances of a given colour to the elementary colours (whiteness, blackness, yellowness, redness, blueness, greenness) are denoted as its elementary attributes. Note that none of the commonly used colour variables (hue, chromaticness/saturation or lightness) are among those. However, hue is the proportion of the chromatic attributes present, and chromaticness is their sum. These relations are used in the formation of the NCS notation. Saturation then is defined as the relation between chromaticness and whiteness, whereas lightness needs a more complicated operational definition.

It is often claimed that measurements can only be made with the help of physical instruments but, according to the Oxford dictionary, **measure** is to "ascertain extent or quantity of () by comparison with fixed unit ..". As soon as we have some mentally conceivable references, we therefore also can measure mentally. I owe prof. S.S.Stevens of Harvard University for having introduced

me into the science of **psychometry**. This was then successfully
applied to Hering's Natural Colour System, when a small Swedish
group set out to deepen and consolidate the NCS theory and to
improve Hesselgren's Colour Atlas, the first on the NCS concept.

We found that the six elementary colours were sufficient as re-
ferences for psychometric measurements of colour percepts. And
furthermore, these references proved themselves to be innate in
the observers, so that no physical references (colour samples)
were needed for comparison, when the apperance of an arbitrary
colour was to be assessed. Consequently, no physical measurements
of any stimuli were needed either. I have recently had the oppor-
tunity to ascertain this with some completely "naive" observers;
there is never any doubt, which colour is e.g. the red one which
is neither yellowish nor bluish.

The NCS notation is not only very easily understood but also
clearly descriptive of the appearance of the colour, proving that
it is perfectly legitimate to describe colours verbally; specia-
lized physical instruments are not always necessary; the human
brain acts as an instrument.

A colour percept can be given an NCS notation in any viewing
situation. The NCS Colour Atlas is a collection of colour samples
(colour stimuli) intended to illustrate the NCS. A notated sample
gives the corresponding colour percept in daylight. In other
situations, the colour sample generates an other colour percept;
this can be described by another NCS notation.

The NCS is the only colour system totally in the psychology
domain, as all definitions are directly related to the properties
of colour percepts. Other systems may be developed through
perceptive experiments, but as there are no natural and easily
recongnizable references, they are then defined by the colour
valences for the selected stimuli. No instructions are given for
the description of colours seen in other situations.

The artist Albert Munsell used physical-mathematical methods −
a spinning disc − to select five principal hues through additive
mixture. His only perceptual definition was that "green" should
be neither "warm" nor "cold". The spacing has since been adjusted
by an OSA Committee, but remains mainly the same. Incidentally,
yellow, green and red are roughly equal to NCS, but Munsell blue
is not at all blue.

The DIN system has no perceptually defined reference nor any
particularly distinguished hues. The chromaticities for satu-
ration 6 of 24 equi-spaced hues serve as operational reference
points, from which all other points are calculated, using
simplifying approximations in CIE space. Zero darkness is defined
as the Rösch-MacAdam surface. Both Munsell and DIN use black and
white with the same definitions as NCS.

The OSA Uniform Colour Spacing system has no reference points
beside the achromatic colour valence, but the positive j (jaune)
axis is chosen as approximatively representing "unique yellow".

Therefore, all these three systems are more specifying colour
stimuli than describing colour percepts.

5. The neural response

To make the sequence complete, it remains to be mapped, how the **neural response** to the physical stimulus is evaluated into the final colour percept. We now know the sensitivity functions of the receptors, and roughly how these are connected to a layer of bipolar cells, which in turn are linked to the ganglion cells. The receptor signals are combined: red and green to a new yellow signal and all of them to a lightness signal; and balanced against each other: red against green, blue against yellow, and light against dark - before they are sent through the axons of the ganglion cells, which form the optic nerve from the eye to the cortex of the brain. Note the conceptual parallells to Hering's opponent pairs!

In the visual cortex the final signal processing takes place, using visual information not only from other parts of the visual field but also stored information from memory, thus accounting for phenomena as colour constancy, simultaneous and successive colour contrast etc.

6. Summary

We can now summarize the visual process:
1. The colour stimulus: What stimulates the visual sense to generate a colour percept - the stimulus is physical in character and can be specified by its spectral power distribution.
    *** This is the physical aspect of colour. ***
2. The colour valence: The spectral power distribution of a colour stimulus, evaluated into tristimulus values - representing a colour match for a standard (i.e. average) observer.
    *** This is the psychophysical aspect of colour. ***
3. The neural response: The electric spikes photochemically induced in the cone receptors of the retina, then coded and transmitted through the neural pathway to the cortex.
    *** This is the physiological aspect of colour. ***
4. The colour percept: What we see as colour - and describe by colour words like red, yellow, green, blue, brown, grey etc. -
    *** This is the psychological aspect of colour - and ***
    THIS IS THE REAL SENSE OF COLOUR.

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Making colour work

Colour works at many levels of our perceptions: as an indicator, a guide, a warning, a stimulus, a pacifier. It tells us that meat is fresh, fruit ripe and that our bodies are healthy. From the time of its development in our earliest ancestors, colour vision has become essential for our survival; and we have learnt to exploit the fact. Food merchants exaggerate the colours to make their products more appealing; cosmetic manufacturers change our appearance; textile designers use colour to catch the eye and create illusions of size and shape; advertisers, and frequently architects, seek to capture our attention by making signs and buildings more eye-catching. The effect, increasingly, is one of visual confusion affecting everything from our immediate surroundings to the wider environment.

My intention is to show how we can learn from the way colour works in nature to make it work more actively to enhance the environment for the present and the future.

Colour in Nature

Colour in nature performs a variety of functions from that of simple attraction to strategies including camouflage, disguise, distraction, mimicry, warning and aggression. We tend to concentrate upon attraction, confusing it with our subjective ideas of beauty, rather than using the colour to achieve specific objectives as we would with other aspects of design. The reason is not far to seek, at least in architecture; architects being taught to design buildings in black and white, leaving the 'colouring up' for later. We do however, use nature's strategies in a variety of ways. Camouflage is a well-known strategy of war, and the use of red for warning is universal in such things as machines, electrical and fire appliances. and traffic lights. We may note, however, that such traditional usages can change. A number of over-enthusiastic Red Guards, during the Chinese Revolution, decided that red was more appropriate as a symbol for GO than STOP. and they reversed the order of the traffic lights. Unfortunately, they did not change them all. It is an amusing story, but sadly, such accidental uses of colour - albeit without such disastrous consequences. except in visual terms - are all too common in the environment.

Colour Pollution

The concept of visual pollution is well-known, and architects and designers have for many years campaigned against the clutter of unrelated objects such as signs which tend to accumulate in all public places. But until recently, colour has not seemed to pose such a problem. However, it is only necessary to look at the average supermarket window to see what visual confusion can be caused. Advertisers have long been aware that colour is a potent weapon. Unfortunately, the knowledge has yet to be fully absorbed by others concerned with the

appearance of our environment. The current colour revolution in the building industry makes this a cause for serious concern.

The problem arises because our view of colour tends to be both subjective and simplistic. The most common objective for its use in our immediate surroundings is for identity: for example, in the painting of the front door or the house facade. There was, a few years ago, a classic planning confrontation in the Georgian city of Bath, when a resident of the Royal Crescent painted her front door yellow, instead of the usual black and white. But we have moved on to much more serious infringements since then, not specifically in Bath but in many other places. Careless interruptions to the architectural unity of terraces and streets are becoming very common. This is most obviously wrong where the buildings are of high quality, but it can also destroy the unity of a street. In such cases it is unwise to be dogmatic because it is the nature of traditions to change and develop. But there can easily come a saturation point at which the tradition is killed. Christopher Alexander recounts how Slovakian peasants, who had for centuries produced shawls with beautiful patterns and colours, were thrown into confusion by the introduction of aniline dyes in the 20th century. The colours and the colour choice were too much for them: the tradition was destroyed.1

The environmental parallel is, of course, not precise. In the terrace or the street we are concerned with a changing population of many individuals, each with their own tastes and desire for self-expression. The argument becomes one of individual versus corporate expression. How can we solve it ?

Colour Analysis and Strategy

We need to consider more than the simple objective of self-expression and to predict the effect that our choice of colours will have upon the surroundings, and for that purpose it is necessary to analyse those surroundings. A methodology for the purpose has been developed by Jean-Philippe Lenclos who pioneered the concept of a Geography of Colour in France and elsewhere. This is based upon the categories of mineral colour, found in rocks, soils, and natural building materials; vegetable colour, and the colour that is applied in the form of paints, plastics etc. Mineral colour is the predominant colour in most of our towns and cities; vegetable colour of the country.

Every situation must be considered on the basis of the special conditions prevailing in terms of its own special colour character. This will include colour changes due to the light, the season, the effects of climate, movement of people and objects within the area, and individual changes to the fabric of the area itself. Finally, it must be considered in terms of the objectives that we want to achieve with colour.

Colour objectives may range from suppression, or even total concealment, to the fullest colour expression as in a painting; but it should be noted that the categories are not mutually exclusive. Invariably, the colour is working in several ways at once.

Camouflage

The modern idea of camouflage was developed by some French artists serving in the army during the First World War. They conceived the idea of using abstract painting to conceal their battery, and it was later adopted by the British, who applied zig-zag patterns of black, white and blue to disguise battleships. But the principle is, of course, common in nature. Its value to us is not so much in concealing things as in changing their appearance in terms of size and shape. The stripes of a zebra, of women's dresses, of buildings and even of birch trees achieve this in breaking up shapes, thereby reducing the mass. The painter, Bridget Riley, carried the idea into Op Art which exploited the impression of movement; it was also developed by Vassirely in the apparently undulating lines of the town square at Creteuil outside Paris. The alternating dark and light stripes demand a change of focus which exaggerates their difference.

The principle can be extended in terms of squares and rectangles of varying degrees of lightness and darkness; and the addition of blue suggests distance, while its opposite forms an advancing visual target. But for many buildings the problem is complicated by different functions housed in different masses, which have to be colour-coordinated to work, not only with one another, but with the surrounding landscape. In most cases the problem is not even confronted: in a few cases, such as the nuclear power station at Wylfa on the Isle of Anglesey, North Wales, the designers have arranged the building complex as a series   of facets in browns and greens to relate to the prevailing colours of the sky and sea, as well as the land itself. In such cases, climate is of great significance, and studies need to be made in all conditions before colour decisions are made. At West Burton in northeast England, the 'bulking effect' of eight cooling towers coalescing into a single mass in the polluted atmosphere was counteracted by colouring one of them deep yellow and two dark grey to give the illusion of depth, as well as adding interest. The use of 'distractive colour' - to arrest the attention and direct it away from adjoining objects - has also been used to considerable dramatic effect in groups of oil storage tanks at Milford Haven in South Wales, where a single bright red tank 'advances' from a field of beige, grey and 'retreating' blue.

Distance

The principle of aerial perspective - 'the blueness of distance' - although used by painters for centuries, has so far been little used by architects, and still less by landscape architects. This is surprising, because the palette of tree colours, particularly conifers,

lends itself well to such colour composition. One striking example, now in the process of implementation, is the undistinguished mountainside at Beinn Ghuilean in Scotland, which the landscape architect has 'painted' with trees, contrasting the 'advancing' colours of the deciduous hardwoods, Norway Spruce and Lodgepole Pine, with the 'recessive' blue-green foliage of Scots Pine and Sitka Spruce. Such a project demands the patience of the 18th century landscape designers; but the principle of using warm and cool colours to manipulate space in the garden is not uncommon. Sensitive gardeners are also aware of the effects of the Purkinje Shift and use blues and whites in areas of poor light. Unusually, this has also been taken into account in the design of the cramped north-facing entrance of the temporary television building on Canary Wharf in London's Docklands. The composition of blues ranging from dark to light works well in the dim light when seen across the water although its 'coolness' can be disconcerting.

Temperature

The most common landscape and building colours are warm, ranging from the reds and yellows through to the greens (although greens are rarely appropriate for buildings). Blue is un-usual, associating better with water especially in warm climates. In London Docklands, which is not noted either for the design quality of its buildings, or for the use of colour, there are a few striking examples. The office buildings on Heron Quays, the Isle of Dogs, incorporating five variants of red, substantially change the 'temperature' of the area, compared with many of the cooler buildings around them. Significantly also, the sky-associat-ed colours, blue and white (as well as mirror-glass) affect the apparent weight of buildings, making them seem lighter.

Weight

Although weight has been adopted as one of the criteria, along with hue and greyness, for colour measurement in the BS+ 4800 (1981) system,[2] as a subjective term for lightness - the saturation being measured in terms of greyness (a convenient method for paint) - it is sub-ject to different interpretations. The painter, Maurice de Sausmarez, states categorically that weight has nothing to do with brightness or darkness: 'ultramarine, for example appears to weigh more than cobalt blue, terre verte more than viridian, cadmium red more than vermilion.'[3] Such subtleties are, however, not of great significance when viewing objects from a distance, for which purpose the first interpretation seems more valid. The concept is illustrated by graded bands of horizontal colour; the term may also be considered appropriate to describe the ways in which colours need to be balanced in a palette for any particular purpose.

+ British Standard

Palette

A painter chooses his palette for a particular painting, carefully balancing one colour against another. In the environment, the need for a balanced palette is similar, but it is complicated enormously by the need to deal with colours in terms of real materials: rocks, soils, vegetation, building materials, as well as paints and other applied materials, not to mention changes in lighting conditions. The palette will differ according to different countries (from the soft water-colour light of the British Isles to the clear bright light of the Mediterranean), different colour traditions in different regions and localities. Ocasionally, this is surprisingly limited by time and place, as in this Dorset farm. More often it demands Skillful extension, * * and frequently it is disrupted by the use of unsympathetic materials and paints of newer brighter colours.   * *

Colour Composition

Although there is considerable colour consistency in the best landscapes and in many towns and cities throughout the world, all are threatened by the intrusive colours of signs and advertisements, as well as the need for change and individual expression. But we must also acknowledge this need as the impetus behind some of the most brilliant coloured settlements that exist: such as Guanajuato in Mexico, Burano near Venice –in   * * which each family has its colour – and Schärding in Austria. All have become tourist   * centres and are now necessarily controlled by Planning Regulations. Others, such as almost all the towns and villages in Malta, are not yet subject to such controls, which   * * are beginning to be necessary.

Such developments are interesting and occasionally spectacular, but they should be accompanied and informed by environmental colour compositions which are carefully calculated - as opposed to intuitive - like those applied to housing estates in Berlin   * * in the early part of the century by Bruno Taut, more recently to housing in France, and   * much earlier, to the ceremonial centre of Turin, now being restored. But first we must   * make people see how colour can be made to work to everyone's advantage.

Notes: 1 ALEXANDER C Notes on the Synthesis of Form 1964
        2 GLOAG HL& GOLD MJ Colour Co-ordination Handbook 1978
        3 SAUSMAREZ Basic Design: the Dynamics of Visual Form 1964

5 Clara Froger Netherlands
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Colour in architecture, ways and means

Clara Froger

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Colour in architecture: ways and means

I would like to begin with telling you something about
myself.
I started my career making large, abstract sculptures
in earthenware and in stoneware. I make paintings as
well, but would not dare to call myself a painter.

As an art student I realised that I wanted to work in
architecture and with architects. To be able to do so,
I had at least to learn their language. So, in my final
year at the Academy of Arts I started to study
architecture and urban planning as well.
Since that time I have always worked in these three
fields: art, architectural and urban design, and have
combined the three of them.

At the Universitities of Technology in Delft and
Eindhoven the study of colour is an optional subject,
and at the Academies of Architecture and Urban Planning
it is not a must either. Nowadays one may become an
architect or urban designer without having studied
colour at all.

For years I have been trying to convince people of the
importance of using colour more sensibly and
sensitively than has been done so far.
This caused me a lot of problems and it took quite some
arguing in the beginning, about 15 years ago, but
gradually people became more interested.
For some years now designers have become more aware of
the importance of colour in architectural design. I
myself have been able to realise some projects, too. I
will try and show you how I chose the colours that I
used and what I intended these colours to be for the
people living there.

There is a nice little joke about my country that I
would like to tell you:
'God created the world, but not the Netherlands !'
'Why ?, you may ask. 'Because the Dutch made it
themselves.'
I think I will have to explain that to you a little.
The Netherlands lie so low, between 4.50 and 6.30
metres below sealevel in the western areas, that more
than a thousand years ago we already started to realise
a net of waterworks to help us keep our feet dry.

Clara Troger

kleurarchitektuur　　　　　**gebouwkunst**　　　　　**vrije keramiek**

This also gave us the possibility to work in and with
the very rich clay of our riverdeltas, both
agriculturally and industrially. We still need a lot of
clay for the bricks we use in our buildings. If we did
not continue to control the waterlevels, the
Netherlands would soon turn into marshland again. We
have also reclaimed large areas of land and have used
that land for agriculture and built colourful new towns
on it. If you would like to know what the Netherlands
look like, you should imagine a country with lots of
water everywhere: ditches, rivers, canals, lakes, sea,
and, of course, rain. The wind and also the four
seasons change our natural colours constantly.
The reason why I tell you all this is because it is
important for the colours I am using in the built
environment. I also think it is important to know that
in my country nearly everything was once designed by
someone. Every inch of it was once destined to be a
park, a street, a town, etc. In 1957 our last primeval
forest was changed into a cultivated one. Another
important aspect is that there are 431 people on every
square kilometre of this little country. Socially
speaking, our society is a colourful one because of the
many different cultures that are living there,
especially in the cities.

I believe that it is in the metropolitan areas all over
the world that we should try and realise - and I mean
realise in the sense of creating - an environment that
is as safe and beautiful as we can achieve. With that
controversial, subjective word 'beautiful' I want to
say 'good' in every aspect of design and I believe that
colour is one of the most important elements or media
to work with. I am often in doubt about the importance
of colour in connection with or in contrast to the
other, clearer aspects of good and bad in environmental
design, but then, from the very moment I start to work
on an object or situation, I remember why I really like
to work with people and their colours. To me, every new
project is a process bringing its own solutions as I go
along - in my own way and with my own meanings. I hope
I can show you some of my projects at this AIC
Symposium: Colour in Environmental Design, Winterthur,
August 1988.

I am really looking forward to the other lectures and
hope that we may all help each other to make people
more conscious of colour and environment.

May 1988

6 **Prof. Attilio Marcolli**   **Italy**
Architect
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The color image

COLOR IMAGE

The City of Venice is the most meaningful color image environment, due to the fact that Venice is the city most prevalently shaped through light and color.

Venice shows that color image in urban environmental design cannot be based on Colour order systems, but on colors lived through in relation with environmental perceptive structures relating to a phenomenon, ∞ in the interaction of chromatic conditions with formal conditions of architecture and the city; among these, "topological" and "figurative" conditions are the most important.

It is on the ground of this interaction - that takes in Venice an amaising expression - that the chromatic shape of the city can be said Erscheinung, in which the ways that color appears are shapes of color, as sign and vision of the city.

In another hand, Venice itself is (asserting it with extreme synthesis) the most eloquent marriage between Andrea Palladio and J.Wolfgang von Goethe.

Our analysis of Color image concerning environmental design in the city, that Venice assumes through an important set of samples, is based on the dialectic of opened-spaces (the square for instance) and closed-spaces (the intense urban agglomerate of the historical centre); in which are included the mediation-spaces.

In Venice, the great opened-space is the Lagoon, a large place made of sky and water, that time ago was the only entrance in the City, from the sea. The Venice closed-space, its inside, is somewhat the dense tissue of houses that face one another on calli (narrow streets), canali (little waterways) e campi (closed-openings little places). Between this outside space and inside one, inside--outside, there is the mediation space of Piazza San Marco and Canal Grande.

The opened-space is the space of full light, from which rise the colores apparentes, fluxi et fugitivi, phantastici, falsi et variantes, that Goethe has also defined as speciosi et emphatici because of their remarkable brightness. There, neither the eye, nor the light are protagonist, in the sense of agents by themselves. The real agents are the turbid media, halftransparents or translucents of the atmosfhere, the air and water, creating dioptrical colors wich originate from light refractions crossing these media in keeping variation (summer-winter, morning-evening, clear-fog, visions against the light, etc.).

The closed-space is on the contrary the space of shade, darkness, in which born the colores proprii, corporei et materiales, permanentes et fixi, that in the active side (of the chromatic disk) proceed through numbness, from white which becomes yellow till culminate at the zenith on plaster building reds, and go on sometimes over the red but still in way to create an oeil de rouge (Goethe) as point of virer (to tack about); and to the negative side, it proceeds through a yellow dialectic, mixed with blu to produce anthonies or green paintings. Then, the organization becomes an organization of a chromatic opposition (middled or emphasized by means of compressions, saturations, dimmings, blends, increases of material turbities).

On the one hand, the opened-space of the light: the white, the clear that gets tainted by colors of refractions, and becomes excited in a contrast of light and shade, clear and dark. With on the other hand, the closed-space of the darkness: the black, the shade that gets tainted by colors of reflections, and becomes excided in a contrast of red and green. For both, the yellow's common denominator, urban chromatism matrix. From one part, in the black and white opposition, the world of light, of opened-space, of north-south vision, of the Lagoon's synthesis. From another part, in the red and green opposition, the world of darkness, of closed-space, of east-west vision, the tissue's analisis of the urban agglomerate.

Between the two color images of Venice - that form a physical color dialectic: physical, dioptrical, refraction's colors and chemical, material, reflection's colors - comes to take one's stand the mediation spaces, still made of physical colors, but catoptrical, of the reflection like material ones, but made of reverberations, of haloes.

Summed up the chromatic conditions of Venice. But these conditions - as already mentioned - to become color image have to unfold in tight relation with formal conditions of architecture and the city, among which the topological and figurative conditions are a matter of primary importance. This signifies that, concerning color image in environmental design, space and color cannot be cut or dealed separately relating to a phenomenon. It means they are not distinct elements but interdependent to obtain an unitarian process of perceptive organitation.

Venice spatial conditions are the margins. In fact the ratio margin-surface (that can be, according to the cases a ratio of internal

border-region, outline-sample, frame or rim and internal spatiality) is the stimulating agent of radiations and reflections; therefore the conditions of appearing and revealing of color.

We can notice it, in what concerns the Lagoon's opened-space, through the San Giorgio Maggiore of Palladio; concerning the mediation space, through the Palazzo Ducale in Piazza San Marco; and concerning lastly the internal space of the urban agglomerate, through the building pictures of the tissue.

I. Reguarding the Palladio, it is a sound observation the one that Goethe expressed, pointing out that there is no chromatic display on uniform surface, but it does exist with margins, where a surface is in contrast with a clearer or darker object, which shows colorated manifestations. The images are made of the association of margins and surfaces (Goethe, 198).

The ratio margin-surface, says the psychologist Kanisza, is a ratio of frontiers and regions stimulated by radiations. From the margin gradient and its "steepness", depends the alteration of the stimulations between the several regions: the internal surface's chromatic quality depends not so much on the material the more on the spatial organization.

The Palladio, says the critic Cesare Brandi, has a predilection for the monochrome, the white or the muddied white, somewhat yellowed. But he does on the front a spatial operation, a dissection: to one face he adds another one making of the outside a brief inside. The giant pillars of the second façade are warped of light that makes shadow, and "steepest" margins, with high gradient, modify the stimulation that comes from the intermediate shapes or surfaces; even if physically emenate the same radiations.

So, the building lives of full color-light that comes from the Lagoon's turbid media, and reflects them. Turbidity's variation is equal to the increase or diminution of media thickness; consequently light assumes yellowed, reddish, purple colorations. Against light, darkness is a through passing vision. So, the muddied water gives purple visions toward the bottom and green to the waves shades, in a dialectic of "volume-colors".

The Palladio showed that a space lives of those conditions of sight among which is involved turbidness and conditions of view marked with "steepest" margins which give out surfaces recieved through variations of clearness.

But Palladio's topological operation sinks also of <u>amodal comple-</u>
<u>tion</u>. The shorter façade gets perceptively completed <u>behind</u> the tal-
ler one, and is availeable of a minor quantity of energy due to the
fact that the whole available energy gets used by the <u>advanced</u> face.
That provokes an optical contraction of the façade "at the back", a
narrowing. This topological perception due to the amodal completion,
collaborates together with the topological perception of the stiff
margins (the giant colonnade) to increase the difference of level,
purely perceptive, of clearness; at times on the limit of brightness,
then with a role of advanced figure as regards the background.

II. In the <u>Palazzo Ducale</u>, with its <u>baricefala</u> (the weight is up)
structure, the outside - the Lagoon's light quiver - is guest to
come inside at the bottom, where the shade appears matter the same
way the upper marble does. Osmosis of outside-light and inside shadow.

In the sea of light the up wall is reflective, the white-yellowed
and white-red bichromism making it quiver. Drazzling.

Various yellowed -

But here are present "margin microstructures". The horinzontal
margin in up, the coronation, and down, the tunnelling, create the
effect of <u>margin gradient</u>, for which the color-light from inside region
becomes softer and compactless. Therefore the "volume-form" is tra-
sformed into surface, cut off by vertical medial margins. These per-
ceptive local aspects carry into effect the passage from one to
another chromatic modality, fixing a difference of clearness. The
chromatic substance thins out, favoured by expansion, dilation, and
way to appear of color, like a "film" (not "volume-color" or "surface"

color of volume   *color of*

-color", but "film color")

The low shadow is a reflecting matter, "color of surface", that,
as background, provokes the irradiation of the pillars, white figures,
which look like becoming larger. So, the black, obscurity, leaves the
eye in a quiet condition, the white, as representing light, makes it
work. The eye is forced (Goethe) to a kind of opposition, going from
dark to clear. That is the true and substancial condition for a
urban space of mediation (even in New York).

III. In the <u>calli</u> and <u>campi</u> (narrow streets and little squares) of
the urban tissue of Venice, the margins are "optical tunnels" from
which the skimming light is emphasized through the reflecting wall's
chromatic material unhomogeneity.

Here the eye needs and looks for totality, and looks into itself

the circle of colors. Between red material walls and green windows shutters white windows margins or/and borders emerge and struck you; for this reason from the darkness of "tunnels" of the <u>calli</u> the energetic light is carved and becomes image of brightness. We have seen that to produce these effects not merely light but a powerful light is necessary; that this powerful light again is not an abstract and general quality, but a circumscribed light, a luminous image (Goethe, 371).

Lastly, the colours which are chiefly exhibited in reflection are red and green (Goethe, 376); therefore Venice material estate is given in order to accentuate the catoptrics estate, and to help the chemical estate to strenghten and praise the physical estate.

Attilio Marcolli
<u>Attilio Marcolli</u>

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8 **Judith Ruttenberg**   **Israel**
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Environmental colour:
Approaches and methods, as expressed
in colour-design projects in Israel

ENVIRONMENTAL COLOUR: APPROACHES AND METHODS AS EXPRESSED
IN COLOUR-DESIGN PROJECTS IN ISRAEL / ARCHITECT JUDITH
RUTTENBERG

Environmental colour adds the "human-dimension" to the
built environment.

The term "human dimension" expresses the set of stimuli
which gives the sensory input to the environment, leading
to a feeling of well-being, allowing the link between man
and his surroundings. The comprehension and enjoyment
of one's environment is a sensory experience in which colour
plays an important role involving the physiological , mental
and emotional reaction to colour.

Colour is directly related to the conceptualization of the
physical environment from the standpoint of dimensions
and proportions, orientation, intellectual and cultural
enrichment.

The examples of environmental colour - planning carried
out in Israel, represent these ways of enrichment of the
built environment by planned colour.

1.   Improving and expressing dimensions and proportions.

      The perception of form is the result of the perception
      of the different volumes and dimensions, understanding
      of the constructive method, noticing the architectonic
      style and details. In that way the built environment
      creates a mental pleasure.

Colour has a main role in expressing the built-in
qualities of the volumes or changing them if
needed the weight - being heavy or light; the
size - helping us to estimate the size (especially
in high-rise buildings) and pointing our the
characteristics of the threedimensionality of the
volumes, to create the right composition of volumes,
their proportions and components.

Understanding the constructive method, enriches the
intellectual enjoyment from the built environment.
Colour can express the function of the constructive
elements, and so explaining visually the whole
constructive system, making the form richer and
interesting.

Using contrasting colours for architectonic details,
make us notice those elements and enjoy their
language of form and style.

2.   Orientation

The unconscious perception of colour, makes it
an efficient source of information for orientation.
In our built environment the meaning and importance
of orientation is not only "finding one's way" but
it has an emotional content: it entails fear,
frustration, horror and indifference.

There are different levels of perception of
information about orientation:

1) Identifying land - marks, areas and places:
    In this case, colour catches the attention,
    the colour-combination creates a unique
    atmosphere which becomes characteristic of
    the land-mark, and helps remember it.

    Supergraphics of numbers, graphic symbols
    etc. When being part of the colour-design
    of the building it adds sofistication and
    provide information.

2) Identification of direction:
    This aim can be achieved by merely using
    colour gradation - monochrom from dark to
    light or a group of analogycal or spectrum
    arranged colours. (for example a gradation
    of colours from yellow through orange to
    red and purple).

    This kinds of colour - conbinations have
    directional characteristics. The colour
    accompany the movement, lead towards the
    "goal" while making the way more interesting
    and by that "shortening" it mentally.
    The coloured areas can be a repeating
    element of the building along the road,
    or any sort of systematically changing
    colours dividing a long wall or ceiling
    into areas of changing colours.

    Supergraphics of forms indicating direction
    like arrows, diagonals etc. can also play
    an integral part of the colour - design for
    directing movement and identifying important
    points along line of movement. (doors,

intersections etc.)

"Identification", as connected to orientation,
may be treated from a more general point of
view, namely of "image". A particular colour-
scheme creates a certain image the result of
associations related to colour and colour-
combinations.

So colour has an integral part in building
a corporate image to an institution or
business.

3.   Emotional enrichment of the built environment:

A monotonous environment is potentially dangerous
to emotional health.
Colour creates atmosphere through associations,
physiological and psychological reactions.

Creating the right athmosphere ensures an
comfortable and pleasant environment which enables
the specific population to keep a level of optimal
activity and emotional balance.

When a colour - scheme of a building is planned
according to the language of the architectonic
style, according to it's original colours, in
coordination with nature and surroundings - it
has then an emotional content which turns a group
of buildings into a "place".

The physiological, intellectual and emotional reactions that the built environment evokes in us, determines a great extent our attitudes and feeling with regard to it.

Planned colour is an integral part of the set of experiences and stimuli, which cause a positive reaction and the tendency to create a link between man and the built environment.

9 **Dr. Leonhard Oberascher** **Austria**
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An ecological approach in environmental colour design:
The work of Paul Meyer-Speer

AN ECOLOGICAL APPROACH IN ENVIRONMENTAL COLOR DESIGN :
The work of Paul Meyer-Speer

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If a symposion is held under the title "Color in environmental design" in the first instance one will probably have to ask what the designation "environmental" really stands for ? To give a straight forward answer to that question seems to be rather a difficult task. As for example it is also hardly possible for the physisist, psychologist, philosopher and artist to agree on one common definition of the term "color", the concept of environmetal design is an ambiguous one. Bechtel, Marans and Michelson (1987,1) express this fact simply by the remark "environmental design means many things to many people" while Craik (1970,5) points out "the rich connotation the term environmental has acquired through many recent efforts to analyze systematically the character of the total contemporary physical environment including its natural and man-influenced, professionally designed and haphazardly formed manifestations". The adaptation of the designation "environmental design" for the disciplines of architecture, landscape architecture, city and regional planning, interior and industrial design as a common name, rather reflects a process of growing awareness of the impact of the physical environment on human behavior than it signifies a specific professional field. While designers, architects and planners usually favor a deterministic standpoint by claiming a strong influence of design on human behavior, "environmental design research" focuses on the interdependence of physical environment and human beings at all scales. Environmental design research as "basic and applied research and research application" is a powerful tool to provide a systematic insight into the highly complex man-environment-system (Moore,Tuttle & Howell, 1985). In the consequence it helps to improve the quality of life through the development of a conceptual instrument to increase the correspondance between human and environmental factors.

With this basic perspective in mind the scope of this paper is to present an "ecological approach" in environmental color design. Thereby the actual impact of color design on environmental perception and assessment is seen as relative to the wide range of interacting environmental and human factors. Nevertheless it should be shown how color can play a crucial role for the perception and evaluation of architectural space and how therefore is a highly effective means of architectural design. Non-visual effects of light and color, or symbolic meaning of color will not be considered in this paper. The discussion will be restricted to the problem how perception of architectural space and elements can be facilitated by color. In other words, what is of particular interest are the questions : How color can be used to make the fundamental "affordances" of architectural space better "readable"; and what design paradigm can in this context be useful for further development in environmental color design ?

An ecological approach to perception : Over a 35-year period the psychologist James Gibson (1950,1966,1979) has developed an "ecological approach to visual perception", which became progressively more radical. Gibsons emphasis to define a totally new approach to visual perception has its reasons in his critique of traditional theories of perception (Gibson,1966,1979). Usually observers were confronted with discrete stimuli in a controlled laboratory situation and their reactions recorded. Findings from such kind of experiments could not explain the perceptual process in a complex environment because they constantly neglect the relation between environment and perceiver. The perceiver only was looked at as a passively recording or information processing system but not as an actively information seeking being. This insufficiency made Gibson demand an analysis of real behavior in real situations. He claims that environment and animal or men are tightly interlocked in such a way that the environment actually constrains the possible actions of an organism. According to his hypothesis (Gibson,1979, 127) meaningful environmental properties - which are thought of as indicators of what the surroundings "offer" or "afford" an organism - can be "directly perceived" since the necessary "information" to specify them is given by the "structure of the ambient

light". Gibson argues that stimulation per se does not lead to perception. Light, in order to carry information about the external world, must be structured. To describe it´s structure an "ecological optics" is needed (Gibson,1961) rather than a definition in the terms of physical optics. For terrestrial animals the environment consists of a "medium (air), substances and textured surfaces". Men and animal do not live in an abstract geometric space of "points" and "planes". The layout, texture and color of surfaces are the main cause why ambient light is structured. "Illumination", which Gibson (1966) defines as the manifold reflection of light between surfaces and the medium as well as in the medium itself, consists of an innumerable collection of light rays of different wavelenghts and intensities. These light rays, which can be imagined "to be ambient" to any possible point of observation, form a hierachical and overlapping set of "visual solid angles". Any angle corresponds to a particular area or component of the environment. The components of the environment are "nested" within others, so are the visual solid angles. Changes in the intensity of light and mixture of wavelength from one solid angle to another, signal changes in the layout and quality of the environment seen from a fixed point of observation. Changes in the total pattern of the ambient optic array are produced by the movement of the observer or the illuminating light source. "Local disturbances" in the structure of the array indicate "ecological events", such as translation and rotation of objects, collision, deformation, changing of color and texture, growing and disappearing. The fundamental task of an observer is now to detect "invariants" and "local disturbances" in the continual "flow of the ambient array" by active sampling over time (Gibson, 1966). Such successive and overlapping sampling will allow the observer to "extract information" not only about shape, layout, consistence and movement of substances and objects in the world but also about his position and movement relative to it (Gibson, 1979). Visual perception therefore can be understood as distant diagnosis of the external world which enables the observer to analyze the affordances of the environment in relation to his position and movement before making contact with them. The chemical values of substances, harmfulness or usefulnes of surfaces, benefit or injury of ecological events are important environmental qualities an observer has to distinguish in advance. Color plays, mainly in this context, a crucial role.

Hence if environmental color design is granted the role of an effective means to alter the optical appearance of our visual surroundings, the above mentioned statements have important implications for the design process. An elaborated design concept which takes into consideration the man-environment relations as they occur in real life, seems to be possible only within the theoretical framework of an ecological approach. What kind of design paradigm might be helpful in environmental color design to link the basic theoretical assumptions of an ecological approach to visual perception with concrete design work, will be discussed in the subsequent paragraph.

A new concept in environmental color design : Paul Meyer-Speer, an ambitious German color designer and theorist, has realized, throughout his life time, some of the most outstanding architectural color designs of this century. Recognizing the need of systematic color order for architectural color design, in 1923 the young artist Meyer-Speer went to learn with Wilhelm Ostwald, who was by that time not only known for having received the Nobel prize in chemistry but also for developing a standardised color order system based on psychophysical measurements. There Meyer-Speer had the opportunity to study carefully the principles of Ostwald´s color system and the concept of "equal value scales". He also was able to help Ostwald to manufacture systematic color scales in powdered pigments and dyed wool. Getting more and more involved in architectural color design, Meyer-Speer soon came to the conclusion that the original color solid of Ostwald can not fulfill his particular needs. It does not contain enough color standards in the less chromatic area, as well as the steps between the strongly whitish colors, which are most frequently needed in practical design work, are much to big. As a consequence he created an elaborated version which excludes colors of high chroma but is much finer tuned around the grey axis. Later, after having analyzed the pigments and coloring of traditional buildings of different historic per-

iods, Meyer-Speer(1980b,1986) built up fine-tuned color scales exclusively on earth-colors. He was convinced that the material itself as well as the aesthetic impression produced by it, was a much more appropiate means to express the "earthy nature" of architecture than synthetic pigments can do. These well ordered and coordinated color scales, which enabled Meyer-Speer to produce any of the nuances contained, were his major tool to accomplish his most impressive and predictive interior color designs of sacral edifice, such as the cathedrals of Mainz, Breslau and Fulda. Intuitively, rather than through systematic research, Meyer-Speer (1968,1980a,1980c,1986) developed a special concept how to apply the principles of color order and harmony effectively in architectural design. According to this concept, which he defines as "color space painting" or "color space architecture" the architectonic form does not purely stand for itself, but is interpreted by color . Thereby color is seen primarily as a space defining element. The function of color is not only to accentuate or diminish discrete architectonic elements, but to *paraphrase* the three-dimensional form of a uniform surface. As a result coloration and surface are not any longer perceived as two independent variables. They form an indissoluble unity which is more than just the sum of its components. Rooms or objects hence do not appear simply to be painted. The coloring manifests itself as a permanently vibrating color space, as an atmospheric tinge of numerous shades, vivid but decent as a whole (see also: Reimers,1965; Lützeler,1975; Hegemann,1964). What "color space architecture" could be like, is best expressed in an article by James J. Rorimer, the later director of the Metropolitan Museum of Art in New York, in which he describes his impressions when in 1927 he first entered the refurbished Cathedral of Mainz and saw the color design Meyer-Speer had carried out on the basis of his fine-tuned color scales:

> In late summer of 1927, just before the completion of the work in the cathedral, it was possible for me to gain access to the great nave. I was thrilled by the symphony of tonal effects unsurpassed by that of any architecture I had ever seen.... I was not aware when first viewing Mainz Cathedral that the entire surface of this vast edifice had been painted in one great scheme to give additional character and vitality to the architecture itself....The achievement of relating the various parts of the cathedral to each other, the giving accent to architectural members and divisions and creation of a harmonious impression are the result of the mechanical application of color. The decorator has fully understood the possibilities of the use of color in many nuances. The colors, which range from dark red-violet to light yellow-green, were suggested by the colors of the original building material (sand and limestone) of the cathedral. The nave is painted with yellow ocher and the aisles with red. The walls become lighter towards the top and the vaults which are supported by ribs painted in dark tonalities are given an etheral quality both due to the lightness of the tone and to the system of application in definite geometric forms. For instance, in the painting of the major cupola alone, some three hundred tones in varying geometric forms are juxtaposed in such a way as to create an unusually vibrant effect. Of course, to the eyes these subtle inventions are not apparent and because of the gradual transitions from part to part one is not aware of the intricacies of the scheme. There are many subtleties which can hardly be appreciated in photographic illustrations. The walls gradually become lighter, commencing at the center of the nave and going towards the two altars, creating an unusually fine perspective. The cupola over the altar is lighter in tone than any other part of the cathedral, for it surmounts the center of religious ceremonies. The aisles are darker than the nave, for their function is less important. As one proceeds from one division of the building to another, there are always gradual transitions in tone. Each individual member has been carefully studied and some of the details, as in the vaults illustrated, are of themselves beautifully complete. (Rorimer,1931,pp.297-299)

In what way now, we have to ask, can such a special concept as Meyer-Speer's "color space architecture" be related to James Gibsons ecological approach to visual perception ? Meyer-Speer (1930) - was convinced that we only can perceive objects or spatial layout of surfaces if light is reflected as color. It is interesting to notice that

Meyer-Speer frequently uses the term "color" in a similar sense as Gibson the term "structured light". Meyer-Speer (1968) also claimed that the physical extensions of an edifice "are not identical" with the one we perceive, while Gibson (1979,15) says that "the environment of animals and men is what they perceive". For Meyer-Speer (1930, 1968,1980c) the crucial parameter of space perception as well as the strongest tool of design to make special features or "affordances" - as Gibson would say - of architectural space better *readable* is color. Hence he demands that architectural color design should literally enable the "eye to walk upon architecture". For Meyer-Speer (1930,1980c) it is of no use just to intellectually understand the "idea of an architectural space" if it was not possible to experience directly the meaning of architecture by visual perception.

If one tries to define the concept of "color space painting" or "color space architecture" in the terminology of Gibson, it could be understood as an artificial modification of the structure of ambient light by alteration of the surface reflectance to change the "information" specifying a particular "affordance" of the environment. As "color-space painting" excludes any kind of concrete meaning in painting itself it falls between the categories of decoration and designation. Gibson (1979) did not deal explicitly with such intermediate cases, but made an interesting remark on this topic when he points out the difference between a picture and decoration. According to his final definition (Gibson,1979,271) a picture is a surface that displays an "arrangement of invariants of structure" and therefore specifies "something other than what it is", while any treatment of a surface as such, like ornamentation or decoration does not: such a surface always will be perceived as a surface. Hence a surface that is modified has to be differed from a picture. But "true mixtures of decoration and description" are possible, "especially in architecture and pottery" (Gibson,1979,273).

On this basis "color space architecture" could be comprehended more precisely as such a true mixture. On one side it superimposes an artificial light structure - which specifies to a certain extend something other than it is - on the light structure given by the architectural form; on the other side the given light structure is not really contradicted by it. The overall impression is not an illusion of something which is not, as in the case of trompe-l´oeil or any kind of illusionistic architectural painting. Nor does misperception of the quality and composition of the substances the building is made of result from the coloring, because Meyer-Speer has used only transparent colors instead of opaque ones so that the original material can shine through. The light structure caused by the color design actually leads to an enhencement of the given architectonical structure. It in a way *freezes* an optimal set of "invariants" and makes them resistant to changes of illumination. The layout or arrangement of the surfaces and architectural elements also remain visible even if there is little light (Meyer-Speer, 1930). In the case of Mainz Cathedral space perception is facilitated in particular because the "gradient of increasing density of texture" - which Gibson (1950,1979; see also: Gibson,E.J. & Bergman, 1954; Gibson,E.J., Bergman & Prudy, 1955; Prudy & Gibson,E.J., 1955) claims to be one of the most important factors for depth perception - is supported by the color design which contrasts every single square stone of the hall. Meyer-Speer intuitively also has made use of the fact that the "medium" reveals an "absolute vertical axis of reference" (compare: Gibson,1979) as he has shaded the colors according to the downward flow of radiant light. As such a design is in accordance with the natural conditions under which visual perception has developed throughout evolution it matches the way man has learned to extract information in order to guide his movement around the physical environment and to organize his activities. It is for these reasons Meyer-Speer´s design concept can be called an "ecological" one.

Having consideres only ecological aspects of Meyer-Speer´s concept aesthetical aspects were not discussed, as for Gibson (1979) "the problems of aesthetics exist in their own right" and is beyond the scope of his ecological approach to perception. Nevertheless there might as well be a way to link aesthetics with an ecological approach to perception. For example Martin Schuster (1985,361-62) notes that stimuli which are "appropriate and useful" for life of man or facilitate perception and infor-

mation processing are experienced as "beautiful"; while on the contrary "disorder or dirtiness" complicate perception and hence lead to a sensation of "ugliness". This thesis to some extent would also support Wilhelm Ostwald´s dogma that "harmony is order", which is at least true for color scales of the same nuance, whiteness, blackness or chromaticness (Ostwald,1924). Maybe in this context it would be possible to think of aesthetic stimuli or harmonic order as exceptionally distinct "invariants" of the ambient optic array. But as different levels of analysis suit different purposes, an ecological approach to environmental color design in the first place might be useful for the solution of future design problems by broadening the theoretical perspective to analyze them in the wider context of men-environment transactions with the pragmatic aim to increase life quality in man-made environments.

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Dimension of colour combination meaning

Dimensions of meaning associated to color combinations

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A basic aspect of man´s visual perception of the environment is his ability to see colors and color differences. Color is therefore of importance from a number of perspectives, not least the psychological - from its purely informative function to its conceivable more subtle emotional influence.

Many have speculated and expressed opinions, and much has been written. Of this, much rests on common sense and much is dogma and bias. Some is perhaps true, but some is probably less true for the majority of us. (Truth in this connection is a concept with a manifold of senses.)

Most of what has been said about the *psychological effect* and *affect* of color on man would hardly withstand any scientific examination (but there are, as is well known, different opinions as to what science is). I will here attempt to localize some of the complex problems that one meets when one, systematically and experimentally, investigates the meaning of color.

On generality

Each and every opinion about each and every thing - even opinions about color - are completely *subjective* occurrences in the head of a person. But this does not imply that all such occurrences, that is in this case the experience of color, are unique in the sense that they are different from each other, that everyone experiences a certain color or other stimulus in entirely different ways.

On the contrary, it is probably so that, with respect to quite many phenomena in our environment, we are quite similar in our comprehension and evaluations of color. But *the degree of similarity* among people in this regard varies depending upon what the phenomenon is.

Most people *perceive* the color "red" in the same way - but the *evaluation* of a certain red color in a certain context can be very different from one person to another. In the former case we speak of high *intersubjectivity* and in the latter of low.

When one, in general, says that certain colors, in a certain context, have this or that affect or meaning for people one often presupposes - consciously or unconsciously - that the generality is total, or very high. This implicit assumption is not, of course, always correct.

When Goethe, or some well known artist, says something original about color it is perhaps of great literature- or art historic interest. But if the statement holds true for only Goethe himself - or for a small number, that is, that it lacks generality, then his assertion is to no real benefit to the designer who is going to make color environments for the rest of us. (In many countries the instruction in color theory for these professions consists nearly entirely of disconnected quotations from artists or famous architects, who perhaps often have a very special relationship to color as a medium and are perhaps not at all representative of any larger group.)

But then not all madmen are artists (or researchers), nor are all artists mad. Quite the contrary, they are most often very good observers of color. This, however, should not be confused with *evaluations of color experience* - we will return to this in a moment. When we talk about how color *appears* we are concerned with phenomena - color phenomena as such in our heads - which has very high generality. It is at the evaluation level that generality varies the most, it can be both high and low.

The generality of the experiences of color in a very broad sense may in itself be considered a large and vital interest- and problem area, and we in Sweden have in a number of studies begun to investigate this question.

On the structure among isolated colors

Possibly the foremost reason that the psychological aspects of color have been so poorly investigated is that psychologists have not been particularly interested in or knowledgeable about color as such. Quite simply, they have not been aware of the complexity of the problem - how many colors there really are and how they can vary, i.e. their interconnecting structure. The color systems which they have accepted have often been limited to a description of the physical properties of the color samples - and they have thereby overlooked that it is the perceptually experienced color which constitutes the stimulus in psychological studies of color. Wavelengths and energy quanta are here of peripheral interest. Just as the systems for additive and subtractive color mixing are of little relevance. Such physical manipulations have, as is well known, been ascribed great color psychological importance and created fuzzy but enduring dogma - with the ambiguous concept of "complementary color" as a prime example within the most muddled area of so-called color science.

The assessment that the existing perceptual and psychological color research was altogether too physics-oriented was a decisive factor leading us in Sweden to choose early on Ewald Hering´s phenomenologically based color description model. And this, as is known, has been available for a long time in the form of the theoretically and practically accessible NCS-system. It offers a frame of reference and a color world in which one can, in a meaningful way, firmly establish and describe both the general and unique psychological effects of color - to the extent that they may be investigated.

On the structure of color combinations

But with a model of the variation of isolated colors we come only a little way. Already quite a number of years ago we carefully mapped how connotations, i.e. associations of emotionally colored words to isolated colors, vary systematically over the different parts of the color world - with varying, but reasonably high generality.

In practice colors never appear alone, but rather always *in combination with each other* and in different contexts.

From our point of view there is a lack of interesting scientific studies which are concerned with the meaning of color combinations, and the reasons are obvious. The field is difficult and the resources available for this type of research are minimal. It is not so much that research of this type requires expensive equipment, but rather that it demands a very long-range, systematic build up of knowledge, which makes the recruitment of researchers difficult. And if one wants to have answers to many questions then many researchers are needed.

The difficulty with the research itself lies in the fact that there are so many color combinations - millions or billions, depending on how one counts. A meaningful sample must therefore be grounded in a meaningful theory of how color combinations can be described - *a color combinatoric.*

A color combinatoric model should not, of course, say anything about how different color combinations are evaluated as, for example, beautiful or ugly. But it should be able to be used as a selection instrument and frame of reference when investigating questions concerning aesthetics - as well as other experiential dimensions which are not directly so-called aesthetic evaluations.

On the structure of meaning

It may well be that one cannot describe all emotions with words -and that assumption probably also applies to the subtle associations of emotion and meaning which color can awaken in us. But one can express quite a lot with words, and in consideration of how little researched this subject is there remains much to be done in the way of studies of the relationship between word and color.

I said a moment ago that there are millions of possible color combinations. There are not as many words to describe color and color- meaning. There are, however, enough for it to be impractical and unscientific to choose them at random in studies of this relationship. One can quite easily come up with list a couple of hundred color related words. Certainly many of these are synonyms - but can we be sure, and are synonyms always synonyms irrespective of the context?

20 years ago I performed a structured analysis of color associated words with respect to *isolated colors*. But it is not at all likely that it is valid in relation to *combinations of colors*. We have therefore made a new such analysis, this time with 130 words - mostly adjectival - concerning how they describe color combinations.

In the study itself the subjects viewed a number of pictures individually and judged how well the different words went with the color composition in question. A factor analysis was performed on the data in order to obtain groupings of words which in turn would give us an idea about the relationships of *synonyms*, on the one hand, and *antonyms*, on the other, within the context of color.

A meaningful factor analytic solution with our data gave five factors, or dimensions - each having two opposing poles. The following are the designations for the five factors extracted:

1. EVALUATION: beautiful - ugly
2. ARTICULATION: distinct - colorless
3. BRIGHTNESS: light - dark
4. TEMPERATURE: warm - cold
5. COMMONNESS: boring - flowing

These groupings can be represented in a space, a color semantic space, which unfortunately has more than 3 dimensions and is thus difficult to illustrate graphically. In order to provide a two-dimensional overview of the overall semantic structure a scaling procedure (MDS, Alscal) was conducted on the original data. Each word was located on a surface based on its relationship to all the 129 other words, much like the plotting of cities on a map based on their distances to one another.

The resulting oval shaped pattern shown below is interesting in a number of respects:
1. somewhat coherent spheres of meaning appeared
2. transitions from sphere to sphere seem natural/logical in a color context, e.g. from soft to harmonious to monotonous
3. spheres carrying antonymous meaning lie on opposing poles

The purpose of this rough categorization of color related words was to bring forth a list with a reduced number of words of meaning which would still represent the different types of meaning that color can have. This in order to avoid having to bear around hundreds of words in our future studies in the tangled jungles of color combinations.

We have met innumerable questions and have begun to investigate a few:
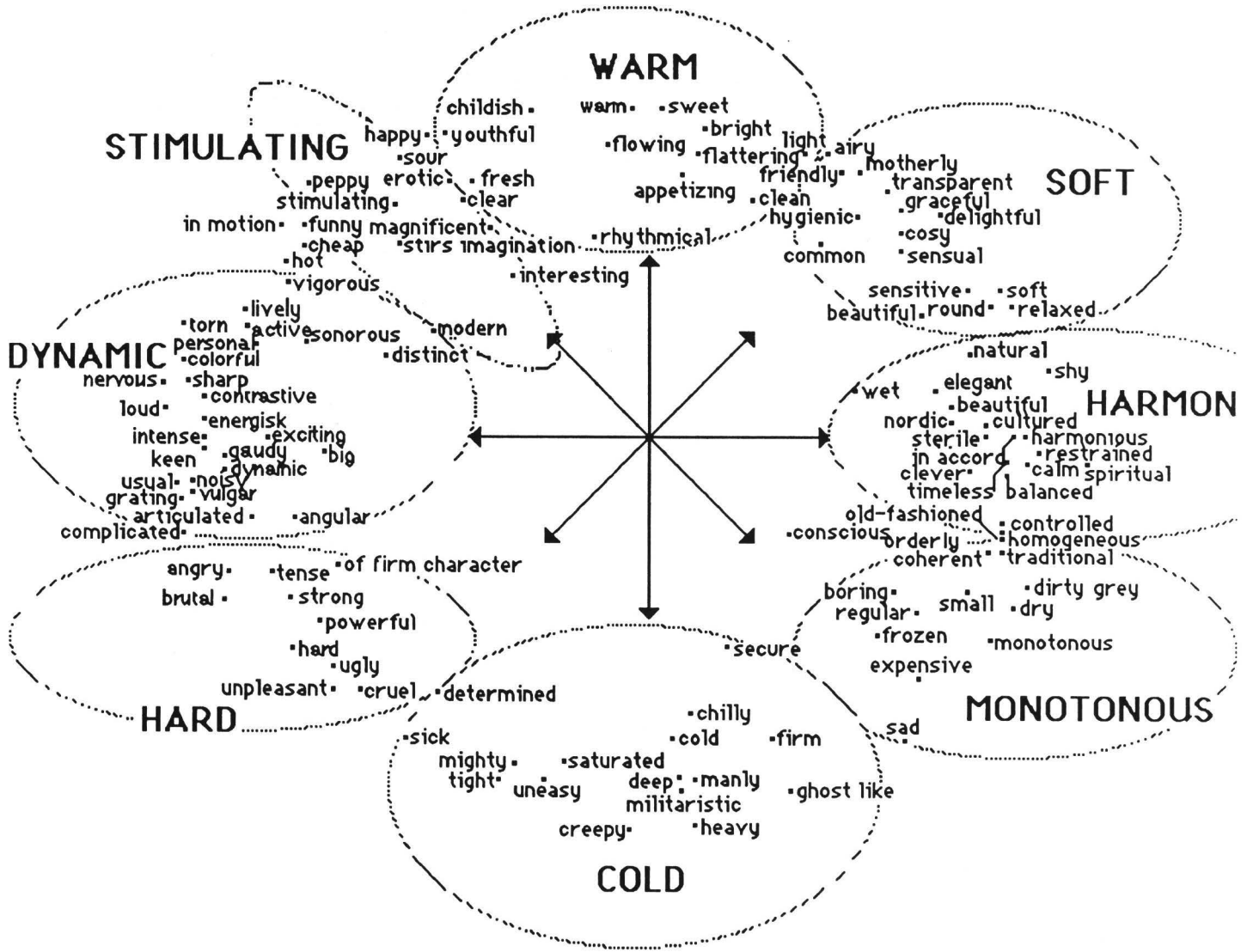
What is, for example, characteristic of the combinations which can be described using the words from the dimensions of meaning just mentioned?

• Distinct - indistinct and light - dark are natural enough.

• But can we with our color combinatoric model describe attributes belonging to beautiful or ugly color compositions?

• Are certain types of color chords more harmonious than others?

• What rôle does contrast play?

• What is the influence of complexity - and how multidimensional is this concept in relation to color?

• A question, for example, which can easily be generated from the NCS-based combinatoric model is one concerning the evaluation of hue constancy compared with specific deviations from such similarities among colors in combination. This question forms a part of a project in which researchers (a few of which are here today) from Italy, Austria and Switzerland and myself are involved.

In the study I briefly outlined earlier which formed the basis for the semantic structure that I have described, we selected the color pictures in such a way that they would be as *heterogeneous* as possible. From these results we can make statements as to how the words comported themselves - but we cannot say anything very general about the color compositions in that they were too few. The results of this study will, however, provide us the possibility in future studies to concentrate more directly on color combinations themselves, rather than the words used to describe them.

During my lecture in Winterthur I intend to show pictures to illustrate the color combinations associated with the various parts of the semantic space which we have identified and discussed above.

The results thus far have generated many new hypotheses, a few of which we will perhaps have succeeded in testing in time for the conference.

10.5

WARM

childish · warm · · sweet
happy · · youthful · bright light airy
· sour · flowing · flattering · · motherly
· peppy erotic · · fresh friendly · · transparent
stimulating · · clear appetizing · clean · graceful
in motion · · funny magnificent · · hygienic · · delightful
· cheap · stirs imagination · rhythmical common · cosy · sensual

STIMULATING   **SOFT**

· hot
· vigorous · interesting
· lively sensitive · · soft
· torn · active sonorous · modern beautiful · round · relaxed
personal · colorful · distinct · natural
DYNAMIC nervous · · sharp · wet · elegant · shy **HARMON**
loud · · contrastive nordic · · beautiful
· energisk sterile · · cultured
intense · · exciting in accord · harmonious
keen · gaudy · big clever · restrained
usual · · noisy · dynamic timeless · calm spiritual
grating · · vulgar balanced
· articulated · · angular old-fashioned · controlled
complicated · · conscious orderly · homogeneous
coherent · traditional

angry · · tense · of firm character boring · · dirty grey
brutal · · strong regular · · small · dry
· powerful · frozen · monotonous
· hard expensive
· ugly · secure **MONOTONOUS**
unpleasant · · cruel · determined · sad
HARD · chilly
· sick · cold · firm
mighty · · saturated
tight · uneasy deep · · manly · ghost like
militaristic
creepy · · heavy

COLD

11 **Prof. Dr. Osvaldo da Pos**   **Italy**
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*An aspect of colour combination theory:
some experimental results*

AN EXPERIMENTAL CONTRIBUTION
TO COLOUR HARMONY THEORY

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Colour harmony has been a subject of major interest for many researchers from the beginning of studies on colour till today (Arnheim 1974). Many, if not most, colour order systems were devised with the precise purpose of establishing clear and easy to use rules to be applied when harmonious colour combinations are needed.

There seems to be wide agreement in the history of art in general, as well as in that of colour, that harmony simply means order, or at least some kind of order ; for this reason colour systems are quite often considered irreplaceable tools for finding pleasant colour combinations.

However, it is also clear that in different periods different aspects of colours have been thought to be the relevant variables to be taken into account. There is no place here even for a short history of colour harmony theories, whose interest is beyond dispute; we only wish to present an experimental research on the subject, following some exciting suggestions recently put forward by W. Spillmann (1985).

While most previous colour researchers based their theories almost entirely upon personal experience and general principles, as well as upon well built and logical structures, we tried to test our theoretical hypothesis experimentally, in the belief that aesthetic sensitivity can be studied, at least in part, by means of appropriate psychological techniques (L.Sivik, 1987). We limited our investigations to simple situations of two colour combinations, and focused our attention on cases where the two colours are of different hue.

For such combinations A. Mueller (1948) and A. Abbot (1947) independently expressed their belief, formalized in the following statement, that colour combinations can usually only be harmonious if the colours correspond to the natural lightness ratios of hues; the inversions of natural lightness ratios of hues can generate colour disharmony.

Following Hering's, Ostwald's and others' ideas, W. Spillmann proposed to modify that statement and insisted on the major relevance of whiteness and blackness, compared with lightness, as the perceptual characteristics which strongly condition the harmonious appearance of colour combinations (A. Nemcsics stresses the importance of COLOROID parameters in the phenomenon, 1980). Leaving open the question about the role of lightness contrast in colour harmony, Spillmann describes a third possible colour combination, besides the two already proposed by Mueller:

that is the vague 'inverted colour combination', so called because here either whiteness or blackness proportions are reversed with relation to the hues natural lightness ratio; according to his hypothesis, in correspondent combinations both whiteness and blackness porportions agree with the hues natural ratio, and both are reversed in inverted combinations.

We performed two experiments with the purpose of verifying some aspects of Spillmann's hypothesis.

EXPERIMENT 1.

Firstly we wanted to examine borders which divide regions of colours producing pleasant (harmonious) combinations with a given nuance of another hue, from regions of colours determining unpleasant combinations with the same nuance. Twelve cards were prepared; for six a common colour (22 54 B10G, Yl= 29.11) served as background while six nuances of G30Y acted as figure; in the other six cards, the same figure/background colours were reversed (Fig. 1).

A 30 20 G30Y (Yl= 37.21)
B 20 40 G30Y (Yl= 40.83)
C 10 50 G30Y (Yl= 49.31)
D 30 50 G30Y (Yl= 24.33)
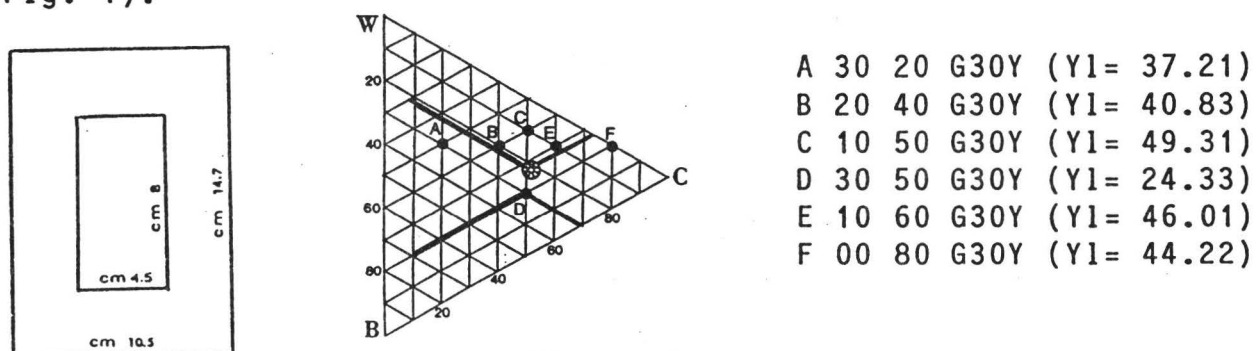E 10 60 G30Y (Yl= 46.01)
F 00 80 G30Y (Yl= 44.22)

Figura 1

The colours were chosen from the Natural Colour System and represented according to its notations, since whiteness and blackness variations are clearly depicted in NCS geometrical structure. Three colours (B C E) were taken from the area of correspondent colours (relatively to the common colour 22 54 B10G, whose hue is naturally darker), two colours (A F) from the 'vague inverted' areas and one (D) from the 'distinct-inverted' area. We expected the three kinds of colours be differentiated on the basis of the pleasantness of the correspondent combinations with B10G.

All the 15 possible pairs of cards belonging to the first series were shown in random order and under natural illumination to 20 subjects (psychology students) who had to choose the combination they liked better. The same procedure was used with 20 other subjects relatively to the second series of cards.

Results were elaborated according to the pair comparison method (Brunoro, 1980). As there was no significant difference with regard to the figure/ground modality of presentation, the two groups of subjects have been grouped together. It is however

worth noting that, when the figure had the common colour, less chromatic background generally produced more pleasant combinations, and this is consistent with the known laws of figure/background organization. The resulting scale of preference is shown in Fig. 2.
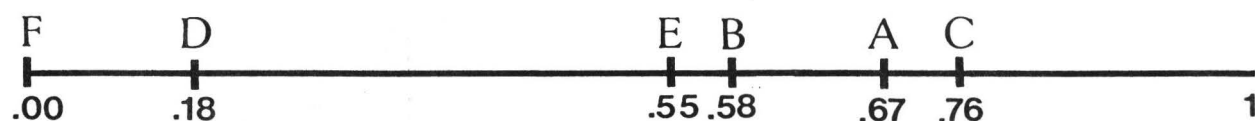

Figura 2.

The first remark deals with the correspondent combinations: as expected, they appear in the first positions of the scale; secondly, both the vague and inverted colours are in the last positions, thus confirming the general hypothesis, even if the two subgroups are not well differentiated. The main problem arises from the position of the vague inverted combinations, one of which appears quite pleasant (A), while the second (F) is the last of the series: neither lightness nor chromaticness differences alone can account for this result, which probably depends on the limited number of combinations which the pair comparison method allows one to compare. Interestingly, the distinct inverted combination 'D' is preferred to the vague inverted one 'F': this fact could be due to some role played by lightness difference, whose importance will be looked into in the next experiment.

EXPERIMENT 2.

In this second experiment we analized a different couple of hues and a larger set of combinations, covering most parts of the R70B triangle. Our aim was to investigate the less chromatic as well the more chromatic parts of the triangle, the more whitish as well the more blackish, and possibly to outline the borders which enabled the vague-inverted combinations to be distinguished from the distinct-inverted ones, beyond the correspondent ones. A further aim was to shed light on the role of lightness contrast in harmonic/disharmonic colour combinations.

As in the previous experiment, we prepared two series of cards of the same form and size, in which the common colour (30 60 B10G, this time) was coupled with one of the following 22 nuances of R70B (blackness, chromaticness):

20 20	50 20	60 20	20 30	30 30	40 30
50 30	70 30	20 40	30 40	40 40	50 40
10 50	20 50	30 50	40 50	50 50	10 60
20 60	30 60	20 70	30 70		

Thirty subjects were presented each card of the series with

the common colour as figure, one at a time in random order, and had to evaluate how much they liked the colour combination by direct estimation method on a scale from 0 to 10. Thirty more subjects did likewise with the second series of cards where figure/ background colours were reversed.

All the subjects (psychology students) received preliminary training to get used to giving direct estimations of pleasantness for a series of 8 non- experimental colour combinations.

Results. The mean estimate for each colour combination has been used to make a scale of preference. Variance analysis showed that in this experiment also there were no significant differences between the two figure/ background series, even if some interesting differences were found: two combinations ranked higher when the less chromatic colours were put in the background than in the figure, consistently with the results of the first experiment. Another case is the combination in which the 20 60 nuance (with the same chromaticness of the constant colour) is present: it ranks very high if put in the background, very low in the other case.
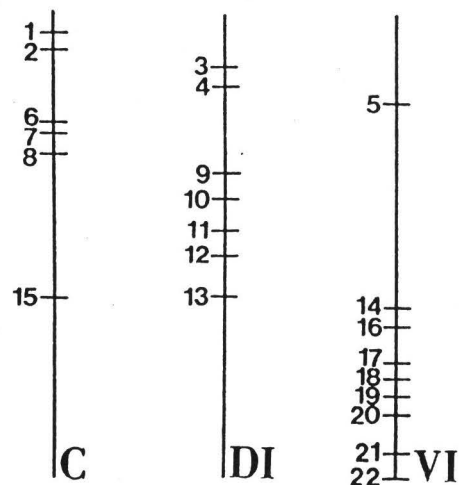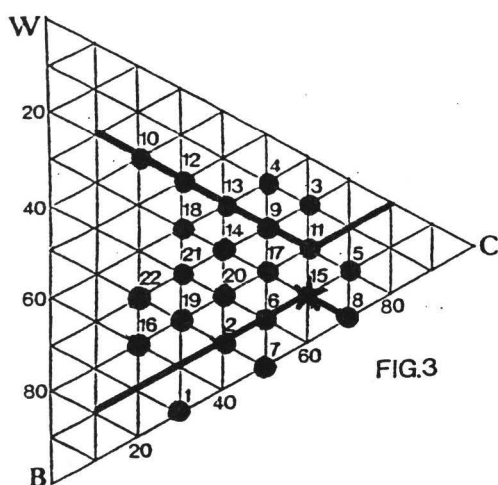

FIG.3

FIG.4

Fig.3 shows the position of each combination in the pleasantness scale for the grouped series, and Fig.4 shows the same results for the Correspondent, Distinct-Inverted and Vague-Inverted combinations, clearly separated. Apart from a few exceptions which will be considered later, the whole set of combinations appears to be divided into the three hypothesized subsets, among which the new vague-inverted group assumes a well defined form. The result seems to confirm that whiteness and blackness are really determining variables of pleasant-harmonious colour combinations. Nevertheless also lightness contrast seems to play some role, as previously hypothesized, but restricted to the inverted combinations; it appears to work in the opposite direction of that predicted by Mueller, i.e. making the "inverted" combinations pleasant.

At the beginning of our research we did not define the lightness

role in colour harmony precisely, although we did not totally
exclude it; on the other hand, examining the results of the first
experiment, we expected lightness ratios to influence colour
harmony (in some way). We now believe that lightness contrast can
help the pleasantness of colour combinations, but only (or
mostly) for those which lie in the distinct - inverted area. To
test our hypothesis we can assign to each colour combination a
proportional coefficient which, on the basis of a particular
theory, denotes the weight to attribute to the correspondent
experimental value, with reference to the predicted pleasantness
scale. If we operate this way for the different hypotheses, we
can effectively compare them; as result of such procedure, our
hypothesis appeares at the moment the one which best fits the
experimental data (S=36,64; for perfect agreement S=0), compared
with Mueller's hypothesis (S=223,89) or that excluding any
influence of lightness in colour harmony (S=214,04).

Two combinations ratings do not fit the hypothesis: one
belongs to the correspondent colours but is quite low in the
scale (at the 15th position); here both colour nuance is the
same, what is generally considered quite pleasant. Then we find a
vague-inverted combination at the 5th position: in this case
chromaticness is very high in both colours. Probably the general
hypothesis must be further specified, taking into account the
difference (or similarity) between the considered hues, as well
as the subjective preference (or dislike) for one or both
colours, separately considered.

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11a An experimental investigation on two colour combinations

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Introduction

Several proposal have been advanced to trace within the universe of colours some "laws" about the best way to organize them and create harmonious combinations.

In 1946 Müller assumed that a couple of nuances of different hues appears harmonious if the two colours are taken with the same relation of lightness as that 'naturally' existing between the respective hues ("correspondent colours"). On the other hand, non harmonious combinations derive from inverting the relation of natural lightness of hues between the two colours ("inverted colours").

However, as Sivik showed in his experimental work (1987), this rule is restrictive: in fact, he found that there aren't statically significant differences between pictures whose colours are in accordance with natural lightness ratio and pictures having inverted lightnesses. This is expecially true with yellow-red hues, a little less with blu and green hues.

So that Spillmann, Da Pos, Sivik and others have reconsidered the concepts of correspondent and inverted colours correlating them, not only with lightness -as Müller done- but also with blackness and whiteness (two important variables at perceptual level). Following this hypothesis a couple of colours can be defined correspondent when their blackness and whiteness proportions agree with the natural lightnesses of hues and, on the other hand, a couple is inverted if blackness and whiteness proportions are reversed compared with the natural lightnesses of hues.

There is a third possible combination which has been called "vague inverted combination" by Spillmann. In this case only one variable (either whiteness or blackness) is reversed with regard to the hues' natural lightnesses ratio.

In order to check Spillmann's hypothesis, O. Da Pos in collaboration with G. Fabrizi has done an experimental research.

The purpose of this work was to find out if a third kind of colours combination exists (vague inverted colours) beyond the two previously defined and to specify how much harmonious they appear. Different stimuli have been shown to two distinct group of subjects using the Pair Comparison method, in one case, and the Direct Estimation method, in the other case. With both methods each two colours combination has been presented according to the Figure-Background modality offering to half of the subjects the combinations under one relation (Figure-Background) and to the other half the same combination in the reversed relation (Backgrond-Figure).

In all cases, anyway, a colour was costant (20 50 B10G for Pair Comparison method and 30 60 B10G for Direct Estimation method) while the others changed (six nuances of G30Y hue for the first method and twenty-two nuances of R70B hue for the second one).

From the results of the first experiment Spillmann's hypothesis, that correspondent colours appear most harmonious, seems to be confirmed. Moreover, the border between correspondent and vague inverted colours doesn't appear well defined, probably because of the very few situations considered. The possible role of "lightness contrast" had to be checked in a successive research with a larger set of combinations.

The second experiment (Direct Estimation method) confirms what was found in the first experiment; beyond others results, an higher preference appeared for those inverted combinations in which "lightness contrast" was relatively strong.

With this experimental work not only the existence of the supposed third area was confirmed, but also the relevance of "lightness contrast", in certain situations, was pointed out.

In order to check again Spillmann's hypothesis, taking lightness contrast in account, we have performed one experiment, separately, using the Ranking method: in a case, with a group of forty subjects (considering the variable Sex) and, in the other case, with a group of seventy-two subjects (considering both Sex and Age).

Hypothesis

This work's aim is to bring a contribution to the knowledge in the field of color harmony. We suppose that:

- a correspondent combination (both proportions of whiteness and blackness are in accordance with the natural lightnesses of hues) will be perceived as harmonious by the subjects;

- an inverted combination (both proportions of whiteness and blackness aren't in accordance with the natural lightnesses of hues) will appear partially harmonious;

- a vague inverted combination (only one variable, either whiteness or blackness, is reversed) will prove non harmonious.

Again we expect that the zone corresponding to vague inverted combination should show more cospiquous than the others. Probably preferences will be explained both by contents of whiteness and blackness and by lightness contrast.

Method

As in the previous works we have used the alternate Figure-Background modality and a constant colour (10 70 B) coupled each time with all the nuances of the other hue (G30Y). Moreover, we have shown the subjects all the stimuli together and employed the Ranking method to elaborate data.

Material

Two colour card's set have been used:

M set (colour combination): six cards (Mf) were preparated as in Figure 1 where the colour of the inner rectangle (Figure) was constant and blue (10 70 B); the colour of the outer region (Blackground) was one out of the six green nuances. Six other cards (Mb) were prepared in which the positions of the same colours were reversed.

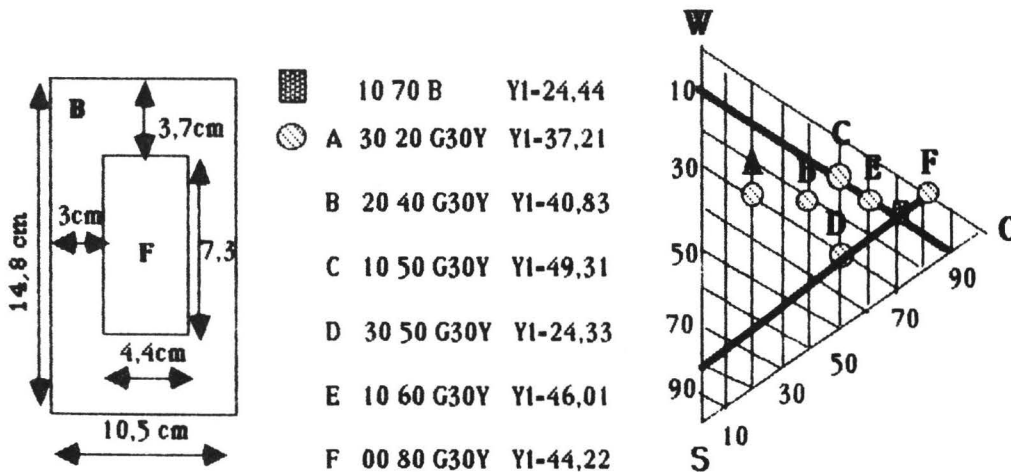C, E and F are correspondent combinations, D is an inverted combination whereas A e B are vague inverted ones.

▦	10 70 B	Yl-24,44
◉	A 30 20 G30Y	Yl-37,21
	B 20 40 G30Y	Yl-40,83
	C 10 50 G30Y	Yl-49,31
	D 30 50 G30Y	Yl-24,33
	E 10 60 G30Y	Yl-46,01
	F 00 80 G30Y	Yl-44,22

Figure 1

N set (isolated colours): six cards (7,5×5,2 cm) of the same green nuances presented in M set.

Subjects

For this experiment 112 subjects (males and females of different age) were tested. Colour blind subjects were descarded.

Procedure

All M set cards were placed in a casual order on a white table (we have only taken care to alternate the positions of cards with blue blackground and cards with green background). Subjects were asked to evaluate the different combinations and then to choose the card appearing the most harmonious, i. e. the most pleasant; then, they had to choose the least harmonious and so on according to the method of Extrems Exclusion. N set cards were placed in a casual order on a white table and subjects had to indicate the one they liked most, and then the least one, and so on.

Data processing have been done using Ranking method. Correlation coefficients have been calculated using Spearman's formula.

We considered the following correlations:

- Mfb and N: Mset (with Figure-Background values unified) and N set (isolated colours);

- Mf and Mb: combinations in which green is Figure (Mf) and combinations in which green is Background (Mb);

- Mf and N: combinations in which green is Figure (Mf) and N set;

- mb and N: combinations in which green is Background Mb) and N set.

Correlation coefficients were calculated between the M-choice of differents sub-groups divided according to Sex and Age:

- males vs. females subjects aged from 18 to 28 years;

- males vs. females subjects aged from 48 to 58 years;

- males subjects 18-28 aged vs. 48-58;

- females subjects 18-28 aged vs. 48-58

in order to check whether Sex and/or Age are intersubjectives variables of a certain relevance.

Results

Preferences orders

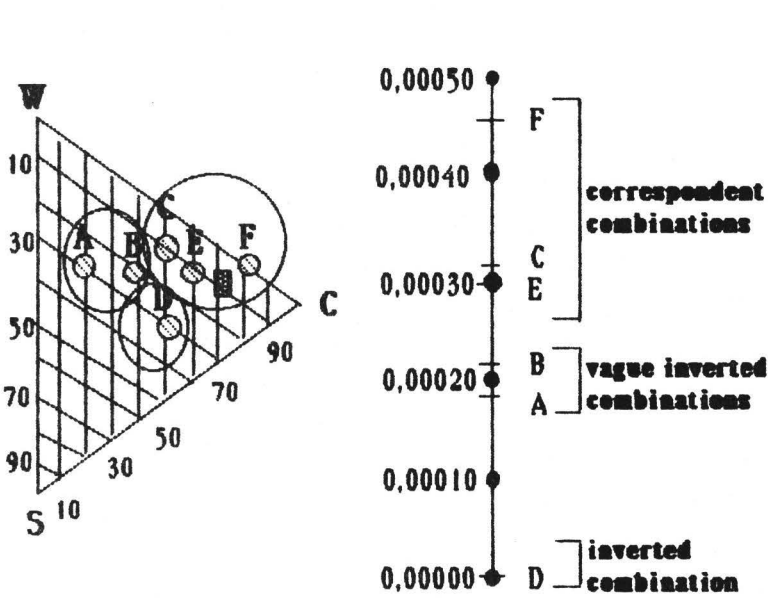### M set (colour combinations)   Subjects =112
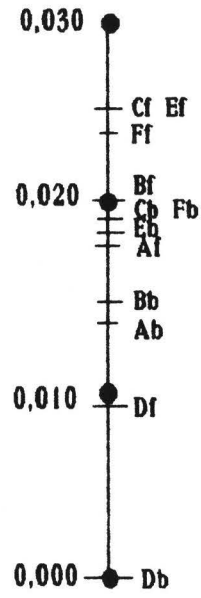

Figure 2

Fig./Back. combinations
are groupped

Figure 3

Fig./Back. combinations
are separated
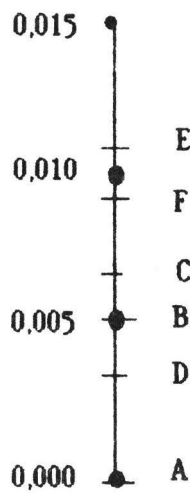
N set (isolated colours)
Subjects=112

Figure 4
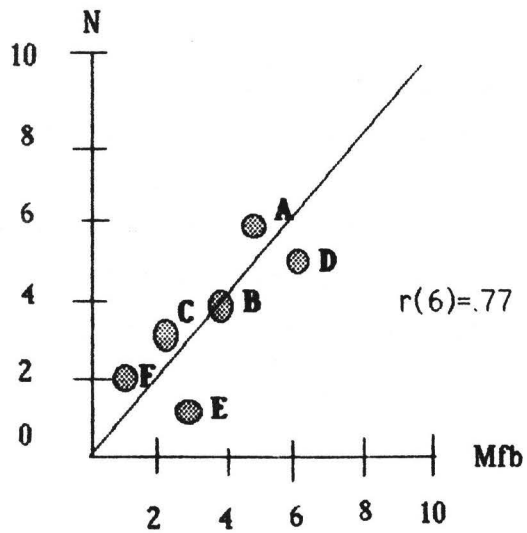
Correlation between
Mfb and N preferences:

r(6)=.77

Figure 5

Correlation coefficients:
Mf-Mb: r(6)= .94; Mf-N: r(6)= .89; Mb-N: r(6)= .77
Males -Females 18-28: r(12)= .94; Males vs. Females 48-58: r(12)= .78; Males 18-28 vs.
Males 48-58: r(12)= .39; Females 18-28 vs. Females 48-58: r(12)= .48.

Discussion

Results confirm the hypothesis.

As to M set (see Figure 2), independently from Figure-Background relationship, combinations that appear the most pleasant are in order: F, C and E, i. e. correspondent combinations. While B and A, the vague inverted ones, follow in the preference order and D, the inverted one, comes in last.

These results are consistent with Spillmann's hypothesis as well as Da Pos' results that according to which both whiteness/blackness and lightness contrast are relevant variables. In fact, lightness contrast between the two colours in D-combination (30 50 G30Y, Yl=24.33 and 10 70 B, Yl=24.44) is very low and doesn't help to make the inverted combination more pleasant.

There is a general tendency to prefere the combinations in which the Figure is green (Mf): probably this is due to the greater perceptual stress assumed by a differently coloured figure on the same background. We have a further confirmation from correlations between Mf and N (r= .89) that is higher than that between Mb and N (r= .77). Instead, as to the preference order for combinations in which Figure/Background positions are reversed the two series don't differ significatly and show very high correlation (Mf-Mb correlation is r= .94).

Mfb set and N set correlation is extremely high (r= .77) showing the possible influence of the different pleasantness of the greens in the choice of combinations.

The influence of Age, but not of Sex, on the preference for different colour combinations deserves further investigations.

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Post-occupancy evaluations of color applications and lighting systems in health care facilities

POST-OCCUPANCY EVALUATIONS OF COLOR APPLICATIONS AND LIGHTING SYSTEMS IN HEALTH CARE FACILITIES: AN INTERNATIONAL EXCHANGE OF USER NEEDS

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Introduction

Color and lighting in health care facilities should satisfy the requirements of an environment with diverse functions and activities. Distinctly different from any other space, the design of health care facilities must provide for patient evaluation, diagnosis, treatment, and recovery; visitor welfare, comfort and education; and staff welfare, task accuracy and efficiency. Color and lighting must be used effectively to accommodate these diverse functions and activities (Beck, Mahnke, Rabin).

Because patients, visitors and staff are in these facilities for different purposes and periods of time, the psychological and physiological status and reactions of these groups differ (Beck and Meyer, Mahnke, Rabin). Therefore, it is essential that interior designers and architects consider the effects and potential use of color applications and lighting systems for each of these groups as important elements in the design of these facilities (Beck, Beck and Meyer, Mahnke, Rabin, Styne and Klesh).

There is genuine concern among color and lighting specialists for the way that color and light are used in hospitals. Feedback about these areas can be obtained by using Post-Occupancy Evaluations (POE) during and after the design process. This presentation will be an in progress investigation of POEs used to evaluate color applications and lighting systems. Dr. Wolfgang Preiser a leading authority on POEs states that during a POE "environmental...and psychological factors are examined to determine their quality for the end user" (Slavin).

In 1983, Illumination Roundtable III met in Keystone, Colorado, USA to "identify the user needs during the decade of the 1980s and to establish a basic and applied research agenda for lighting." The sponsors of this workshop were the Electric Power Research Institute, the Illuminating Engineering Society of North America, The Lighting Research Institute and the National Bureau of Standards. The panel of users, researchers and facility planners for health care facilities concluded that research should focus on nine priority issues, three of which dealt with color and/or POEs.

The Use and Benefits of POEs: Designing to Meet the Users' Needs

As a design tool, the primary focus of a POE is the impact on the user. Done usually 6 months to a year (Diaz) after installation or renovation, a POE has 2 major purposes: 1) immediate feedback for a project and 2) development of information for future projects.

The American Institute of Architects Committee on Architecture for Health has a Subcommittee on Post-Occupancy Evaluation chaired by Tadeusz M. Ogrodnik. This subcommittee has been charged "to develop a recommended approach to the evaluation of occupied health care facilities". To date a survey has been done to determine the extent and use of POEs by Subcommittee members. John Zeisel, President of Building Diagnostics, Inc. of Boston and Montreal, in a workshop for this committee stated "that a POE of a hospital is a systematic set of procedures and methods used to identify the problems and opportunities that the facility in-use presents to the way the hospital works and the way it and its departments meet the purposes for which they are designed."

This systematic evaluation provides feedback from the user and the client. Social impacts on design evaluations can make the design process cyclical, so that pre-design programming can benefit from information about previous color and lighting projects. The environment is evaluated for how well it supports the behavior, performance and satisfaction of its users (Brill). Evaluations should be supportive of the planning process and done with the support of administrative mechanisms that will facilitate change. The work of Dr. Janet Reizenstein Carpman is a good example of immediate impact on the health care environment as it is being built.

Methodologies

There are a variety of methods used for POE data collection and include systematic document analysis, inventory taking, observation of behavior, structured interviews and questionnaires (Zeisel). Joan Harvey from Health Facilities Design Division, Health and Welfare Canada has used the Touring Method with the New Zealand Ministry of Works. This three stage process involves 1) a formal briefing with participants to explain objectives and procedures; 2) a three hour site visit guided by an observation checklist where each individual searches for what does/does not work, desired changes, etc.; and 3) a formal de-briefing with the team to note the findings.

The presentation will include methodologies used to evaluate color applications and lighting systems as well as the findings of these POEs.

An International Exchange of User Needs

A survey will be distributed to Interior Designers and

Architects during the Symposium. This tool will provide an avenue for the exchange of information about color applications and lighting systems. The results will be shared at the 6th Congress, COLOR 89 in Argentina.

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Integration of surface color and light in architectural space

INTEGRATION OF SURFACE COLOR AND LIGHT IN ARCHITECTURAL SPACE
by Alexander F. Styne, IDSA/FIES

The impression of an architectural space within a structure, or that formed by the volume of several structures, depends on configuration, particularly by the light reflected from their surfaces. This reflected light is the result of the composition of radiation from light sources and the absorption and reflection characteristics of the surface creates the visual impression.

We know that the composition of daylight is changed constantly by two factors: the angle at which sunlight penetrates the atmosphere due to the rotation of spaceship earth and the atmosphere itself, as variable filter that changes with the composition and density of cloud cover and smog. However, we like to think of daylight as a trustworthy source by which we can judge color effects any time. We are prone to disregard our own state of visual adaptation or that of others with whom we might attempt to reach consensus on a color stimulus for one reason or another (Ref. 1,2,3). Color constancy makes us believe that color is part of the object. Memory associations lead us to think that grass is green, the sky blue and sunflowers yellow. Remember the orange sky of a sunset gilding the grass yellow? Or, think of the time you tried to find your red car under the scotopic condition of a dark night.

The appearance of colors has become even more problematic, when we observe them under artifical lighting. We rarely do this critically and retain in our memory what really "meets the eye". Color constancy gets in our way until we see objects of the same surface color - or colorant, as we should really call it -, side-by-side, lit by different light sources. Unless we understand what happens, it can create a real surprise.

White light from different light sources can have very different spectral compositions. Their characteristics can be described by plotting their energy output in the different wavelengths along a spectral distribution graph (Fig.2-5). The resulting curves show the peak of energy output in each wavelength. As our visual system cannot separate them, we see white light. This sensation can also be produced by just two wavelengths; for example, one beam of radiation producing a blue-green (490 nm) and

another producing a red (670 nm) sensation (Ref.3). The resulting white light would not give us full color information. For this we need a minimum of three wavelength ranges: blue, green and red, or short, medium and long wavelengths. When these three "bundles" of energy are seen together, they can produce a white light sensation: when reflected from objects and moderated by its colorant, we can receive a "normal" color stimulus (Fig.4).

If you consider the spectral power distribution of an incandescent lamp (Fig.1) you can recognize that very little light is produced in the short wavelength range, which stimulates a blue sensation. As you read across the spectrum, energy output increases toward the "red" part. You can also see how this energy output goes beyond the visible range where it produces heat (or infrared radiation). You can see that "average daylight" (Source "C") on the same graph shows much more energy in the "blue" range and has less in the middle and longer wavelengths.

In Fig.7 light from three sources is reflected from a well saturated red sample (Munsell 5R4/14); as the energy from the incandecent lamp (Source "A") has more energy output in the long wavelengths than average daylight (Source "C"), the sample will look more saturated under incandescent light. As low pressure sodium light (Fig.6) has only visible radiation in a narrow band producing a yellow sensation, the "red" sample will appear gray or brown and dark.

Depending on the observer's experience, he may possibly predict the appearance of colorants when spectral power distribution of the light is known. Visual evaluation is only possible by exposing the sample to the light source and light level projected for the intended use: the architectural project.

The example given here is an over-simplification. In most cases specific colors are seen in context with others, the quantity of one stimulus against another, the viewing angle (which determines how much of a stimulus will impinge on the retina) and distance of eye to stimulus, which determines the intensity. All are factors that enter into the evaluation process. They will de-

termine the integration of light and surface color, or if you prefer, the combination of direct radiation from the light source with reflected radiation from building components.

The color rendering characteristics of a light source may be described by the Color Rendering Index (CRI), a number that is often quoted and seldom fully understood. Eight test colors (determined by international agreement (Ref.2) are illuminated by a standard source and their measured location is plotted on a CIE chromaticity diagram. The same colors are then illuminated by the test lamp, which must have the same color temperature as the standard. The distance of this plot location from that under the standard illuminant determines the Color Rendering Index number: Identical plots of rendered chromaticities of all eight colors produce a rating of 100. Distances of the plots are averaged and a percentage rating is found. One must be cautious in accepting this as a judgement of the test lamp's "capability".

Referring once more to Fig.1, one can understand that light from an incandescent lamp will produce less saturated stimuli from a blue-green range than from orange-red. However, an incandescent lamp is rated with a CRI 95 or above. Take in contrast Daylight (Source "C") - a mixture of sunlight and skylight: Blues and greens are as lively and saturated as reds. The CRI does not tell how much each color shifts, nor in which direction, such as toward blue or red, greater or lesser saturation. One can obtain an idea how colors will appear by studying the spectral power distribution curve. It is not too difficult the guess that a high pressure sodium lamp (Fig.5) just cannot make trees look healthy. Anyone familiar with the directional signs on US highways, with their white lettering on green ground, knows that these appear black under the much used high pressure sodium lighting. The Color Rendering Index is helpful in the understanding of this factor for the use of surface color in architectural space. Interior color schemes should be assembled and evaluated under the type and the level of light under which they will be used. Exterior colors should be evaluated on the planned location in day and night

lighting conditions. Extraneous light from roadway or street light-
ing, or from flood lighting on adjacent structures should be con-
sidered.

In 1976 Westinghouse introduced the first tri-phosphor lamps,
that had been invented during the 1960's by Dr. William Thornton,
under the name Ultralume. Since then, many manufacturers have pro-
duced lamps made on the same principle with their own phosphor
compositions. The radical difference from standard fluorescent
lamps is this: Most commercial fluorescent lamps are intended to
maximize lumen output without regard for the quality of the color
rendition. Tri-phosphor lamps produce energy output in three nar-
row bands at approx. 440-450 nm, 535-550 nm and 610-640 nm (Fig2),
to which the cone cells of the retina in the human eye are most
sensitive (Fig.8).

It is generally accepted that the tri-phosphor lamps - in
their best versions - produce impressions of greater color gamut,
that is increased saturation as well as extended recognition of
individually distinguished colors in the darker, ligher and less
saturated ranges (Ref.1,5). The extended color recognition may
well be part of the reason for increased visual clarity (Ref.1).

Tests have proven that equal visual satisfaction and perform-
ance can be obtained from the light produced by these lamps at
lower levels of illuminance than from standard fluorescent sources.
Their proper use can lead to substantial savings in energy. It
must be realized that a completely new way of seeing colors has
been introduced. It can benefit the occupant of the architectural
space, especially if colorants are selected as described before.

Comprehension of the sequence from light production to color
stimulus response is the basis for successful coloration of the
environment.

* * *

Miami, March 1988

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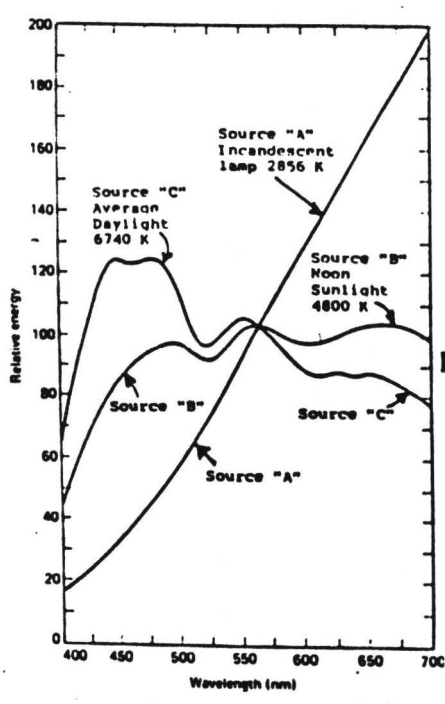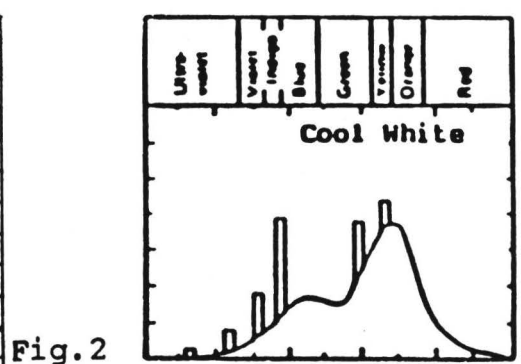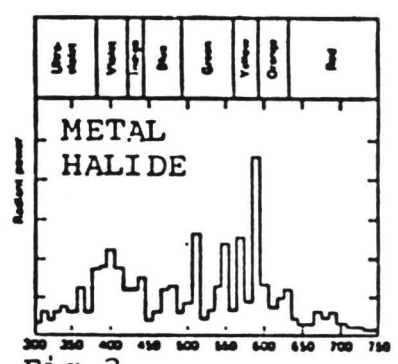J. Illum. Eng. Soc. Vol 7, p. 85, Jan. 1978

Fig.1 Three Standard Light Sources

Fig.2

Fig.3
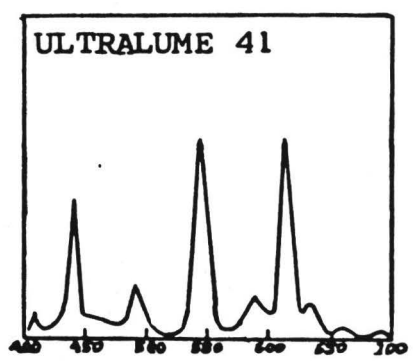
Fig.4

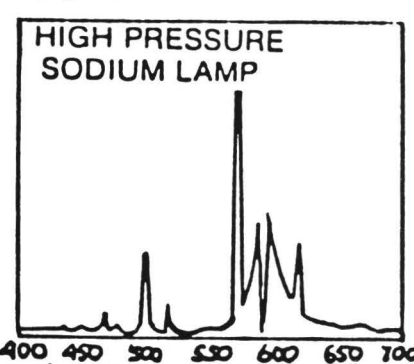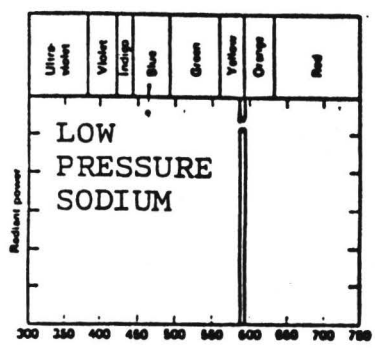Fig.5
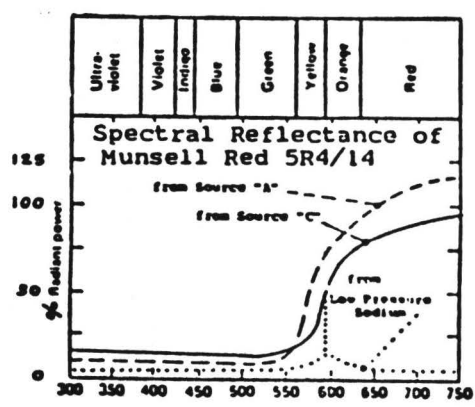
Fig.6
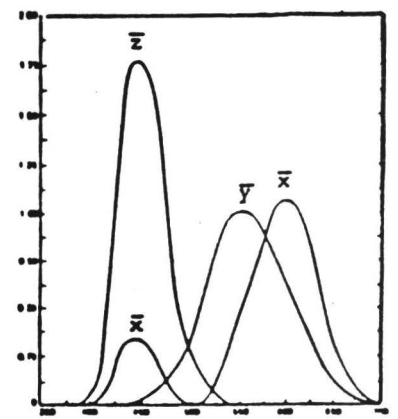
Fig.7

Fig.8 Tri-stimulus Values

14 **Prof. Anders Hård/**
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    Colour Researchers
    Chalmers University of Technology
    School of Architecture
    Göteborg

Experience of rooms with different colour and lighthing designs

EXPERIENCE OF ROOMS WITH DIFFERENT COLOURING AND LIGHTING
Anders Hård & Maria Kowalska

Theoretical background

Based on phenomenological analyses and extensive psychometric and psychophysical research experiments we have been able to show how colours, as visual percepts, are related and possible to describe in an unambigious way in a 3-D colour space called the Natural Colour System (NCS). According to this, colour percepts can be ordered by their varying degree of resemblance to the six elementary (imaginary) colour sensations white, black, yellow, red, blue and green. The resemblances are named the elementary colour attributes, white(ish)ness, red(ish)ness, etc. NCS can seen as a cognitive model (Fig.1) or map of what goes on in the human brain with regard to the characterisation of colour percepts, of relevance for design.

Another aspect of how colours interact in the design context is the contrast, defined as the Distinctness of Border (GT) between adjacent colour elements. This phenomenon has also been studied and we have shown that GT can be quantified as a power function of the sum of differences in the NCS quantities lightness correlated blackness (Δs_v), chromaticness (Δc) and hue ($\Delta\emptyset$) with certain constants. A special case is the definition of constant NCS Lightness Value (v) as all colours showing a minimally distinct border (MGT) to one and the same grey colour in an achromatic lightness reference scale from black to white.
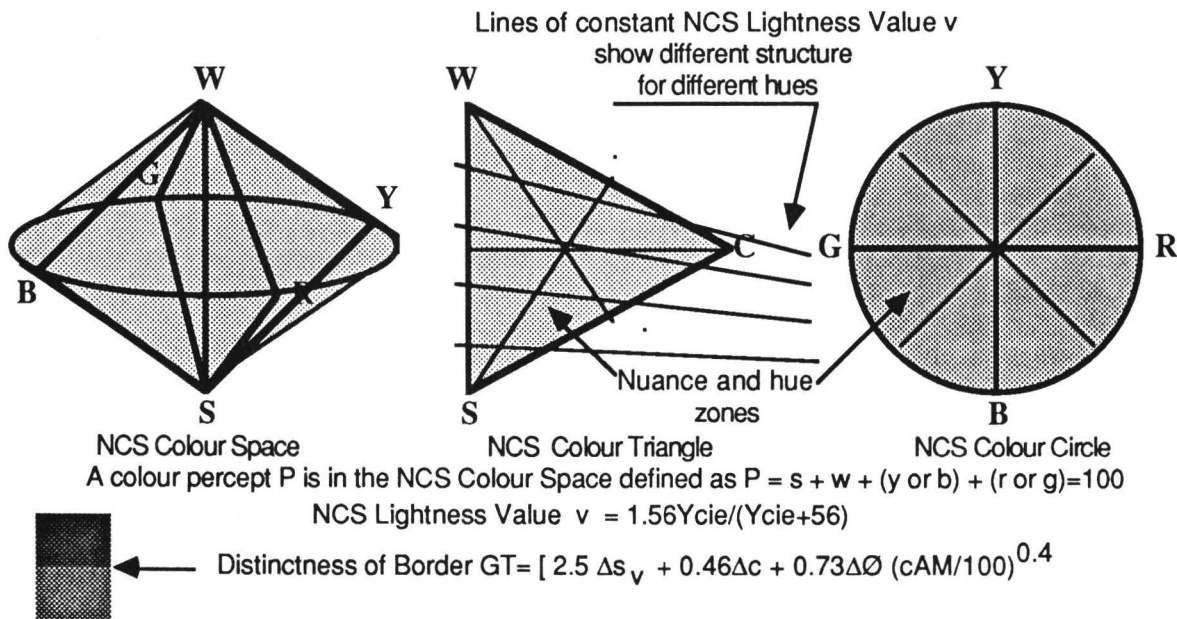
Lines of constant NCS Lightness Value v
show different structure
for different hues

NCS Colour Space   NCS Colour Triangle   NCS Colour Circle

A colour percept P is in the NCS Colour Space defined as $P = s + w + (y \text{ or } b) + (r \text{ or } g) = 100$

NCS Lightness Value $v = 1.56 Y_{cie}/(Y_{cie}+56)$

Distinctness of Border $GT = [\ 2.5\ \Delta s_v + 0.46\Delta c + 0.73\Delta\emptyset\ (cAM/100)^{0.4}$

Fig. 1. Models of NCS colour space, Distinctness of Border and constant lightness

Based on these studies and further phenomenological analyses of the colour gestalt we have outlined a new colour combination theory of environmental interaction for which the NCS model, with its subdivision in characteristic hue and nuance zones, has shown itself to be a valuable tool for exploring new concepts in colour. The grapfical model shown in Fig.2 presents our representation of the three characterizing main dimensions of the colour gestalt along with their respective three sub-dimensions. The fourth "dimension" indicates that the experience of a defined colour gestalt also depends of the visual context.

•**Complexity** •**Content** •**Type**
THE CHORD

•**Distinctness
  of Border**
•**Kind**   **INTERVAL** ← THE COLOUR GESTALT → **VISUAL
•Size of   CONTEXT**
  the Kind**

TUNING
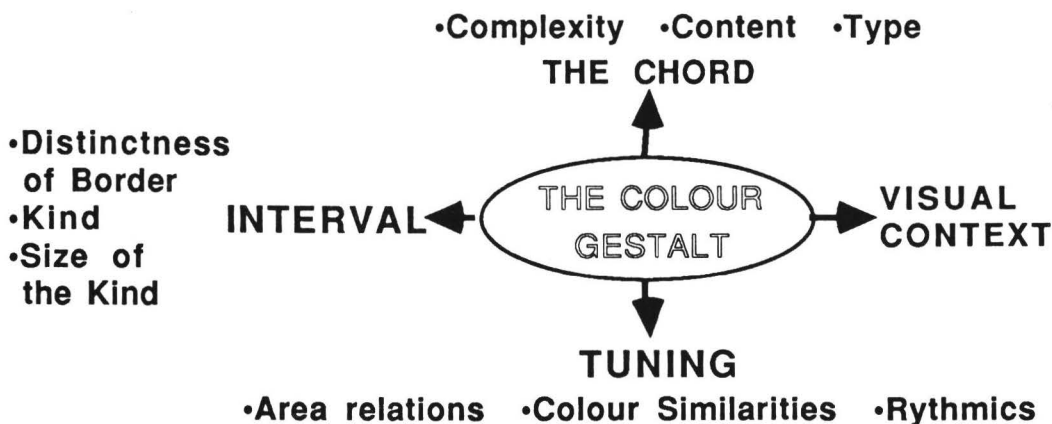•**Area relations** •**Colour Similarities** •**Rythmics**

Fig 2. Model of the 3x3 dimensions of the colour gestalt related to the context dimension

THE INTERVAL dimension indicates what visually happens in the abstract "gap" between two adjacent

colour elements. We here have to count with the three sub-dimensions:

1) The **Distinctness of Border** determines how well a colour element discriminates from its surround
2) The **Kind** of the Interval specifies the two elementary colour attributes constituting the interval and
3) The **Size** of the Kind indicates the relative difference between the two actual elementary attributes

THE CHORD dimension deals with the characteristic colour relationships between the colour elements in the gestalt and how they interact. The chord has three subdimensionsas well:

1) The **Complexity** refers to how many elementary colour attributes are present in the gestalt in the form of Main and Secondary attributes.
2) The **Content** indicates which of the elementary colour attributes that are perceived in the colour gestalt
3) The **Type** specifies how Main and Secondary attributes are bound to each other and are categorized with respect to which hue and nuance "zones" in the NCS space the colour elements belong .

THE TUNING dimension has to do with the variation in concordance between the elements of the colour gestalt with reference to the three subdimensions:

1) The **Area relations,** defines the relative extent of the gestalt that thedifferent colours occupy and stands for the "importance" of certain colours in determining the total colour character of the gestalt
2) The **Colour Similarities** represent a kind of harmonization of the colours into such perceived formal colour constancies as constant whiteness (degree), constant hue (ratio), constant lightness (contrast) etc.
3) The **Rythmics** is the subdimension that has to do with the order in which the colour elements are perceived to come with respect to colour, contrast, area size etc.

This colour combination theory represents the last step in a theoretical analyses of how colours perform and might be dealt with in environmental design .

A fullscale study

Having established the theoretical background,
• the colour order and notation system (NCS) by means of which we can describe a colour percept in any arbitrary viewing and illumination situation,
• the form-giving dimension of colour differences called distinctness of border (GT) and
• the outlined dimensionality of the colour gestalt
we have found it of interest to initiate investigations of how people experience colour design, both in pictures and in rooms with the aim to test our theoretical models and other existing composition ideas.

At the Department of Architecture at Chalmers University of Technology we therefore carried out a full scale study of how different categories of people experienced a room varying in colour and lighting design. We were especially interested to see if architect's (or more correctly fourth year students of architecture) evaluations of various rooms were similar to other people's.

Room description: A normally furnished room of about 4x4 m and 2.60 m high.

Colour design: White ceiling and a beige floor. The walls were in two alternatives:

A) A uniform bluish gray colour, NCS 2020-R90B, with a luminous reflectance factor of Ycie≈45% and
B) Dark blue (7020-R90B) and white (0502-B) vertical stripes of equal but varying width with an average luminous reflectance factor of Ycie≈(84+6)/2=45%.

Lighting design: For each of the colour alternatives the room was illuminated in three ways:

1) Spot illumination with incandescent bulbs in four different locations in the room
2} A general illumination with incandescent bulbs centrally located in the ceiling
3) Point illumination = 1) but with fluorescent bulbs
Totally this gave 3x2=6 differently designed rooms.

We also carried out experiments in a full scale room laboratory in which we studied many variations in colour design of ceiling, walls and floor, but the results of that study are not ready to be reported here.

Observers: The sample of 60 observers, who took part in the experiment, was drawn from the following three groups composed of 20 observer each a) Retired persons over 65=Pensioners; b) Students of technology =Tech.students; c) fourth year students of Architecture =Architects

Method: The observers were seated in the room and were presented with 35 different semantic bipolar scales. Their task was to decide *how well the words of each of the scales fit their experience of the room.*

Factor analyses

For each of the scales and for each of the room alternatives the mean value of the observers judgements was calculated. These meanvalues were computed with a special program for Factor Analyses, a statistical method used to determine which of the semantic scales that approximatively represent the same factor or dimension of experience and to which degree. The following table presents the English translations of the word-pairs used in the study as well as which factor they mainly belong to. The factors or dimensions have also been given names representing our verbal interpretation of which kind of experience the factors represent, here in English translations. They are illustrated in Fig. 3 in which the size of the circles approximately represents the importance of the dimension in the total experience. Only one of the words of each semantic scale is provided. Some words might belong to different factors as indicated in the figure.

Translation from Swedish of word-pairs ordered according to main factor
(from instruction: *how well do you think that the words fit tyour experience of the room)*

FACTOR 1 (pleasantness)   insecure–safe; negative–positive; unkind–friendly; soft–hard; restful–tiring; nice–ugly; harmonious–disharmonious; manly–womanly human–-mechanical; pleasant–boring; cold–warm, strange–familiar; poor–rich; stable–unsteady; common–odd; confined–airy;

FACTOR 2 (spaciousness)   narrow–spacious; large–small; broad–narrow; oblong–squarish;

FACTOR 3 (manifoldness)   active–passive; complex–simple; varied–monotonous; uniform–motley; lively–calm

FACTOR 4 (comprehensibility)   ledgible–blurry; right side up–topsy-turvy; easy to find the way in–difficult to find the way in

FACTOR 5 (brightness)   bright in the room–dark in the room; a light room–a dark room

FACTOR 6 (roomishness)   short–long; low ceiling–high ceiling; common-place–festive

FACTOR 7 (ageness)   youthful–old-fashioned
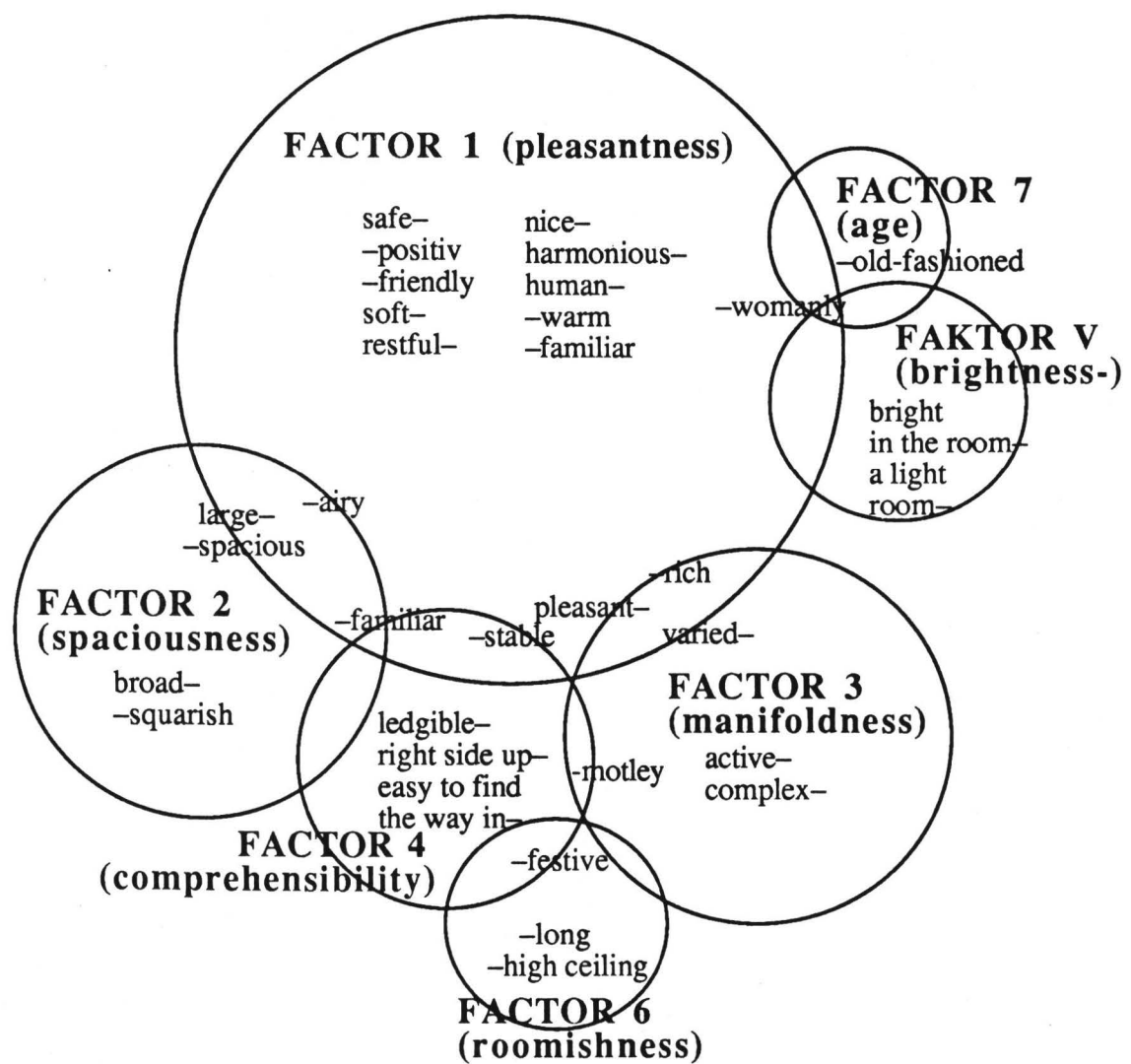
Factorstructure of the scalewords
(only one of the words in each scale is shown)

Fig. 3. Result of factor analyses

Interesting is that the cold–warm scale does not come out as a separate temperature factor but here belongs to the pleasentness factor including scalewords like –positive, –friendly, –soft, –restful, etc. This indicates that when people talk about a warm colour or illumination, they do not necessarily mean the temperature but rather mean that they have the same pleasant feeling that they get when it is warm.

Factor scores

From the factor loadings of all the scales in each factor the comprehensive factor scores for the different

room alternatives and for the different category of observers were computed . The factor scores make it possible to compare how different alternatives, in an experience dimension, are evaluated by different observer categories. In Fig. 4 factor scores in the **pleasantness factor** for the six room situations and for the three observer categories are shown, as well as for the whole group. To be observed here is that the zero point is arbitrary and that it is only the intervals that are of relevance.
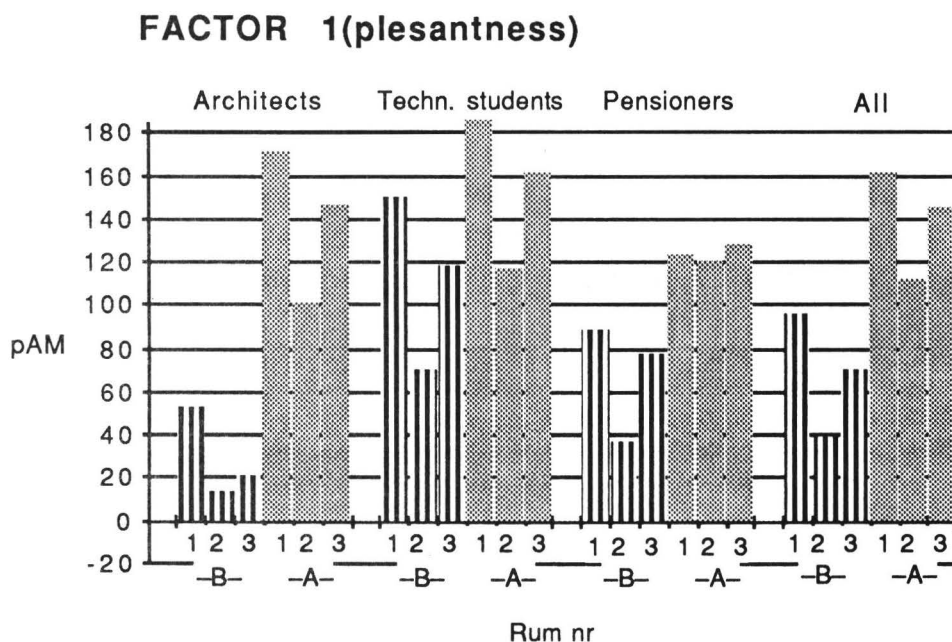
FACTOR 1(plesantness)

Fig. 4. Factor scores for different cathegories of observers in different room situations in the pleasantness factor. A= the uniformly and B= the striped coloured room; 1=incandescent spot, 2= –"– general and 3 f luorescent spot illumination

Comments

Looking att the scores for the whole group one finds that:
• the uniformly coloured room was experienced to be more pleasant than the striped in each of the three illumination situations
• general incandescent illumination is least pleasant in both the uniformly and the striped colour alternatives
• point illumination with incandescent bulbs was more pleasant than fluorescent bulbs
For the three category groups of observers was found :
• that the uniformly coloured room was experienced to be more pleasant by all three groups than the striped and that this difference is much more pronounced for the Architects than for the other two
• that Pensioners scored their *most pleasant* alternative (A3) much lower than how the two younger groups rated the alternative they thought*most pleasant* (A1)
• scoring of the illumination alternatives follows the same pattern as for the whole group except for the Pensioners who do not differentiate between the three illuminations of the uniformly coloured room.
When looking at the results in the pleasantness factor we observe some divergences between the Architect group and the other two. It appears as if they overestimate the difference between the uniformly and the striped coloured room. Unfortunately we cannot draw any conclusion as to the reason from this investigation. Can it be that their professional experience as architects has made them more sensitive or conscious observers so that they really experience such strong differences? Or is it so that they respond to the questions in the way they guess that other people would? Or is there any other reason? Your guess is as good as ours..
The factor score conceal a lot of information in that it represents a kind of mean value of the semantic scales belonging to a certain factor. Therefore individual scales have been analysed. An example is presented in Fig. 5 where the scale values (arithmetic means) in the semantic scale hard–soft for each room and the three groups of observers are shown. The general trends of the factor scores are also found here.
To be observed is that
• the room in incadescent spot illumination was experienced as softer than both the general incandescent and the fluorescent spot illumination except for the Pensioners in the stripe coloured room in which they rated the fluorescent highest
• except for the Architects, fluorescent spot illumination was rated higher than the general incandescent illumination in all room alternatives.
Exactly the same patterns as for the scale hard– soft were found in the scales cold–warm, unkind––friendly, negative–positive, unsteady–stable and poor–rich.
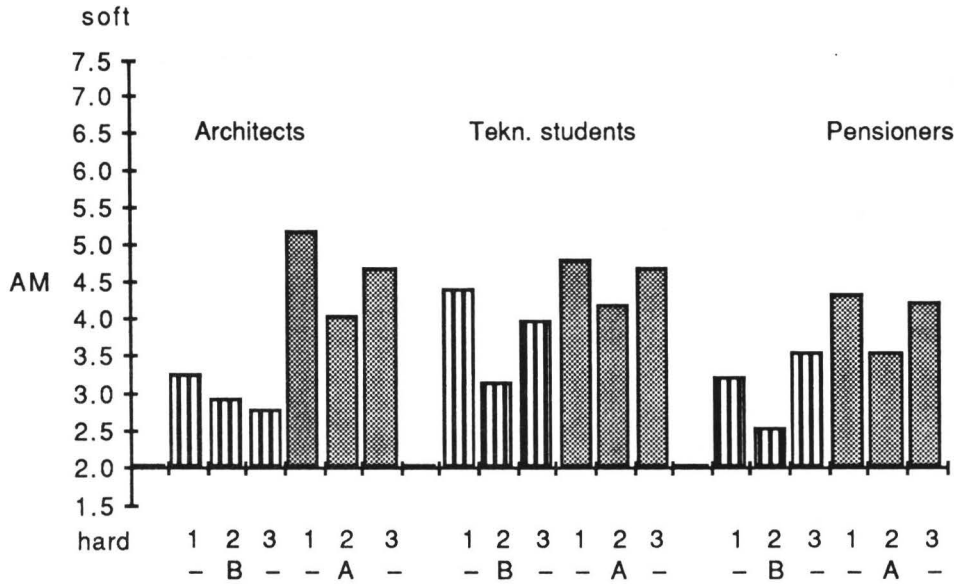
Fig. 5. Mean values in the semantic scale hard–soft

Based on interviewes with interior designers we had formulated the hypothesis that a room with white and dark patterned walls would be perceived as brighter than with uniformly coloured walls as long as the average luminous reflectance factor was the same. In Fig. 6 is shown the factor scores for the brightness factor. From this can be seen that on a general level we have to reject the hypthesis and draw the conclusion that the uniformly blue gray room was perceived as brighter than the white and dark blue striped, especially pronounced among the Technological students. However, there are exeptions in the case of general incandescent illumination located in the middel of the ceiling in which both Architects and Pensioners scored the striped coloured room as brighter than the uniformly coloured.

FACTOR 5 (brightness)
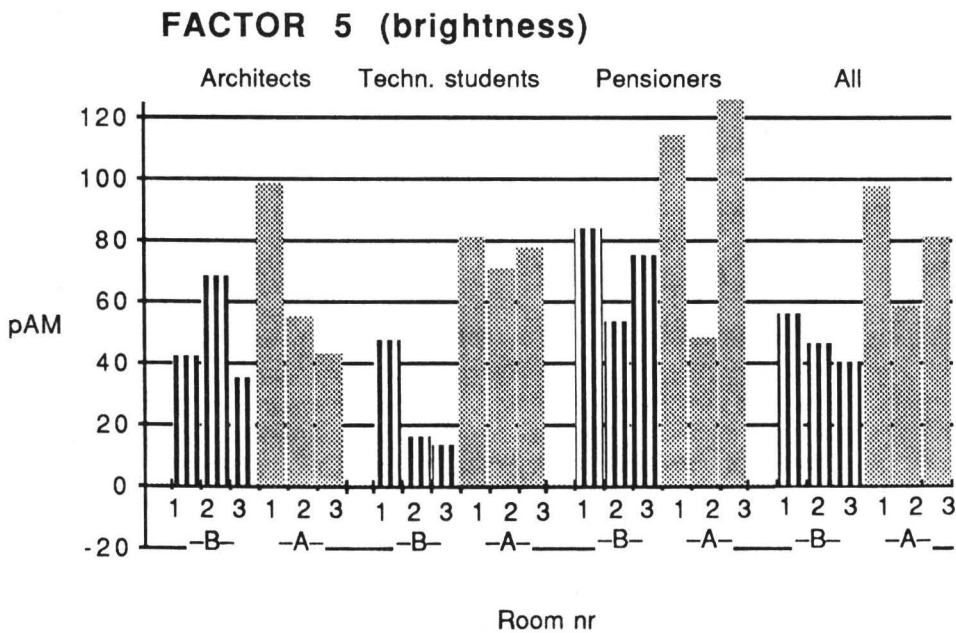
Fig.6. Factor scores in the brightness factor

When finished there is much more information of this kind to be extracted from this study which those who work professionally with environmental colour design could make use of. However, they will not find any standardized and stereotype recipes for how to go about colour design but hopefully they will be reminded that other groups might have other evaluations than themselves. It may also serve to call into question some dogmatic rules which might excist within a profession.

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The Coloroid colour system and atlas

Antal NEMCSICS:

The Coloroid Colour Atlas and its Use for Practical
Environmental Colour Design

Coloroid Colour Atlas relies on Coloroid Colour System
relations, enabling it in particular for the use in
environmental colour design.

A fundamental feature of Coloroid Colour System is
partly its continuous and aesthetically uniform
colour space including both bright and surface colours.
Its aesthetic uniformity is meant as a perceived evenness
relying on harmony threshold measurements, and evaluates
scales in the colour space integrally, with starting and
final points. This feature enables it to determine
colour harmony complexes and to describe them by its
colour symbols.
Another fundamental feature of the Coloroid Colour System
is that its colour symbols can be directly transformed to
physical magnitudes, colour stimuli, so that the given
colour can be displayed by means of the colour symbol
and a suitable simple means. This feature permitted
to determine e.g. different densities of each stencil
plate for the press production, at an exclusive accuracy,
of colour samples for the Coloroid Colour Atlas.
Coloroid Colour Atlas has three parts. The first part
contains 1650 colour samples 15 by 20 mm. On each of
the 48 pages of colour samples, there are different

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colours but on each page those with the same Coloroid
basic hue. Saturations of colour samples in square
mesh arrangement have the same saturation in each
column, and the same lightness by rows. Saturation
and lightness intervals vary page-wise, correspondingly
not only the colour space domains represented by colour
samples on each page are different but so are thevarious
spots of the corresponding Coloroid axial section.
To help survey, size and location of the colour-sample-
presented colour domain are illustrated by sketches
in each page. This unusual selection of the colour
samples permitted for the colour samples of the Coloroid
Colour Atlas to represent colour space colours primarily
needed for specialists of environment colour design.
Thus, the Coloroid Colour Atlas is not simple a presentation
of the Coloroid Colour space but an essential assistance
to the colour designer.

Second part of the Coloroid Colour Atlas helps the
user to be oriented in the colour space. This part
comprises five outfolding hard plates presenting, in
turn, the Coloroid colour circle of 48 elements, the
Coloroid grey scale of 100 elements, a detaileg axial
section of the Coloroid colour space with colours of
the same hue, a section produced by a coaxial cylindrical
surface with colours of the same saturation, and a plane
section with colours of the same lightness. The entity

of these plates contains other 758 colour samples in all.
Positions of these colour samples in the Coloroid colour
space are seen from perspective drawings.
Third part of the Coloroid Colour Atlas contains textual
parts and tables. A short description is given of the
Coloroid colour system, completed with explanatory diagrams
and definition tables, containing, in addition to Coloroid
indices of the colour samples in the Coloroid Colour Atlas,
their tristimulus values in the CIE XYZ system, colour
coordinates X,Y,Z and x,y, as well as Munsell, DIN and NCS
colour system indices. Tables have been composed by using
Coloroid-Munsell, Coloroid-DIN and Coloroid-NCS transformation
equations. Tables are rather helpful to users searching
for a given colour in the Coloroid Colour Atlas indicated
by indices of some of these colour systems, or wishing
to record colour designs made relying on relationships
of the Coloroid colour system and the Coloroid Colour Atlas
in terms of indices of another colour system.
Coloroid Colour Atlas colour designer helps specialists to
simply compose colour harmony complexes. In the Coloroid
colour system, every colour bears a group of three numbers.
There are definitely related for harmonic colours. Picking
out colours agreeing with these relationships from the
Atlas yields harmonic complexes. For instance, all colours
of the Atlas are harmonic with identical numbers the first

- 4 -

place of the group of numbers, while second and third
numbers form an aritheetic series.
The Coloroid Colour Atlas has been published in English,
German and Hungarian.

Fig. 1. A page of the Coloroid Atlas with the Coloroid
          colour circle
Fig.2.   "   grey scale
Fig.3.   with identical Coloroid hue colours
Fig.4.   "   saturations
Fig.5.   "   lightnesses

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              1988.
- A.Nemcsics: Color Space of the Coloroid Color System.
              Res.Appl. 12.3.1987.

15.5

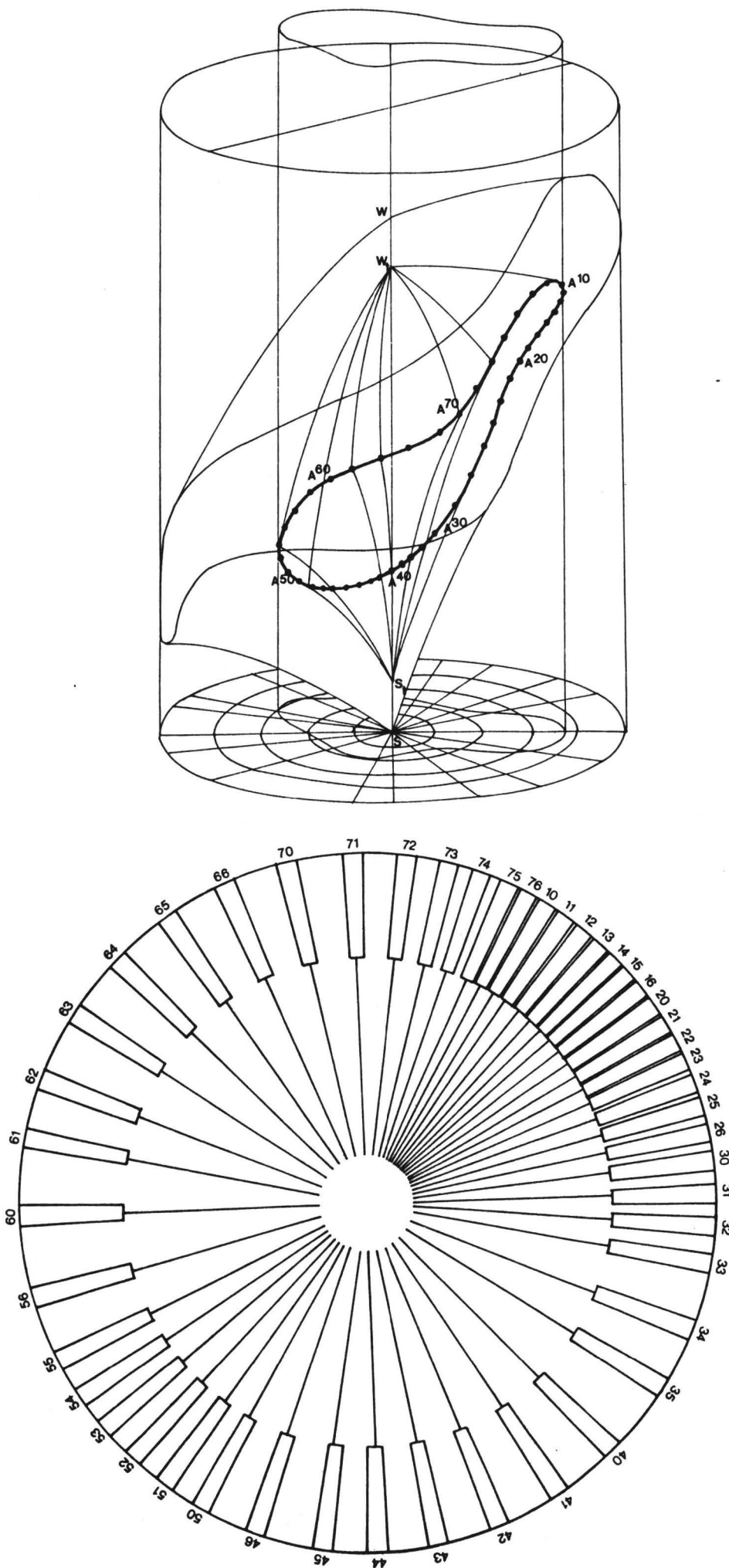Fig. 1.

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*Evaluation of the spatial effects of colour
in buildings*

EVALUATION OF THE SPATIAL EFFECTS OF COLOUR IN BUILDINGS

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In this paper, a conceptual model is offered for examining the combined spatial effects of colour, texture and form as a whole in the content of interaction between these visual elements and the total perception modalities; in a way that the model is based on an approach "whether the whole is more than the sum of its parts"(1). This interaction system depicts that many perceived colour effects in a space could be manipulated by controlling the other visual variables (i.e., texture and form), and the physical environment variables (i.e., auditory, thermal and visual conditions).

On this model, spatial effects are evaluated according to the "Perceptual Judgements" that are submitted as the results of perceptual responses rooted in cognitive processes, and evaluative responses rooted in affective processes.

INTRODUCTION

The studies on colour in environmental design is a growing area of research as the visual phenomena is beginning to emerge as the most important criteria in the design process. There has been some studies concerning colour preferences since the end of the nineteenth century. On the other hand some psycho-physiological researches have found influences of visual elements on blood pressure, respiratory rate and reaction time etc. (2). It has been found that reactions to colour through the eye are many, varied and intriguing (3). There is a strong tendency in many studies to regard colour as being determined by the physical attributes of the light since the light produces such features of a colour as hue, saturation and brightness (4). Furthermore three dimensional colour diagrams are introduced after Newton's initial mapping of its equator in 1660, its geography has been classified and re-annotated by a series of systems, namely those by H.Lambert (1772), M.E.Cheureul (1861), A.H.Munsell (1898), W.Ostwald (1915) in 1976, by A.Hard (5).

In the light of those researches and experimental studies, this paper claims that colour in environmental design cannot be evaluated alone, because many perceived colour effects can be manipulated by controlling other visual variables and physical environment variables. In other words, the perception of colour is constantly experience of texture and form; in a way that we experience of each of the spatial elements as a component of all the others. Furthermore, spatial effects can be modified by visual, dimensional, auditory, and thermal perceptions -

perception modalities-that are affected by spatial elements; colour, texture and form (6).

These effects can be evaluated by perceptual judgements which are submitted as the outputs of the "Stimulus-Organism-Response" process in the content of "Man-Environment Interaction System". Within this process which is called "Human Information Processing", sensory information is integrated into incoming data with the relationships abstracted from previous transactions with the world and permitted the organization of appropriate responses (7). As those responses take place in the content of cognitive and affective processes which have an objective value of the spatial effect, they are called perceptual judgements (8). Furthermore those judgements describing the spatial effects reflect the structural quality of each visual element as it is seen on the Interaction Matrix of System Variables.

Thus perceptual judgements express the relationships between the physical variables that can be measured and the perceptual variables that can be evaluated.

A CONCEPTUAL MODEL SUGGESTED IN EVALUATION OF THE SPATIAL EFFECTS IN BUILDINGS

With an approach in parallel to the human information processing, a conceptual model is developed in three stages: (1) the constitution of the Interaction Matrix of the System Variables; (2) the preparation of the Semantic Differential Scales based on this matrix; (3) suggestion of the perceptual judgements that are gethered into a radial diagram.

An Interaction Matrix of the System Variables :

In the light of the various research results concerning the psychological effects of colour, texture and form, an interaction matrix of the system variables is suggested to show the dispersion of the words describing the evaluations. The interaction matrix of the spatial and physical variables is aranged by expressing these words in terms of ajdective pairs (Table 1). On this matrix, visual design elements of the space are considered as independent variables; and physical environment variables that can be modified by colour, texture and form perceptions in the space are thought of as dependent variables.

So the matrix of [A : (3,4)] is arranged in such a way that probable emotional responses which are the words describing evaluations are shown in the content of interaction system between two kinds of variables.

Semantic Differential Scales :

The framework of this matrix is adopted to semantic differential scales in such a way that words expressed in term of adjective pairs; those with positive evaluations are placed to left and those with negative evaluations to the right. In representing the results of semantic scaling for each spatial elements, the arithmetic averages of subjects' judgements are shown together with their dispersions.

			VISUAL VARIABLES (independent)					
			COLOUR		TEXTURE		FORM	
			WARM	COOL	ROUGH	SMOOTH	ORGANIC	GEOMETRIC
PHYSICAL ENVIRONMENT VARIABLES (dependent)	FACTORS AFFECTING DIMENTIONAL PERCEPTION	WIDTH	NARROW	LARGE	NARROW	LARGE	INDISTINCT	DISTINCT
		DEPTH	NEAR	DISTANT	NEAR	DISTANT	ACTIVE	PASSIVE
		HEIGHT	LOW	HIGH	LOW	HIGH	DYNAMIC	STATIC
	FACTORS AFFECTING THERMAL PERCEPTION	WARMTH	WARM	COOL	WARM	COOL	MOTLEY	UNIFORM
		HUMIDITY	VITALITY	TANQUIL	FRIENDLY	HOSTILE	COMLEX	SIMPLE
		VENTILATION	ACTIVE	PASSIVE	PLEASANT	UNPLEASANT	UNREGULAR	REGULAR
	FACTORS AFFECTING VISUAL PERCEPTION	HUE	HARSH	INSIPID	VARIABLE	MONOTONOUS	VARIABLE	MONOTONOUS
		SATURATION	EXCITING	REPOSEFUL	CALM	UNEASY	SYMBOLIC	MEANINGLESS
		BRIGHTNES	SPACIOUS	BORING	LOVELY	ANNOYANCE	DISAPPOINTING	GLAD
		LIGHTNESS	PROTECTING	EXPOSING	PROTECTING	EXPOSING	VARIABLE	MONOTONOUS
		DARKNESS	HOMISH	CHEERLESS	STRONG	PALE	FRIENDLY	HOSTILE
	FACTORS AFFECTING AUDITORY PERCEPTION	LOUDNESS	LIGHT	HEAVY	SATISFACTORY	OFFENSIVE	UNREGULAR	REGULAR
		FREQUENCY	STIMULATING	SLEEPY	HARSH	INSIPID	UNEXPECTED	WELLKNOWN
		REVERBERATION	DYNAMIC	STATIC	SPACIOUS	BORING	INTIMATE	SOLEMN

Tablo 1. Interaction Matrix of System Variables.[x]

Giving an example of the modified perceptual effects of colour, it can be shown that although the width, depth and hight of a space is kept constant, the dimensional perceptions of this space can be modified according to the use of cool or warm colours. When the warm colours are used in an enclosed space, as these colours advance (9), the space is perceived smaller than its real size; when the cool colours are used, as these colours recede (9), the space is perceived larger then its real size. Similarly when cool colours are used, the space is perceived cooler than its measured temperature; and warm or dark colours are used, it is perceived warmer than its measured temperature (7).

Perceptual Judgements Placed on a Radial Diagram :

After obtaining the subjective values on semantic scales, the correla - tions between the words on the scales were calculated and clustered into eight factors represent the perceptual judgements (Table 2). Those perceptual judgements representing the responses which are considered as the outputs of human information processing, give an idea about the spatial effects of colour, texture and form in buildings. The eight perceptual judgements - i.e., unity, visual balance, continuity, constency, expressiveness, variety, enclosedness, spaciousness - are defined by clustering of the words describing evaluations.

The objective value of each judgement is shown on a radial diagram on which the eight radius, representing each perceptual judgement, are divided into 4 scales as it is shown on semantic scales. The values that each judgement take on the radius are combined by the closed profiles that can be called evaluation profiles (Fig.1). In representing the results of the evaluation by those profiles on this model, it is pos- sible to compare the spatial effects of different environments accord- ing to the perceptual judgements.

(x) Various sources are used : (9),(10),(11),(12),(13),(14),(15).

PERCEPTUAL JUDGEMENT	THE ADJECTIVE PAIRS DESCRIBING EVALUATIONS (SUBJECTIVE VALUES)		PERCEPTUAL JUDGEMENTS
VARIETY	VITALITY	TRANQUIL	UNITY
	DOMINANCE	INSIPID	
	ACTIVE	PASSIVE	
	VARIABLE	MONOTONOUS	
	DYNAMIC	STATIC	
	MOTLEY	UNIFORM	
SPACIOUSNESS	LARGE	NARROW	ENCLOSEDNESS
	HIGH	LOW	
	DISTANT	NEAR	
	SPACIOUS	BORING	
	SOFT	HARD	
	EXPOSING	PROTECTING	
	COOL	WARM	
	INDISTINCT	DISTINCT	
CONTINUITY	LOVELY	ANNOYANCE	CONSTANCY
	CALM	UNEASY	
	COMPLEX	SIMPLE	
	EXCITING	REPOSEFUL	
	UNREGULAR	REGULAR	
	HOMISH	CHEERLESS	
	PLEASANT	UNPLEASANT	
EXPRESIVENESS	SATISFACTORY	OFFENSIVE	VISUAL BALANCE
	UNEXPECTED	WELLKNOWN	
	DISAPPOINTING	GLAD	
	INTIMATE	SOLEMN	
	SYMBOLIC	MEANINGLESS	
	STIMULATING	SLEEPY	
	STRONG	PALE	

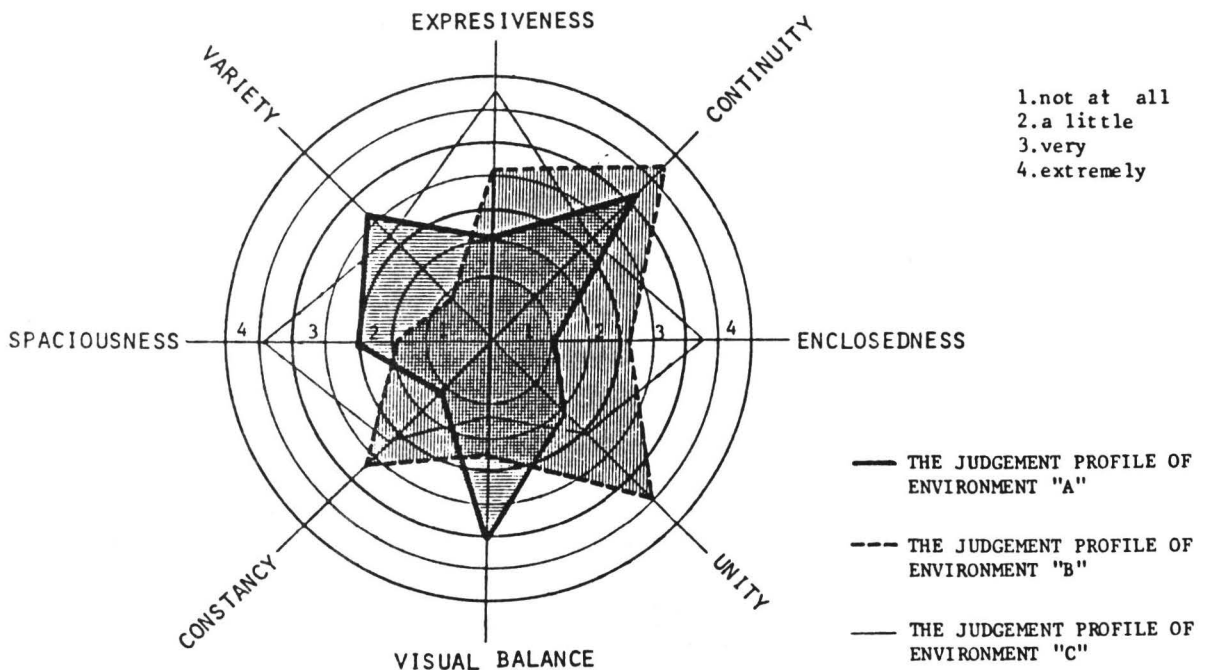Table 2. Clustering of the Words Describing Evaluations into Perceptual Judgements.

Diagram 1. A Model of Perceptual Judgements.(x)

(x) Systemazing the perceptual Judgements the diagram which is developed by S.Hesselgren is used. It seems similar in structural form, but the concept is different (7).

CONCLUSIONS

It seems that the interaction between the occupants and all the visual components of the environment causes the modified visual, thermal, dimensional and auditory perceptions. The results of this interaction process are put together on the conceptual model in order to compare the values of perceptual judgements in different buildings.

As a result, this model involves the perceptual judgements offering a conceptually new approach to understand peoples perception of and interaction with their environment. As the perceptual judgements reflect the structural quality of the visual - spatial - elements and the relationship between perception and stimulus, they should lead to new and deeper insights in the design and analysis of environmental control system in buildings.

A systematic approach is proposed to the problem defined as "Evaluating the spatial effects of colour in the context of perceptual relations by means of this conceptual model.

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*The study of psychological effects of the
light-shade relation in architecture*

THE STUDY OF PSYCHOLOGICAL EFFECT OF THE LIGHT-SHADE RELATION IN ARCHITECTURE

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THE SUMMARY

The study presented in this article covers the psychological effects of different light-shade which is formed by the differences of artificial lighting in the interieur space on the non furnished model spaces with an experimental method.

The experiment was done in a laboratory in which model spaces were placed at the Faculty of Architecture of Yıldız University. The subjects were asked: 1) to define the subjective qualities of the space by looking at the model spaces, 2) to fill in the semantic differential tests for each experiment, 3) to tell the arrangement of the experiment that they prefer. The results were evaluated in terms of % (percent, arithmetic mean, t test and factor analysis).

CONCERN

In this study: (1) the measurement of psychological effects of the three different light shade formations on space perception, (2) the investigation of the assumption that the senses of excitement, interest and liveliness were denser where light-shade was distinct, were aimed at.

STIMULI AND APPARATUS

In the formation of light shade,

A- The distinctiveness of light-shade

B- Light-half shade

C- The indistinctiveness of the boundary of light-shade were taken as independant variables and three experiment design were prepared. With this aim, two model spaces having 1/5 scale of the space place in the experiment room with an accepted height of 2.90 m and with 4.00x5.80 m original dimension were used.

With the help of no 1 model space, the A experiment design with no 2 model space, the experiment design B and C were shown. By removing one of the walls of the model spaces, the subjects were made to see the model spaces through these places. The inner surfaces of the models were painted with a dull gray plastic dye.

The furniture, window and door of the model spaces were removed and they were the elements left out the experiment. Colour, texture, the density of illumination the types of lighting sources, the effects of light-shade figures were all kept under control by means of equilization and left out the experiment.

Since they give a light similar to daylight lamps with redhot wires were prefered. In each of the three experiment design, light for the model spaces were taken from above. In order to keep the density of light equal and obtain the same light-shade figure in the three experiment design, the spaces above the model spaces and the place of the light bulbs were arranged in a different way in each experiment design. The eye level of the subjects was kept as high as the ceiling level.

120 total subjects aged between 20 and 25, 60 being students of architecture (30 female-30 male), the other 60 being non architecture students (30 female-30 male) were used.

Pre-Experiments: (1) In terms of light-shade distribution which would be used in each of the experiment design and, (2) The identification of light density between the original space and its model space, because there was no exact correlation which was caused by the changement of the scale, pre-experiments were made in order to find the density of light in model spaces.

As a result it was found that the light density of the central point of the model spaces should be 80 lux.

PROCEDURE

With the aim of the study, the subjects were asked:

1. to define the space effect, looking at the lighting in the model space with a few adjectives (the three experiment designs were shown to the subjects in a quaisi random.

2. to fill in the semantic differential tests which consisted of 24 pairs of adjectives, for each of the experiment designs (by looking at the model spaces).

   Adjective pairs used in the semantic differential scale are as follows:

Monotonous	: Interesting	Pleasant	: Unpleasant
Stifling	: Lively	Insufficient:	Sufficient
Large	: Small	Wide	: Narrow
Unexciting	: Exciting	Long	: Short
Complex	: Simple	Attractive	: Unattractive
Ineffective	: Effective	Disordered	: Ordered
Bright	: Dull	Angular	: Rounded
Dynamic	: Static	Clear	: Hazy
Exhilarating : Depressed	Warm	: Cold
Extraordinary: Ordinary	Luminous	: Dark
Harmonious	: Discord	Weak	: Strong
Indistinct	: Distinct	Relaxing	: Irritating

3. Which experiment design they preferred for lighting.

DATA ANALYSIS

1- The Subjects Defined

Light-shade distinctiveness with 51 different adjectives

Light-hafl shade situation with 48 different adjectives

Light-shade indistinctiveness with 37 different adjectives.

After the question was evaluated, the adjectives with the highest frequencies are as fallows:

Light-shade distinctiveness (Experiment design A)

- STIFLING, IRRITATING, EXCITING, INTERESTING, OPPOSITE, CLEAR, ANXIETY

Light-half shade situation (Experiment design B)

- STIFLING, IRRITATING, PESSIMISTIC, COMPLEX, UNPLEASANT

Light-shade Indistinctiveness (Experiment design C)

- RELAXING, EXHILARATED, MONOTONOUS, STIFLING, VAGUE, UNCOMFORTABLE, COLD EMTY, LUMINIOUS, DIM,

2. The semantic differential test in the second question, was evaluated by arithmetic mean, t test and factor analysis. For each experiment design in addition to three factor analysis in which all the subjects were taken into account, 12 more factor analysis were tested to investigate whether there was any role of education and sex in the process.

Since it was determined that education and sex didn't vary in large quantities, here only the results of the factor analysis which was related to three experiment designs and which all the subjects participated have been presented in a table (Table 1).

TABLE 1. For three experiment design factor analysis in which all the subjects were taken into account

		LIGHT-SHADE DISTINCTIVENESS (A)			LIGHT-HALF SHADE SITUATION (B)			LIGHT-SHADE INDISTINCTIVENESS (C)	
FACTOR 1	EVALUATION	Relaxing-Irritating	0.93	EVALUATION	Relaxing-Irritating	0.85	EVALUATION	Relaxing-Irritating	0.96
		Pleasant-Unpleasant	0.88		Pleasant-Unpleasant	0.81		Pleasant-Unpleasant	0.85
		Exhilarating-Depressed	0.81		Exhilarating-Depressed	0.76		Ineffective-Effective	0.84
		Stifling-Lively	0.77		Stifling-Lively	0.63		Attractive-Unattractive	0.80
		Warm-Cold	0.73		Harmonious-Discord	0.62		Stifling-Lively	0.69
		Attractive-Unattractive	0.71		Warm-Cold	0.62		Harmonious-Discord	0.67
		Luminous-Dark	0.68						
FACTOR 2	EXCITEMENT	Unexciting-Exciting	0.72	EXCITEMENT	Dynamic-Static	0.72	DIMENSION	Luminous-Dark	0.73
		Dynamic-Static	0.71		Monotonous-Ordinary	0.71		Bright-Dull	0.62
		Complex-Simple	0.67		Unexciting-Exciting	0.70		Clear-Hazy	0.54
		Extraordinary-Ordinary	0.66		Ineffective-Effective	0.63		Wide-Narrow	0.50
		Monotonous-Interesting	0.60		Complex-Simple	0.60		Large-Small	0.48
		Ineffective-Effective	0.58		Extraordinary-Ordinary	0.58			
FACTOR 3	FORCE	Indistinct-Distinct	0.69	DIMENSION	Large-Small	0.69	EXCITEMENT	Unexciting-Exciting	0.62
		Weak-Strong	0.54		Wide-Narrow	0.68		Dynamic-Static	0.56
		Disordered-Ordered	0.47		Spacious-Cramped	0.42		Monotonous-Ordinary	0.55
								Ineffective-Effective	0.42

3. After evaluating the third question the subjects were seen to prefer:

49.2% (59) Light-shade indistinctiveness (C)

35.8% (43) Light-shade distinctiveness   (A)

15%   (18) Light-half shade situation   (B)

And in the distribution of these groups however, architecture students seem to prefer the experiment design A with a less degree than the non-architecture students (31.6%-40%) and they seem to prefer the experiment design B more than the other group (20%-10%).

THE RESULT

When the results of the factor analysis are examined, under the heading of the evaluating factor of light as the first factor, the qualities like pleasant, irritating, relaxing, stifling, cold and exhilarating have come out as effective. This result shows a parallelism in terms of the most frequent adjectives given in the responses for the first question. In the experiment design A consisted of exact (definite) shades and desing B consisted of half shades, the qualities summed up under the heading of the excitement factor of light, like interesting, exciting and extraordinary have an effectiveness of a second degree level. Where as in the experiment design C, consisted of the indistinctiveness of light-shade, the perception of the dimensions of the space has an importance of a second degree level.

In the third order, the factor of force in the experiment A, the factor of dimension in the experiment B (this was in the second order in experiment C), excitement factor in the experiment C (that was in the second order in the experiments A and B) have been in the third order.

In both the result of factor analysis and the arithmetic means (which not exist here), the emotions of excitement and interest were found to be denser in the experiment A than the others. But it was seen that the subjects preferred static simple, luminous, regular, exhilarating spaces more than the others.

Secondly, an experiment of space and medium which reveals an activity sense that is opposite to passivity and that of silence and peace, and where the adjectives like effective, interesting, exciting and distinct have gained a density has been preferred.

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*A research on the psychological effects
of texture in architecture*

A RESEARCH ON THE PSYCHOLOGICAL EFFECTS OF TEXTURE IN ARCHITECTURE

The architect who is the organizer of an artificial environment puts forward a new environment which is different than the natural one, with the form and space of his architectural works which he produces by means of various construction materials and by making use of technology. In designing the environment, however, the principle of providing a balance between the human needs (like physiological, psychological, aesthetic) and the stimuli from the environment is an important fact. Researches have been made on determining the effects of the elements of space which is the smallest environmental unit, the lighting level, the size and location of window, lighting-shade, colour, equipment, proportion on space perception. However, studies on the effects of the plastic value of surfaces which determine interior and exterior space and a designing element that is texture, on the perception of space are few in number.

At the Faculty of Architecture of Yıldız University,

- . a research on the variables which affects the degrees of relative hardness of texture by means of visual and tactual perception,
- . identification of the relationship between the surface textures and lighting and colour,
- . determining the types of textures which are chosen for interior and exterior spaces,
- . Experimental measurement and evaluation of the effects of textured surfaces in different degrees of hardness on space perception,

have been studied.

In this decleration, experimental studies related to the effects of the use of texture in degrees of different hardness on the surfaces which form the space, on the magnitude of the space perceived with the meaning and comprehension of space, have been presented in the visually perceived space.

SUBJECTS : The questions in the experiments were answered by 50 subjects (25 female + 25 male) aged between 18 and 30, and who have not been educated in architecture and those 50 subjects (25 female + 25 male) educated in architecture.

EXPERIMENTAL DESIGN : In the experiment, three space models having a real dimension of 3.65x5.77x2.70 m. and a scale of 1/10 have been used. By removing one of the walls of the model spaces, observation of soft, medium soft and hard textured surfaces which are placed as frontial located has been provided. In model spaces, homogenous lighting conditions have been provided ($E_{min} > 0,8 E_{max}$) and lighting level, lighting density, the place, type, direction of light sources, the dullness and colour of surface, the material, the form, distribution and the number of texture elements have been controlled by equilizing these.

EXPERIMENT 1 : Those visually perceived take into account the subjective evalua-
tions related to the perception and meaning of the spaces being its real density
constant on surface and having a surface texture in various degrees of hardness
(soft - medium soft - hard). In determining subjective responses of the subjects,
a semantic differential scale has been used. 26 pairs of adjectives have been
chosen with the results of pre-experiments. The order of giving these opposite
adjectives to the subjects and regarding the meanings of the adjectives as posi-
tive or negative, the placement has been determined by a method of quasi-random.
The space between these opposite adjectives has been arranged in terms of a Scale
of 7 units*. The Semantic differential scale has been applied seperately to the
subjects for each of three model space.

RESULTS : Datas have been evaluated in two ways:

1. It has been understood that the differences in responses of the subject groups
with different sex and education for three model spaces statistically are of no
importance. The distribution of frequency and arithmetic mean have been observed.
The arithmetic means of all the subjects are:

In evaluating the soft textured surface space, the adjectives being soft, simple,
modest, smooth, understandable, wide, friendly, calming, inviting, sympathetic,
shallow, pleasant, hot, weak, empty, unrestricted, static space,

In evaluating the space with medium-soft surface, the adjectives are comprehen-
sible, understandable, positive, friendly, restricted, full, deep, expressive,
strong, defined space,

In evaluating the space with hard surface, the adjectives are; hard, coarse,
strong, deep, repelling, exaggerated, restricted, comprehensible, defined space,

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* The opposite adjectives are as follows:

Wide-Narrow	Relaxing-Irritating
Restricted-Unrestricted	Repelling-Inviting
Defined Space-Undefined Space	Dead-Alive
Paradoxically-Comprehensibility	Shallow-Deep
Annoying (depressing)-Exhilarating	Unpleasant-Pleasant
Empty-Full	Strong-Weak
Hard-Soft	Friendly-Unfriendly
Dynamic Space-Static Space	Sympathetic-Antipathetical
Modest-Exaggerated	Smooth-Coarse
Uninteresting-Interesting	Surprising-Understandable
Positive-Negative	Expressive-Unexpressive
Hot-Cold	Ordinary-Extraordinary
Exciting-Calming	Complex-Simple

alive, expressive, extraordinary, exciting, cold, narrow, annoying, dynamic space.

2. Secondly, the datas have been evaluated with regards to factor analysis. For three model space, 12 factor analysis (Table 1) in which the responses of the subject groups with different education and sex have been evaluated seperately, and 3 factor analysis (Table 2) in which the responses of all the subjects exist, have been designed.

		Female (50)	Male (50)	No architectural background(50)	With architectural background(50)
SOFT TEXTURE	Factor 1 Factor 2 Factor 3	Evaluation Strength ---	Evaluation Strength Dimension	Evaluation Complexity Dimension	Evaluation Strength Dimension
MEDIUM-SOFT TEXTURE	Factor 1 Factor 2 Factor 3	Evaluation Strength Complexity	Evaluation Strength Complexity	Evaluation Strength Complexity	Evaluation Strength Complexity
HARD TEXTURE	Factor 1 Factor 2 Factor 3	Evaluation Strength Complexity	Evaluation Strength Complexity	Evaluation Strength Complexity	Evaluation Strength Complexity

Table 1

In results of factor analysis for 3 factors, without any effect of sex and education in each space having soft, medium soft and hard textured surface, as a first factor EVALUATION has its place (Table 1).

In soft textured space, the second factor is STRENGTH and COMPLEXITY. And the third factor comes out as DIMENSION (Table 1).

In medium-soft textured space, the second factor has been STRENGTH for all subject groups without being affected by education and sex and the third factor has been COMPLEXITY (Table 1).

In hard textured space, as the second factor, STRENGTH and as the third factor COMPLEXITY have been seen (Table 1).

With the results of the evaluation of the responses of all subject groups through factor analysis, for each of the three spaces having soft, medium soft and hard textured surfaces, it has been understood that the first factor is EVALUATION (Positive-Negative, Sympathetic-Antipathetical, Relaxing-Irritating, Depressing-

Exhilarating, Modest-Exaggerated, Unpleasant-Pleasant, Friendly-Unfriendly, Hot-Cold) (Table 2). When regarding the arithmetic means of the pairs of adjectives which exist in the factor referred to soft and hard textured spaces, it has been seen that the means are guided towards opposite values.

TOTAL SUBJECTS (100 SUBJECTS)			
	SOFT TEXTURE	MEDIUM-SOFT TEXTURE	HARD TEXTURE
Factor 1	Evaluation	Evaluation	Evaluation
Factor 2	Strength	Strength	Strength
Factor 3	Dimension	Complexity	Complexity

Table 2

It has been identified that the factor of STRENGTH takes its place as a second factor in three spaces with different hardness of surface texture (Strong-Weak, Dynamic space-Static space, Dead-Alive, Ordinary-Extraordinary). When arithmetic means are taken into consideration, it has been understood that in soft textured space STRENGTH has been a factor whereas in hard textured space a kind of factor with a meaning of strength occurs (Table 2).

It has been identified that the third factor in soft textured space is the factor of DIMENSION whereas (Wide-Narrow, Restricted-Unrestricted, Empty-Full, Defined space-Indefined space), in medium-soft and hard textured spaces COMPLEXITY is the factor (Complex-Simple, Surprising-Understandable, Ordinary-Extraordinary) (Table 2).

EXPERIMENT 2 : The degrees of texture hardness has been studied in terms of its effects on the perceived magnitude of space.

The subjects have been asked whether there is a magnitude difference among model spaces by showing them the spaces having the soft, medium soft and hard textured surfaces altogether. It was asked that if there was a difference in magnitude. And the subjects who observed that there was a magnitude difference, were asked to make an order beginning from the biggest space to the smallest one.

RESULTS : 94% of the subjects have told that there is a magnitude difference. It has been observed that education and sex differences have no effect on the results. 89.4% of the subjects who have told there is a difference in perceived

space magnitude, have explained that the soft textured space is greater than the other two spaces. The least perceived space, on the other hand has been understood as the space having hard textured surface.

THE RESULT

At the end of the research, it has been understood that texture has a significant place while perceiving the space, and the hardness of textured surfaces which form the space affects both the perceived magnitude of the space and the meaning of space. It was observed that the differences of education and sex don't have much effect on the results. For this reason, the texture of the surfaces which form the space and form that should be taken into account as being physically and emotionally acceptable while creating the environment that is aesthetically satisfactory, in both design stage and in choosing material which is suitable for the effect expected from the space together with the surface colour and lighting reveals its importance as an element.

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*How the change of colour in space effects
the atmosphere of the room*

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*How the change of colour in space effects
the atmosphere of the room*

ANJA DANSKA

HOW THE CHANGE OF COLOUR IN SPACE EFFECTS THE ATMOSPHERE OF THE ROOM

The building

A Finnish bank built a training centre for the employees. I was the main interior architect. The building lies near the seashore in a park surrounded by forest.

The centre mainly serves as the site of courses, the participants of which come from all parts of the country. They live in this atmosphere of intensive learning for one or two weeks or even a month. Therefore it was appropriate to create an exciting and harmonious atmosphere, which can be done by colours. The interior and its forms are straight and peaceful and give a feeling of dignity and festivity inside the building.

The surroundings

In Finland people still have a connection with the nature and its life. The seasons divide the year and give variation and interest to the phenomena of the nature.

The Finnish nature is variable in its colouring. Each season has its own distinctive colour. Winter is white. The spring has its special light green colour of new grass and small leaves of the trees. The summer is green - many people call it the green winter of Finland. In the autumn the frost gives colours to the whole nature in all shades of yellow, orange, red and brown, which have as their background the deep green of evergreen coniferous trees such as pine and spruce.

By planning the interior I had the subconscious desire to bring inside the elements of the colours in the nature.

The interior

The actual colour of the room is given by the carpets. In the lobby and the main hall, the carpet has blue tones, and in the dining room it is a composition of yellow and brown tones.

The blue lobby is a peaceful connection with the outer landscape and the inner spaces. Through the window walls nature also has an effect on the room. The variable blue and green colours of the nature continue in a natural way in the blue tones of the interior. It gives a harmonious feeling.

The blue colour is also pertinent in the entrance for another reason: it is the symbolic colour of the commercial bank in question.

Thirdly, it is a tradition to use blue colour in the entrance. In old Finnish houses the walls inside the porch were painted blue to protect against disturbing insects. I have also heard that in oriental thinking blue colour protects against all bad.

The Finnish people like blue colour. The most beautiful things in the nature are blue. Even the colours of the Finnish flag are taken from the nature; white and blue. In winter the snow shines in variable white and blue tones below the blue sky. In the summer the blue sky with white clouds dominates the landscape. This you may notice every time you return from central Europe.

The carpet is the changeable component of a room. It is even possible to alter the atmosphere of the room by changing the colour of the carpet.

The ceiling is the permanent component of a room. The ceiling reflects the colours which give the different atmosphere to the various rooms.

The dining room is composed in yellow tones to give warmth and to create an atmosphere which allures to interaction between persons attending a course. Yellow and brown tones also give the right atmosphere to a pleasant mealtime.

In the seventies there was a trend in interior architecture and furniture design named *high tech*. I wanted to have an up--to-date style in the interior. Therefore, I was happy to come up with the idea and to have the opportunity to use aluminium as the material of the suspended ceiling. The aluminium plate is 1 mm thick, which is firm enough not to produce a disturbing rattle of sounds. It is anodised in natural colour which reflects light, and thus attains the colour of the carpet.

The design of the suspended ceiling has its base in the construction of the building. The ceiling is divided in modules exacting the distance between the pillars.

The lighting consists of mixed sources: Fluorescent lamps are located in wide squares. Bulbs, which give shades and warmth to the interior, are placed in the ceiling elements. The placing makes each module around a bulb a lamp.

The floor in the entrance is made of Finnish marble for the purpose of creating a connection with the stone and sand in the landscape.

The walls are covered with shiny ceramic tiles, which have a striped relief in the surface. It gives the walls a variable texture. The tiles are glazed in white. When light reflects on the stripes of the tiles it gives one an image of the shiny snow or waves of the sea glittering in the sunshine.

In the centre of the main hall there is a fireplace. It is designed in stainless steel to conform to the suspended ceiling. The fire burns on gray soap-stone and welcomes the arriving guests and collects them together.

Evaluation

When planning the ceiling I had to have the courage to decide to have the shiny colouring of aluminium. I was afraid of the reflecting effect. After months of waiting I had the opportunity to visit the site when the ceiling had been assembled. I was happy - the ceiling was harmonious and the reflections of light were beautiful.

The building was completed fifteen years ago. Today I would not use bulbs but modern sources of light. That would also influence the design of the ceiling elements.

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The effects ot the principal hues in office interiors

THE EFFECTS OF THE PRINCIPAL HUES IN OFFICE INTERIORS

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Research is being conducted to obtain preliminary results in the examination of the effects of color in the office environment on worker mood and productivity. Since environmental color does not serve a direct work function, color in the environment is more likely a catalyst for indirect effects on the office worker (Becker, 1981). As a catalyst, color may induce a series of behavioral reactions related to worker satisfaction, mood, absenteeism, and performance. However, these effects may be difficult to assess. Physiological changes in response to colors have been documented, especially increased arousal to the color red (Wilson, 1966; Ali, 1972; Jacobs & Hustmyer, 1974). However, Kaiser (1984) postulates that these responses are mediated by cognitions based on past, culturally-based experiences with color. It is not clear as to what these physiological changes mean in terms of mood or productivity. After a review of over 200 articles on color in a study funded by the National Aeronautics and Space Administration, Beach (1987) concluded that few generalities could be drawn from the existing literature because of inconsistencies in results and experimental procedures, broad latitiudes being taken when interpreting results, and lack of realistic settings. Also, values and intensities of colors used in various experiments have not always been well documented, and perhaps create a more prominent effect than specific hues.

The first step in approaching this topic was to create realistic settings in which to test subjects. Three offices (8 ft wide, 11 ft 9 in long, and 8 ft 9 in high) were built and furnished with a desk, two chairs,

books, a window, lamp, small plant, fan, phone, two framed prints and certificate (11" x 15"), small desk, file cabinet, stool, and other office amenities. In an initial experiment (Kwallek, Lewis, and Robbins, 1988), 36 subjects performed the task of typing business forms for 20 min. in either a monochromatic true blue (Munsell color notation 1.51PB 4.95/8.05) or true red (Munsell color notation: 6.05R 4.59/11.15) office and then asked to complete the Eight State Mood Questionnaire (8SQ; Cattel & Curran, 1976). In the second half of the experiment, subjects either returned to the office of the same color or moved to the office of the other color, and the same procedure was followed. Significant main effects were for the number of errors made on the typing task. The subjects who moved to the office of the different color made more errors than those subjects who remained in the office of the same color. On the mood questionnaire, group differences were not statistically significant, but the mean anxiety and stress scores were higher for the subjects who remained in the red office, the mean depression score was higher for the subjects who remained in the blue office, and the mean arousal score was higher for those subjects who switched to the office of the different color. It should be noted that both of these colors are of medium value and are very bright with the red being more intense than the blue.

Generalizing from these results is limited due to the relatively short time the subjects were exposed to the offices, but the findings do suggest caution when considering a bright red or blue for the interior of an office space, especially if personnel move from one office to another.

In a second experiment, subjects were tested in red, white, and green offices. Goldstein (1942) performed seminal work on differences in performance of tasks involving psychophysical judgments and psychomotor functions in a red environment versus a green environment. He found that for brain-damaged individuals, psychomotor coordination was much more precise in the green space than in the red. Nakshian (1964) attempted to replicate Goldstein's findings using normal subjects. He found limited support for Goldstein's theories. Jacobs and Suess (1975) found that subjects exposed to rooms illuminated by red or yellow lights had significantly higher anxiety scores than subjects in blue and green illumination conditions.

To test the possible differences between a monochromatic bright red and a bright green office with

implications for office workers, one of the offices was painted bright green (Munsell color notation 3.45G 4.44/7.89), another was painted white (Munsell color notation 9.75YR 8.74/0.45) as a control space, and the red office was utilized again in order to validate that this environment may induce anxiety and/or stress for the worker as found in the initial experiment. This second experiment employed a between-subjects design. Two hundred twenty-two subjects (111 males and 111 females) were administered standardized number and name comparison tests, a common office task of proofreading, in either the red, green, or white office. The subjects also completed the Profile of Mood States Questionnaire (POMS; McNair et. al., 1981) before and after they worked in one of the offices so that any change in mood could be assessed. The POMS gives scores on six scales: Tension-Anxiety, Depression-Dejection, Anger-Hostility, Vigor-Activity, Fatigue-Inertia, and Confusion-Bewilderment. The subjects were also administered a final questionnaire on which they indicated their color preferences, opinions on how the color might have affected their mood and performance, and assessment of whether they found the office spacious or confining.

The main finding was that the subjects in the white office made a significantly greater number of errors, especially on the name comparison test (the second test) than the subjects who performed in the red or green offices. However, more subjects reported that they preferred working in the white office and thought that the color had an effect (mostly positive) on their work as compared to the ratings of the subjects in the red and green offices. The fewest number of errors were made by the subjects in the red office. The most preferred color was blue. Almost forty-four percent of the subjects chose blue as their favorite color. Red was the second most preferred color; 16 percent chose this color, and green was the third most preferred color with 14 percent choosing green. This color preference finding is consistent with past color preference studies (Eysenck, 1941; Granger, 1955; Guilford, 1959).

The Confusion-Bewilderment score decreased for all subjects in the red office. The subjects in the white office reported an increase in anger, but these subjects reported a greater amount of anger prior to the experiment. The subjects who reported that they would not like to work in the office where they were placed or independently reported they did not like the color of the office, reported an increase in tension. The subjects who did not like the color of the green office

made more errors on the number comparison test than the other subjects in the green office. More subjects believed the red office distracting when compared with the other two offices.

Most of these results were not expected. Surprisingly, an increase in Tension-Anxiety was not reported in the red office. Also, although subjects expressed preference for the white office, more errors were made in the white (control) office. The incongruency between the subjects' ratings and their performance suggests that white is widely accepted as an appropriate color for an office, but may not be as conducive to productivity as believed by most people.

When considering value and intensity, white is not saturated as are red or green. Perhaps, subjects in the bright red and green offices worked to ignore the bright surrounding color, concentrated more on the test, and therefore made fewer errors. Subjects did find the red office more distracting, but reported less Confusion-Bewilderment, and made fewer errors. Hockey (1984) refers to the narrowing of one's attention, or selectivity, as a coping mechanism for dealing with environmental stress factors. He postulates that over time, the necessary effort needed to ignore distracting stimuli may have a detrimental effect on the worker. The effects of long-term exposure to bright red, green, or white environments need to be conducted in order to verify whether a decrement in performance would occur in the long run. Another plausible explanation for fewer errors made in the red office is that subjects were optimally aroused (Duffy, 1957) in this environment.

Important in these findings are the differences based on individual preferences. Subjects reporting they did not like the color of the office indicated a significant increase in Tension-Anxiety. Compliance with worker preference about his or her environmental color may be helpful for increasing job satisfaction.

Similar data are being collected on the effects of bright orange, yellow, and blue offices. The results will be presented at the conference. The results of these first experiments are considered preliminary in preparation and anticipation for more elaborate studies that are being designed with input from NASA. NASA is planning for six-month long-term space flights, and they are concerned with providing an appropriate environment for the astronauts on these flights. Thus, after these preliminary experiments, and when funding is available, examinations of color schemes and variations in color value and intensity will be conducted.

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Colour and environments for work

COLOR AND ENVIRONMENTS FOR WORK

PATRICK DESOMBRE. DESIGNER / COLORISTE

The progress of the chemistry of colourings, *and pigments.* the outspread of highly sophisticated mass tinted material, the constant broadcast of coloured pictures on the television, in publicity and in the medias have modified our behaviour towards colour: it forms a part in our life, our daily surroundings and plays a role of seduction when we chose the objects around us: our clothes, our interiors, our cars.

However, the localitys in our life (the street, shopping centers, sports centers) work surroundings, officies or factorys, are too often grey, neutral or dull.

Being used to decorating our own residence, we accept to work in dreary and mediocre surroundings.

Of course, at the same time, there are economic reasons: grey costs less and needs little maintenance. And psycological reasons: colour means making a choice therefore risking critisism. Meanwhile, the factorys shelter more and more sophisticated and fragile materials, that are used by qualified staff who attach growing importance to the quality and conditions of work and environmental conditions.

Painting to protect the materials and to insure cleanliness has become a necessity. But at the same time, and without much extra cost, colour can play an important part in the improvement of working conditions Colour can inforce security, insure better visuel comfort, inform, draw attention to dangers, lighten up spaces and make them more human, reduce the constraints obtain a greater degree of comfort and propose an aestetics.

We feel that it is not only a question of choosing colours, but organising the space, rendering it actuel, to create a harmony and to awaken an atmosphere.

But if we choose according to our own tastes, how can we be sure not to make mistakes when doing it for a group?

As we know, colour can effect our moods, it talks to our sensetivity which differs according to individuals, their culture, sex, their own background. Some like green, some can't bear it: men like certain colours, women prefer others. According to different nations and cultures, colours don't convey the same symbols. Fasion modifies our chromatical sensitivity.

The question is: Are there objective criteria to which we can refer to avoid arbitrary decisions and errors?

Some elementry rules can help us:

1. Colour and light form an inseperable couple and this is the best contrast which must be aimed at, especially on the working level, in order to avoid visual fatigue.

2. The eye does not perceive all colours with the same speed, this is why yellow orange and red are the secure colours, as they have been 'seen more rapidly than blue or green.

3. Dark colours make an area look smaller, light colours make an area look bigger. This rule helps to modify the perception of buildings.

4. Colours can affect our bodies. Cold colours, hot colours, stimulating colours, soothing colours.

5. Colours appeal to our psyche and refer to more or less concient symbols.

6. Colours in our surroundings are never isolated. They are always associated to other colours which create an overall impression, a chromatical harmony.

If these few elementry rules help avoid serious mistakes their application does not ipso-facto mean successful results. We have to coordinate, proportionalize, balance the colouring to create a coherent atmosphere in different spaces and their functions in the factorys.

Because of its dimentions, a workshop would need a more 'scenographical' colouring than an office.

Cloakrooms, resting and talking areas should be treated as transition places between the life outside and life inside the company.

In short, for the colouring to be successful, it has to be adopted by the users: To find a dialogue, open a discussion, to associate the partners in the elaboration of their work surroundings. All this plays a part in the general procedure towards a quality environment.

This is where the colourist comes in. Being forien to the company, he is free from the internal hierarchical ties and will more easily get everybodies support.

Enriched by his experience, he has a method of approach to the environmental problems and bases his research on a careful analysis of the context on a diognostic

that is worked out on the premisis, which takes all
the parameters into consideration.

- The architecture of the buildings: the dimensions,
  the material, the volume, the light, the geographical
  position...

- The staff: male or female, age, prospects...

- The work: mechanical or manual, repetitive work,
  or requiring concentration...

- The manufactured materials: are they coloured?

- The constraints: The noise, the fatigue, the thermal
  conditions, the dangers, the dirt...

- The budget for the acheivement and the delay of work...

- The maintenance...

Starting with these points, the colourist proposes his
idea of colouring, inevitably marked by his temperament
and thus subjective, but also based on an objective
analysis and on the dialogue with his parteners, which
allows him to adapt his project to their desirs, without
jeopardizing the result, for which he ultimatly remains
responsible.

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Color model environments:
Color and light in three-dimensional design

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COLOR MODEL ENVIRONMENTS: COLOR AND LIGHT IN THREE-DIMENSIONAL DESIGN

by Harold Linton

Today, designers and artists who work with color at the scale of
the built environment are redefining their art not as a narrow,
arid and reductive modernism, but as a rich, varied capacity to
birth new images into an old world. The new generation of design-
ers who have matured slowly, skeptically, privately, and with great
difficulty, have had to struggle to maintain conviction in an art
that the media and the public said was barely alive.

The inspiration for significant environmental color works does not
lie within the literal material properties of the physical environ-
ment as pigment on walls and ceilings, but behind the proverbial
looking-glass of consciousness, where the depth of the imagination
knows no limits. By calling attention to the spatial qualities of
architecture through immersing an environment in a volume experience
of colored light or by embedding the physical attributes of a
structure in a spatial layering of pigment, environmental color
works today do not ignore the fundamental assumptions of modernism -
which precluded any regression to the conventions of illusionism
and representation, but stress originality, individuality and
synthesis which are marks of quality in color work today - as they
have always been.

The capacity of color to evoke, imply and conjure up magical illusions
that exist in an imaginative mental space, which like the atmospheric
space of a Miro, a Rohtko or a Newman, or the cosmic space of a
Kandinsky or a Pollack, cannot be confused with the tangible space
of physical architectural forms, is that which differentiates environ-
mental color works from other arts and from the everyday visual experi-
ences of life itself.

The idea that environmental color works are somehow a visionary and
not a material art, and that the locus of its inspiration is in the
artist's subjective unconscious was the crucial idea that Surrealism
passed on to Abstract Expressionism. After several decades of re-
jection of imaginative poetic fantasy for the purportedly greater

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'reality' of an objective, functional environment based exclusively
on economic facts, the current rehabilitation of the metaphorical
and metaphysical implications of imagery is a validation of a
basic Surrealist insight. The liberating potential of art is not
as literal reportage, but as a catharsis of the imagination.

The renewed conviction in the future of large-scale color works
on the part of a happy few signals a shift in values. Instead
of trying to escape from history, there is a new generation of
artists ready to confront the past without succumbing to nostalgia,
ready to learn without imitating, courageous enough to create works
for future environments of larger and more invitingly complex
architectural spaces. To transform matter into some higher form,
one must believe in transcendence. Those who perpetuate an art
that fills environments with color and light are true believers -
their conviction in the future of environmental design and art
is a courageous act of faith.

Serious colorists of the Eighties are an extremely heterogeneous
group - some far more lyric and abstract while others embrace
narative and topical forms. Their aesthetic, which synthesizes
tactile and optical qualities, defines itself in conscious opposi-
tion to all forms of mechanical reproduction which seek to deprive
(by flattening out) the color-space concept of its unique "aura".
It is, in fact, the enhancement of this aura, through a variety of
means, that color work in three-dimensions now self-consciously
intend - either by emphasizing the involvement of the designer/
artist's hand, or by creating highly individual visionary images
that cannot be confused either with reality itself or with one
another. Such a commitment to unique images necessarily rejects
seriality as well.

These original and individual interpretations of "allover" structure
point to the wide number of choices still available with visual
as opposed to physical rendition of our environment. For in sub-
mitting itself to the supporting role that decorative styles
inevitably play in relationship to architecture, painting, sculpture,
interior design and the graphic arts, the environmental colorist
renounces its claim to autonomy.

The imagery of those committed exclusively to colorist traditions
in the design and fine arts, an inner world of stored images ranging
in moderism from Itten to Lewitt, is entirely invented; it is the

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product exclusively of the individual imagination rather than
a mirror of the ephemeral external world of objective reality.
Even when such images are strictly geometric, as in the case
of designers and artists like Carlos Cruz-Diez, Jean Phillipe-
Lenclos and David Barr, they are quirky and sometime eccentric-
ally personal interpretations of geometry -- always asymmetrical
or skewed, implying a dynamic and precarious balance, the opposite
of the static immobility of the centered icon, emblem or insignia.
The rejection of symmetry and of literal interpretations of
"allover" design, such as the repeated motifs of Pattern Painting,
defines these colored environments as exclusively projects referr-
ing to space in front of and within, rather than beyond the angles
and points of reference contained by the physical geometry.

These designers and artists are equally committed to a distinctively
humanistic art that defines itself in opposition to the a priori
and the mechanical: A machine connot do it, a computer cannot repro-
duce it, another artist cannot execute it. Nor do their forms of
art and design in any way resemble graphic art, advertising,
billboards, etc. Highly and consciously structured in its final
evolution (often after a long process of being refined in preliminary
drawings, paper studies and model experiments), these environments
are clearly the works of rational planning, painstaking research
and experimentation with high conceptual content.

As organizational and informational aspects of two and three dimen-
sional design, the elements of color and light are not only an
aesthetic force but also a language. Their potential power can
stimulate or relax, alter the appearance of size, shape and form,
and change our perception of space and movement. Those who work
creatively with color and light require a thorough understanding
not only of their resources and expressive potential, but of the
manner by which they may be ordered harmoniously to convey a vision
in it's most effective form.

Color Model Environments was written to focus on the developments
in color education for artists and designers who work in three
dimensions. The viewpoint maintained throughout the book is that
an awareness of the vocabulary of design and the fundamentals of
color and light are basic to all personal explorations in three
dimensional design and that incorporation of these elements, including
knowledge of the properties of materials, lends direction and support
to individual expression.

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The works of student and professional artists and designers have been organized within the subject areas of the book to reflect a relationship between the visual and physical properties of dimensional form and to support the following criteria for the role of color in design education:

* To experience the qualities of color and light and their combined effect on form in planning and practice.

* To acquaint one with the special possibilities of color materials and their methods of application in three-dimensional design.

* To understand the structure and planning of color as a fundamentally rational and visual process interwoven in the act of design.

* To utilize drawing as a means of furthering an analysis of the qualities of form and composition in the design process.

* To realize a complex form in its entirety as a harmonic whole.

* To increase awareness of the methods used for color and light planning by professional artists, architects, and designers.

Attempts should be made to adapt suitable methods of design representation to these background goals - of fully appreciating any idea that satisfies the initial criteria of a design problem. Although the materials used in model making will differ from those used in actual construction, they will provide the designer with the tactile experience of shaping physical space and thereby influence the quality of form it replicates. Within the framework of a creative and developing design dialogue, design tools can be harnessed to serve each individual in his or her pursuit of unique concepts of form and space.

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*Models-building of colour environment –
a fashion or a useful design-method?*

MODELS - BUILDING OF COLOUR ENVIRONMENT -

A FASCION OR AN USEFUL DESIGN METHOD ?

Based on some examples of colour design of industrial environment

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Making colour decisions for industrial environment,we are faced with almost all of the diversely acting environmental factors, which specific conditions and general rules of colour perception and colour influence might bring forth. By renovation the number of considerations grows still larger.

Any useful tools which modern science and techniques might offer are quite welcome, if they help us to objectify and visualize the process of colour design. And any concept of how to use them systematically, might be helpful.

"Modelling" or "models-building" (the term came in fascion in the age of computerization) has actually always been an useful design method for architects. An architect always builds,and uses some models - logical,graphical,material (spatial or flat), colouristic,photographical.

Furthermore,the comprehensive consideration of environmental factors, in their interaction (which we call today with the modern name of "systematic-and-environmental approach") has always been a guarantee of architectural success.

There is no reason why these useful methods should be neglected when making colour decisions, though artistic intuition might still be leading.

A two-sided question has to be answeared:

What models could a colour designer use,at the different stages of the colour design process ?

Theoretically, colour environment might be considered as an unity of two interrelated sides:

1.colour contents (the set of colours and colour combinations, with fixed colour characteristics), and

2.colour structure (the spatial disposition of colours,with fixed areas,corresponding to the "colour-form-space" interrela-

tion (ill. 1,examples).

An architect is usually better prepared to handle with colour structure, than with colour contents.

To fix the motivating factors of a colour decision (contents and structure), we need some more interdependent theoretical models of the environment :

- a model of its structural levels (workplace-interior-exterior) and its functional zones (production,service,communication) , which all have specific requirements for colour design and should be treated in due form (ill. 2,examples) ;

- a model of the environmental components (architectural, constructive,technological,decorative,design-elements,furniture, visual information etc.), each one of which is a specific colour-bearer and actively influences the colour picture (ill.3, examples).

Making colour decisions,we always need to have in mind such a general model of the colour environment :levels,zones and elements. If not,some small detail might be neglected, and the final effect- accidently spoiled (ill. 4,examples).

Each environmental component has its own form,geometry,texture and material characteristics,spatial disposition,function - and corresponding requirements of colour treatment. Its colour features are to be coordinated to all the rest components,and to the general concept of the environmental design. These are also models of correspondence,which a colour designer usually sticks to (ill. 5,examples).

Requirements of the environmental colour design are always set with respect to man, performing special functions and exposed to specific influences, in the process of work and recreation. A necessary tool for a colour designer is the model of the determinating factors - physiological,psychological,functional, aesthetical (ill. 6,examples), and their relation to the colour characteristics of the environment, based on colour compensation of its negative impacts.

Modern science provides quite a lot of detailed information on the correlation between human reactions to colour combinations and human requirements of a certain environmental type, in order to build these models of correspondence (ill. 7,examples).

When dressed with particular colour images, all the theoretical models mentioned so far, are quite useful. They might help us to make some colour decisions,which are logical and correspond to the specific necessities of environmental organization.

The use of such models is to come systematically in the general
process of decisions-making, the model of which is usually
worked out individually, in the long course of practice, though
some regularities still might be fixed (ill. 8, examples).
"Irrational" deviations from this scheme are always possible
(f.e. using colour symbols, counterpoints etc.), which actually
might give a touch of originality.

But the process should always be "modelling", i.e. preliminary
forming an idea of how the future environment will be organized,
and multilaterally directing its design, by using models of
various type.

What other models could be helpful at the different stages of
the process of colour design ?

At the stage of general survey and analysis, the use of theore-
tical models is quite helpful for carrying out the investigation,
the factor- and complex analysis, Natural observation, samples
collecting, discussions with the future users- all these might
give us precious information of the objectives, which is to be
fixed in tables, graphics, photos, verbal descriptions. In the
analysis process, when we try to make first formulations of the
colour solution, such models and modelling proves quite helpful
(ill. 9, examples).

Using a colour system, f.e. NcS, the initial information could
be graphically fixed and the "zones of influence" of each factor
easilly determined and visually represented (ill. 10, examples).
If the graphical models of the factors are put together, the
colour zones could be fixed, where most of the factors are
"colour-compensated". This is already quite a basic scheme for
any further design (ill. 11, examples). Similar models are to
be built on base of colour harmony and combination theory (ill.
12, examples). Their juxtaposing with the models of the "zones
of factors" will fix some schemes for further colour design
work (ill. 13, examples).

Having fixed the zones of colour influence with their general
characteristics, i.e. the "colour contents" of the future envi-
ronmental design, we are still in the sphere of the ideal.
These schemes are usually not bound to particular environmen-
tal elements, and do not consider with their plastic characte-
ristics, function, relative surface areas, priority in the general
composition etc., i.e. the "structure" of the colour field is
to be determined.

Thus further, the model of the "colour contents" has to be put
together with the spatial model of the environment (buildings,
architectural and constructive elements, all the other environ-
mental components). This is already the stage of decisions-
making. Though, of course, even at the stage of prior fixing of

the colour zones, we surely must have had in mind which the
particular colour-bearers are, and even fixed some colour zones
for the basic components' groups on the graphical models (ill.
14, examples).

Visually most convincing and useful are material models (spatial
or flat). If the colour system disposes of coordinated colour
samples- papers,paints,materials (as f.e. NCS),variants of the
colour scheme are easy to be realized,and a visual image of the
colour concept quite near to the real,to be represented,

Flat models,however, are far from reality.Spatial models are
preferable,where volumes and spatial components are represented
in colour (ill. 15,examples), But to get a real notion of the
future colour picture,we need quite a big-scale model,which is
rarely possible to realize. One solution is,to have the general
idea on a model of a realizable scale, and the important frag-
ments- in a larger scale,applying even some samples of the
materials to be used in reality. These are "models of materials
and colours",giving quite an approximate notion of the spatial
influence of colours and materials (ill. 16,examples).

Modern photo- and cinema-techniques provide some means of judg-
ing experimentally about the visual effects of the future colour
environment.Experiments have been done,with moveable photo-
and cinema-cameras, simulating human perception from different
points of view,angles and distances,and in motion (ill. 17,
examples).The registered information appears on a display,or on
photos,slides,films. This gives the designer the chance to make
a detailed survey of how things will look in reality,and take
measures to correct some failures, in advance. If a "hard-copy"
is made,graphical colour schemes could be done,much better
related to reality,than free-hand scetches and drawings(ill.18,
examples).

An effective means of examining the behaviour of colours in the
future environment is to simulate their interaction with space
and light. A special dynamical lighting-device might be used,
to permit some modulations of the spectrality and direction of
illumination (ill. 19,examples).

Using these methods, a modelling "in full action" takes place.
The design process and the very project are thus"regulated" ,
by change of light,disposition,colour,general visual effects.
A colour designer works already with images,corresponding to his
style of thought.

Modern computers and colour displays give the chance of dynami-
cal modelling,too, on flat or on spatial models,using some
principles of combinatorics. The advantages of such methods are:
quickly adding or taking away some colour elements,making change
of disposition of colour elements,a great lot of variants,
operated in no time, change of the colour contents of a constant
colour structure or,vice versa,change of colour graphics,etc.
(ill. 20,examples).

Modelling and models are,therefore, important methodical tools
in the general process of decision-making of colour environment
and its detailization, allowing to direct the "colour-contents"-
determination,its harmonization,and the "colour-structure" -
determination.

They give some chance to objectify and visualize the design
process, for the designer himself and for the future users.

Visual representation is sometimes decisive at the stage of
"defence" of the colour concept. Colour design and some expenses
on it appear much more convincing.

Thus models and modelling give a designer opportunities to have
always in view all the important considerations for a good
objective colour design, and the means to explain it. Their use,
however is still a matter of artistic intuition. A rationally
chosen colour scheme could be treated free of architectural
forms and spaces (f.e.supergraphics,symbols),if no contradiction
with function is provoked.

And these hardly enter any logical scheme or model (ill.21).

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«Uncoloured colour»
The subjective syndrome and the objective
objective in teaching architectural colour design

"THE SUBJECTIVE SYNDROME AND THE OBJECTIVE OBJECTIVE IN TEACHING ARCHITECTURAL COLOUR DESIGN"

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COLOUR WORKSHOPS

The mobius strip converging with itself expresses most aptly the intimate merging between subjectivity and objectivity, intuition and reason and demonstrates an inherent error in any colour design teaching attempt that bifurcates the experience into two distinct, separate systems. Any beginning (and finishing) student is both the participant and the designer.

In the teaching of colour our conceptual constructs must allow subjectivity and objectivity to come together in an initial and a concluding hypothesis. This ultimatly will not be a single hypothesis; many hypothesies will be needed and will evoke many more.

Consequently it does not matter with what hypothesis we begin or how experienced and knowledgable a student is or is not. The process of constructing hypothesies based at one extreme on an intuitive sense of colour (subjective response) and upon a reasoned colour order (objective response) at the other extreme, will reveal how the mind works in its patterns of intuition and reasoning and how these patterns can merge, reinforcing and stimulating each other.

I introduce these hypothesies into the colour design curriculum by constructing a frame of reference, in this case the colour workshop, in which 'beginning' colour work is integrated with other 'beginning' design work.

Students of architecture have more or less highly developed intuitions that are more or less adapted to dealing with ideation. These students also have more or less highly developed capacities for reasoning that are more or less adapted to problem solving. One important aspect however is that initially students subjective (intuitive) responses are more sensitive and more rapid than their objective (reasoned) responses. This is the nature of the way the mind works as we first sense and then reason. Certainly intuitive subjective responses are inate but they can be honed, developed and cultivated to serve and enrich reasoning.

Although the modius strip stresses the binary nature of intuition and reason the systems need to be pulled apart a little so that their separate characteristics can be examined and understood. In other words it is necessary to adopt teaching strategies that will demonstrate each separately and both together. I believe that an aware and respectful intellect becomes conscious of intuition and reflects upon what it observes establishing a self-correcting, self-modifying and self-improving process. The mind functions as a self-organising, self-developing system which possesses the means for feed-back and the potential for feed-forward.

In the colour workshops a simple task is set initially and then by adding elements to it a particular mental construct is mapped. Elements of the construct include subjective timbre, free association, association, cognition, process and forms. The colour studies are thus linked systems of awareness, feedback, instruction, and instruction, feedback, awareness, run in parallel with design and communication exercises which include model making, photography, drawing (freehand and mechanical), spatial and formal composition and decomposition(fragmenting). These 'beginning' studies come together and culminate in a 'beginning' design problem, in this instance a 'Gateway/Entrance' project for our School of Architecture.

The intent of the colour workshop is to allow the more or less untutored mind to observe, comment on and react to what it produces and to what is produced by others. The workshops allow modifications and change in the product/outcome which in turn causes further reactions upon intuition and reason and upon aesthetic and intellectual responses. The implicit patterns and forms given are transformed by intrinsic and reasoned actualisation into explicit expression of colour and design intent. These colour constructs become more sophisticated in subsequent years in the School of Architecture and by the final years students display an advanced level of colour competence which however retains the common parlance of 'popular' colour, and which allows colour cognition to be enriched by well comprehended intuitive and subjective predilections. Colour design is no longer restricted or impoverished by subjective reliance but rather liberated from indecision and vacillating perceptions of style, fashion, feeling or personal preference.

THE SUBJECTIVE SYNDROME

"Inspiration; does it have eyes or is it sleep walking?" - Paul Klee

We are all more sensitive than we appreciate; more things affect us without our conscious awareness or concern than we notice. We live in a sea of sensations of which colour is but one. We feel different in different environments, affected by our surroundings, by our experiences and by the way we percieve them. We sense former times as we are reminded of past events, past circumstances, past colours. Although we are often unaware of what affects us we constantly try to become more and more comfortable, searching for order and balance.

One of the first questions students ask is, "is it true that you either have a colour sense or you don't?" This question is quickly followed by others such as "can you learn colour?" "Are there general rules and laws of colour or is aesthetic appreciation of colour governed solely by subjective individual opinion?" My answers tend to be quite simple and along the lines that, "if you are more or less unknowingly able to create wonderful colour designs, great, but how often can you achieve this and in what circumstances?" On the other hand, I say, "if you are more or less unknowingly unable to put colour together successfully or have difficulty doing so, then it will become possible and a lot easier if you come to 'know' colour, and colour relationships".

Students display a subjective bias early in their colour work and many never lose it. After years in the School I can recognise a student's work from forty paces just by the colours employed in the presentation of their architectural proposals.

In the first colour workshop each student probes their subjective colour domains (what Itten referred to as their subjective "timbre"). The purpose of the workshop is to demonstrate (without any suggestion of character or personality analysis) that each student has differing colour likes and dislikes, values and preferences, associations and experiences, by which they produce their own work and by which they judge the work of others. Students also become aware of how others make their judgements. Through this process students gradually become introduced to and attentive to certain norms of colour design. Prior to any discussions of these norms or orders however, students complete a series of investigations which include:-

1.   Subjective colours in squared grid.
2.   Subjective colours in Composition (adapted from Itten).
3.   Subjective colours in drawings of 3D model.
4.   Adjunct exercise. Associations in squared grid.

Instructions to students are simple. Students are asked to use whatever colours or combinations of colours they find 'pleasing' in the various circumstances. A workshop introduction with a colour questionnaire focuses their attention on their own colour feelings. Towards the end of the workshop outcomes are compared and discussed and it is noted how private and individual everyones conception of colour harmony tends to be.

First attempts at colour combinations may be in fashionable or commercial vogue and will fail to reveal a students colour "timbre" at all. Similarly extensive use of black, white and grey, or the use of only one hue may obscure a student's real colour propensities or 'cover' a lack of confidence in handling colour. This does not matter as no interpretation of subjective colouring is intended.

What does happen is that the relative 'merits' of the studies produced are discussed and the reasons for choice are investigated. These discussions can lead to disputes where one subjective colour judgement collides with another, but more generally a large measure of agreement is reached as to which are adjudged the 'best' compositions.

Objective learning begins with these shared attempts to determine why some subjective examples are more successful or more acceptable to a larger number of us and why certain combinations are more dramatic, more ordered or more pleasing than others. In these discussions it further emerges that colours can express ideas of form, shape, edges, lines, volumes, depth, distance, illusion, allusion, association, feelings, character and ambience (brio).

THE OBJECTIVE OBJECTIVE

"Sacred stones yesterday,
 Today, without enigma.
 Today, sence!"   - Paul Klee

Subjective experimentation leads to discovery; discovery is elucidated by theory and theory is followed by objective practice. However where objective colour exercises are directed to totally systematic aspects such as value and chroma scales, simultaneous contrasts etc., self expression tends to be eliminated and although these exercises can be useful for learning mixing and colouring techniques, objective aspects can more quickly and easily be presented via good, readily available colour media material. Students are thus introduced to the idea that accepted colour theory (objective colour) embraces the principles of colour harmony or disharmony, colour order constructs and colour perceptional effects. Ultimately order is recognised as different from disorder; one is distinguished from the other without either losing their relativity in design.

Students quickly find trial and error colour design methods both time consuming and frustrating and that accidents along the way are not always rewarding. They are happy to assimilate patterns and configurations which have proved consistently effective and have been established as principles in contemporary colour co-ordination and colour standards for the environment. When the desirability of a colour relationship or change can be assessed prior to action the objective objective has been reached.

In the objective colour design workshop students basically repeat the previous exercises having been introduced to the dimensions of colour and the necessary definitions of relationships between colours. Again the instructions are simple. The student employs an objective (knowledge based) approach, of their choice, to the colouring of the 'pattern' and their drawings of their models. The choice of approach ranges from achromatic or monochromatic scales to full spectral harmonies. Students find restricted

palettes quite stimulating to work with. Subordination to someone elses colour palette or to a 'disliked' colour palette are additional exercises not only to be permitted but encouraged. Discords as well as harmonies are attempted.

Although this work is harder than the subjective studies it is found to be much more rewarding, as the 'pattern' and the drawings of the students models are all 'coloured' to selected schema.

Inevitably in the assessment of the workshop outcome a discussion ensues as to the relative/comparative 'merits' of the previous subjective colouring and the objective colouring. The outcome of both workshops are displayed and the students are asked which they prefer collectively and individually. In this discussion students admit that the objective studies are more ordered and that more are acceptable, but add that they perhaps lack some of the spontaneity, variety and vividness of the few 'better' subjective examples. This would have to be a very fair comment as there are always a few good intuitive colourists in any group of students taking up architecture and there are always a few 'happy accidents'!

The colour knowledge gained in the objective exercises also allows the students to communicate colour effectively to others and they are able to discuss and explain rational colour solutions in design terms whatever the context or situation might be.

THE MERGING OF SUBJECTIVITY AND OBJECTIVITY

"One eye that sees
another, that feels" - Paul Klee

At this stage of the workshop final schemes were designed and transferred to the 3D models. These were prepared using the outcome of both subjective and objective studies as the students saw fit. These 3D outcomes were in their turn discussed particularly with respect to the forthcoming architectural design task - the 'Gateway/Entrance' project intended to put design and colour design into an environmental, social and communicational context.

It became self evident at this juncture that if colour is to reassume a more positive role in architecture it must enter the design process at an early stage. Architectural form must anticipate the function of colour, understand its meaning and be sympathetically related to its organisation and expression. It is not just a matter of applying colour to architecture. This is why our colour studies necessarily run hand in hand with formal and spatial concepts in the architectural design workshops. Colour design knowledge extends ideas of form, space, weight, distance, relationships, textures, reinforcment, confirmation, contrast and contradiction etc., in the architectural idea.

Students record the process of their 3D colour designs and a final assessment more often than not, reveals that the most successful results are those which adopt a combination of knowledge base and intuitive intervention. When the 'rules' are known they can be manipulated even broken, but only then. In colour design it is the existance of colour conventions and the knowledge of them which allows us to propose inovations, (i.e. increasing knowledge not mystifying colour). Some students find confidence amongst 'rules' and with little intuitive intervention produce very acceptable results assuredly based on known schema. There are no 'bad' schemes and the metabiological evolutionary phenomenon of creativity is not excluded.

It is the capacity of the human mind in wakefullness or in sleep to allow the binary systems of the left and right brain to collaborate, which is one of the most important processes in this phenomenon of creativity and intention.

We must accept that any limbic intensive response contains an emotional element and that it is the right brain which has the monopoly on perceiving colours outside the limited range of primary or exotic. In spite of (or because of) the initial dependence on intuition there are 'learning' aspects of colour which have a significant effect on creative performance in the environmental colourist.

As in the playing of a musical instrument the capacity to perform may be inborn but training, practice and experience are required to confirm and extend the talent in reality. Similarly a colour designer with an intuitive and creative insight will extend his or her competence by practice and by any cognitive development acquired from adult training. By the same token and in the same way a colour designer, with perhaps not the same degree of intuitive colour sense, can greatly improve his or her colour competence. I believe capacity for performance can be enhanced in all design fields and that confidence gained by knowledge practice and experience can go a long way towards compensating for a paucity of intuitive ability. When I tell students that colour to a large extent can be learnt, the relief amongst some is almost tangible. Making intuitive colour designers and strong subjective colourists accept that they need to 'learn' the art of colour decision making and the art of expressing choice, is not so easy. Eventually students are able to operate in unfamiliar design contexts with equanimity; they are no longer torn between reactions of self interest and reactions of community or group interest; they can serve both by understanding both.

It becomes clear in architectural colour design teaching that right brain thinking must not be divorced from the entire brain system. Certainly the right brain responds to texture, sophisticated colour and tone and is biased towards discovering patterns of coherance, but the emotional response to high chroma, brightness, shine, glitter, symbolic and base associational meaning, must not be ignored.

The modern and late modern periods in architecture saw great building blocks of uniform colour. It was not appreciated that only people of corresponding colour sense (and these would not be many - a few other architects perhaps?) would enjoy these buildings and all others would be more or less repelled. Until recently architects have had little predilection for the emotions in design (these were often equated with vulgarity). Architectural colours tended to be those which were supremely cerebal. For limbic satisfaction it was necessary to go to the market place.

The aesthetic implications were clear and we are once again beginning to exteriorise our emotions, giving colour its rightful central role to play in the environment. Colouring in the environment is not the mere prettification of buildings or the clever production of visual gestalten. Nor of course is colour in the environment the idle manipulation of personal choice of colour or imagery for its own sake. It is the process of ordering form itself, drawing forward what is important and relegating that which is unimportant to the background. The considerable contemporary concern for creativity in our environment in an age when dominant values and achievements tend to be of a technological or economic order, confirms that it is not enough for something to be useful; creativity imbues acts with quality value.

Today's architects and urban designers have to be able to achieve a dialetic balance between reason and emotion. The cerebral interactive rhythms of wavelength profiles of colours perceived on different levels of the brain are essential to that special experience we once had the temerity to call beauty.

I believe that a balanced experience in the training of architects and environmental colourists, merging the subjective syndrome and the objective objective in a mobius strip like contingency, will most effectively address this need and restore colour, beauty, variety and enjoyment to the environment.

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*Expression of nobility and truth –
tile work in Multan architecture*

EXPRESSION OF NOBILITY AND TRUTH
BLUE TILES IN MULTAN ARCHITECTURE

BY

MOHAMMAD NAEEM MIR[*]

BRIEF

Multan is famous for four things - Dust, Heat, Saints and Shrines. The old city panorama and skyline is dominated by tombs, shrines and mosques.

Architectural tradition of Multan is distinguished for exclusive use of Blue glazed ceramic tiles in exterior and interior finishing of buildings. The choice of blue colours is due to the aesthetic, mystic and symbolic values of this delightful colours.

Blue had been a revered colour through ages - associated to the Kings, Nobles, Saints and Mystics. Different shades of blue has been named accordingly e.g.

ROYAL BLUE - represents the elegence, delicacy and dignity,
NAVY BLUE - strength & power.

No other colour has such associations.

This presentation is about the use of the blue colour in religious buildings of Multan - as a symbolic expression of nobility truth and fidelity.

ARCHITECTURE OF MULTAN

The prosperity and progress of a civilization are depicted through the cultural, socio-economic status of its people and architecture. Architectural monuments bear testimony to the past through their tangible existance and could tell more about a culture and its people than any other written or descriptive material.

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Among the few ancient cities of Pakistan, Multan has the distinction of possessing an almost uninterupted history of religio-political activities spread over a period not less than five thousand years. Multan and its environs posses numerous grand adifices representing diferent faiths, Hindu, Muslim, Sikh and Christian. However our subject restricts our discussion to Architecture created under Muslim patronage only.

The history of Muslim Architecture in Multan started with the arrival of Mohammad bin-Qasim, Arab Muslim warlored in 713 A.D. He got built Jamia Mosque at the old fort of Multan - only Archeaological evidence is remaining.

Muslims of the region often travelled to Persian Turkish and Arabian cultural centres in persuit of knowledge, learning and fulfilment of religious obligations. This resulted in further amalgamation of cultures. The literary and fregmentary evidence suggest that the north western region of the sub--continent, Sind Multan and south west Frontier had been developed as an extension of Turko-Persian cultures. This new cultural formation has its manifestation in the form of tomb of Baha-ud-Din Zikirya and his grand son Shah Rukn-i-Alam and the contemporary buildings.

Tomb of Baha-ud-Din Zikirya built entirely with finely burnt brick tiles, square in plan, with sloping walls. Following the contemporary central Asian tradition of Muslim Architecture. The exterior and interior surfaces were decorated with blue glazed tiles. At the first sight one can not help appreciating its majestic size, grandeur, bewitching and unique form. It is the bold, manly and a remarkable specimen of majesty strength and solidarity. Its decoration are intricate, subtle, pleasing sublime shades of blue. Sir Marshal, the famous Archeaologist says, "One of the most splendid memorials ever erected in the honour of the dead".

Later on this tyle of decoration - use of glazed tiles veneered to brick work with different, floral, geometric, and calligraphic patterns in different shades of blue, sparingly yellow and green colour also became the significant feature and mark of identity for Religious Buildings. This was fashioned after Persian models, however a lot of contribution of the local intellect and skill was also involved. These enamelled glazed tiles are named as "Multani Tiles".

BLUE COLOUR

The use of blue colour for tiles and ultimately to the total Architectural form has many reasons, aesthetic, mystic, even symbolic. The introduction and the tradition of use of this delightful colour in the Architecture of Multan has an ancient history. As much of the Architecture is inspired and influenced by central asian examples so is this colour evidently a major derivation of the Persian tradition.

> "Symbolically the blue colour represents nobility, truth and fidelity".

Evolved during the sassanid period in Persia, this colour was derived from precious stones and the day time colour of the sky. In the sassanian period, blue was a revered colour and was considered the royal colour. Courtiers used to wear different shades of blue to show their ranks. Turquoise was used by the nobles of the highest rank in the realm and the next rank was marked by other shades. The throne of Khusraw-II called "Takt-e-Taqdees" (Throne of Holiness) was in two shades of blue.

This tradition travelled to Muslim and Sind areas of Pakistan with the advent of Islam, when many saints came from Iran to settle in the northern parts of Pakistan. These mystics and saints wore blue dress and people revered this colour due to its association with these holy men. These

men preferred blue, as is explained, because they saw in it a realm of emotion and mystic experience, which led them to meta physical transcendence.

Later, in 1000-1100 A.D. when Islamic art took roots, blue was prominently used in the expression of other arts and crafts, especially in architecture and pottery. In the 14th & 15th century these arts reached their zeith.

The most common shades of blue used in architecture are cobalt blue, indigo blue and turquoise. Cobalt Blue is highly brilliant and represents an appeal to the sun, whereas turquoise blue is rather pale and represents an appeal to the moon.

BLUE WITH OTHER EARTHEN COLOUR IN MULTAN ARCHITECTURE

Brick tiles are the basic building material of Multan architecture. These brick tiles usually reflect red and yellow hues. Along with these dull brown shisham has also been used. These two materials create a very dull visual impact. To cool down this warm and dull effect in the eye of viewer blue is added to building as a part of decoration.

The over all earthy brown colour of the buildings create an organic relation with the ground (on which the building stands) Maximum glazed blue decoration is provided on the upper parts of the buildings. The pyramidical form of the building take the vision upward, where the blue colour decoration create very strong relation with clear blue sky. (Building seems to blend with the sky)

The climate of Multan is dusty and warm most of the year. Blue is added to buildings to neutralise and reduce this uncomfortable impact, as blue is the soft and cool colour, it is the colour of sky and water which always give a cool and comfortable feeling in hot weathers.

SHAPE AND PATTERN OF TILES

The tiles are of different shapes, but the most common are square, rectangular and arched, size:6"X6", 9"X9" & 12"X12", thickness varying from 1/2" to 1".

Special motifs and shapes are also produced which are placed in different parts of the structure.

Boreazia are those small pieces which are joined, together to compolete a larger pattern.

ARA MATTI tiles are placed on the neck of a dome.
KINGRA tiles are placed outside the parapet.
NALISA tiles are used as borders on the doors.

PATTERN   The tiles can be devided into four types of decorative patterns:-

1.   Floral patterns.
2.   Geometrical Design.
3.   Calligraphy.
4.   Figure.

R E F E R E N C E S

1.   INDUSTRIAL ARTS OF INDIA
      Sir George Birdwood.

2.   TILE WORK IN PAKISTAN
      Sajjad Haider

3.   MULTAN - HISTORY AND ARCHITECTURE
      Dr.Ahmad Nabi Khan.

4.   MAUSOLEUM OF SHEIKH RUKN-I-ALAM, MULTAN
      Mohammad Wali Ullah Khan.

5.   ANALYTICAL STUDY OF MULTAN ARCHITECTURE
      Architect Ajmal Siddique

6.   IRANIAN BLUE IN SIND
      Mumtaz Rashid's paper in Seminar,
      "Sind Through Ages"

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*Artistic design and reconstruction
of historic buildings in Berlin GDR*

Artistic interior design, renovation of historical buildings
and the inclusion of art objects

This article will deal with the renovation and artistic interior
design of three very different historical buildings, all to be
found in Berlin, GDR: the Akademie der Künste (Academy of
Arts), neobaroque style, Palais Unter den Linden, an example of
classical architecture, and a historical station in neo-Gothic
style faced with clinker.

The character of towns and many beautiful interiors of buildings
have suffered due to renovation programmes which include
modernistic reconstruction, masking and poor choice and combi-
nation of colours, thus depriving them of their original indivi-
dual identity. When renovating historical buildings it is
important to take note of architectural structures. Drastic
modernization should be avoided, modernization should remain
within the context by, for example, adding modern details in an
appropriate form so as to present the visitors with something
marked by its aesthetic appeal. In so doing, it is not always
possible to remain true to the original, as lighting, heating,
insulation, acoustical elements, modern technology and the
emphasis today on functional use all require modifications to
the historical previous structure.

At the same time, however, endeavours should be made to coordi-
nate the design of the building as a whole with the individual
rooms and details, that is to say, alongside the functional
aspects, the visual effect must also be given due attention so
as to underline the essence of the building. In this respect,
a decisive role is played by architectural division, the

distribution of light and shadow, the choice of colour and materials and, so as to enrich the interior and make the room complete, the inclusion of art objects.

This presupposes certain conflicts with the laws of architecture concerning division, structure, construction, materials, colour and the effects of light and shadows.

Colour plays an important part being an architectural element of division. It is through colour that general harmony is achieved. Colour divides, reinforces, contrasts, dematerializes, mediates - with colour you can round things off, hold things together, destroy or emphasize. The design prinziple always involves striving to achieve completeness.

The design concept for each building takes the rooms and buildings as one complete work of art and follows common principles. The result is an aesthetically interesting structure achieved through the effective use of colour, light, form, fine art, script, information and furnishing. This principle of completeness represents the underlying philosophy of design applied in the following examples.

Examples

1. Akademie der Künste (Academy of Arts)

The present-day Akademie der Künste of the GDR in Berlin was built in the neobaroque style between 1904 and 1906 and housed the Prussian School of Medicine. Hans Eberhard von IHNE was the architect. The exterior of this neobaroque building is sandstone, while the division in the vestibule and staircase of the interior is determined by an artificial material made to look like stone, some marble detail, ornaments as well as the subdivided windows.

After considerable reconstruction around 1950 and inappropri-
ate use of the building the architectural divisions in the
entrance hall, on the staircase and in the assembly hall were
either concealed or changed. Within the framework of a new
renovation programme for the Akademie der Künste it was
decided to draw up a new plan for the design and coloration
of those areas of the building under a preservation order.
This included the entrance hall, the staircase, the assembly
hall and the president's office as well as the board room.
In cooperation with those involved in the preservation of
historical monuments it was decided that the main objective
shoult be to restore the original character of these rooms,
for which considerable changes had to be made concerning the
state of the building.

On the construction side, the built-in side doors in the
entrance hall were opened to the vestibule and the marble
alcove on the right-hand side of the entrance uncovered. The
brickwork on the stairs which had been plastered over was un-
covered so as to emphasize the original architectural divisions
of the individual floors.

In the assembly hall the soundproofing was removed from the
walls which had been concealing the room structure and architec-
tural divisions. Spotlights and soundproofing were reinstated
into the room as creatively and tastefully as possible. All the
old light fittings which remained, including the chandelier in
the assembly hall, were restored by the curators. Doors and
panelling were rubbed down to remove the old paint and were
stained brown - Macoré approximately - giving a natural wood
effect. The windows, which had been double-glazed, were resto-
red to their original form.

By studying the surfaces it was possible to distinguish the original colours, ochre, white, various shades of grey, a yellowy and grey stone and a warm brown were prominent. The stone floors in the entrance hall and staircase were grey with burgundy stripes. All light fittings, door fittings and information accessories were made of brass, being either restored or newly manufactured. The upholstery for the chairs, podia and stage in the assembly hall was blue and grey, as was the carpet. To round things off, all rooms were provided with suitable works of art.

2. Palais Unter den Linden

Towards the end of the 17th century it was decided that the ramparts around Berlin were no longer necessary and the land was made available for construction projects. In 1753 Johann Gottfried Donner, the king's valet, had a three-storey residence built with 15 windows along the front and two entrances. Around the middle of the 19th century it was reconstructed and re-equipped to house the Prussian Ministry of Finance. Around 1863 the plans were submitted by Heinrich Bürde, the king's building advisor and a personal colleague of Schinkel, as a result of which the central entrance, the new staircase, the present-day marble hall, two storeys high, and a few richly furbished rooms were added. Since 1950 the building has been used as the Central House of German-Soviet Friendship. Latching on to the historical aspects of the building, a project was worked out to introduce creative variations in the design of additional premises within the building. This included, on the ground floor, the entrance hall, cloakroom foyer, the corridor to and in front of the puppet theatre and the

foyer of the theatre, complete with a small art gallery. On
the second floor, the restaurant, restaurant lounge, "Winter
Garden", the hallway leading to the library and the two
staircases came under consideration.

The design project involved the division of the rooms, colora-
tion and furbishing, for example, designing windows, curtains
and venetian blinds, lighting, doors, panels and hinges, choo-
sing materials for the floors, furnishing, integrating sound-
proofing and electrical appliances, putting up paintings and
works of art and helping to choose and integrate art objects
and historical details.

Alongside coordination of the building as a whole, the aim is
to give each room an exclusive character according to its func-
tion. Due to the height of the doors and windows, beams and
moulding, the character of most of the rooms tends towards
classicism. While this is given due consideration, some modern
aspects of design are also tastefully included. Thus the
existing modernistic divisions (hanging ceilings, false divi-
sions of the walls and furnishing) have undergone radical chan-
ges. Efforts are focussed on restoring certain interior archi-
tectural design aspects to their original form, adding detail
und choosing materials and colours widely so as to ensure the
highest level of creative design, while at the same time impro-
ving the air conditioning, acoustics, lighting, information
services, the floors and the addition of art objects.

3. A historical station in Berlin

The station I am referring to used to be known as Börse station
and was constructed according to Johannes Vollmer's plans
between 1878 and 1887 serving local trains. It is in neo-Gothic
style faced with clinker. Nowadays it is known as Marx Engels

Platz station, situated near to Hackesche Markt.

The platform is appro imately 16 m wide and 100 m long and is covered with a low arched roof with an iron framework and saddle-shaped window light (probably according to Schwedler's plans). Characteristic of the station are the wide pillars, dividing up the ares equally, with the arches of the viaduct on the lower part, and the round windows on the upper part of both the south and north sides which are elaborately inlaid with stone in mosaic design.

Marx Engels Platz station is the only station in Berlin to date from the time when the local train was set up 100 years age. This station, architecturally very valuable and artistically designed with love and care, is being renovated and, in future the whole of the station both inside and out, will carry out a specific function for the public's benefit. The arches underneath the platform will be occupied by public amenities. Proposals for the design of the station were worked out in 1985 and are presently implemented in line with the plans.

The main objective is to considerably enhance all sections of the station open to the public by means of good architectural design and appropriate coloration, while at the same time preserving features of historical value. In the first project the following areas were included: inner and outer facades, announcement box on the platform, stairways and corridors, provision for selling tickets and newspapers, the integration of a bar with terrace, a refreshment kiosk and a flower shop. In addition, proposals for the choise of colours and materials, light fittings and furnishings, the integration of technical equipment, secondary architecture, signs and information, as well as the addition of artistic details.

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*The relevance of folklore and tradition
to the practice of modern architecture*

THE RELEVANCE OF COLOUR AND FOLKLORE TO THE PRACTICE OF MODERN
ARCHITECTURE.

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It is a long time since man ceased his nomadic existence and
started to live in settled communities. Buildings form the
immediate physical basis of the community environment, and people
conciously or unconciously make certain demands of their colour,
pattern and design. It seems to be widely considered that
traditions of the people in architecture are not of the present,
but are a thing of the past and can therefore be ignored.
This is not so, all communities are built around their past as
well as their present, and tradition and superstitious practices
have developed around the land, design, erection, construction
and contents of buildings.

There are two factors which control our beliefs and our
day-to-day behaviour. First, we do as we are told by the
official, regulatory organisations in our life; for example,the
state or the church and second, our activities are controlled by
what we have learned from our parents or from our general
experience of life. The architect is too often seen as
belonging to the first category; that is, as someone who imposes
his wishes on the shape of the landscape, ignoring the general
custom and tradition of the inhabitants or neighbourhood. The
traditions and folklore referred to in this paper are of the
second gategory.

This paper is divided into three parts. The first contains a
statement of folklore in architecture from the viewpoint of the
people. The second is an examination of aspects of the inner city
problem from the point of view of folklore and tradition
transfer. In the third part, suggestions are made on how some of
the discrepancies observed may be overcome and how the impact of
such problems may be lessened.

The People, Tradition and Architecture.

Throughout the world, superstitions are and have been associated
with every stage of the architectural process. Before a building
is erected in Thailand, permission must be gained from the earth
spirits who own the land. In many places foundations were once
guarded by burial of horse skulls or witch bottles. Live cats or
babies' shoes were concealed in the walls. Roofs still are
guarded by straw pigeons or storks. Entry of evil spirits into
the house was prevented by witch rings in the fireplace, white
paint or curtains at the windows and doorways. The garden,
outbuildings and animals were protected by particular trees,
colours or designs.

In England the church is usually the oldest building in the community and therefore often acts as a stable centre of village folklore. The theme of legends differs with the region, but may involve the devil, ghosts or giants.

Continuity of belief can be also be found in the protective evil-eye and circular based hex patterns inscribed or built into walls and support timbers. For generations the evil-eye inscribed on buildings and boats has formed a colourful part of life in the Mediterranean countries. The hex sign, probably related or derived from the evil eye, was originally to be found in ancient Egypt and has since travelled the world. From at least the fifth century, it has been associated with superstitions or used as a charm.

People's active involvement, although not necessarily belief, in folklore is a thing of today. All over the world there are ceremonies and customs which have been enacted for centuries. The Mardi Gras, Morris and Maypole dancing, ceremonies of fire and light, and calendar customs are examples. Colour, pattern and design form a vital part of most of these events.

There is a long tradition (from 15,000 BC) of colour associated with dwellings. When houses are built with limestone or granite, the community will be a tone of grey; if sandstone or brick is used, it will be red, and if stone is not available, houses may be built of mud and wood which can be painted. The colour triad of red, black and white found by anthropologists in all tribal body painting (1) is to be found in architecture for much the same reasons - these colours have high contrast and occur naturally. Colour is also imposed on buildings by man, from the browns, yellows and reds of, for example, Italy and Southern France to the brighter whites of other parts of the Mediterranean and northern Europe. These colour traditions are regionalised according to the availability of raw materials and custom. They have been established and used for many years. Colour is a vital part of a whole scenario of visual cues which are present in the environment.

A Folklore and Tradition View of the Urban Problem.

Looking at the urban problem, towns should not be about individuals; they are communities. The word community is derived from the Latin communis which means common. Personal contact and communication are of vital importance to the transfer mechanism of tradition , folklore and way of life which the family and community have in common.

Architectural change in the environment can bring disaster particularly to urban dwellers, through reducing the

effectiveness of personal communication. There are at least four ways in which this change occurs. First, destruction of the recognisable landscape; second, using designs which isolate individual families into non communicating units; third, designing to include novelty, speed and change, those benefits of modern technology; and fourth, the replacement of traditional white and natural pastel colours with bright, saturated, colours and the architects' insistence on using little understood materials which do not weather acceptably. These factors can combine to produce a strange, more ugly and visually violent town environment, which results in the loss of cohesion of the community through the destruction of their tradition, folklore and psychological framework.

Can the Folklore Approach Help ?

"Architects and planners openly admit that when designing an estate they are primarily concerned with practical and aesthetic conditions. To them the all important factors are such things as the final appearance of the estate and whether the traffic will flow smoothly around it." The important statistically controlled study from which this quotation is taken concluded that in an estate houses of similar appeal should be situated together, and that there should be easy visual contact between the residents (2). There are many instances in which these principles have not been adopted.

In England the break up of established communities was deliberately advocated in the 1950s and 60s according to political principles of equality. The social life of such areas has not recovered. This did not help the worsening reputation of planners and architects, who ought to have learned from the pre second world war experience of the Germans. For a long time, architects have not been trusted. This is still true, hence the construction of new shopping centres and arcades behind older facades.

So, what lessons can be learned for architects and planners from folklore considerations ? Personal communication is vital. Unfortunately it is much easier to destroy communication by destroying the urban landscape than to establish a new community. In the UK this lesson is at last being learned. For example, many of the upper floors of inner city properties have been neglected and this of course threatens the whole building. Many towns now have schemes by which affected properties are being renovated, using traditional designs and colours. After the Chinese had demolished the ancient city walls of Beijing they realised the importance of the environment to the inhabitants. The renewal of the centre of this city is now being carefully controlled so that the historical physionomy is preserved and colour, design

and height are specified so that the beautiful old buildings are complemented and not hidden from view. The buildings of the new city of Brasilia are beautiful in a Euclidean, geometrical way, but they are mostly achromatic. The resettling into this environment of peoples from traditionally highly coloured villages was a disaster. This lack of awareness and consideration for colour is not surprising, because in most university architecture courses a total of only five or six hours is devoted to colour and lighting.

When people are left to themselves they will colour most things. Fairground horses, Indian teepes, canal barges, river boats and they themselves can be highly coloured. In addition, if colour is not used well in the built environment, residents often take over, creating formal wall paintings or resorting to the indiscriminant use of spray cans. We really need to find out in what ways people prefer and feel comfortable with colour in their immediate and townscape environments.

In this way we can postulate a limbic ecology, which is based on belief, tradition, fear and hope - one which we should not overlook. However, we are badly in need of more research and study into community behaviour. This can be done through experiment and observation within the community as well as using psychophysical methods on individuals from the community. These techniques will provide a means of studying how the community works in its everyday surroundings. One very important part in this total concept of eventually achieving urban peace and understanding is to discover the role and purpose of colour. This type of work has been carried out by Tosca in her studies on the natural, home made and preferred colour environment of settled Greek gypsies (3).

Architects are blamed for many evils of this world but I believe that it is only by research such as this that we can hope to help them design as stress free an environment as possible for our children. Ecology is the study of living organisms in relation to their environment. We are used to hearing of ecology in reference to animals in the wild, but research and a sympathetic approach are needed to understand the physiological and psychological ecology required by human beings.

Finally this paper has:
    first, demonstrated the importance of the use of colour and custom and folklore to the total life as well as to the architecture of the "man in the street" and
    second, that although colour is important in human ecology, more research is required to understand its precise role.

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*Symbolism, tradition, colour and ecology
in architecture*

THE SYMBOLIC,TRADITIONAL AND ECOLOGICAL DIMENSIONS OF COLOUR IN A R C H I T E C T U R E

In 1981 I was submitting my D.E.A. thesis at the 1stUniversity of Paris on the colour rendering of a traditional marketplace in Paris.It was a project directed by J.PH.LENCLOS,based on the investigation of the perceptual dimensions of Colour by LARS SIVIK's method in his "Study of exterior Colours".What right did I have to extend the local palette of the colourful shopzone to the zone of residences within a broader colourless context?What made the parisians recognize Old Paris in my project,although there exist no representations of it?

In 1985 I was presenting at the AIC Monte Carlo Congress my Doctor's thesis on the aesthetic and structural restructuring of a refugee settlement near Thessaloniki by Colour alone.This time it was a project based on the colour composition pattern resulting from a colour preference inquiry on a semiotically analysed sample façade. Why did I term "folklore-flash" the resulting architectural style, as opposed to that of the local and broader urbanscape based on Planning Authorities regulations?With what right did I dare the visual distinction of the gypsy majority of the residents under the pretext of area particularization?

My colour structure did not deviate from the plastic structure of the buildings,allowing for no freeer solutions by the residents themselves.

Finally,even while diversifying them,I tried to combine all the constructions of the area in a harmonious whole.

Concerned myself in the above questions already in Monte Carlo,I accepted my friend's J.HUTCHING's invitation to investigate together with him the relevance of Folklore,Colour and Architecture.An experienced Folklore specialist himself,he specified that the point of view would be that of superstition,prejudice,etc.,to my embarrassment due to Greece's well-known shortage of... efficient witches. To take courage I recalled THOMAS W. MACKESEY's words in the "Architect and the City" (1962):
"...we are not building our cities for the sake of transportation or for fine and abstract architectural compositions but for man with all his prejudices and convictions,aspirations and inhibitions, his irrational likes and dislikes - man who still hopes and fears".

From the beginning John was luckier than me to find round "hex"
motives on building walls of his own country.I,on the contrary,
was discovering economy,utility,demonstration,fashionability
behind noticeable colour peculiarities.Then I tried to picture a
black house and a magenta church.I felt overwhelmed not by surpris-
ingness but by fear in the first and shame in the second case.So
I thought of orienting my research into another direction,the in-
vestigation of symbolism,irrationalism,non-rationalism,subconscious.
Perhaps there were deep-rooted colour connotations that might have
yielded colour constants,for example,over four architectural periods:
the cretan,the byzantine,the post-turkish and the contemporary one.

My next study consisted of:
a)a research on the colour composition possibilities in the con-
   temporary greek urbanscape based on colour preferences for a
   semiotically analysed sample façade
b)three colour composition analyses of decorative and structural
   surfaces of the previous architectural periods
The results were a colour composition pattern relying on contrast
between general and detail palettes,colour palettes for each element
and the correlations between the colour attributes and the colour
elements corresponding to one another for all the four periods.

The comparison of the new findings with those of the parisian and
Phoenix studies gave different colour palettes and colour compos-
ition patterns for each case.In my hands I had a tool enabling me
to control,with the assistance of the public,the consistency of
the evolution of architectural colour or its creation indigenous-
ly to a group of residents,no matter what the time and space,in-
dependantly of isolated morphological details like "hex" motives.

According to MARTIN FOSS "symbolism is exact the more it succeeds
in omitting details and abstracting from everything which could
distract from the one and only route to the whole".Other versions
of the "hex",the "mandala figure",the "world tree",the "sacred
pillar" are objects of archetypal symbolism to which man tried to
identify his cities,his ojectivated environment,in order to at-
tribute to it the superpowers,at a time when he did not trust at
all his own powers.

The question is why should people's colour preferences be still
"superstition" dictated now that we are,on the contrary,...obsessed
by our own powers.Neurobiology teaches us that the cortical system

which consists of three subsystems chiefly perceives according to
primitive rules including a predisposition to respond to configur-
ations of space.light,etc.,striking an archetypal chord.And because
the primitive optic sytem "sees" before the classical system its
mode of response can condition the conscious reaction of the neo-
cortex.This,I think,already justifies the term "folklore-flash
for my Phoenix preference-based colour style,as opposed to all
other eventual rationalistic solutions.But Phoenix is also an object
of the subconscious for its symbolicness as the result of a change
of space announcing a new pouvoir,a new social conception.

Symbolicness is manifested by oppositeness.Space-generated,dialect-
ically opposed concepts (as in the inquiry bi-polar scales),as-
sociated with the collectively engrammed memory patterns of arche-
typal symbolism cause a potential arousal of the human brain.This,
according to BERLYNE,is a condition of pleasantness.This is also
why J.Ph.Lenclos and I dared conceive of a colour operation in the
heart of grey Paris and were justified by the willingly co-operat-
ing parisians.The parisians who dress more colourfully than any-
body else in Europe!

But perception is also based on memory.The long-term schemas con-
sisting of the basic patterns established during childhood as the
elementary model of the world,as well as the presumably already
engrammed information in the deep-rooted mamalian portion of the
brain,may be modified by extension but rarely change their infra-
structure.Memory functions irrespectively of conscious awareness.
Here is the basic fact upon which relies my concept of colour con-
stants per culture and space through time in my "Epilogue...".This
is also why the parisians thought of recognizing Old Paris in my
project.

However the human brain is taught.Due to system-maximization new
environmental inserts become,as they increase in number,all the
more familiar.The degree of their acceptability depends on the
induced degree of complexity and intensity which,below a moderate
level defined in the WUNDT curve can cause sleep-walkingness (grey
towns) and above it bewilderness and agony (frantic wall-paintings).
In both cases the memory matrix contracts.On the other hand,re-
garding the scale and the dynamic state of the new insert,environ-
ment generated pleasantness also depends on the consistency of the
spatiality of exterior bodies to the conscience of our own bodies.

It becomes evident that here are two limbic criteria related to urban design of major ecological importance.

A final operational characteristic of the memory-recall system concerns the effect of context."Reflexivity" is extremely signigicant in determining the style of perception.All the elements of the built milieu interact and any change affects a big area arround the new insert.Innovation should not radically change the "force system" of an environment.For this reason I tried to thoroughly combine all my structures in Phoenix.

But memory patterns are analogous to natural species.Strong ones, due to a lowering of the arousal threshold of the neocortex by positive feedback,become stronger as the RAS becomes progressively perceptive to subtlety and detail.This must be a criterion for the traditional character of a construction.This is also why,besides my social attitude,I stressed the already strong quasi gypsy character of Phoenix.As for the residents' happiness with this solution,it is a matter of progressive education (rational procedures coupling subconscious ones) following habituation.

The new symbolic space generated by the change of space,is also an architectural space,a physical space which will,by its arrangement,induce an order fundamentally opposed to the caprices of Nature and Society.The new increasingly man-made space must respond to a long-term schema encompassing,in Nature's good old way, everything that is in it and establishing no less than the relation of relations.Or else ,in the "mandala" terms,it should embody:
a) integration into a wider system of being
b) social cohesion
c) reconciliation of all opposites and the transcendence of unity over diversity
d) elegance

My latest study,"The Stuff of Dreams...",attempts,according to J.BATESON,a slit in the veil incorporating all existence,an instantaneous substantialization of the "pattern which connects" everything in a town,constructions and beings.High-rise buildings are unavoidable in order to cope with overpopulation and installations-centered lay-out,modern construction materials,traffic and publicity are a fact.However there still remains Colour to humanize urban forms that have gone out of control.Colour as a factor of pleasantness ,free of the dimensions of the ideal and the eternal,for real-

ity is as subjective and ephemeral as the human thought.Colour,
among all material properties,creating a triple impact on the
mind,on the three levels of hue,value and chroma.

My "Stuff of Dreams...",still in elaboration and testing,consists
of a chain of four colour preference experiments alternating the
semantic with the semiotic analysis for a contemporary urban build-
ing façade within its natural and built context.The objective of
these experiments is the evaluation of the coloration of the above
façade from two points of view concerning the connotations of the
colours tested each time and their appropriateness within the com-
position patterns proposed each time.The relatedness of the results,
the contextual parameter,as well as that of the involved subjects'
personality are assured by:
a) the initial archetypal colour palette,as defined in my "Epilogue..."
b) the geographical palette of the area
c) the palettes of each experiment serving as basis to the subsequent one
d) the subjects' coming from the studied area

The semantic analysis scales belong to the three categories of
stimuli responsible for pleasantness according to Berlyne,the psy-
chophysiological,the collative,the ecological.The algebraic sum-
mation of the prices of all three gives the positions of the test-
ed colours on the McCLELLAND curve for the sake of comparison.

Ending up I wish to remind to all those who condemn man's techno-
logy-based future that change is our natural way.After all it has
always happened.Except that now we have difficulty in following
its rate dictated by the overdevelopped neocortex.The primitive brain
must be allowed to develop in its turn.The arousal threshold of
the neocortical system must lower,affected by the primitive brain,
so that details may also cause quick and deep emotion.So that more
elaborate and dynamic patterns may consist long-term memory schemas
or,in other words,become pleasantly recognizable.

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Colour preference in Turkey

COLOUR PREFERENCES IN TURKEY

Every research concerning the colour preference has used
different methods and every researcher chose his colours
from a different scientific colour system.

We too carried out a research and determined those colours
our subjects preferred most and those which they disliked
by using the experimental psychological method. In this
work quantitative analysis of colour preferences were made
by using frequencies. Our subjects were university students
between the ages of 18-25 of both sexes, who were grouped
as those who had an architectural education and those who
hadn't.

The experiment was carried out in a space where the ceiling,
walls and the floor were painted to a grey that had 0.40
reflectivity and that was equivalent to a value of 6 in
Munsell colour chart.

The hues used in the experiment were 5R, 5YR, 5Y, 5GY, 5G,
5BG, 5B, 5PB, 5P, 5RP from the Colour Chart of Munsell
Colour System together with those that were saturated most
and least of the same hues. Apart from these, white and
black that were equivalent to 2 and 9 in Value Scale of Munsell
and greys that were equivalent to 4-5-7 in the same scale were
included to make a sum of 35 hues used in the experiment.

Presentation of the 35 colour carts (measured 8 x 11 cm)
all together in a preliminary experiment caused hesitation
and conflict in the stimulus perception. For this reason
the colour carts were grouped randomly (five in each group)
and placed on 7 seperate plates which were then presented
one by one to the subjects who were asked to answer the
following.

1. "Write down the three colours you like best in the order of preference and write down the three you dislike most".

2. "While choosing these colours have you thought of them as abstract colours or have you chosen them thinking that they might be used in some way or other".

3. "If you would paint the walls of your living room with the colours you have chosen, in what order of preference would they take place in your list".

Furthermore, bearing in mind the possibility that there could be colour blindness in people in varying ratios the subjects were tested with the "Ishihara Colour Blindness Test".

When the results were evaluated the colours most preferred by subjects (boys and girls-whether having or not having architectural education) were in this other :

        1. Preferred   5PB 4/8

        2. Preferred   9 (white)

        3. Preferred   5PB 7/6

Whereas, the colours disliked were as follows:

        1. Disliked   5BG 3/2

        2. Disliked   2 (black)

        3. Disliked   5R   4/6

Thus it was observed that the colours preferred were generally those that had short wave lengths. In both groups of subjects the preferences about hue-the characteristic that makes up colour-tended to incline towards the short-wave side of the spectrum.

The preferred colours were those that had values ranging from

grey having a value of 4 to 7. The third dimension of colour - saturation-like the value dimension had also accumulated at a certain level among the preferences of the subjects.

It was observed that saturation dimensions of all the colours preferred were generally at a level of 6. Thus the general formula for the preferred colours can be stated as follows:

- Short wave   7/6 -

In general, the subjects that had   architectural backgrounds had a wider range of preferences compared to the other group and this indicated the effect of architectural education on these.

The colours that were disliked were generally those that had long waves, that were dark and saturated. As far as the value dimension is concerned it was observed that middle grey, the grey of the lower levels and those that were close to black were disliked.

Furthermore, it was suprising to observe that yellow (the fashion colour of that year, 1986) was disliked and that there was always a certain amount of yellow in the colours that were also disliked. The general formula for the colours that were disliked is as follows:

-Long wave   4/0   -

The value dimension seemed to have a definite effect on the preferences. Generally black and those colours that were close to black were disliked. The first colour on the list of the subjects belonging to both groups for the disliked colours was observed to be the same, but the colours for the second and third preferences were different.

The second and third disliked colours of the subjects having architectural backgrounds varied widely compared with the other group of subjects. This also was an indication of the effect of architectural education showing the fact that these subjects had a wider colour spectrum then the others.

While determining their preferences 53% of the subjects stated that they thought the colours as abstract elements, whereas the 47% of them said that they made their preference thinking their colours would be used in some way.

As a result it was seen that in general different sexes, different educational backgrounds and the colours being thought as abstract or concrete didn't make much difference in the preferences.

It was observed that most of the subjects who made their preference thinking the colours as concrete, thought they would be used on cloaths, on wall surfaces, and on those elements that surrounded them.

Among the 35 colours presented the subjects made their preference for the colour they would use on the wall surfaces of their living room like the following:

1. Preference   9 (white)
2. Preference   5RP 8/6
3. Preference   5PB 7/6

In general, the colours preferred by the subjects between the ages of 16-25 having architectural backgrounds or not were those that were light, cold and dull.

Colour Preference General	Colour preference for wall surfaces
1. Preference 5PB 4/8	1. Preference 9 (white)
2. Preference 9 (white)	2. Preference 5RP 8/6
3. Preference 5PB 7/6	3. Preference 5PB 7/6

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COMPARISON OF COLOUR PREFERENCE IN TURKEY AND OTHER COUNTRIES

	JAPAN	DENMARK	NEW GUINEA	AUSTRALIA	U.S.A	GERMANY	TURKEY	
Most preferred	1. white	vivid blue	vivid blue	vivid blue	vivid blue	vivid blue	5PB	4/8
3 colour	2. vivid blue	vivid red	vivid yellow	vivid yellow	vivid yellow	vivid yellow	(9)	white
	3. light blue	deep blue	pale sky	vivid red	brown	vivid orange	5PB	7/6
Most disliked	1. dark red	pale pink	deep purple	vivid purple	purplish pink	purplish pink	5BG	3/2
	2. dark purple	pale yellow green	deep red purple	olive	dark purple	pale pink	(2)	black
	3. dark yellow	beige dark	dark purple	vivid violet	light yellow green	deep yellow	5R	4/6

Note : The preferences listed above are taken from T.Yanase, G.Ohmi and M.Saito, "Colour Preferences in Japan" ,
AIC Colour 81, Berlin". (Except those about Turkey)

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The colour as a means to create continuity and change

THE COLOUR AS A MEANS TO CREATE CONTINUITY AND CHANGE

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Van Eyck's unique approach in using colour as an integral component of architectural planning constituted an appropriate background for a series of colour exercises which was designated to cope with the objectives Van Eyck had set forth as well as englarging the repertoire of means to achieve these objectives.

Aldo van Eyck, in the course of presenting his attitute towards the use of colour in architecture, states that "Although active colours are a major ingredient within the reality of the senses they are still hardly recognized for what they are worth in architecture"(1).

When there is an intentional use of colour in architecture, it is mainly focused on influencing the character of the athmosphere, diffusion and balancing of light in the inner spaces, on the functional or territorial identification of places and in the two-dimensional articulation of building elevaitons. Van Eyck complains that "in the urban scene active colours still play an insubstantial part, appearing incoherently on signs, advertisements, vehicles, clothing; packaging - on whatever is mobile, loose or temporary. In a spatial sense", he says, "they unfortunately contribute next to nothing.(1).

Van Eyck presents his own way to use colour in architecture in Hubertus House (home for single parents and their children in Amsterdam, Holland - designed 1973-75, executed 1987-78). In this building he uses all the colours of the rainbow, and arranges them successively according to their order in the spectrum.

- The psychological effect of colour was expressed by setting the cold hues)mainly blue and green) on the elevations outside the building and the warm ones (orange and red) on the partitions inside.

- The colour's identification effect was used to counteract the lack fo spatial definition which resulted from the use of a lot of glass in the building.["It became quite clear that active colours alone could give the slender steel the visual presence necessary to establish the sense of enclosure the desired openness called " (1)]

- The <u>variability of colours</u> was used to strengthen the spatial quality of the building. This quality is discovered by the changing appearance in space as one's viewpoint changes. Relating to the dimension of motion in the building (which is called by him "the fourth dimension") committed Van Eyck to design the colours according to the building's plans. Consequently, he demonstrates not only a unique approach of using colours in design but also ascribed his work to the unique area of environmental design which is visual (like most visual plastic arts), and perceived through the dimension of time (like music, poetry, play, etc.).

Van Eyck's project was presented to students in Architecture during colour theory studies in order to (1) Make them recognize the potential of colours as a substantial design component; (2) Create an opportunity to enrich the repertoire of possibilities for using colour for the sake of a defined design objective.

The goal set for the exercise was to create continuity and change in a continuous spatial context (analogous to a street or a passage in a complex building). Preparations for this exercise were made in two complementary directions:
(A) Enriching the repertoire of possibilities for creating gradual transitions from one colour to another;
(B) Studying in depth the notion of continuity and change (or continuum and development) by a structural analysis of poems and musical pieces.

(A)   The selection of colours as was done by Van Eyck in Hebertus House (i.e. using all of the colours of the rainbow according to their order fo succession in the spectrum) is only one of the many possibilities for creating a gradual transition between different colours. Enriching the variety of possibiliti4es for creating a succession of colours compelled attention to each one of the colour's components, namely: Hue Brightness and Saturation. The five main colour scales built systematically on these three components are illustrated in Fig. 1, on the colour sphere.
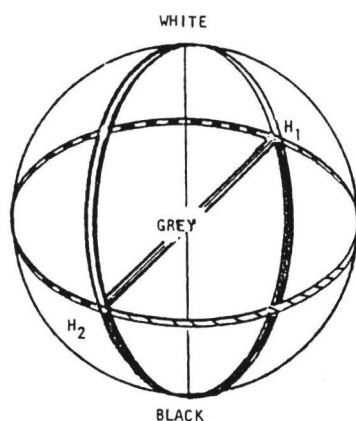
H_1 - a given hue
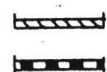H_2 - the contrasting hue

Changing Brightness
(1) Through the white
(2) Through the black
Changing Hues
(1) Through half of the spectrum
(2) Through the other half
Changing Saturation
(1) Through the grey
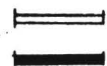
At this stage "colour cards" were prepared by the students. In each "card" the three complementary colour pairs were connected by means of the five scales described above. The discussion on the basic scales focused on the various qualitative products of each one of the scales, and in the different influence each type of colour-mixture has on each one of the basic hues. The students' attention was also drawn to the endless possibilities of creating colour scales from the five basic ones.

(B)   After clarifying the various possibilities for bridging between the colours, another preparatory exercise was assigned. The exercise was meant to enrich the students' approach to organizing artistic means for creating the experiences of continuity and change. In this exercise a musical piece, or a poem, was translated into a colour array following Kandinsky's approach which assumed that:

(1)   There is an internal basis (mental or emotional) common to artistic works in different fields.

(2)   The way to reach this base passes through the senses (of the observer or the listener).

(3)   There is a need for a strict, well calculated methodological array of stimuli in order to create an unequivocal internal impression (2).

Carrying out the exercise included:

(1)   Quick improvisation of the segment considered appropriate, after the initial impression. At this stage, the students had chosen those main colours they found to be appropriate for transmitting the main idea.

(2)   Analogical translaiton of the above mentioned piece, while analyzing its structure, rhythm and development.

Following a discussion regarding the psychological meaning of choosing colours, their mutual arrangement and the various technical possibilities to design colour scales - the students were required to carry out an applicative type exercise in an field analogous to architecture, i.e. developing continuity and change in form and colour along a continuous axis.

The rules of the exercise followed Van Eyck's principle: that the dimension of depth will not be achieved by painting a three-dimensional object, in a manner which from a certain point has the perception of volume, but rather through a combination of two-dimensional planes which shift in relation to each other as one's viewpoint in space changes.

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*Report of activities of study group for coloring
in public place*

REPORT OF ACTIVITIES OF STUDY GROUP
FOR COLORING IN PUBLIC PLACE (SCPP)

M. Hihara

It can be said that an atomosphere of a certain environment shows the level of the area culture and the sense of the residents. From this viewpoint, many model cases are examined in other countries.

Recently, Japanese people have also started various activities in this field being aware of the social needs. The SCPP pay attention to color effect which takes an important role to the amenity of environment.

This activity of the SCPP stands on the long range view and wants to inprove visual environment. The SCPP has disccussed the way of refining and has suggested solutions for actual problems. We have also urged people to understand what is the public colors.

Public color is defined as the totalcolor of the sphere which influences the public or the semi-public. Environmental color is defined as the color of the total space composed of the combination with visual elements. Therefore persons concerned should be responsible for the environmental color. Although people have recently become aware of the necessity of the amenity, the public environment have become invaded by disorder such as sound-noise, unpleasant-smelling and color-noise.

The SCPP is the committee which consists of volunteers and is open to the public. Activities of the SCPP intend to cover symposium, lecture, study conference, collection of information and data, field-survey and publishing of news and books.

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The SCPP is consists of about 80 committee members started by the proposal of the staffs of Japanese Color Research Institute. Anybody can join the group if a candidate can get the member's recommendation from a member and the committee's agreement.

Major activities

· 1981 : The SCPP proposed the new coloring for the Tokyo metropolitan buses : the color should be more adequate for public transportation. The SCPP obtained the agreement from the governor of Tokyo after the campaign had been spread among the people. According to questionaires, the color combination of the deep yellow color of the bus body with the dark red stripe accents gave a sence of uncomfortableness to 70% of the people. The color combination does not harmonize with the town scape which is flooded with overcolor. The public transportation should have a more sensible color combination.

· Symposium

1) Tokyo Symposium (Annual, 1982~)

" Thinking the public color and town planning", "Station Plaza" etc.
The simposium has been held six times with the support of the Ministry of Autonomy, the Agency of Environment, Asahi News Paper Co., NHK (Japan Broadcasting Station) and relating academic societies.

2) Local Symposium

The symposium is held about twice a year in local area with the joint -sponsorship of the local self government. Recent local resident's interests are what region identity is and how to appeal to the local character.

· The award of the public color

This activity has been held three times since 1986. The committee makes prejudge of the whole applications which were subscribed in the film of prints or slides to judge if the scene has brought a large merit on the landscape of the environment. The main judging committee (50% members are commissioned from outside) gives the awards of the public color and announces the results of the best 10 at the symposium in Tokyo.

· Public color campaign at Harajyuu Station

The SCPP launched the campaign of the color concept using 14 large panels (3m✕ 4m) arranged at the length of 100m along the platform of Harajyuku Station which is right near a well known fashionable area in the city.

· Support for activities against visual color noise

1) The lowsuit which requested color regulation was started by residents in Setagaya-ku in 1985. The cause was that a big chain store co. of fast -food started to buid a huge tower on the condominium for advertisement the neon sign on the tower was to work in red and yellow colors.

Therefore the residents of this area were against to the construction of the tower. The reason was they would get irritated, exhausted, and get in a condition of lack of sleep by turning the red neon sign on and off it would cause destruction of environment. The SCPP attended the resident's meeting and mobilized journalizm such as a news papers and Tv. The SCPP was also concerned with the content of petition.

2) In 1986, one morning, one of residents at Takasaki City got up and felt too mutch light dazzles by the effect of the colored building of a discount camera shop which had opened quite recently. The whole facade of the building was painted in fluorescent orange red color. Accordingly, residents of this area sued that they would eventually go mad. So many of this kind of stores can be seen in Japan, but most of them are in the shopping center so that their existance are usuaslly camouflaged.

However, in this case, as the shop was located in a newly developped town and the building of the opposite side was colored in red by the intensive reflection of sunlight. This color which is called lumi- scarlet was an image color of this shop and the whole building was painted in this color for the sake of advertisement.

The SCPP co-operated with the residents and submitted the petition of improvement to the store and the municipal office. The office took the last measure to give this store a letter of advisement to improve the situation. Finally, the store accepted this and now the store has been

painted in gentle beige.

The SCPP subjects and principle for the future

1) It is not an ideal measure to restrict the town planning by regulation. However the municipal office should take the lead to enlighten the level of the citizen conciousness to guide a town planning.

2) Public color is a subject of an aesthetic sence of the residents, and it is nessessary to get a consensus by common standard. Basically, regional color will be decided from the viewpoint of the common happiness of the majority of the people, a color which can be accepted in a very natural mood.

3) Actually, a pretty great number of people who are architects or designers have critical opinions that regulations may restrict free expression.

4) From the shopper's side, they insist that the building with striking color increase gathering of people and that it helps the developing of regional shopping towns.

5) It is hard to indicate the standard so that each occasion or each person can be satisfied.

6) As a matter of fact, there are a lot of criticism about the disorders of the Japanese townscape by the foreigner and Japanese who retern from overseas.

7) How to obtain solutions to go with the stillness residential area, various activities of the town, locality, tradition, traffic signs, information signs advertisement and street-furniture etc?

The SCPP should show the concrete proposal of the philosophy, such as what to do from now based on those conditions.

35 **Åke Svedmyr** **Sweden**
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Swedish Colour Center Foundation
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Appropriate colours for outdoor painting

APPROPRIATE COLOURS FOR OUTDOOR PAINTING
A colour selection for outdoor paint based on technical, economic and traditional aspects.

Åke Svedmyr, Scandinavian Colour Institute, Stockholm

Paper given at the AIC symposium on Colour in Environmental Design in Winterthur, Switzerland 1988

Background

Environmental colour design is today often worked out in a studio on a white drawing-board, using colour and material samples. In Sweden and in many other countries big colour sample collections are used, like NCS which contains more than 1500 colour samples covering the entire colour space.

Manufacturers of paint and building materials try to respond to the demand by producing more and brighter colours, even for outdoor use, sometimes with dubious compromises between quality and economy.

For colour specifiers this colour freedom is fallacious and often frustrating . Many architects work only infrequently with colour schemes and have difficulty in finding their way among the huge number of colour samples. Due to a gap in their education, many architects are not really aware of the differences in appearance between small colour samples on a white drawing-board and large surfaces in the reality of buildings.

In contrast to interior colour design, surrounding colours must always be taken into account in exterior colour design, whether they be colours of buildings or of nature.

In order to facilitate the task of exterior colour design and to help professionals and laymen avoid big mistakes, we have compiled an outdoor colour card. It is a selection of 270 colours appropriate in different respects for the exterior painting of buildings. This paper presents the underlying ideas and investigations behind the colour selection. My experiences in this field is limited mainly to Swedish circumstances, but I believe they are relevant in other countries too.

Available materials influence exterior colours

Today, as in former times, colours in our building environment are totally dependent on available, appropriate surface materials. The choice of pigments for exterior paints has always been a question of price and durability.

Up to the present century, chromatic pigments for outdoor paints have almost exclusively been natural earth pigments or their synthetic equivalents. These pigments have an extremely good durability and, compared with most other pigments, they have always been very cheap. Chemically, earth pigments are mainly iron oxides with varying contents of other minerals. We know them as ochres, umbers, terra di Sienna, yellow oxide and red oxide and they cover a range of dull yellow and red colours, browns and yellowish greys.

Since the middle of the 19th century the expanding chemical industry has developed a lot of more chromatic pigments, but those with very good durability are much more expensive than the traditional mineral pigments.

The rather dull green pigment, green oxide of chromium, with very good durability at a moderate price, has had a dominant influence on exterior green colours for more than a hundred years. Blue has always been an unusual colour on facades, since the few blue pigments with good durability have been very expensive.

Traditionally, ever since people started to paint plaster and wooden facades, chromatic paints have been mixed with one of the earth pigments and more or less of a white pigment, sometimes with a hint of black or another chromatic pigment, but almost never with more than two chromatic pigments. This gives the rather limited but very characteristic colour scale that still dominates most of our cities and older buildings.

Today, in our industrialised and specialised society a large gap has arisen between architects, painters and paint manufacturers. Knowledge about the traditional colour scales is fading away.

I see three important reasons why this this knowledge should be reco-vered, and more consiously taken into consideration in exterior colour design:

1. Technical/economic reasons. The mineral pigments related to the tra-ditional earth pigments still have the greatest durability and the lowest price. A much more expensive pigment is needed to give a more chromatic colour with the same durability.

2. Historical reasons. Most of our buildings were built when cheap mine-ral pigments were totally dominanting in outdoor paints. All colour specifiers making colour schemes for older buildings, ougth to know about the range of possible original colours, even if they decide not to follow the traditional colouring.

3. Aestetic reasons. The colour-giving substance in building materials such as bricks and stone are chemically closely related to the tradi-tional mineral pigments, and these materials are also closely related in appearance. Furthermore I believe that recognition is a fundamen-tal factor in the experience of beauty and harmony in colour design, as well as in music and art. The traditional colours of our building environment have, I believe, the same importance as a common visual reference as have the colours of nature.

The most important substratum of the selection presented in our outdoor colour card is therefore the colour scales that can be produced in tradi-tional paints with earth pigments and corresponding mineral pigments.

Colour analyses

We have mapped these scales in a number of colour analyses by means of NCS. We have mixed the most common earth and mineral pigments with diffe-rent amounts of a white pigment in a linseed oil binder. The paints were coated on paper and the samples were measured in a spectrophotometer. The NCS coordinates calculated from the CIE tristimulus values were then plotted into the NCS colour space (fig.1)

Fig.1. Some traditional mineral pigments in a linseed oil binder mixed with increasing amounts of zinc white. The colour scales are illustrated in NCS colour triangles, showing variations in whiteness, blackness and chromaticness. The hues are notated in each end of every scale.
a. Yellow ochre (goldochre)
b. Red oxid (English red)
c. Raw umber
d. Green oxide of chromium
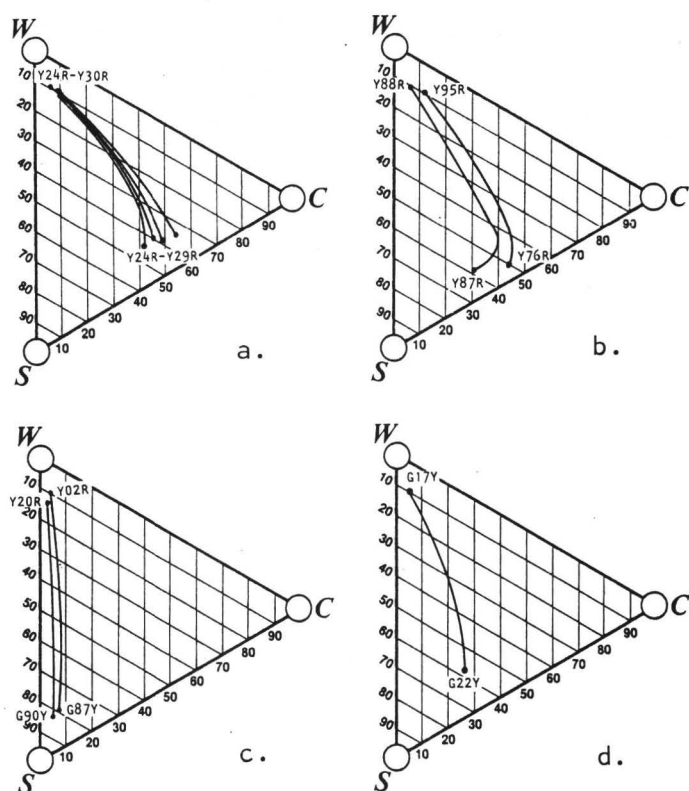
The Swedish Central Office of National Antiquities has made corresponding colour samples with lime paint on lime plaster. We have also measured these samples and plotted them into the NCS colour space (fig.2).
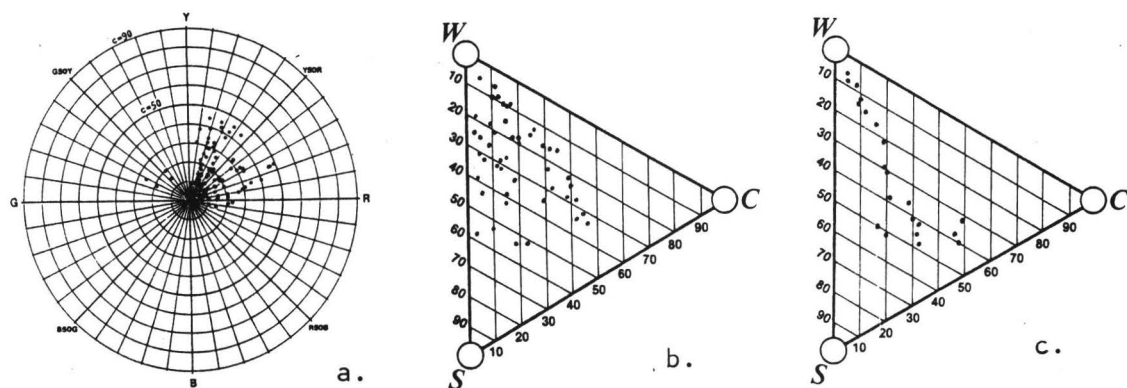
Fig.2. Lime paint with traditional mineral pigments. The samples are from the Swedish Central Office of National Antiquities. The colours are plotted in:
a. the NCS colour circle showing hue and chromaticness c.
b. an NCS colour triangle for yellow hues (Y1OR-Y4OR)
c. an NCS colour triangle for red hues (Y6OR-Y9OR)

Finally we have in the same way analysed concrete samples coloured with mineral pigments recommended for concrete and lime and cement paint (fig.3).
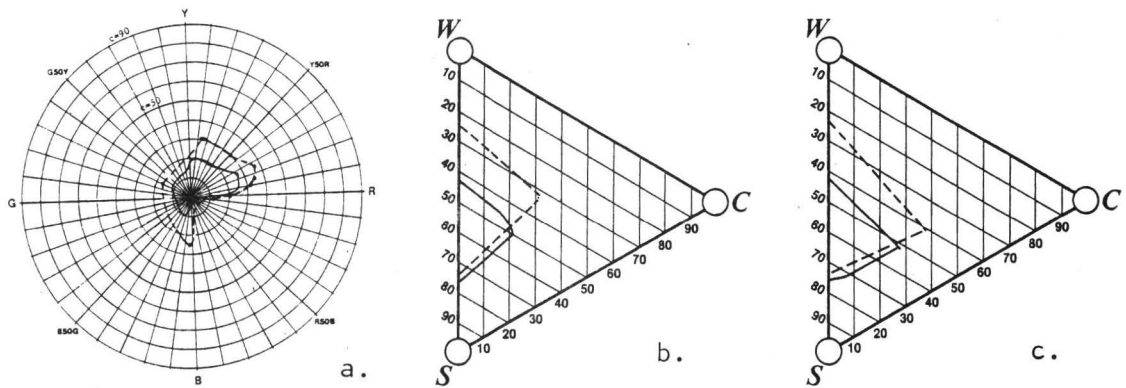
Fig.3. The range of colours possible to produce in concrete with appropriate mineral pigments (samples from Bayer). The colour range is shown in:
a. the NCS colour circle
b. an NCS colour triangle for Yellow hues
c. an NCS colour triangle for red hues
The dashed lines show colours of concrete with white cement. The continuous lines show colours of concrete with grey standard cement.

The NCS outdoor colour card

These analyses defined the boundaries of our selection. Colours in the NCS colour atlas that cannot be produced with these materials were omitted. Within the boundaries of the selection the colours are as a principle as close to each other as those in the atlas.

The selection is dominated by yellow, beige, brown and red colours. The blue and green colours are of lower chromaticness than the yellows and reds, for both technical and aesthetic reasons (fig.4).
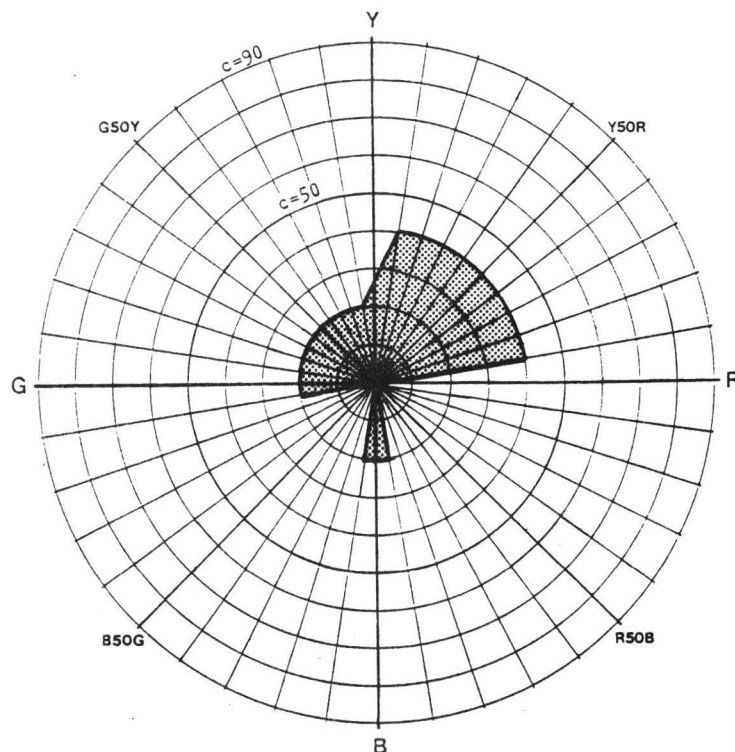
Fig.4. The colour selection in the NCS outdoor colour card illustrated in the NCS colour circle showing hue and chromaticness.

Blue exterior paint is technically still a problem. The blue pigment
normally used in modern tinting systems, thalocyanin blue, has good
durability itself, but has a tendency to affect organic binders, so that
the surface chalks and whitens. This is most chritical for the more
chromatic and dark blue colours. In paints for plaster and concrete the
only blue pigment with good durability is cobolt blue, which is still a
very expensive pigment.

All these colours are not of course appropriate in all kind of paints or
on all surfaces. The darkest colours are normally most suitable
for windows doors, metal plate work and other details. Futhermore they
are impossible to produce in mineral paints for plaster and concrete.

There are of course situations where a colour outside
the boundaries of this selection could be justified on a facade. This
colour can then be found in the complete NCS colour sample collections.
The important thing is to be aware of the choice, technically, economi-
cally, traditionally and aesthetically.

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*A conception of exterior colour design
for a plant in Bulgaria*

A CONCEPT OF EXTERIOR COLOUR DESIGN

FOR A PLANT IN BULGARIA

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The character of the specific production process and its products suggested the leading idea of the colour design of a plant for peripheral devices in the town of Plovdiv,Bulgaria.

The adopted interior colour design is strictly functional : it provides conditions for precise visual operations and suits the microclimatic requirements for hermetic cleanliness. There were two alternatives for the exterior colour design:

1.to adopt a counterpoint colour decision, by using active saturated colours on large surfaces, and have the effect of emotional stimulation,majority,attractiveness; and

2.to have a symbolical expression of the preciseness and cleanliness of the interior production processes.

This second idea was adopted and represented by the white colour (with a bluish touch), predominating in the whole complex of buildings.

Two more symbols were used in the exterior colour design of the plant. Carefully considering the architectural form and the character of the facade treatment of the main production building, an idea of the application of a colourful band was adopted. It splits the architectural form in a way,suggesting the form and function of a peripheral device -the main product of the plant.On the other hand,a floppy disk,inserted in such a "split" of a peripheral device, bear an enormous amount of information, registered with the help of ellectro-magnetic waves- and this is symbolized in the exterior scheme by using the whole range of their visual spectrum in the colourful band.

The use of these symbols was not frivolously accepted.

Thus conceived, the colour design is also coscious to the general architectural and compositional idea, and is based on a profound examination of a number of motivating factors and the corresponding data:

- the specific layout of the industrial complex in the surroundings,
- the spatial characteristics of the architectural forms and spaces,
- the character of the facade treatment and the type of architectural details,
- the choice of materials and construction scheme,
- the specific circumstances of visual perception from different points, angles and distances.

The whitish complex, with a bright colour accent, forms a counterpoint to the rather featureless industrial surroundings. The aim of the colour treatment was unification of the buildings and accentual treatment of the compositional and functional centre- the main production building. Its refined architectural volume suggested the simplicity of the accepted colour scheme- with no more articulations than just the colourful band. Its asymmetric disposition is considered with the functional articulation of the facade: it covers some openings of service installations and underlines the window range. The strong chromatic accent of the band is to be ballanced by the predominating whitish colour of the large facade surface. The idea of colour unification is supported by the treatment of the "fifth facade"- the roofs are also conceived in light whitish colours. Unification was the idea of the colour treatment of all the air-tubes and other devices, appearing on the facades and the roofs.

Talking of symbols, the colour plate is designed to become a simple, but characteristic "firm-sign" of this plant. It is considered to be percepted from different distances, angles and the main points of view and to create a well-remembered unique image.

So far as technology of performance is concerned, some simple means were used to realize the colour concept.

The main surfaces of the alluminium wall pannels are treated with polymeric facade paints and the colour band- with alkyd oil paints, gun-sprayed.

The experience of the teamwork of an architect and an artist proved the advantages of such collaboration.

One more conclusion is, that the simultaneous work on architectural composition and colour design might prove quite more successful.

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Some visual, lighting related effects of ancient tapestry in Tuscany

SOME VISUAL, LIGHTING RELATED EFFECTS OF ANCIENT TAPESTRY IN TUSCANY

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A b s t r a c t

During the first decades of the present century,and, in a few cases even
nowadays, in Tuscany, the "important rooms" were named according to the col
our of wall tapestry. The gamut of available hues of these "ancient-like"
textiles covers, practically,the whole spectrum. The overall effect is magic
ally fascinating. For a number of reasons, probably related to the intimate
micro-structure of the textile,the variegated dependencies on the lighting
and observation angles contribute to rendering "alive" the indoor spaces.
In addition, the colours are   saturated enough,to result(except for yellow)
in a lightness-luminance discrepancy,accompanied by a strong inter-indiv
idual variability. In addition,the red-blue lightness comparison strongly
depends on the luminance level,because of the Purkinje shift.

To optimize the appearance of environments coated with ancient-like
wall tapestries,the designer is faced with a delicate task, which probably
would require a computerized multi-dimensional assessment of the matt versus
lustrous speckled effects (gloss),to be combined with the proper lighting
strategy.

1.Aim of the work.

In the framework of the history of interior design(1),the development
and use of wall tapestry is well codified. In turn, the complicacies of the
fine structure of the textiles, their contribution to colour and to colour
changes when the orientation angle is varied,represent a problem of pract
ical interest(2). The reports of microscopic observations on textiles, the
light-fiber interactions,the polarization effects,the Moiré-like phenomena
and similar, belong to the history of Applied Optics (3).

The present paper aims at considering one of the aspects of the above
big area of research.We simply try to "test",photometrically and visually,
some samples of wall tapestry, familiar to the inhabitants of Tuscany aging
beyond the fifties, and still available to-day, although often replaced
by the cheeper modern solutions. Our attempt might be funneled into the
channel of the evaluation of textile gloss(4), resulting in a quantitative
"classification" of wall tapestries, say, according to the way in which they
contribute to render "alive" the environment,rather than in a mere nostalg
ic quantification of the "lost values".

2.<u>Experimental procedure and findings</u>.

The problem of lighting conditions on textile appearance is a difficult one(5).The conditions adopted by us,resembling the major situations current ly met in rooms,during the daytime, are shown in Figures 1a) and b).

Measurements, at photopic levels, have been made with a photoelectric Luminance Meter Minolta LS 100,for various rotation angles (α) around a vert ical axis of monochrome samples with matt flowers on lustrous background. The presentation of data is of the type shown in Figure 2, which refers to a yellow sample, and includes both instrumental data(open squares) and the subjective evaluation of the ratio of the brighter to the dimmer items.The points lying on the line labelled "equal" refer to those cases where the luminances and/or the lightnesses of the flower and of the background are the same.The upper portion indicates how many times the flower exceeds in luminance and/or in lightness the background (regarded as "unitary").The lower portion indicates how many times the background exceeds in luminance and/or in lightness the flower,now regarded as "unitary". The observers had to be carefully instructed about the way in which they could make use of their "internal" relative lightness scale.

Note the individual differences in Figure 2. Indeed, the photoelectric instrument "averages" across the tested area. The human observer "weights" the set of local lustrous versus matt differences,according to his own strategy. This leads us to argue that the environmental fruition is relat ed to a sort of individual "personal equation".

The above procedure has been adopted in situations like that shown in Figure 1b),where the illumination produced by the window varies with angle η ,as is shown in Figure 3(left), which refers to two ancient-like (A) and one modern-like(M) tapestries,the gaze being directed perpendic ularly to the sample, whatever η is.

Figure 4 shows how this η -dependence varies during incoming sunset, when a red sample is compared to a blue one.Probably, we are faced with the consequences of the "Purkinje shift".

Figure 5 refers to the brightness-luminance discrepancy. In the left portion,some ancient-like samples are ordered according to their hue,on the abscissae, from blue to red-purple.On the ordinates,the ratio of the lumin ance(as recorded with a Schmidt-Haensch,N°238,visual photometer, in an het erochromatic brightness match color-to-white),and the "luminance" given by the above said photoelectric photometer.Data from two observers(four in the blue)are compared.In the right portion of Figure 5,the data obtained from 34 observers (one is protanomalous, the others normal),faced with a sample consisting of a red-orange stripe flanked by a yellow stripe, are shown. Note the spread of individual estimates of the RO/Y ratio,exceeding the instrumental(photoelectric) prediction of 0.66, in the majority of cases. These data are in line with the data found in the literature on other- -than-tapestry luminous and non-self-luminous objects(6-7).

3.Toward a theoretical prediction.

The question arises whether the "magic" atmosphere created by ancient-
-like tapestries,combined with the proper lighting installation,can be pred
icted.As a first step,let us assume that modern computerized facilities allow
the needed multi-dimensional photometric and colorimetric assessment,at var
ious locations in the room,as complex as needed. Next,a model evaluating how
the environmental fruition occurs,by taking into account that the man shifts
his gaze and moves across the room,is needed.Problems of this kind have been
intriguing the theorists since long. For instance,Henry's dynamogenic-inhib
iting model of scientific aesthetics(8),dated 1888,could be used as a concept
ual basis,followed by Birkhoff's mathematical approach to aesthetics(9) culm
inating in the recent evaluation of the spectral entropy (10).

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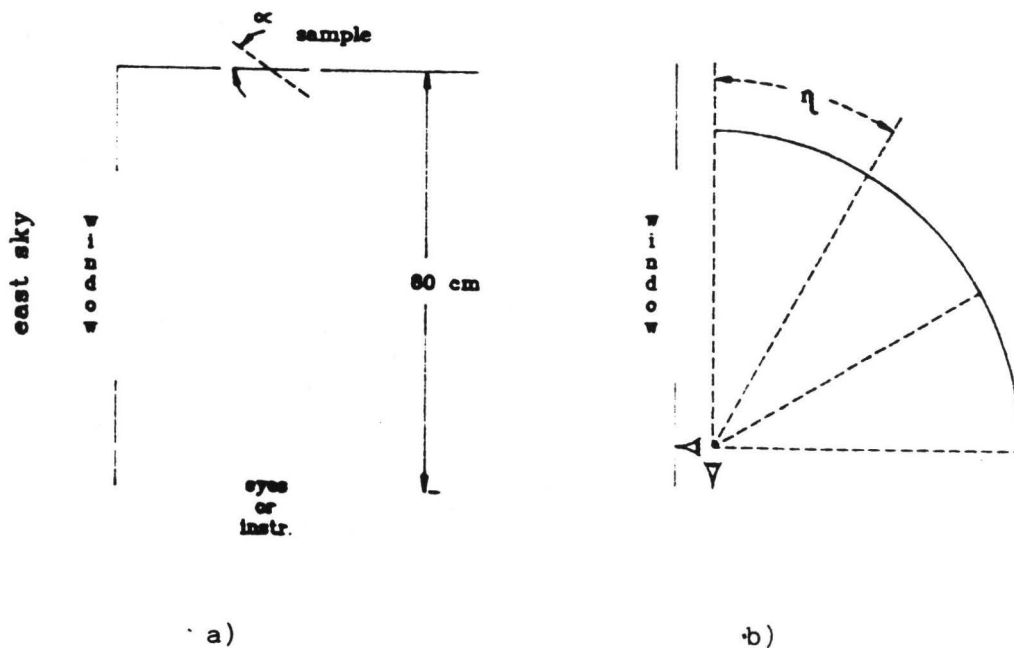(10)-M.Markus,S.C.Mueller,T.Plesse and B.Hess- Biol.Cybern. 57,187-195,(1987).

Fig.1 The two experimental arrangements used to test the samples of wall
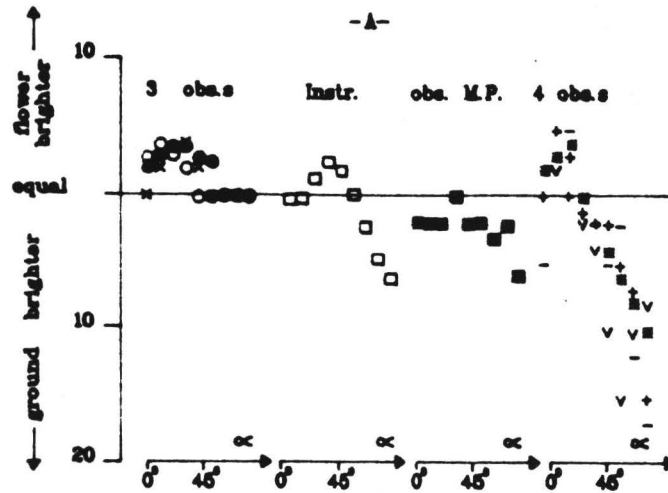tapestry.

Fig.2- Abscissae: angle of sample rotation around a vertical axis.
Ordinates: evaluation of flower-to-ground contrast.Visual data
from different observers are compared to the response of the
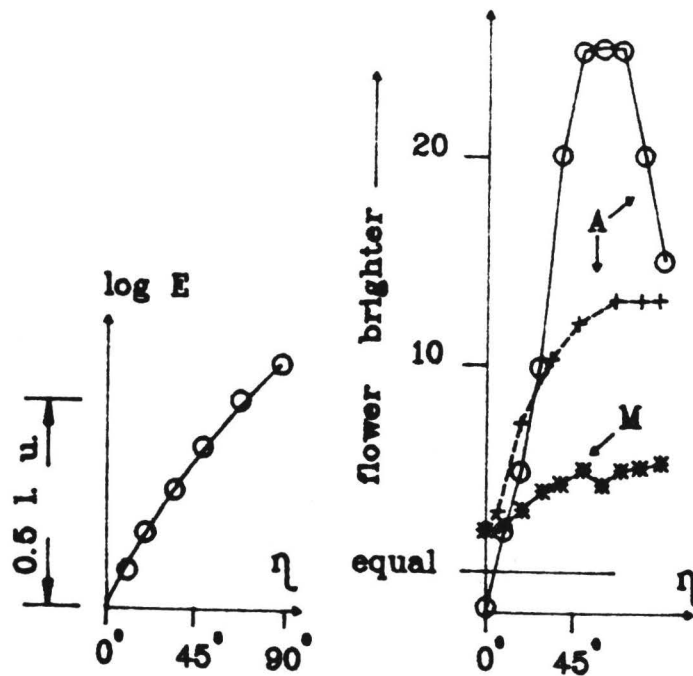photoelectric instrument(open squares). A,for "ancient-like".

Fig.3-Data obtained with the set-up shown in Fig.1b). Left:angular dependency
of illumination(on a vertical plane). Right:angular dependency of flower
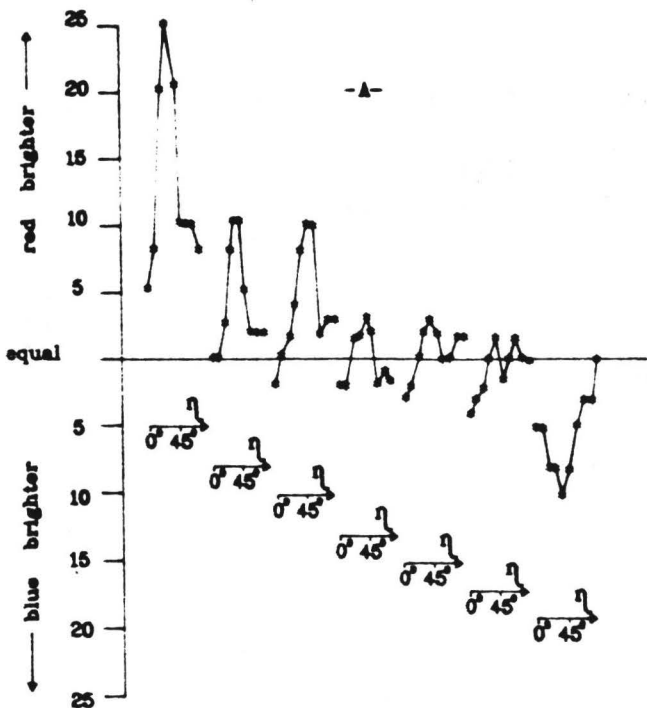to ground contrast evaluation for three different tapestries. Data from
one observer.

Fig.4-Angular dependencies of red and blue lightnesses comparison, for one
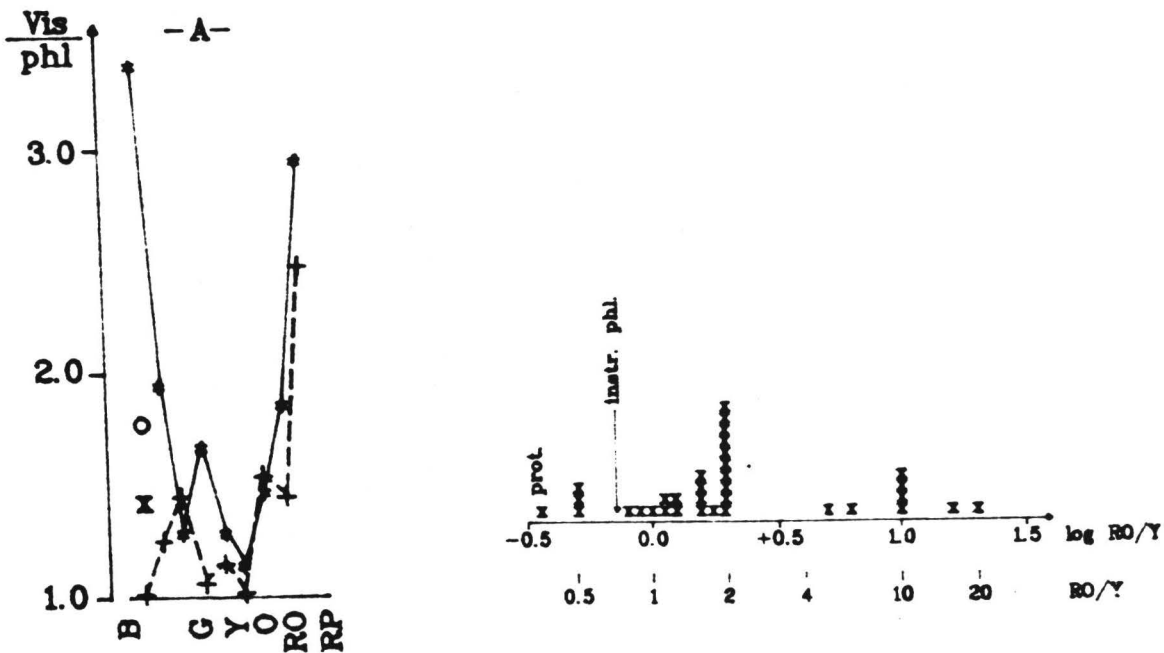   observer.Various plots refer to decreasing luminances, during sunset.

Fig.5-Left:Abscissae:various ancient-like tapestries,arranged according to
   their hue(Blue,Green,Yellow,Orange,Red-orange,Red-purple).Ordinates:
   ratio of "luminances"measured with the visual and the photoelectric
   instrument,respectively.Labels *,x,O,+ denote different observers
   (using the visual instrument). Right:spread of the individual estimat
   es of Red-orange to Yellow lightnesses,for a two-stripe sample of
   ancient-like tapestry.Each cross denotes a different observer.

39 **Urban Willumsen**   **Norway**
Art Critic/Colour Design
Sandefjord
Our colourful life

OUR COLOURFUL LIFE

Urban Willumsen, Norway
Artist

Tasting the word COLOUR on your tongue, or at the
mere sight of the written word, a series of associations
appears. "A colourful person" does not mean a dark skin-
ned person, but an imaginating human being. "Her meanings
were coloured by...." tells about statements marked by
somebody else. "To change colour" means to change opinion.
"Colourless" may tell about a grey matter, but it might
tell about a dull person aswell. The word allways conveys
a feeling of something extreme, unusual and special,-not
common. So, the headline of this paper tells about our
lives, being filled with colourful surroundings, but it
also brings up the opinion that to live is a very event-
ful thing.

Our daily contact to environment is in some way limi-
ted to our senses. Vision, being our main sense, will ef-
fect most of the communication man/environment, and col-
our perception by preference.

Of course colour straight away means yellow, red,
blue, green, white and black, according to old Hering.
In the first hand attributes for signals and messages
from your outside environments. But it also conveys gai-
ety and fun, and in a more advanced way, - aestetic attr-
ibutes. Once professor W.D.Wright asked: "What are col-
our for", and his own answer was: "Colour is for infor-
mation". Of course he was right, - partially. But truth
has many facets. Let's put focus to some of them.

The word colour does not express just one single and

clearly defined conseption, indeed. Among a series of
meanings it will be useful to separate three specific
ones. In our living situation we meet colour at three
quite different levels of engagement.

1. COLOUR AS INFORMATION
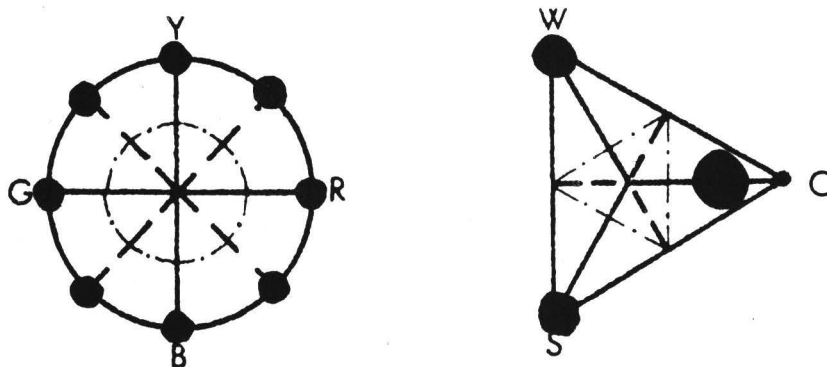2. COLOUR AS SPONTANOUS EMOTION OF FUN
3. COLOUR AS AESTETIC PERCEPTION

1. Our five senses, may be six - some mean seven -, ma-
kes survival situation bearable. But the efficiency of
the senses is rather varying. Related to the dogs very
good sense of smell, man is born with noses nearly cold
and nonpenetrating, neither can he compete with the eag-
les brilliant longdistance sight. But, to compensate
such inefficiency man got the sense of colour vision. No
doubt, it is for information, in duty of the survival.
In our daily life colour gives us lots of information
about the condition and qualities of our environments.
Some colour informations are just interesting, others
come in very useful, ans some are of the most urgent
importance to our survival. Most of the perceptual con-
tact to the surroundings goes through vision, and col-
our vision.

Colour can tell us if the meat is fresh or not, if
the fruit is ripe or not. Colour also helps us to recog-
nize or identify things and abjects. We use colour to
signal messages, and there are for instance international
mutual consents about the use of signal colours in indu-
stry, trafic etc. Established use of colour like this
very often control our associations in daily life. Heral-
dic and liturgical use of colour is by tradition connec-
ted to precisely defined colours, and in the literature
of banality, tradition has built up conventions about the
"psychological" contents of colour, like "red for love
and emotion", "green for peace" etc.

2. The mere sight of rich colour variation seems to give
positive, emotional reactions, like good humour, gay and

exiting feeling, or happiness. When children are picking
and collecting wild flowers they do it for fun, and the
bunches shows no trace of a plan. The finest and most ex-
iting bunch will be the one with the greatest variations,
the highest saturations and the biggest contrasts.
When man is celebrating he decorates with bright colours,
and dresses up with nice colours. The childrens parties
gleam of highly saturated colours. And to give a positive
impression modern advertising uses the same high satura-
tions. The colour contrasts and the polychrome effects
itself give that happy and gay feeling.

The NCS models for colour notation illustrates the type
of colour and nuances used in the case 1. INFORMATION
and 2. SPONTANOUS EMOTION OF FUN.

3. But colour also can be picked up, and brought together
as a result of a plan. Colour combination in design, arch-
itecture, home decorating, art and other aestetic ends
seems to document that the aestetic choise of colours
is based on specific relationship between their visual
attributes. Colours in a constellation or composition
can be related by visual similarities, like for instance
equal hue, equal lightness, saturation (chromaticness),
blackness or whiteness according to NCS attributes. Such
relationship between colours seems to create an impress-
ion of order, balance and quiet - perhaps "harmony" as-
well. The word "harmony" is a rather strained one, when

connected to aestetic terminology. but the term "colour harmony" has tacitly been historical accepted as the ends and means of colour combination and composition.
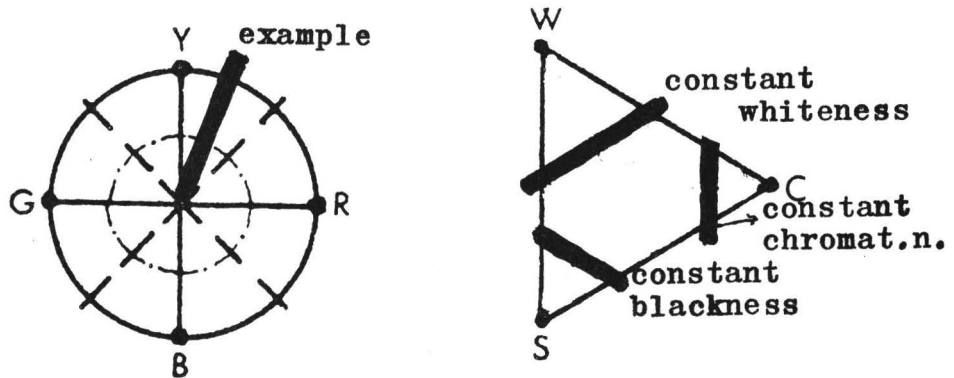
The NCS colour notation models illustrate how colour very often is used in aestetic composition.

In art the colour impression will content at least a component of all the three aspects mentioned. In the impressionistic paintings, for instance by Claude Monet, colour gives information about things and objects. It even tells about the time of day and the weather situation. But the bright colours and contrasts also spontaneously give fun. And, at the same time, to the artist the emotional atmosphere probably was the main inspiration and aim of creation. Very often the three aspects will alternate in the mind of the spectator, making an exiting impression of a visual "happening".

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Colour decoration art of China architecture

THE ART OF CHINESE ARCHITECTURAL PAINTINGS

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In world history of architecture, Chinese ancient architecture holds an important and unique position. One of the widely used arts in the ancient architecture is the architectural painting, which forms a major part in architectural decoration.

At first, people painted simple patterns on wooden structure of their houses with mineral paints and tung oil, for practical purposes of preventing the exposed wooden parts from eroded by natural forces or eaten by moths. Later, more aesthetic elements gratually entered such kind of painting that it developed into an artistic form rather than merely a practical one.

During 1600 years of the Slave Society (21C.B.C.-- 476B.C.), bright primary colours and coloured paintings had already been used on the wooden structure of palaces. The different colours which decorated the architecture at that time represented the different grades of the buildings.

In early Feudal Society (475B.C.--281A.D.), the architectural style of the ancient China gradually came into formation. In architectural decoration, there appeared varieties of patterns as figure pattern, geometrical pattern, or plant and animal pattern. These patterns were used in ground bricks, beams, columns, bracket sets, windows, walls, ceilings and roofs, in forms of paintings, carvings and castings. Besides, new colours were added to traditional ones. For example, columns of the palaces were painted red, and coloured paintings were used in bracket sets, ceilings and ties; as for walls, there came blue purple or even frescoes. So we may well conclude that paintings, carvings and Chinese characters were mostly used to decorate buildings at that time. This has become one of the major architectural decoration forms in ancient China.

During the year 265--581, along with the introduction of Buddhism, the decorative patterns in architecture appeared somewhat religious and exotic (mainly in Indian, Persiam and Greek styles). Chinese architectural decoration entered its first booming period in history.

In Sui and Tang Dynasties (581--979), colour bleeding was first used in the composition of architectural paintings, which greatly influenced the primary characteristics of the architectural painting in Song Dynasty.

In the palace architecture of Song, Liao and Jin Dynasties (976--1279), gold and green were painted under the eaves to sharpen the contrast in the shade parts. Skills of the architectural painting in this period were explained in detail in a book called ' Rules for Structure Carpentry ', which was written in 1103.

Colours and patterns of the architectural paintings in Liao and Song Dynasties learned a lot from Tang Dynasty style, with vermilion and yellow being the dominant colours, sometimes mixed with green. In Northern Song Dynasty(960--1127), there were three major styles in architectural paintings, indicating the different grades of the buildings and the social positions of the owners. The beam heads painting included sceptre and fang-hsin, and the use of colour bleeding here aimed at weakening the contrast of the different colours. This had given inspirations to the architectural painting in Ming and Qing Dynasties.

In 1271, China entered Yuan Dynasty. Multiple religions and cultures of the multiple nationalities brought nes patterns and colours to the architectural decorations, especially in Dadu City, capital of Yuan Dynasty. This had paved the way for the development of the architectural decorations in Ming and Qing Dynasties.

Chinese architecture in Ming and Qing Dynasties achieved great successes.

In Ming Dynasty (1368--1644), scroll patterns played a dominant role in architectural paintings, with simple colours in cold tones as blue and green. The technique of colour bleeding was introduced into the patterns, which, chequered with blue and green, conveyed a simple yet elegant taste. Vermilion and gold were occasionally mixed in such patterns to make them look brighter and more vivid. In order to achieve a clear and beautiful contrast of colours, the architectural paintings during this period discarded the traditional technique of the ourline-drawing with gold, as well as the seperating effect with white. The pattern designs were made in two major styles: fine, close lines, or big, unfolding leaves. The different styles expressed different aesthetic tastes. In a word, the creative compositions, the exquisite mixing of colours and the fine drawings all made the architectural paintings in Ming Dynasty a pure, perfect success.

There were new developments in both patterns and techniques of the architectural paintings in Qing Dynasty (1644--1911). Under the feudal hierarchy, different styles of paintings were used according to different grades of buildings. Some most commonly-used styles were: imperial-style

painting, Suzhou-style painting and scroll pattern painting.

The imperial-style painting was the highest-grade architectural decoration in Qing Dynasty. It was used in major imperial palaces where emperors conducted state affairs, offered sacrifices to heaven and ancestors, or resided.

Such paintings usually took dragons and phoenixes as their most frequently-used images, accompanied by some other images as scroll patterns, lotus and water chestnut flowers. Glod colour was exaggeratedly used in the imperial-style paintings to make the palaces took more majestic and magnificent.

The Suzhou-style painting was mainly used in gardens, parks and residential buildings. Natural sceneries, animals and plants, and historic stories were all its favorite subjects. Compared with the imperial-style painting, the Suzhou-style painting was more secular and accessible, therefore enjoyed greater popularity among the ordinary people.

The scroll pattern painting could actually be considered as a variation form of the imperial-style painting, distinguished from the latter by being used in minor imperial buildings and temples. Based on Ming Dynasty tradition, it had further developed into eight forms in correspondence with the different scales of the buildings. Its designs were evenly laid-out and lines closely drawn, with blue and green as the dominant colour, embellished with black, white and gold, thus giving the tone a grave and solemn air.

Besides the above-mentioned three styles, there was another style of architectural painting in Qing Dynasty, which combined Suzhou-style painting with scroll pattern painting to achieve a unique effect of lively compositions.

The architectural painting contributes much to the beauty of the architecture in both the richness of colours and the outlooking of the building. Take the example of the three major halls in the Palace Museum (namely the Hall of Supreme Harmony, the Hall of Moderate Harmony and the Hall of Preserved Harmony), vermilion and gold are painted on those parts exposed in the sun, so that they reflect a dazzling splendour; while the shaded parts beneath the doubled-eaves are painted into cold tones, mainly blue. Thus a sharp contrast is formed that adds to the depth and thickness of the projecting eaves. The red columns and the white marble carved banisters are also included into the organic whole, with each part in great harmony with another, all served to represent the imperial majesty.

Chinese architectural painting is an important part of Chinese traditional decorative arts. Through thousands of years of architectural practice, Chinese architectural painting has developed into a systematic art form with strong national flavour, and has lent lots of inspirations to modern architectural decorations.

For the architectural colour paintings of 1911--1949, more copying of the traditional Chinese patterns than creations were made.

After 1950, along with the development of building technology, the main factors of the architecture, namely architectural function, technology, material and art, were accordingly changed, so were the requirements for the architectural colour paintings. Gradually, the modern architectural colour paintings were brought out on the basis of Chinese traditional paintings which charactorized the modern times.

As an important role in modern architectures, the modern architectural colour paintings are mainly used in the interior decorations, such as , on the ceilings, beams, columns and lamp sets etc., and can be found occasionally in the exterior decoration of an architecture.

To make the overall colours of an architecture in good harmony, the colour designing of the modern architectural colour paintings pays much attention to the arrangements of all the colours in an architecture. In some cases, the architectural colour paintings may play a leading role in an architecture, whereas they may also serve as a foil in another cases.

After 1955, the architectural colour paintings are largely influenced by the Dunhuang Wall Paintings. Much intermediate colour and warm tones are used instead of the primary colours and cool tones which are always found in the colour paintings of Chinese ancient royal palaces. So that the whole effect of the colours in the paintings are warm, comprehensive, elegant and bright.

In dealing with the lines of the colour paintings, the traditional diagram of dragons and phoenixes are substituded, in a great extend, by the figures of plants, animals, geometry figures and folk arts. In addition, some methods of the composition of spacial arts, such as the sense of scale, proportion, etc., are largely introduced into the modern architectural colour paintings, which enhance the arts of the colour paintings the charactors of the age.

The arts of Chinese traditional colour paintings are the precious heritage left over by our ancester, they are also the inexhaustible sources that we can make use of in our future design of the architecural colour paintings.

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Colour of Ta Er Si temple

The Taer lamasery is situated at Lu-shar-Zhen, Huang-Zhong Xiang, Qinghai Province. It is the sacred place of the Dge-lugs-pa Sect of Tibetan Buddhism, as well as the birthplace of the Great Master Tson-Kha-pa, the Founder of this Sect. This Lamasery is a typical example in which the colour of the interior and outside environment of the architecture influences people's psychology. Everyone who has been to Taer Lamasery must be touched by the action of devout Buddhists. Some of them come as far as several hundred, even several thousand li (kilomters). As soon as they enter the Lian-hua Mountain district where the Lamasery is situated, they begin to make long Kowtows once every two steps encircling the Mountain for several kilometres, and then encircling the Taer Lamasery. Blood oozes out of their foreheads and they prostrate themselves before numerous tourists. Everyone of them is completely oblivious to others else present and neglects not the slightest detail of his duties (figure 1). The strength comes from religious belief without doubt. However, it is important element that the architecture established in the fourteenth century applied colour to creating an environmental atmosphere which aids in the psychological control.

Red, yellow, blue, green, gold and white are the chief colours in the architecture of the Taer Lamasery. They not only make the Taer Lamasery appear to be halls of God on earth, but also strongly reflect the straight-forward and uninhibited disposition of the herdsmen of the Zang (Tibetan) nationality together with the butter smell emitted by the moulded butter offerings.

1. The Colour of Gold

In the architecture of the Taer Lamasery a large quantity of the gold colour has been applied. For example on the entire roof of the Grand Golden Tiled Hall (figure 2), the entire roof of the Minor Golden Tiled Hall (figures 3), the golden lid vases and makara on their ridges , and the copper streamers, pennants, deer, etc. of copper auspicious ornaments on the roof of the Big Hall for Sutra-reading are all gilded (figure 4,5,6). Such huge solids of gold stand high on the top of the architecture and they add great charm to the Lamasery.

In the Halls the holy niches (figure 7), column heads, roof beams, ridgepoles are all decorated with gold (figure 8). Many big exquisite lampstands, sacred vessels and musical instruments are all made of solid gold (figure 9,10). Almost all the ex-expressive images of figures of Buddha are applied with gold lacquer. A few chief figures of Buddha together with the ornaments behind them and the Sumeru pedestal on which they stand are completely covered with gold lacquer. (figures 11,12)

Among a lot of colours without lustre, the brilliance of gold gives one a sense of luxury and nobility. It has played a decorative role not

to be ignored in this type of architecture. According to custom, people
recognize gold colour to symbolize gold itself. Half of the value of gold
is determined by its brilliance and the brilliance of the colour in turn.
symbolizes its value. Gold marks wealth and the colour of gold will
satisfy and bring apparent prosperity to people. Thus, even though the
object itself is earthen, once it is covered with gold, a sense of dignity
and luxury is produced.

Gold is a heavy metal. The colour of gold can give a sensation of
heaviness no matter what it is applied to . The architecture of the Taer
Lamasery is filled with large quantity of the gold colour giving a sense
of heaviness, constraint and a deterrent force which can not be resisted.
For devout believers in Buddha the sense of constraint will produce a
force which compels people to surrender..

In th Taer Lamasery gold are applied to large areas, overlapping each
other and stressing itself over and over again. Golden colour not only
plays an important decorative rôle and lends the architecture a resplendent
and magnificent effect, but also embodies the idea of value for people to
show off the glorious achievements of Buddha and the wisdom of God, so it
plays an important psychological role in conquering people's minds.
2. Red, Yellow, Blue and Green

Yellow, the chief colour of the Taer Lamasery, occupies a dominant
position, because the founder Tson-Kha-pa and his disciples wore yellow
caps. This sect was also known as the Yellow-Cap Sect or Yellow Sect.

The statue of Great Master Tson-Kha-pa is dressed in yellow, (figure 13) as also
are Sprul-Sku and the lama dignitaries. (figure 14) All members of this sect wear
yellow caps, the interior decoration of Great Sutra Mansion takes yellow
as its leading tone. (figure 15) Yellow is the emblem of the Dgelugspa Sect.

Yellow is the colour which is highly valued. It stands for brightness
and wisdom and is able to bring the believers who struggle in misery the
illusion of hope.

In many countries in the East yellow was applied to symbolize power
by emperors, therefore the yellow of the Taer Lamasery also contains a
sense of mystery and dignity.

From the point of view of architectural structure, it is necessary to
take yellow as the leading tone because none of the halls has a window, and
the interior illumination relies on butter lanterns where only the highly
valued colours can be seen easily. Thus, using yellow is scientific. White
of which the degree of value is the highest was not applied which shows
that at that time the people attached greater importance to the emblemment
significance of colour. The dignified sense of yellow can not be replaced
by any other colour.

For compatibility red and yellow are interwoven into a burning hot tone of warmth. Almost every column, every door and many of the wall ornaments, Mani-wheel(figure 16), altars, tables and chairs are decorated with red. Nearly all the Kasayas (patchwork outer vestments worn by Buddhistm monks) worn by several thousand lamas are red(figure 17). When a thousand butter lanterns are lit up in the halls, people will be burning with righteous indignation as if they were in a world of fire(figure 18). Bright red and yellow cause people to sense happiness and gaiety, as if they were in Western Paradise(The Land of Purity). At the same time, red and yellow cause people to sense terror, as if they were in Purgatory. In the Taer Lamasery, red is applied in such an excellent and wonderful way so that it unexpectedly creates a huge conquering mystic force which can shake everyone around.

It is not an isolated fact that red is applied inside the halls of the Taer Lamasery. Most of the believers who go on pilgrimage to the Taer Lamasery are the herdsmen of the Zang nationality who move about in search of pasture and spend all their lives between the blue sky and green grass. They can not depart from blue and green for even a moment, just as one can not leave air and water. However, regardless of physiology or psychology, it is necessary for people to require complementary colours. The complementary colours of blue and green are red and orange precisely (the orange of the Lamasery melts into red and yellow). The herdsmen's hunger for red and orange is compensated for by their deep beliefs in Buddism. Surrounded in an internal environment filled with red, the believers even if in a state of utter exhaustion can gain the height of inspiration in spirit. Regardless of the sense of terror or cheer their consciousness can be summoned and they are perfectly content after their pilgrimage. The comfort which Buddha has given to the believers includes nourishment of colour.

People are thirsty for complementary colours of blue and green----red and orange, but it is inborn for people to be sentimentally attached to real life, thus in the architectural colours of the Taer Lamasery blue and green which serve as contrasting colours to red and orange appear again and again. in many places. The outer wall of the Grand Golden Tiled Hall are built with vaidurya (cat's-eye gem) bricks which together with the natural surroundings of the blue sky and green trees seem to blend into each other, enabling people to sense friendliness and solemnity(figure 19, 20). It is such a natural colour for the external architecture that it serves as a contrasting background to the unconventional atmosphere which the red and orange of the inside halls has created .Before entering the halls, people are encircled by a large area of blue and green. When they step into the halls of Buddha, the tone in the field of vision alters from cold to warmth suddenly. The red and yellow halls in which there is not a single window and butter lanterns glisten not only cut off the people

from the outside world, but also give people a false impression of time and space thereby imbuing a spirit of sublimity.

By the complementary colours contrasting usage of the blue-orange, green-red, which appear sooner or later outside and inside the architecture of the Taer Lamasery, we can deduce that as early as the fourteenth century the monks of Buddhism and craftsmen already quite understood the psychological effect of complementary colours. Viewed as a means of psychological conquest, the technique of using complementary colours——inside and outside the Taer Lamasery is particularly suitable and wonderful.

However, the outer wall of the Upadhyaya Mansion which is not far from the Grand Golsen Tiled Hall is red. The Upadhyaya Mansion was erected in 1650 and rebuilt in 1687. In 1777 the Emperor Qianlong of the Qing Dynasty dispatched personnel to construct its walls, iron gates and doorway pediments, thus it retains the architectural style of the Han nationality (figure 21). Red of its outer wall echoes the red colour of the wall of the Imperial Palace. The reason for adopting red for the outer wall of Han paplaces is that red endowed with the emblematic significance of auspiciousness by the Han nationality. Moreover, red palace walls overshadow the small grey houses of common citizens, thus emphasizing the absolute superiority of imperial authority.

After the Upadhyaya Mansion was built, the Minor Golden Tiled Hall was (figure 22) built in 1692 and the Longevity Hall in 1717 (figure 23). The outer wall of the two buildings also adopted the red colour affected by the Upadhyaya Mansion and this reflects the close relationship between the Qing Dynasty and Dgelugs-pa sect, which is one between principal and subordinate. These historical legacy is reflected in the way in which colours affects and is in architects. The Zang nationality possessed a deeper affection for green. In the halls blue and green are the two important contrasting colours appearing on ornaments. The background behind Great Master Tson-Kha-pa's statue, adorned with yellow hat and yellow clothes, is bright green (figure 24), which not only stresses the image of the golden statue, but also enables the image not to lose its sense of kindliness.

It is necessary that the space among the yellow pillars standing in great numbers inside the Great Sutra Hall is broken up. Here the designer has applied sky blue screens which enable the separated spaces to give a realistic sense of separation with large areas of blue in the orange and yellow world (figure 25). Because blue can not gain overwhelming superiority since the leading tone of yellow blots out the sky and land, its usage can be bold and it can emphasize the contrasting effect, matching the yellow to more active .

In the Taer Lamasery many of the frescos have adopted bright blue and green for contrasting colours, whereas the colour of the frescos of the Tibetan Buddhism Sect have adopted the representative style where red , yellow, blue, green, white and gold are the leading colours, and the difference of hue and value is employed in portraying shapes. *(figure 26,27)* However, colours of low purity seldom appear in the frescos and this is the most outstanding characteristic which is different from many frescos of the Dunhuang Caves.

3. White

Lamaism is a branch of Buddhism, the Sect of Tibetan Buddhism. The basic religious doctrine of Buddhism is "everything including man does not exist realistically" and it attempts to propagate "severing every desire of pursuing realistic profit in order to free and purify oneself in spirit". Thus, white without colour is endowed with emblematic significance of nihlity, space, holiness, purity and loftiness. The architecture of Taer Lamasery thus adopts a great quantity of white, and was mainly on the outside buildings. The bodies of the Eight Tathagatas Chaitya are covered with white, which have been erected to eulogize the eight accomplishments of the whole life of Sakyamuni. *(figure 28)* In addition, the bodies of Bodhistupa, *(figure 29)* a Stupa with Four Gates *(figure 30)* and Kalacakra Chaitya *(figure 31)* are all covered with white. The outer wall of the Grand Golden Tiled Hall, *(figure 32)* the Kalacakra Institute, the Manjusri Hall (alias the Nine Apartments Hall), *(figure 34)* the Medicine Institute *(figure 35)* and the Esoteric Buddhism Institute *(figure 36)* are all white with a grey base and the top decorated with brown ochre spen-ma. These have formed the specific style of architecture of the Zang nationality.

When we stand on the Lian-hua Mountain with a bird's-eye view of the whole panorama of the Taer Lamasery, the continuous architectural complex appears in the main tone of white which signifies that it is a piece of pure land. The pure and clean white gives pilgrims a sense of trust and its nihility, space, holiness, purity and loftiness give a sense of honesty and openness.

The colour of the Taer Lamasery is the crystallization of science and religion and is a model of the combination of environment and colour psychology in our country in ancient times. It has confirmed that environmental colour can have a profound psychological influence on people through the form architecture from the angle of religion.

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*Quality of color, relation between changing
distance of vision and matching colour*

The Quality of Colour

Colour possesses quality. Every colour influences people's psychology with its own qualities. In the coordination of a lot of colours, either cooperation or exclusion emerges between the colours because of the difference of quality and their respective primary and secondary relationship in the picture.

1.   Classifying Qualities of Colours

From the viewpoint of the NCS (written abbrev. for: Natural Colour System), white and black are both designated as elememtary colours. This is a propriety, because no kind of pigment, whether it is artificial or natural,is pure or clean compared with the colour of the solar spectrum. Some pigments look delicate, and can be sensed to be made by mixing pure chromatic colour with white, some look   dark, as if they are made by mixing black into them; and some can be seen to be mixed with a mixture of white and black and look turbid. Only the colours of the solar spectrum are absolutely pure chromatic colours. Due to the contrast of the solar spectrum colours,it has been verified that white and black are elementary colours and no common colours can be produced in everyday life without them.

All coôours are divided into four different types of quality on the basis of the elements of white, black and the pure chromatic colours. which they contain individually: PC (Pure Chromatic Colour), CL (Clear Colour), TU(Turbid Colour), CO(Complex Colour).

Pure Chromatic Colour:

The intensity of these beautiful PCs in the solar spectrum is saturated. Human beings are not capable of making pigments and dyes as pure as the colourso of the solar spectrum. "Pure pigments" can only refer to these pigments which/can be obtained as pure as possible by human beings, so we have to discuss the quality of colours within the limits of such a "relative purity" for practical application.

Each PC stimulates a different part of the visual nerve, but each/of them is imbued with a strong exciting action. PCs ênable people tô sense gorgeousness, satisfaction, vividness and activity. Seeing PCs for the first time will excite and cheer people; however, watching a large PC area

for a long time will upset and tire people. This is the quality of PC (figure 1).

Clear Colour:

When PCs are mixed with white gradually, the intensity begins to drop, the colours become light and appear clear. Now a type of colour with a new quality ---- clear colour ---- has emerged.(figure2) The extreme of CL is white.

Although CLs are still pretty and contain emotion, they are much more gentle and softer than PC, and like a graceful girl of peaceful disposition, because white has weakened the PC emotion on that, and the colour value has been lightened, a CL----a new mixture has been produced. White possesses the cleanest feeling; so mixing white into a PC lowers the saturation, but can keep its pure and clean feeling within the human consciousness. CLs are light,clean, limpid, transparent, gentle, sweet, but sometimes may be felt to be monotonous and weak. These are just the qualities of CL(figure3).

Complex Colour:

A very small amount of black is sufficient to lower the intensity of PCs so long as black arouse sense. If black is mixed into a PC little by little, a CO---- a type of colour with new qualities has emerged.(figure4). The extreme of CO is black.

The value of CO is lower than PC. COs look neither beautiful nor lively, still less exciting. They are deep, cold and detached, steady and profound, just like a reticent firm and persistent man of generous and tolerant disposition. The intensity and the value of COs are both low. Sometimes COs even look filthy and obsolete. (figure 5)

Turbid Colour:

If a mixture of white and black----neutral grey is mixed into a PC, a new type of colour emerges which we call a "turbid colour". However, when the value of neutral grey is rather high , the colour will tend to have the quality of CL. On the other hand, if the value of neutral grey is rather low, the TU will tend to have the quality of CO. Thus, only by mixing a neutral grey of medium value into PCs, can we make TUs----a type of colour of new quality which is completely different from CLs or COs. (figure 6) The most obvious characteristic of TU is muddy and turbid. They are not so gorgeous as PCs, and they are not so limpid or transparent as CLS either, and they are not so profound as COs. TUs are not bright or dark enough, so they seem gloomy and obsolete and are not spectacular (figure 7). However, when a few areas of TUs stand side by side simultaneously,they can give us much food for thought with their subtle differences and can fully express character of TUs, a character that is soft, veiled, ripe and refined (figure 8).

White and black are the colours of high intensity, but a mixture of white and black----neutral grey-possesses the qualities of TU. White possesses the qualities of CL and black those of CO. Thus white and black are the most flexible colours which can not only be suited to whatever surroundings but also play an important role in matching colours.

2.   Matching of Colours Determined by Colour Quality

The qualities of PC, CL, TU and CO are completely different.If we do not understand the effects due to interaction which emerge in matching colours, it is quite possible to overstate the shortcomings of qualities of the opposite side which occur from mutual repelling. Therefore the result of the colour matching is often psychologically refused.Conversely, if we can grasp the four kinds of colour, we enable them to set off one another and bring out their fine aspects more distinctly and strikingly.

The four kinds of qualities form two groups classified by whether or not they contain black, PCs and CLs do not contain black, and they arouse people's cheerful emotions of beauty and freshness, ----these we call "colours containing no black"(figure 9). Both TUs and COs contain black, they are the colours which can steady people's morale but sometimes are considered dirty and outmoded----these we call "colours containing black" (figure 10).

In polychrome matching colour area is often used to adjust the force of the effect of various colours. We choose the phrase "to put into" to express "to place a small area of a certain colour into a large area of another colour".

As a result of many surveys, we have constructed a "Contrast Chart for Harmonizing Colours of the Four Quality Types". The chart shows four case A,B,C and D. The arrow direction expresses "Put into"; red expresses the scheme of harmonizing colours which gives the effect most easily accepted by people; yellow expresses the effect which most distasteful; blue ex- presses the effect which intervenes between the two effects (intermediate effect).

In cases A and B in the chart the red arrows suggest that it is psy- chologically acceptable when we put any colour quality to an underpainting which contain black (figure 11). In this case full play is given to the characteristic brightness, liveliness, brilliance and excitement associated with PCs,and their shortcomings of disturbance and exhaustion will be played down due to the effect of the large area of the steady and reticent "colours

containing black". Now let us have a look at these dark and gloomy under-
paintings compared of "containing black". While assist the PCs to sparkle
and glisten, they themselves show the most glorious characteristics----
generous, composed and simple. These contrasts in value, hue and intensity
tally with the recognition of nature by human beings, the degree of adapt-
ability of our visual organ and psychological requirement. Consequently,
these matching schemes are accepted most easily. (figure 12)

CLs are put into the underpaintings of COs and TUs (as A2, B2 in the
chart). Set off by considerable areas of "colours containing black", the
CLs look more bright. All of "colours containing black" possess the cha-
racteristic of low intensity, thus enable matching-colours to seem more
reserved.(figure 13)

Put TUs and COs into each other (as A3 and B3 in the chart).Since the
combination of them can touch people by the characteristics of intranquil-
lity, gentleness, calmness, thus produces quiet, tasteful and reserved
effect. (figure 14)

In C1 of the chart, the underpainting is one of the CLs, putting PCs
into it. On the light underpainting which contains a large amount of white,
most of PCs will appear dark and loose dazzling splendour, thus the bright
sense of PC suffers heavy losses. (figure 15)

In D1 of the chart, the underpainting is one of the PCs, while putting
CLs into it, the effect is sensed pale, because CLs of which the chromatic
degree is low originally are surrounded and contrasted by PC. (figure 16)

While the underpainting is one of the CLs, the TUs and COs are put into
it (as C2, C3 in the chart). Or the underpainting is one of the PCs, TUs
and COs are put into it (as D2, D3 in the chart). These two effects are
both repelled by visual sense and psychology, because when a small spot of
"colour containing black" appears in a large area of beautiful and clean
"colour containing no black", its character of containing black will be
isolated and magnified, thus the colour becomes dirty and outmoded and it
looks ugly (figure 18). Even if the areas of the small spots of the "colour
containing black" are extended and occupy the central position to which
visual sense directs, they will not become the centre of interest. The
beautiful backgrounds often replace the leading part just as a presumptuous
guest usurps the host's role. (figure 18)

When CLs are underpaintings, TU, which contain comparatively much white
are put into them (as C4 in the chart). These two colours can be in harmo-
nious proportion because of the same character of containing much white
(figure 19). However, if TUs contain comparatively much black, they will
become sonsiderably ugly on the backgrounds of CL. So in C4 of the chart,
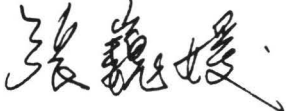
the yellow arrow appears too. (figure 20)

The concept of "matching colours"in this article does not limit to a single surface of painting, it also refers to the relations of all the colours in the field of vision. Thus this regularity is also suitable for the matching colours of environment and works and the planning colours of environment itself.

3. "Common Recognition" and "Striving for Freshness" of Matching-Colours

The above-mentioned principle of matching-colours has resulted from various qualities of the colour. The principle is a reflection of recognition of nature and aesthetic customs by human beings, and it is a convention of matching-colours based on common recognition.

However, the consciousness of human beings has both aspects of conservatism and striving freshness. Persisting in conservatism will disgust people, but striving for freshness without the basis of common recognition will be refused. Only when the new creation has come true on the basis of common recognition, do the works have vitality.

By matching the colours of various qualities, we can produce all kinds of effects. Human beings appraise the effects in the light of the aesthetic customs and experience. The matching-colours of four qualities summed up in this article has reflected the customs of appraising the beautiful colours. It does not mean oversimplicity of matching-colours. The domain of matching-colours is boundless because though there are only four qualities of colour, the colours of each quality are countless for the different hues, values and intensity. Thus after we have grasped their basic qualitied, we can further create fresh successes of works with countless colours.

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