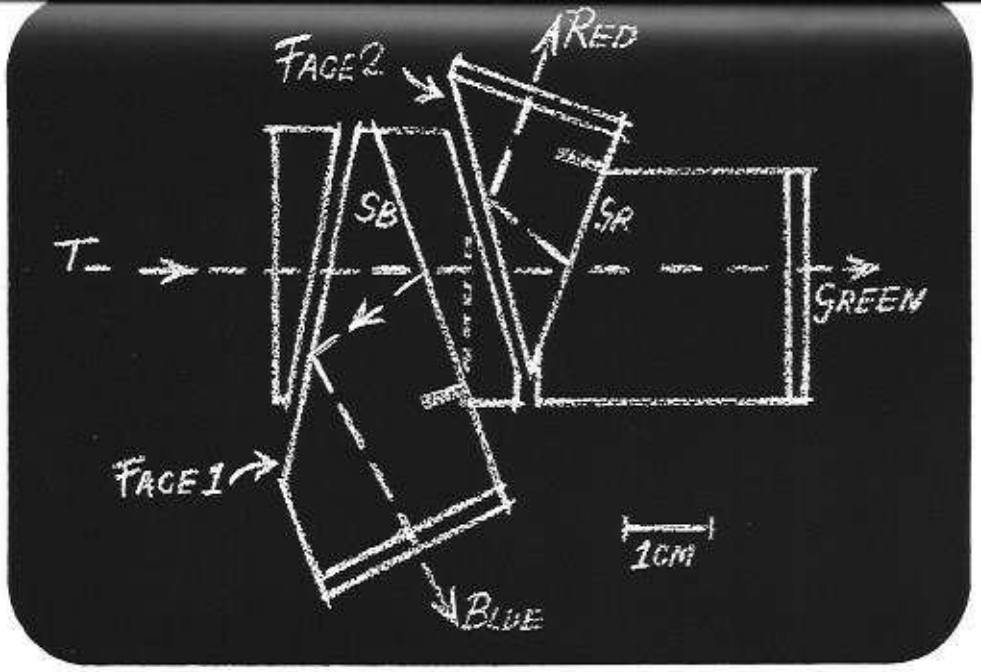

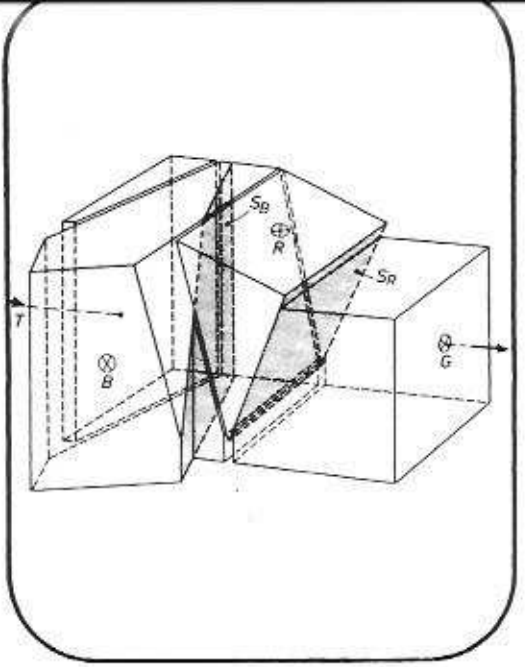

How to make a television camera human

(from a lecture by Dr. H. de Lang of Philips Research Laboratories, Eindhoven, The Netherlands)

Science and Technology are constantly trying to improve on Nature. But when it comes to color discrimination, the plain old-fashioned human eye takes a lot of beating.

In the early days of color television (a couple of years ago), many people viewed it with a jaundiced eye. There tended to be a harshness in the tinted images, an over-emphasis of strong color and a washing out of the lighter ones. One of the main reasons was that the color separation in the cameras depended largely on a system of dichroic mirrors consisting of interference layers deposited on flat glass plates. There are a number of inherent drawbacks with this system: the mirrors take up a relatively large amount of space, the objective fitted to the camera has to have a fairly large back focus, the support plates cause aberrations, the mirrors are exposed to damage, and large angles of incidence have to be reckoned with. This last named drawback is associated with spurious color gradation across the image, unsatisfactory color separation and unfaithful color rendering when the incident light is polarized.

To overcome these problems, Bouwhuis and I developed a new system in which the color interference layers are enclosed in a cemented assembly of prisms and which appreciably reduces the effective angles of incidence.

The whole idea of this camera was to match the color discrimination of homo sapiens - since homo sapiens was the species that was going to do the viewing (sundry cats and dogs excluded).

Our camera contains three Plumbicon* pick-up tubes, one for each primary color, with spectral sensitivities approaching that of the human eye. Each pick-up tube has the same sort of surface area as the human eye and - apart from noise in the amplifier chains - is just about as sensitive. The scene to be transmitted is conveyed by three „optical" channels to the photosensitive layers consisting of a vapour-deposited porous film of tiny lead monoxide crystal plates with dimensions in the order of 1 micron or less. The blue, green, and red target images of the scene are all observed from the same point, having a common entrance pupil (like the human eye) to avoid parallax phenomena which would affect the congruity of the three images. For the actual focussing of the target images, similar objective lenses are used to those for black and white television.

For separation, use is made of color-selective interference filters having the property of reflecting a pre-determined part of the spectrum, and transmitting the complementary part. Such filters consist of a number of very thin transparent layers of alternatingly high and low refractive indices deposited on a glass surface by evaporation in vacuo. In our device the glass surfaces are those of a prism system. A number of such systems were designed and one of them is shown on the blackboard above. The colour-selective interference layers are at S_B and S_R, where the faces of the prism sections are cemented together to protect the layers against dust and moisture. To keep the angle of incidence on the interference filters as small as possible, thin air layers are provided that cause total reflection of the blue and red rays at faces 1 and 2 respectively. The green rays pass straight through the system. For each of the colored beams the system behaves as a plane-parallel plate placed at right angles to their optical axes. Before leaving the system, each component passes through an absorption filter, which is cemented on to the prism, to remove any unwanted wave length that might still be present. In this compact design we take special precautions against glare from spurious reflections.

One practical form of this prism system is shown above. Here the part at the right of the vertical dotted line in the blackboard version has been rotated 90° with respect to the part on the left. The shaded faces carry the interference layers.
In actual practice we use a system which reduces the effective angle of incidence for the most critical separation - red/green - from 40° to 20°.

How effective this innovation is can be easily seen when Plumbicon television cameras swing into action. There is no harshness in the tinted images, there's a nice subtlety in the color balance and some beautifully subdued tones.

So the camera sees eye to eye with its viewers ... humanly speaking, that is.

*Registered Trade Mark of N.V. Philips' Gloeilampenfabrieken of The Netherlands for television camera tubes.

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