Fig. 4.

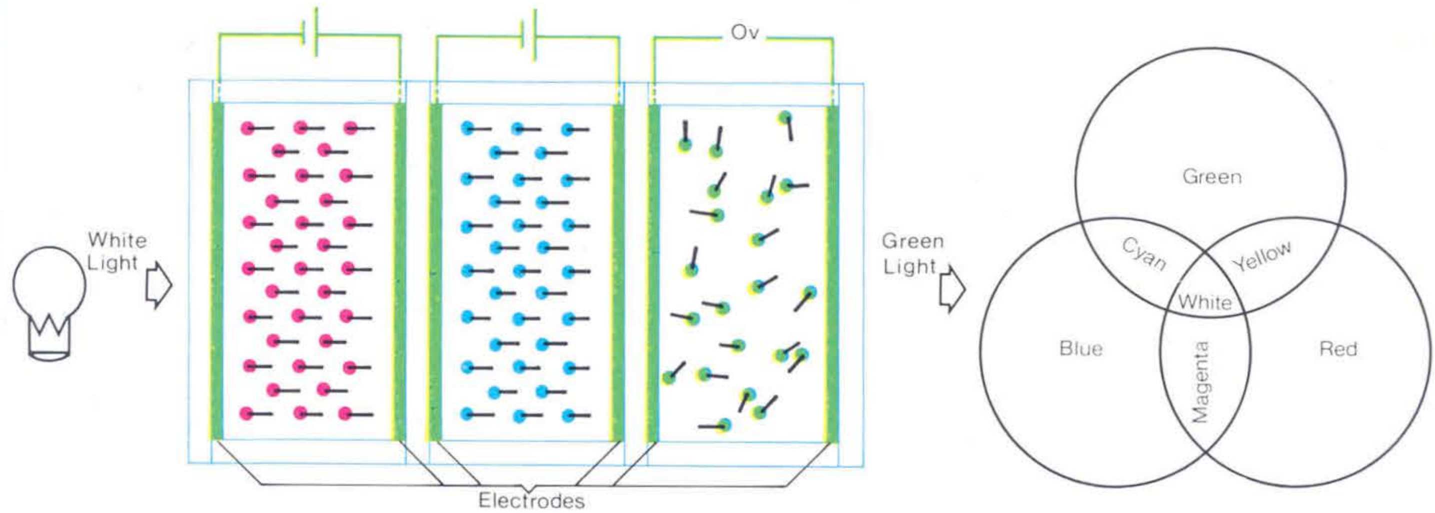
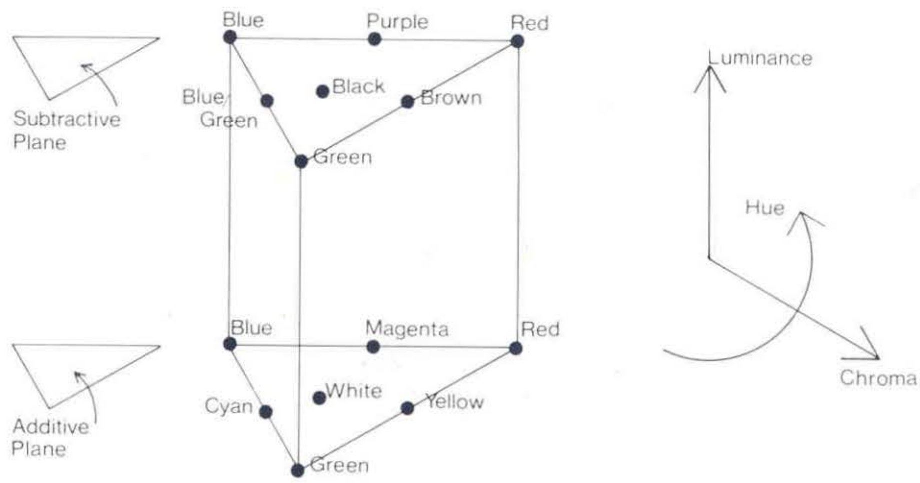


Fig. 5.



the capability to mix colours addititively and subtractively. Efficiency is much increased by using secondary dyes (yellow, magenta, and cyan) rather than primaries. Thus a red is obtained by switching off the yellow and magenta cells, and switching on the cyan cell. How possible is a device of this nature? What are its faults? How much would it cost?

With a very limited amount of research funds, we have managed to make some very basic liquid crystal cells and with a poor substitute for the correct dyes (which are only now being manufactured) managed to get a cell to turn from a light pink to colourless. Before a device of this nature becomes practicable, a considerable amount of research on the dyestuffs needs to be undertaken. A major problem is the loss in efficiency of transmission of white light caused mainly by losses in the glass. This loss could be as much as 20%.

The control of such a device may require a new approach from the Lighting Designer. Light can be described using three variables: *Chroma, Hue, Luminance.* These are easily explained diagrammatically. We are sure that you are all familiar with the primary colour triangle that shows how the three primaries may be used additively to make white. If you think about this, not all the colours may be represented on this triangle: any colour darker than a primary is not there. Consequently we must enlarge this into a colour prism (fig 5) similar to the *Munsell Tree* used for pigments. The top triangle represents colour mixing by subtraction while the bottom one shows mixing by addition. It is possible to select any specific point within this prism, which covers the total spectrum, with our three variables. As you can see the *Hue* is the colour be it a primary or a mixture. The *Chroma* denotes how saturated the colour is, or, in the case of M.I.C., for how much of the cycle white light is actually passed (note that we do not need to make up white light by the addition of primaries as the device is capable of passing white light by switching all the cells on). *Luminance* is a measure of the intensity of light, be it controlled by filter or dimmer.

The lighting designer could sit at the colour controls and mix his desired colours. A digital read-out would show the selected colour and by punching up this number on a keyboard this colour could be recalled at any time during performance. This colour information could obviously be recorded on a cue-by-cue basis as an addition to the intensity (and positional) data already stored in memory control systems.

The use of liquid crystals with theatre spotlights can be extended a great deal further than has already been mentioned. By positioning a single liquid crystal cell with a black dye and carefully depositing electrodes at the gate of a profile spot (if heat problems can be overcome) it would be possible to make a device that could operate as shutters or iris—again controlled electronically from the control room.

If a matrix electrode structure is used, it is possible to address any specific point in the cell individually and switch it either on or off, giving an infinitely variable gobo. With a computer programme, an effects projector could be created.

Thus a device of this type fitted to a remote-pan-tilt-focus spotlight would mean that a specific spotlight could be angled, focused, shuttered, goboed and coloured all from the control room.

Now all this may seem a little bit like science fiction but, if you will excuse the phrase, *we have the technology*. Whether the necessary research and development will be undertaken depends on favourable assessments of the likely cost/effectiveness of M.I.C. However, in our view, such development is necessary if stage lighting is to become the true *painting with light* that it is frequently alleged to be.

The authors first experimented with colour control by liquid crystal while undergraduates at the University of Nottingham. Michael Wolfe now works for Thorn Theatre Lighting Division and John Schwiller is at the Thorndike Theatre, Leatherhead.