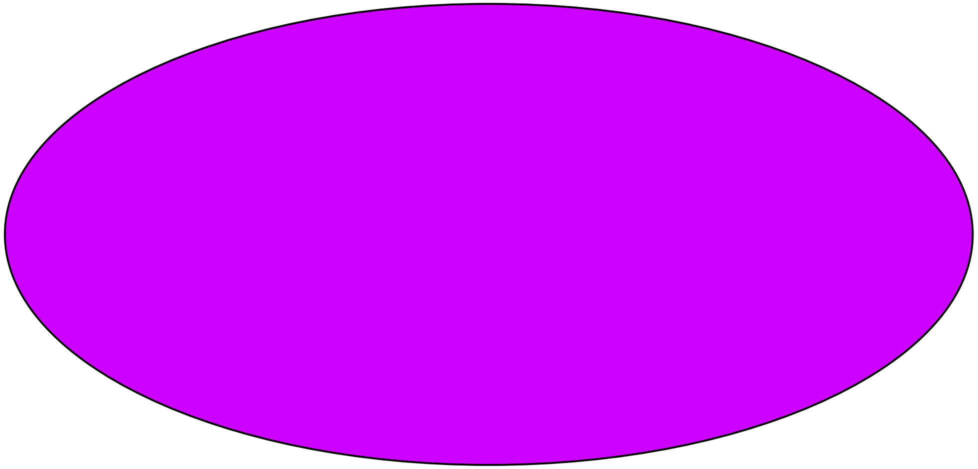
ANATOMY OF COLOUR

Return to Main

GLOBAL PACIFIC

CAN YOU DESCRIBE & COMMUNICATE COLOUR?

How will you describe this colour?

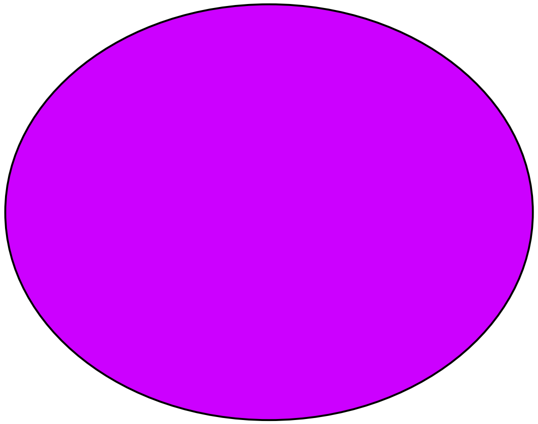


Some may call it Violet, a few Mauve, while others Medium Rubine.

Return to Main

WHAT IMPRESSION DOES MEDIUM RUBINE CREATE?

- ***How dark or light is this medium rubine?***
- ***How red is this rubine?***
- ***How much bluer is it?***



Thus colour cannot be described nor communicated in simple subjective terms

Return to Main

COLOUR ATLASES

- To overcome lacuna of describing colour precisely, several Colour Atlases were made, containing samples of coloured chips/fabrics.
- Customers ordered their consignment to be dyed with reference to these Atlases.

Return to Main

GLOBAL PACIFIC

LIMITATIONS OF COLOUR ATLASES

- All Atlases had limited shade range.
- Since samples in Atlas were different from the consignment to be dyed, this led to several disputes- due to metamerism.

Return to Main

GLOBAL PACIFIC

VISUAL MATCHING OF SAMPLES

- Due to limitations of Colour Atlases, customers sent samples for visual matching, often on materials different from the one to be dyed.
- Dyers could give a close match….. BUT DOUBTS REMAINED!

How close is the match?

What are the tolerance limits?

Does it look the same in all lights?

Return to Main

OBJECTIVE DEFINITION OF COLOUR

- To overcome lacunae in describing colour subjectively, modern approach is to define colour precisely in objective terms.
- In Objective methodology, colour is expressed in numbers, this has many advantages.

Return to Main

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ADVANTAGES OF OBJECTIVE SYSTEM

- Exact Colour can be defined and communicated in terms of numbers.
- Tolerance limits can be set for colour difference, in matched samples.
- How colour will look in different lights, can be determined in advance.

Return to Main

GLOBAL PACIFIC

HOW COLOUR IS EXPRESSED IN OBJECTIVE SYSTEM

Colour as it appears in specific defined light, to average human eye is expressed in terms of:

L	:	Defining how dark or light, the colour is.
+a –a	:	How Red or Green it is.
+b -b	:	How Yellow or Blue it is.
H	:	What is the exact hue (e.g. Red/ Yellow/ Green/ Blue/ Violet) of the sample.

Return to Main

GLOBAL PACIFIC

WHAT IS COLOUR

- Colour is a sensation created in the brain, when visible light enters the eye.
- Cones and Rods in the retina release some pigments, the combined effect of which gives the impression of colour.

Return to Main

GLOBAL PACIFIC

FACTORS INFLUENCING COLOUR

- Visible Light that enters the eye, also depends upon two other factors viz.

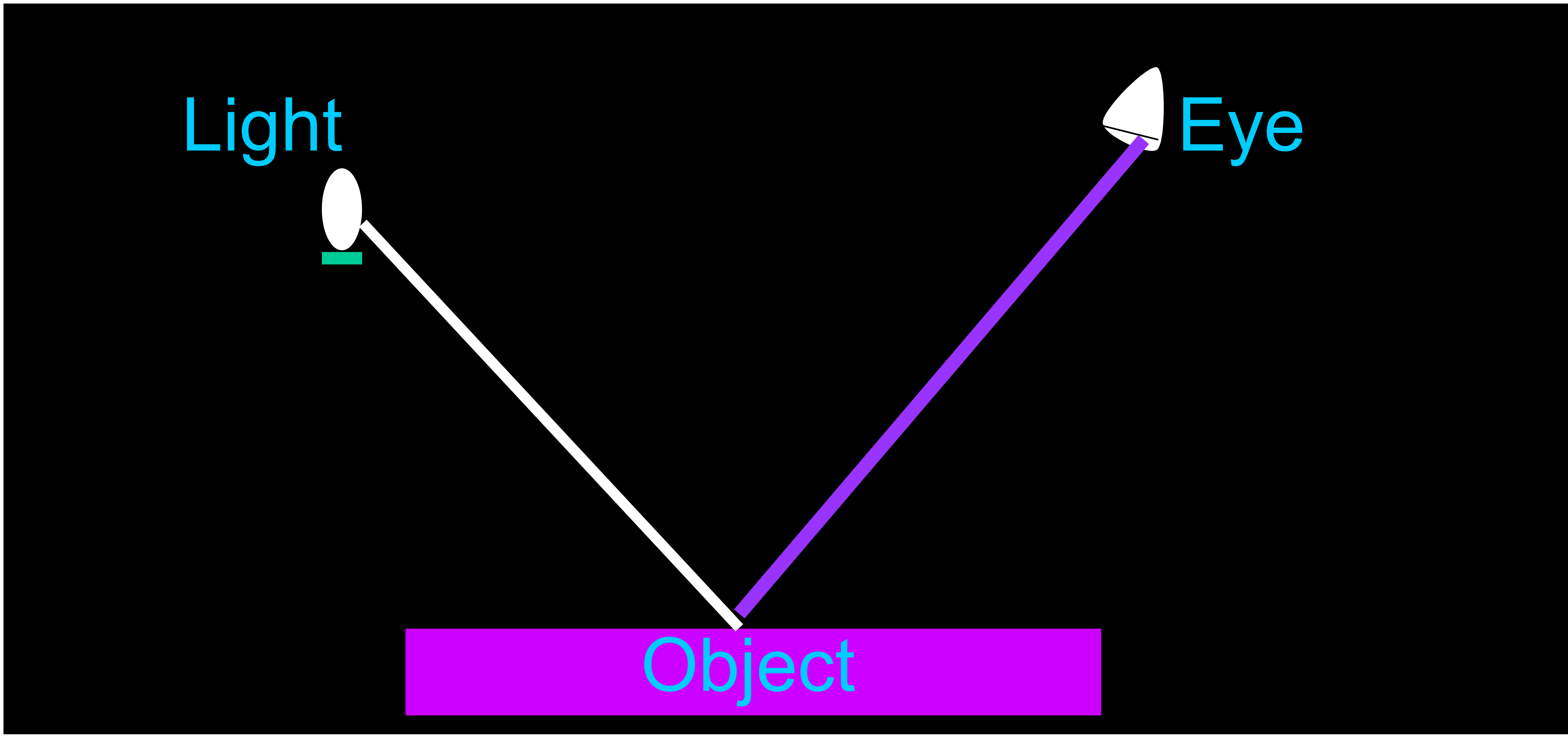
  The Light Source

  How the light is modified by the object, on which it falls.

- Hence, for defining colour, one must standardise light & measure how coloured object modifies light.

Return to Main

ELEMENTS INVOLVED IN PERCEPTION OF COLOUR



Return to Main

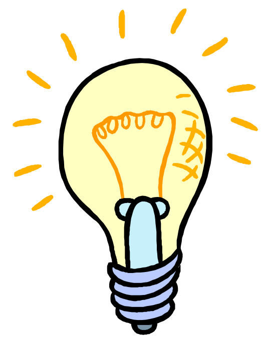
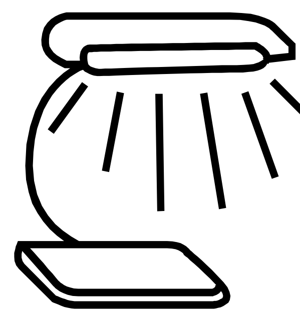
GLOBAL PACIFIC

COLOUR DEPENDS ON LIGHT FALLING ON THE OBJECT

Lights are both Natural & Artificial


Natural Lights: Direct Sunlight, Daylight, Evening light, etc..

Artificial Lights: Tungsten Lights, Tube Light, etc..

Return to Main

INTERNATIONALLY DEFINED ILLUMINANTS (LIGHTS)

- Composition of each Light- Natural or Artificial- varies and has been internationally defined as Illuminants.
- Widely accepted Illuminants are **D65**, **A**, **CWF**, **TL84** etc. Their spectral emission can be checked using Spectroradiometer.

Return to Main

GLOBAL PACIFIC

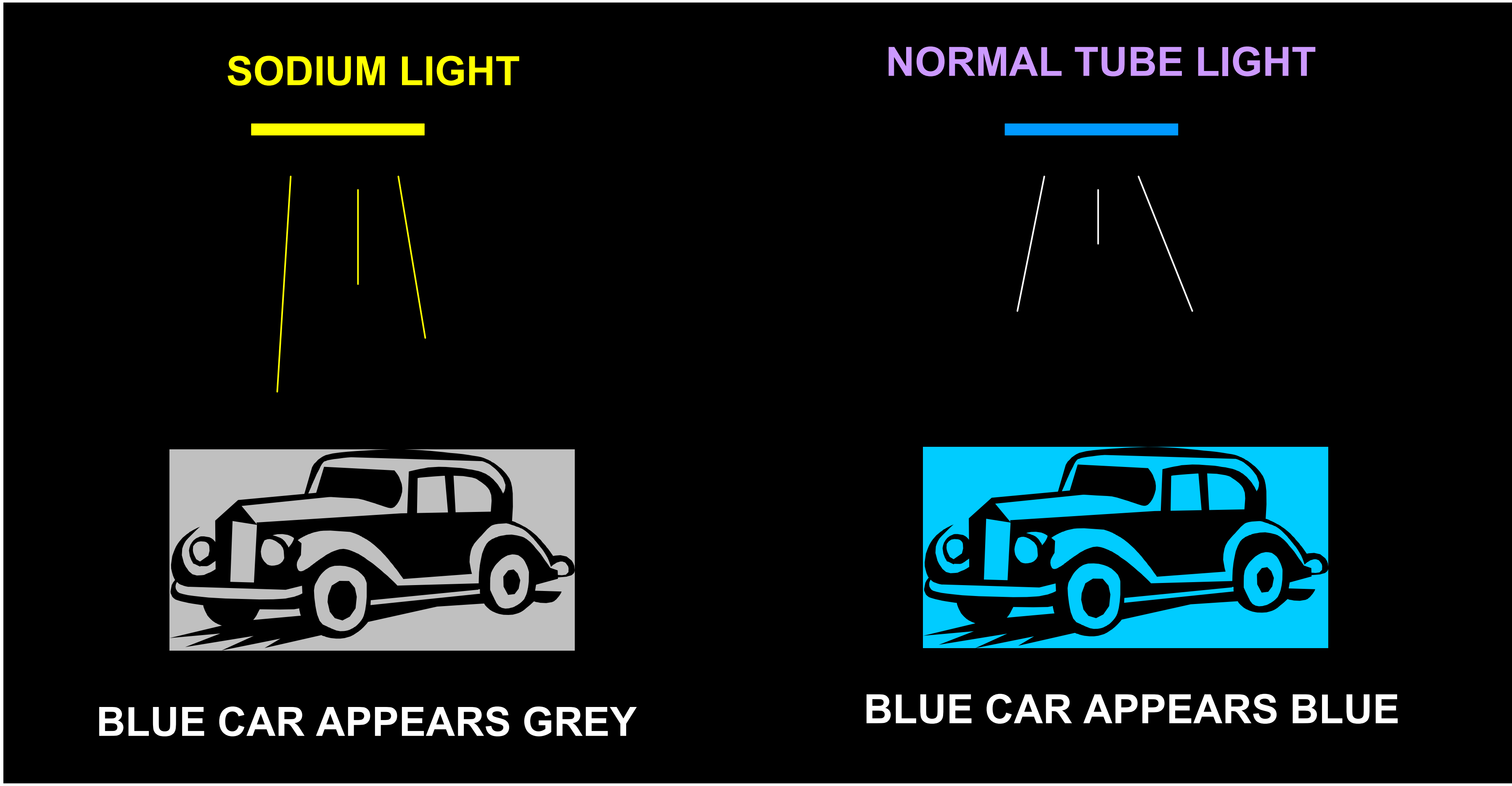
STANDARD ILLUMINANTS

- D65: This is equivalent to average daylight having temperature of 6500K.
- A: This is Tungsten Lamp at Colour temperature 2856K.
- C W F: This is Cool White Fluorescent Lamp widely used in stores in USA ~ 4230K.
- TL84: This is Fluorescent Lamp widely used in stores in Europe ~ 4000K.

Return to Main

GLOBAL PACIFIC

INFLUENCE OF LIGHT ON OBJECTS



Return to Main

GLOBAL PACIFIC

HOW LIGHT MODIFIED BY OBJECT IS DETERMINED

- When Light falls on an opaque object, it is reflected before & after absorption.
- Reflectance of an object is measured by SPECTROPHOTOMTER.
- This instrument determines the amount of light reflected with reference to the standard white object MgO at each wavelength in the visible region.

Return to Main

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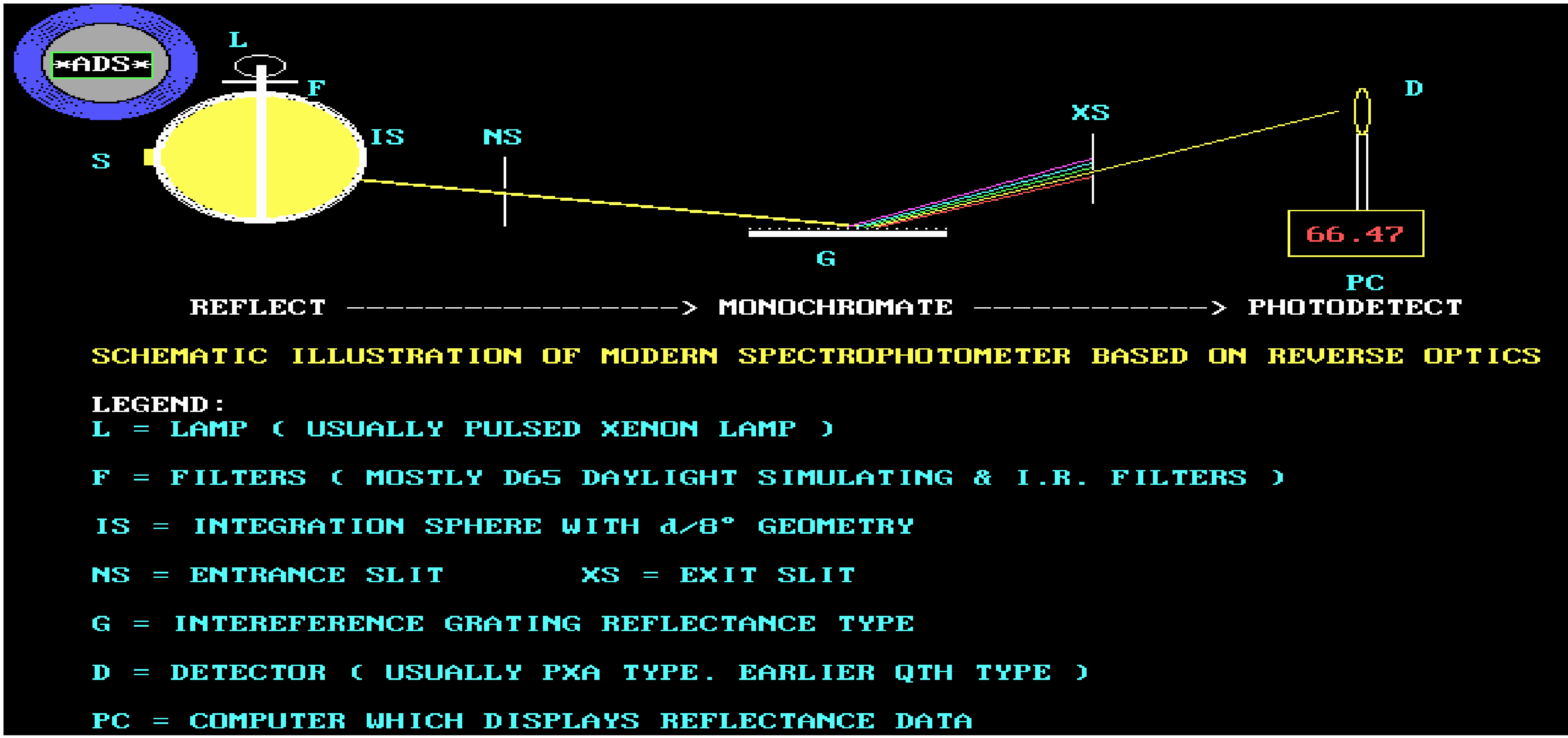
ELEMENTS INVOLVED IN PERCEPTION OF COLOUR



Return to Main

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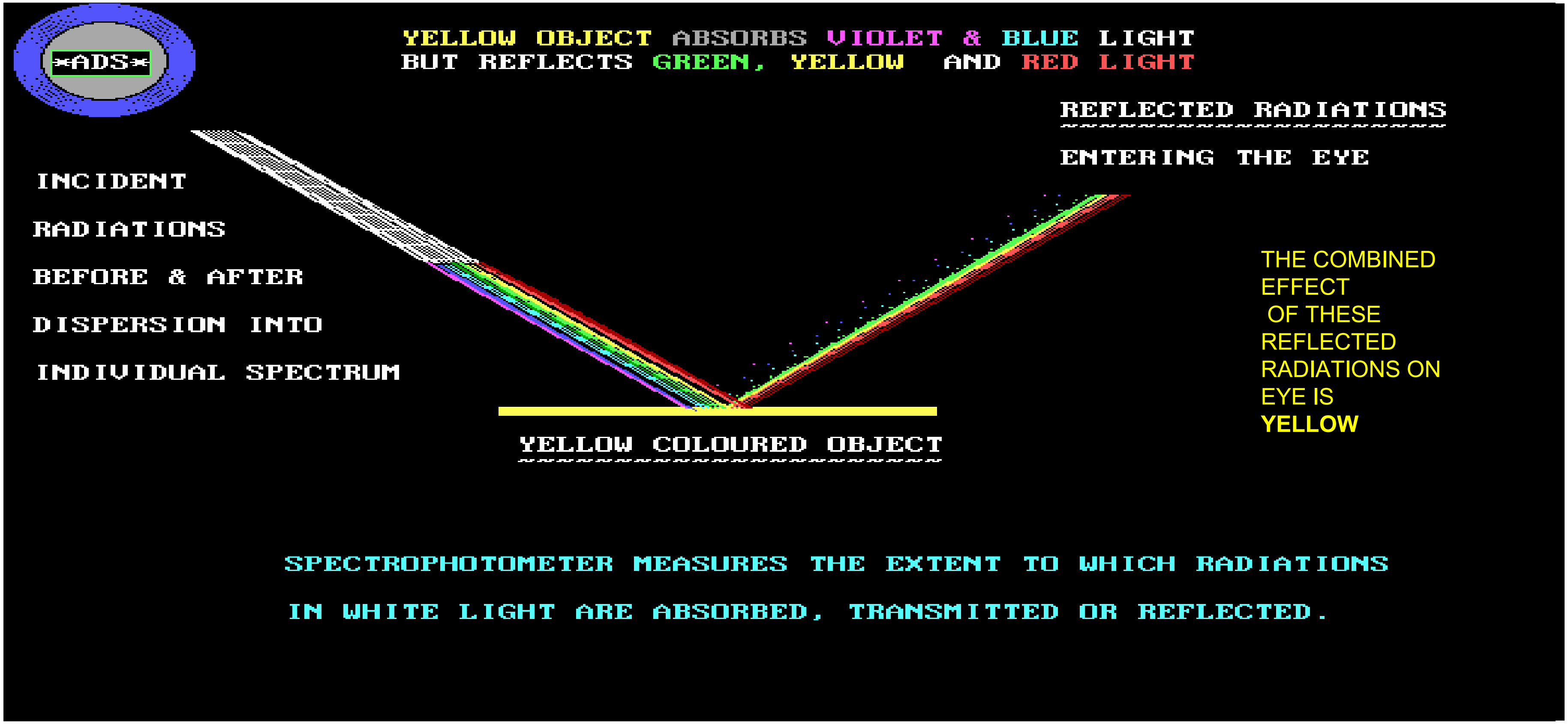
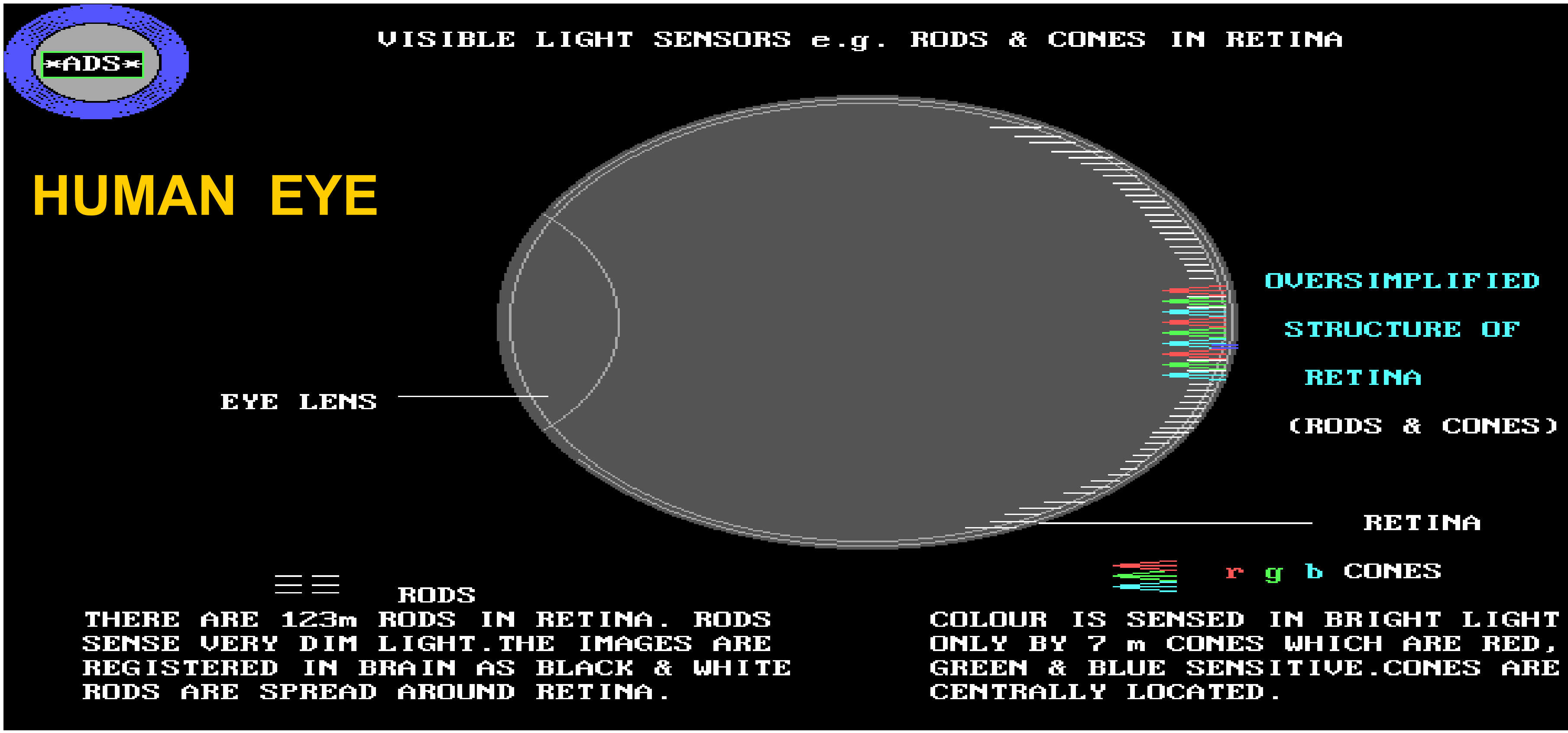
ELEMENTS INVOLVED IN PERCEPTION OF COLOUR



Return to Main

ELEMENTS INVOLVED IN PERCEPTION OF COLOUR



Return to Main

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VARIABILITY IN HUMAN VISION

- It is obvious that the number of cones and density of rods may vary from person to person.
- Each Person will therefore sense colour in a slightly different manner.
- Hence, it was necessary to standardise Average Human Vision as a first step.

Return to Main

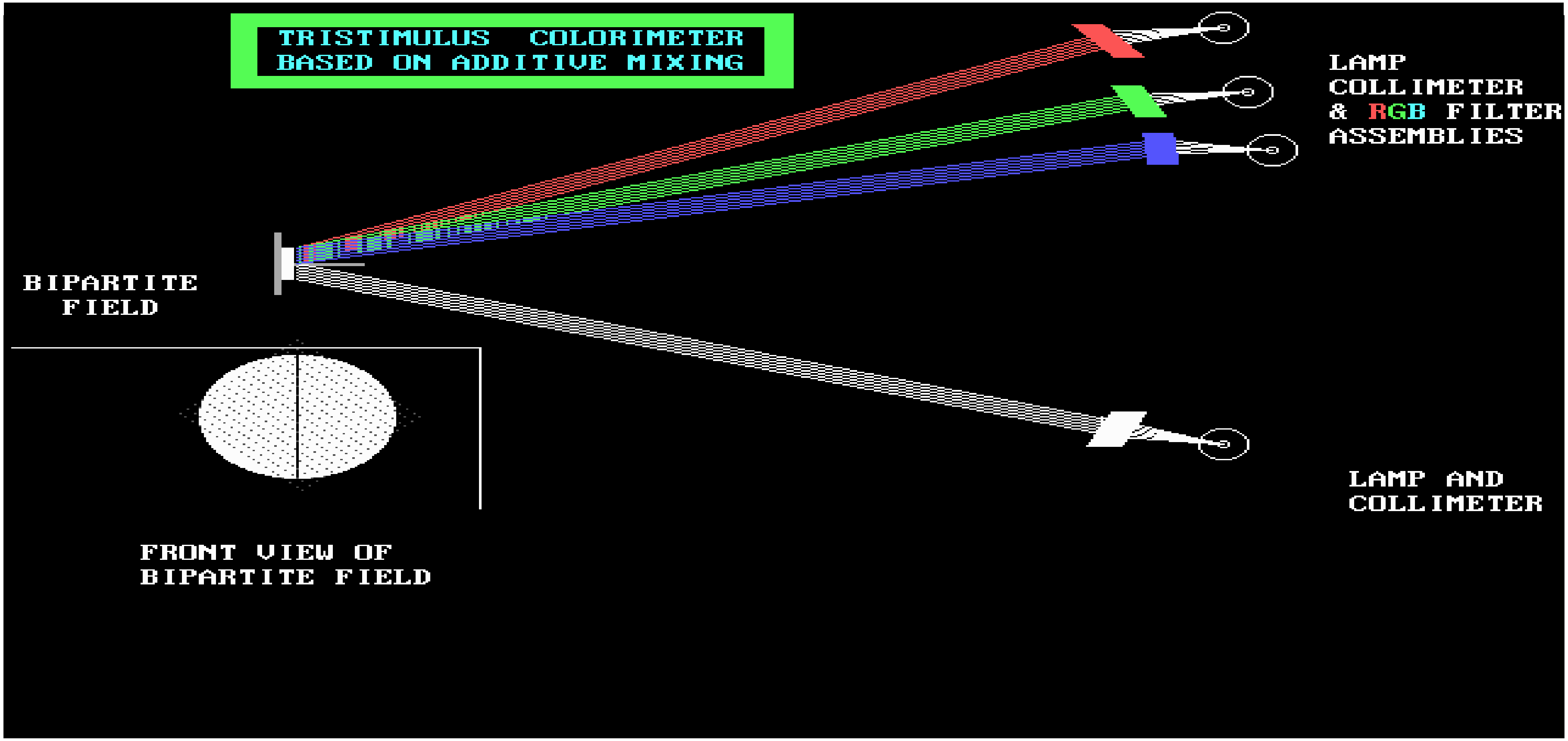
GLOBAL PACIFIC

MATCHING SPECTRUM COLOURS

- Spectrum Colours are the purest colours.
- They were matched wavelength by wavelength, in the visible region, by a group of observers using a special instrument a shown in the next slide
- The average results of such a matching were published for a small field in 1931 and for a wider field in 1974. These results are known as 2° Standard Observer and 10° Standard Observer, respectively.

Return to Main

MATCHING SPECTRUM COLOURS IN THE VISIBLE RANGE



Return to Main

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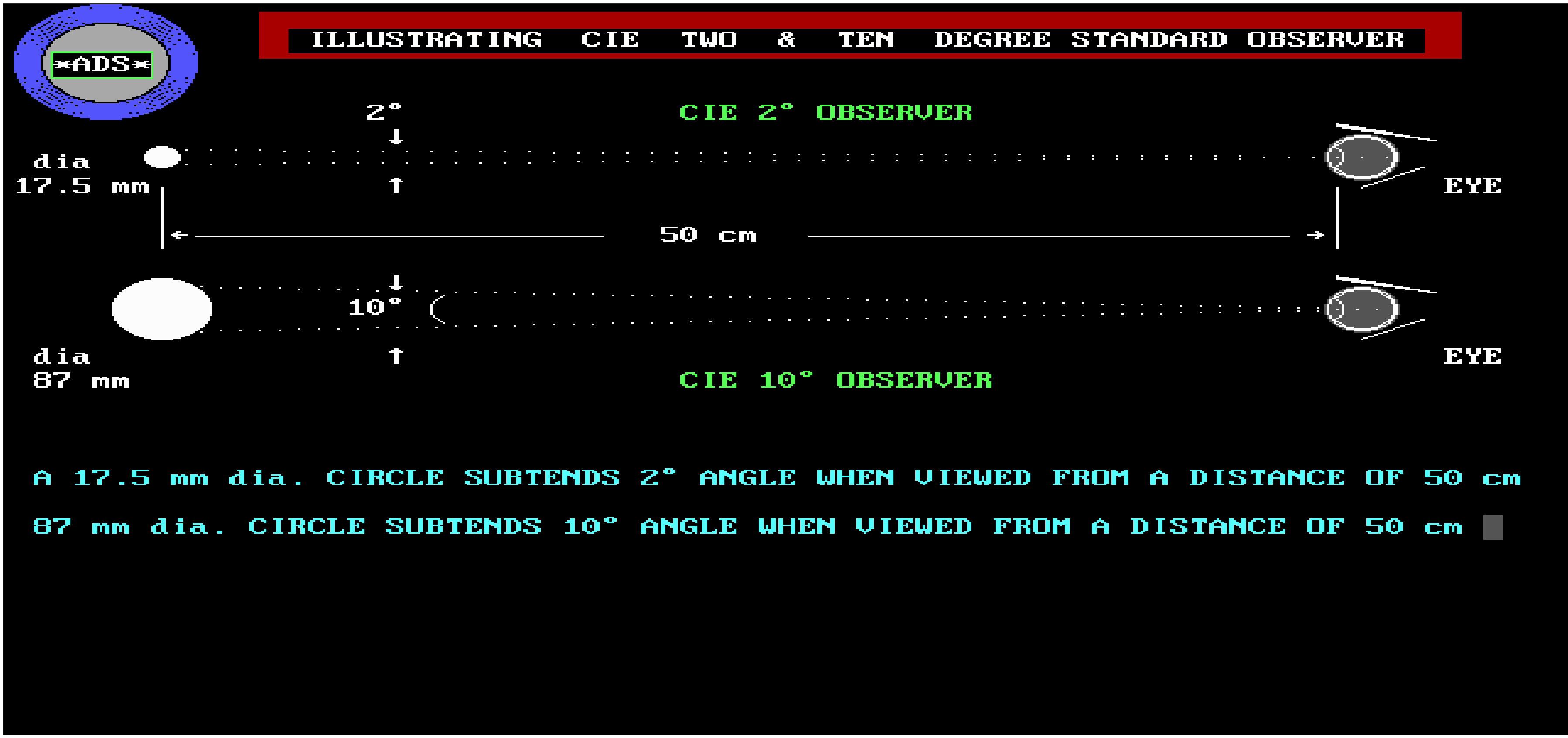
TODAY ONLY 10^{o} OBSERVER IS USED



Return to Main

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TRISTIMULUS VALUES

- Colour is computed from internationally standardised weight factors for Standard Observer and Specified Illuminants.
- When these weight factors are multiplied with reflectance at each wavelength in the visible region, we obtain **TRISTIMUUS VALUES** denoted by **X Y Z**

Return to Main

COMPUTING TRISTIMULUS VALUES

- Tristimulus Values are the first step toward objective specification of colour

  Mathematically, they are computed as:

  $X = \Sigma\, Wfx \,.\, R \qquad Y = \Sigma\, Wfy \,.\, R \qquad Z = \Sigma\, Wfz \,.\, R$

  where Σ are summation from 400 to 700 nm for the products of Weight factors Wfx, Wfy & Wfz and Reflectance

- Tristimulus Values do not convey colour and are converted to more familiar L a b C H values in the Colour System

Return to Main

GLOBAL PACIFIC

WHAT L a b C H CONVEY

L conveys how Light or Dark Colour is

+a indicates degree of redness

- a indicates degree of greenness

+b indicates degree of yellowness

-b indicates degree of blueness

C indicates degree of saturation of colour

H indicates hue angle of colour (0 – 360º)

Return to Main

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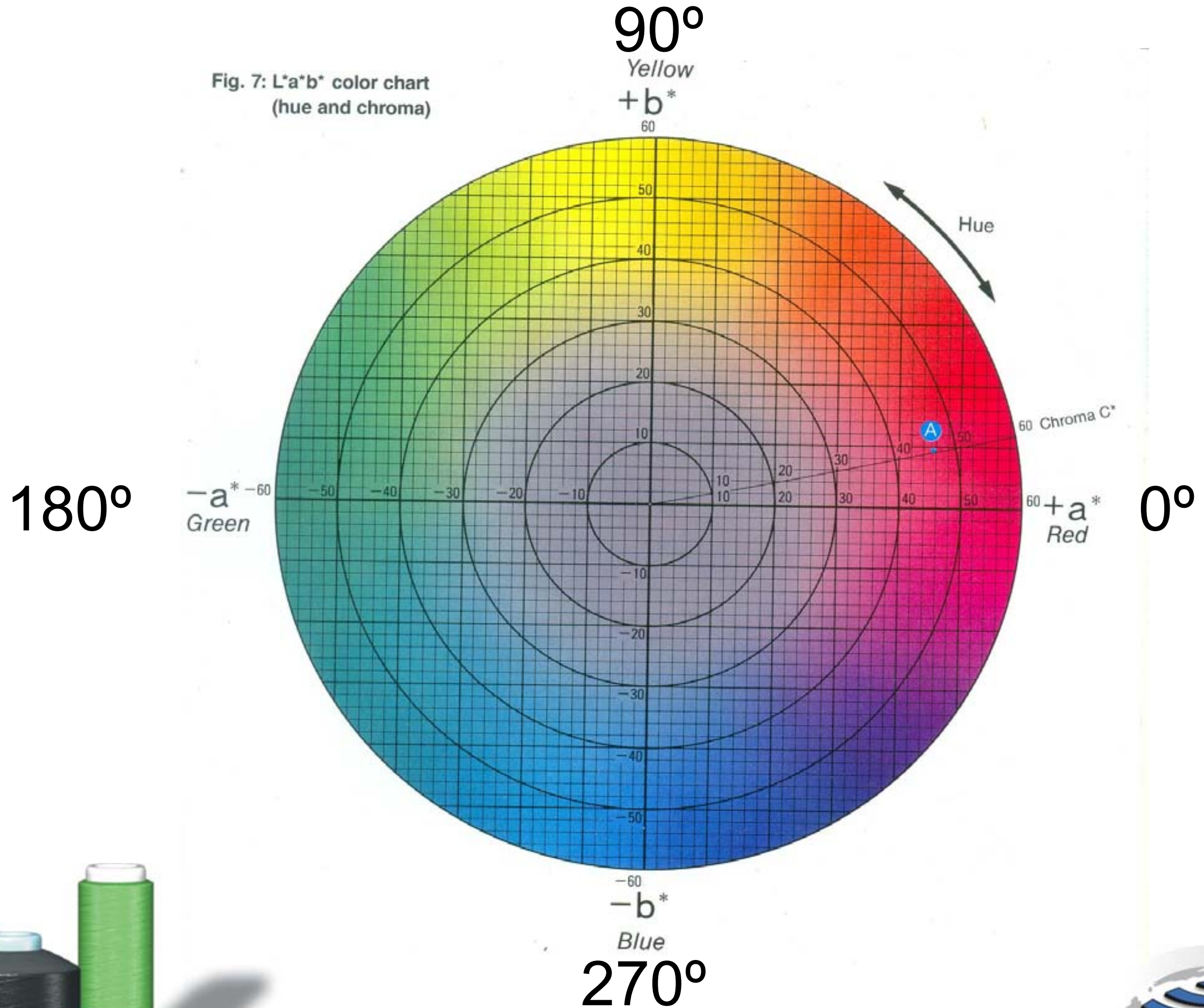
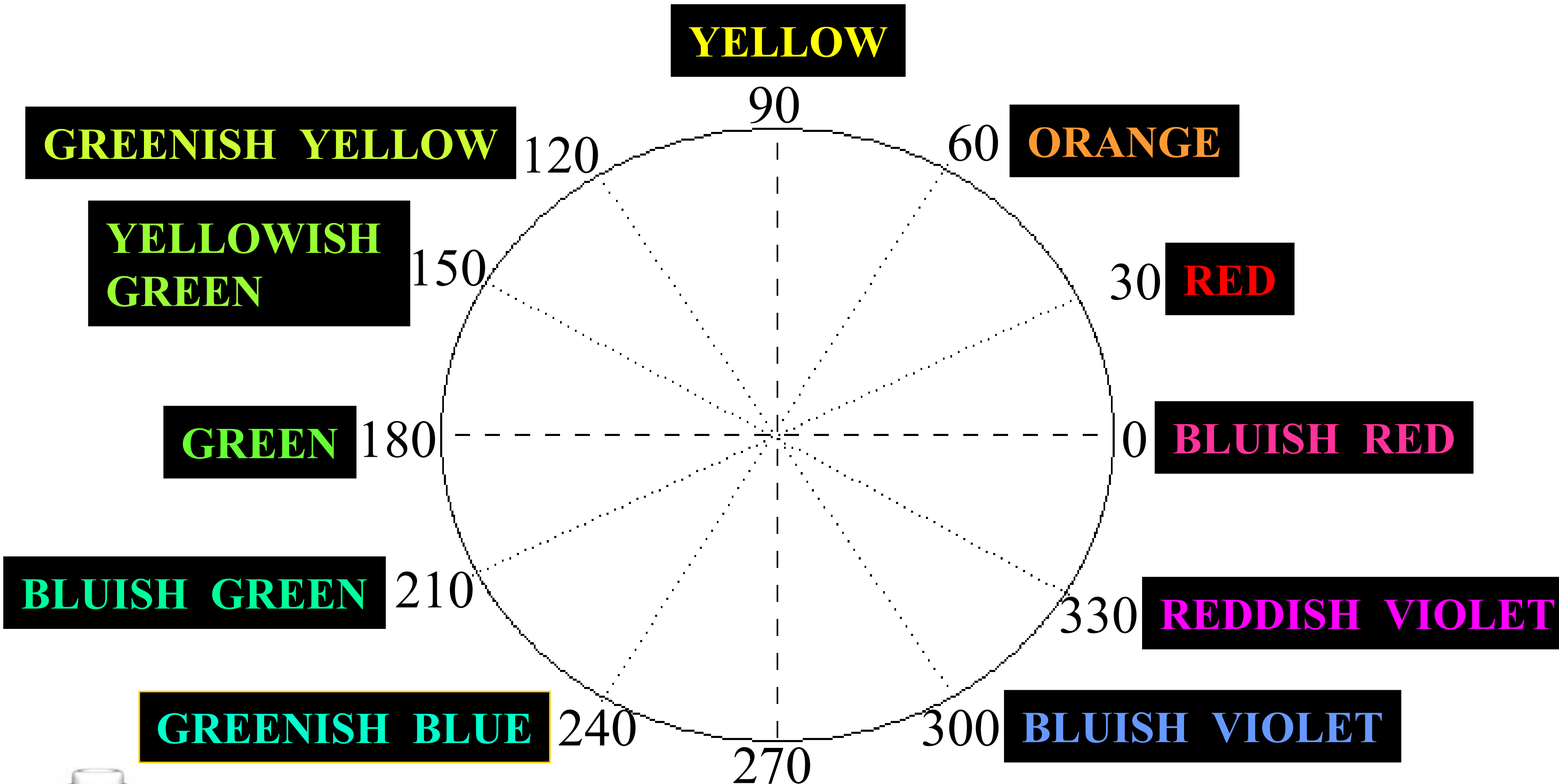
HUE CIRCLE



Return to Main

HUE CIRCLE WITH ANGLES



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Return to Main

GLOBAL PACIFIC

UTILITY OF Lab-CH SYSTEM-I

- End of Subjectivity in Defining Colour.
- Expressing Colour in Numbers which is precise & easy to communicate.
- Predicting Recipes by Computer Colour Matching.
- Correcting Off Shades.

Return to Main

GLOBAL PACIFIC

UTILITY OF Lab-CH SYSTEM-II

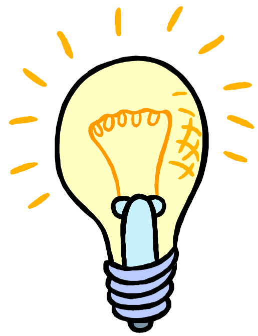
- Predicting Metamerism (See Next Slide) & Selecting recipes with minimum Metamerism & cost.
- Measuring Colour Difference.
- Setting tolerance limits to end disputes.
- Predicting appearance in different lights.

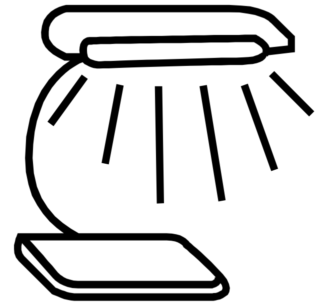
Return to Main

GLOBAL PACIFIC

NON–METAMERIC MATCH

STANDARD SAMPLE TO BE MATCHED





DAYLIGHT

TUNGSTEN LIGHT

TUBELIGHT

Shade of matched Sample Looks the Same in All Lights

Return to Main

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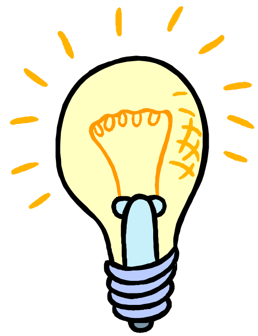
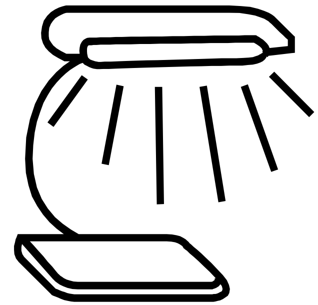
METAMERIC MATCH

STANDARD SAMPLE TO BE MATCHED

DAYLIGHT



TUNGSTEN LIGHT



TUBELIGHT

Shade of matched Sample Varies in Different Lights

Return to Main

GLOBAL PACIFIC

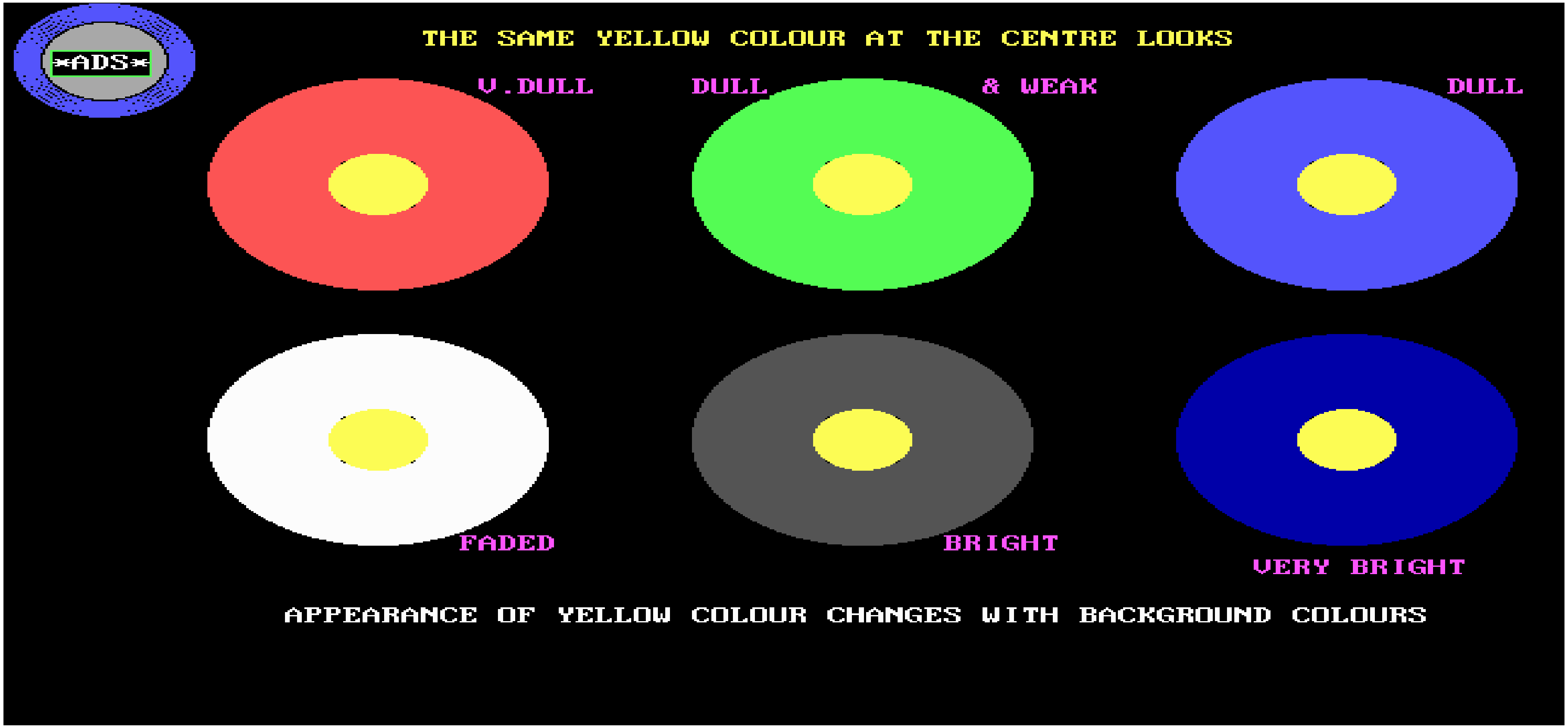
IS OBJECTIVE SYSTEM THE END OF ALL DISPUTES?

- NO!! NOT AT ALL!!!
- Background Colours also influence colour.
- Customers MUST view samples in Standard Light (using a Colour Viewing Cabinet).
- Different People may find a match close or off, even if LabCh values match.
- If the Standard or Sample have a different Gloss, even a dead match will appear different.

Return to Main

GLOBAL PACIFIC

DO THESE YELLOWS LOOK THE SAME?



Return to Main

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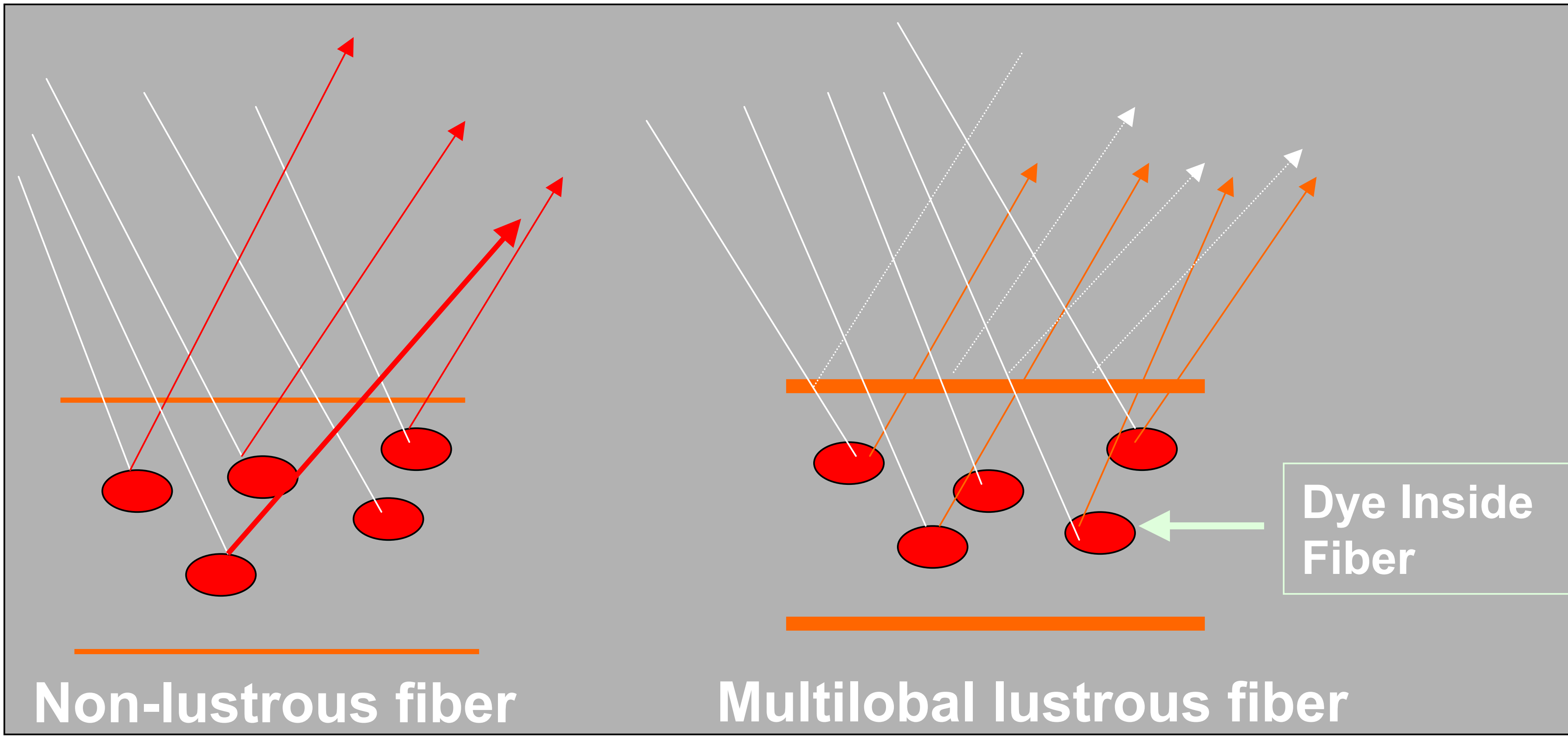
BACKGROUND COLOUR

- If Warp used is different in sample, Label appears different even if Weft is the same.
- This difference in Warp may be due to difference in Optical Whiteness. Optical Whiteness can induce Metamerism. Label appears close in one light, but different in another light.

Return to Main

EFFECT OF LUSTROUS SURFACE OF FIBRE ON REFLECTED LIGHT



Return to Main

GLOBAL PACIFIC

IMPORTANCE OF USING IDENTICAL SUBSTRATE

- One can match colour, but not necessarily the luster
- If shade has to look the same, the substrate on which matching is to be done, must be the same.

Return to Main

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