EXPERIMENTAL ANIMATION TECHNIQUES
MARGERY BROWN

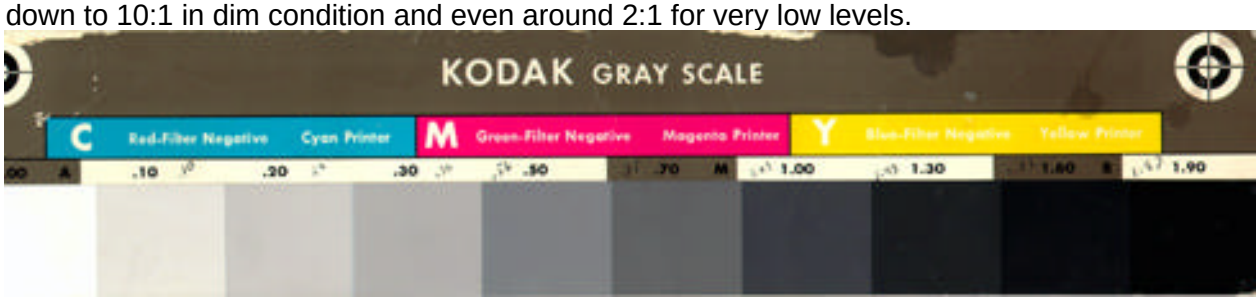
3D PRODUCTION LIGHTING

There is a great deal to be known about light, color, the eye and the camera which will be beneficial in the long run to any person seriously pursuing studio video production. These brief pages, however, will only briefly mention those four things and concentrate on the characteristics of lighting, functions of lighting, the basic lighting process, the tools and the practical production lighting process.

BASIC LIGHTING ATTRIBUTES

Human vision is highly adaptable. Consequently, one always has to distinguish between the subjective effect the eye thinks it sees, and the objective effect that a camera will detect. The two aspects can be substantially different. When discussing color, three aspects must be considered: hue, saturation and brightness. Hue is the predominant sensation of color - whether it is red, green, blue, yellow, etc. A surface entirely lacking in color is termed neutral or achromatic. Saturation (also called its chroma, intensity or purity) is the extent to which the color has been "diluted: or paled by the addition of white light. Brightness is a confusing term and thus further broken down to luminance, for true brightness (double the illumination intensity and the surface luminance is doubled); lightness for perceived brightness; and value, a term used by the Munsell system to indicate subjective 'brightness'. Other terms also used widely but uncertainly: tint (hue diluted with white), tone (a grayed hue) and shade (tint mixed with black).

When comparing relative lightness of surfaces, we use the gray scale. Because the tonal transitions between white and black on a continuous total scale merge so imperceptibly, the scale has been divided into ten steps for practical application in film, photography and video. The contrast range of a piece of film or video camera is the number of different visually perceptive tones of gray between the "whitest" and "blackest" portions of the image. The ten step gray scale is used primarily for electronic calibration and reference purposes, but the video camera has a contrast range of 10:1 to 20:1 for adjacent tones and 30:1 on widely spaced areas. By comparison, a film negative may register a ratio of 200:1, a glossy print, 60:1; a projected slide, 160:1; motion picture, 35:1 to 40:1. The contrast range with which our eyes can perceive tonal gradation alters with light intensity. The ratio varies from 1000:1 in fairly high ambient light levels, down to 10:1 in dim condition and even around 2:1 for very low levels.



The practical application of contrast range in color or black and white video is in lighting the important object within a scene within the contrast range of the camera system. The camera responds and is adjusted to the most luminous surface in the scene. If the least luminous surface is beyond (or below) the contrast range of the camera, it will not be picked up by the camera or will be so faint as to be indistinguishable. The hue and saturation of the surface also affect its visibility in color video (a study of the Munsell System will clarify this inter-relation). Contrast range can also influence the pictorial effect of a scene. Bold high contrast images may have "arresting vigor: or appear harsh and unsympathetic, high contrast can convey depth and destroy the subtle gradations of tone, which suggest form and texture. An image with a large number of gray tones will appear subtle, dull or somewhat flat. As we shall see in the practical production section of this unit, of particular importance are the contrast ratios between the lightest and darkest areas of the face -- the facial tones to their backgrounds.

The eye and the camera - often the human eye is likened to the camera, they do have broad similarities but the parallel is misleading. Both control the amount of light admitted by an iris and focus the image within a lens onto a light-sensitive screen. The similarity ends there, however. The eye and brain "see" the world in three dimensions, the camera does not, the eye/brain "know" what color a surface ought to be regardless of the lighting and sees the surface that way. The camera sectionalizes the scene into rectangular segments, on which the subjects are differentially focused. The eye settles momentarily upon a series of isolated spots and by moving quickly from one to another, joins them spatially. By putting a frame around the scene, a camera presents relationships not present or easily recognizable in the original.

BRIGHTNESS ADAPTATION

The eye is capable of operating under a wide range of brightness levels - from 10,000 foot candles in strong sunlight to 0.01 foot candles of artificial light. Two features enable us to do this; first, the iris opens and closes from about f2 to f10, giving us about 20:1 control of light reaching the retina. Secondly, the retinal sensitivity changes depend on the brightness or dimness of the scene.

This combined phenomenon explains why it is impossible for us to judge brightness accurately by the eye - only with an exposure meter. Unlike the camera, the eye can scan a scene, stop at fixed points and adapt to that point's brightness. This, in combination with the brightness and constancy phenomena (in which we interpret object brightness relative to its background illumination) assists us in perceiving shadow detail (and thus usually underestimating shadow density).

COLOR ADAPTATION

As mentioned earlier, because of our rapid process of color adaptation, we habitually interpret surfaces as being of reasonably similar color to their daylight version. As we make these compensations continually and automatically, the actual variations in color under different lighting conditions is usually for less pronounced to the eye than we would expect. The color camera, however, cannot make these compensations automatically and only very slightly manually. And the color camera was designed to properly transmit an object's 'true' hue within a specific foot-candle range, contrast range and light source, and color temperature range. We must also be careful of local and lateral color adaptation. After staring at a strongly colored object, the eye retains for awhile a positive or negative after-image in more or less complementary hues. Prolonged exposure to large strongly colored areas can modify our entire color interpretation of colors following. Lateral color adaptation is the effect between an area and its surroundings. Colored objects tend to induce a complementary hue in a neutral background or a colored background may modify a foreground subjects color. Colors appear lighter against black, darker against white.

COLOR APPLICATIONS

Color can effect the apparent depth of a scene, as warm colors appear to advance while cool hues recede. Warm colored scenes tend to look smaller, while cool colors appear further away and larger. The ability of the eye to detect fine color detail varies with hue; visually acuity is greater in the orange and cyan hues than green and magenta. Clarity of detail is also influenced by the colors involved. Some colors have greater powers of attenuation than others. Saturated colors draw the eye more readily than pastels. Color can trigger memories, emotions and associations; a few are listed here:

Red	Warmth, anger, crudity, excitement, power strength
Green	Spring, the macabre, freshness,
Yellow	Sunlight, the Orient, treachery, brilliance, joy
Blue	Coolness, ethereality, the infinite, significance
Black	Death, gloom, sorrow, hidden action
White	Snow, delicacy, purity, cold, peace, cleanliness, elegance
Black relieved with white	Sophistication, vigor, newness

PRINCIPLE CHARACTERISTIC OF LIGHTING

LIGHT QUALITY

The nature of the source of light determines its initial quality. Light can range from hard, sharp and shadow producing to diffused, shadowless and soft. Hard light is clear-cut and vigorous, creates strongly defined shadows, reveals surface contours and texture. It is highly directional and can be localized. Soft light on the other extreme is scattered, shadowless illumination, which suppresses texture, lightens shaded areas without creating further shadows or sharp highlights. Exclusive use of soft light will evenly and flatly light a scene, which is acceptable in three-dimensional reality where spatial differences and plane are obvious to the eye. But on a two-dimensional screen, flat lighting becomes too vague, lacks sparkle, sharpness and depth.

LIGHT DIRECTION

The direction of light falling on a subject must be considered in relation to the viewpoint or camera position(s), rather than the direction the subject itself is pointing.

A subject lit from the dead frontal or 6 o'clock position, the appearance is flat, modeling and textural effects are suppressed because no shadows are cast by small surface irregularities. Frontal lighting makes faces look younger by disguising wrinkles, bulges and surface irregularities. As the source of light moves around the subject in an arc, surface irregularities cast shadows on adjacent surfaces and the eye and camera recognize contour, shape, form and depth. When the light source is 90 degrees to the viewpoint (at 9 or 3 o'clock), the slightest irregularities cast long, exaggerated shadows. Shallow-textured surfaces become strongly modeled under Avis edge light. Finally when the light source moves directly behind the subject, the lamp is hidden and only illuminates translucent, furry or feather edges or stray hair. It we move the light to the 10-11 or 12 o'clock positions, we have a three-quarter backlight which illuminates the side edges, outline of the subject - separating it from the background.

Shadows or a shadow effect both come from a lack of light. A surface may only be partially lit, give the effect of shadow in the unlit section or a surface may be lit from an angle which causes shadows to be cast by the surface irregularities. Shadows can be divided into three kinds: a primary shadow on the surface itself caused by its own contours or irregularities; a secondary shadow on an adjacent plane (wall, floor, etc.) caused by the subject interrupting of the light source; and tertiary shadows are shadows falling on the subject from other nearby objects (usually distorting the subject's appearance as they fall over its contours).

FUNCTIONS OF LIGHTING

Light can direct attention to specific areas, giving prominence to particular feature, while subduing others. A spotlight with surrounding darkness is an artless but unambiguous way of focusing attention. Variations in lighting levels between the subject and background, or silhouetting and color contrasting will also focus attention but illuminate the void background.

- Light can reveal shape and form, giving the illusion of volume, contours, size and proportion by effectively using shadow, hard vs. soft light and color.
- Light can establish the environment, the subject's surroundings, spatial relationships, scale and perspective; again by using lighting angle, shadow, light quality and color.
- Light can establish mood, atmosphere and time with angle, shadow, light color and quality.
- Light can act as a compositional element enabling the eye to co-relate objects, groups, compositional line.
- And finally, controlled lighting makes possible an optimum proportion of scenic tones within the exposure limits of the camera system. Minimum illumination, differences in illumination and contrast range are all controllable.

THE BASIC LIGHTING PROCESS
After the subject's position(s) and direction(s) have been established, the position of the principle light can be located. This light is called the key light and generally speaking, there must be a key light for each primary subject at each location in the scene. Only one key light should predominate each subject in each scene. Two or more key lights on the same subject in the same or nearly the same position will reduce modeling, and crate a confusion of shadows. Usually the key light will be in the cross-frontal position relative to the camera, thus creating principle shadows and revealing form, texture and determining exposure. The key light is angled between 30-45 degrees above the subject's point of view. This angle casts the shadows downward and, in combination with the cross-key position, to one side or the other.
To reduce the harshness of shadows cast by the key light and to reveal detail, (and thus reduce the contrast ratio), a fill-light is introduced. This is a shadowless soft light, which should not modify the exposure, create shadows or nullify the effect of the key light. The fill-light also serves to bring the illumination of the background up to the proper, necessary or satisfactory level. Normally the fill light is placed next to and just above the camera, to partially fill in those shadows below the eyebrow, nose, chin and so forth.

The third, primary light is the backlight, which separates the subject from the background and helps reveal shape and contour by lighting the rim of the subject. The backlight also illuminates shadows created by the key light and not sufficiently filled by the fill light. The backlight is hard, directional and usually located slightly off axis from the camera through the subject and between 120-135 degrees above the horizontal from the subject's point of view.

THE LIGHTING TOOLS
The tools of the lighting system include the lights (formally referred to as instruments) and their attachments, the grip cart contains all of the equipment necessary for lighting a three-dimensional set and characters. The dimmer controls control the amount of electrical energy going to the instruments, the light meter for measuring brightness and a step ladder for physically moving and to adjust the instrument's position.

THE INSTRUMENTS
In the 3D Lab, at TESC we use three different kinds of lighting instruments: 200-watt Tiny-Mole, 200 watt Mini-Moles, and 100 watt Altmans. These instruments are used for both key lights and backlights and their attachments include: removable 2 and 4-leaf barn doors for selective beam cut-off, removable scrims and diffusion to reduce and diffuse the beam, removable gel frames to hold the gel at a distance from the hot lamp, focus lenses and snoots for specific isolation of the beam, and C-stands to support the instruments and provide for their raising and lowering. The cantrell holders secure the foam core boards, used to lighten shadows and provide general scene illumination, or to mask out shadows and reflections. The cucoloris is used to project a patter on the set or object. It is primarily a set decorating device rather than an illuminating device. The grid is the overhead pipe, which runs the width of the studio table. The grid's sole purpose is to provide a structure to hang scenery, curtains and props. There are also some 1000-watt and 2000 watt, softlight instruments which are used to light backgrounds, skylights, etc. Our video camera is designed to give accurate color reproduction with 3200 degree Kelvin lamp operation at 110 volts at 125-foot candles. Normal incandescent lamps are not used because they slowly but constantly drop in Kelvin temperature so they burn, turning the light from white to yellow to orange. Tungsten halogen lamps burn constantly at their proper Kelvin temperature (3200 degrees in our studio) until they expire. Note that the light from these lamps will turn yellow and orange if dimmed below 110 volts. How far the lamps can be dimmed before noticeably affecting color rendition depends upon the subject, setting and lamp to subject distance.

THE DIMMER REMOTE CONTROL
Mounted on a mobile cart and normally stored next to the production table is the dimmer control. There are six small circuit breakers for each of the dimmable circuits. Along the front of the box

are the six dimmers with a circuit breaker and indicator light for each. Always leave dimmer circuit breakers "on" and use the master breaker to turn the system on and off. The dimmer box and control are connected by two 20-foot umbilical cords. Each of the six dimmers have an actual dimmer control and an on/off indicator light.

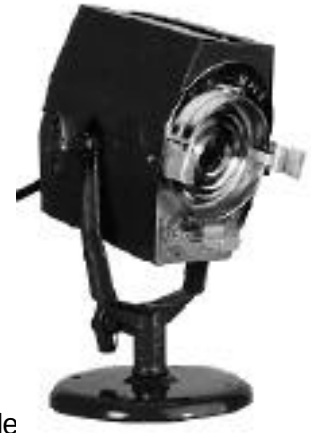
THE LIGHT METER

We use a Sekonic Studio Deluxe Model L28c2 light meter to measure the foot-candles illuminating the subject. For our purposes all you need to know is: the half-sphere should be on the rotating head with the "high" slide in its pocket on the back of the meter; to active the meter, push the center 'needle lock button, place the meter and half-sphere in the proper light reading position (to be described later), release the lock button and read the foot candles on the upper most scale. Normally, the key light should be 125 f/c all over the subject, the backlight should be between 64 and 80 f/c at the shoulder level facing the backlight and the fill light should not increase the key light reading nor be greater than 100 f/c in non-key areas. The Sekonic meter can be checked out from Media Loan.

PRACTICAL PRODUCTION LIGHTING PROCESS

The step-by-step process required to properly light a set can be divided: a) establish set, talent and camera positions and movements; b) determine proper light position, knowing (a); c) plot lighting instrument positions; d) position and connect the actual instruments; e) control the quality and coverage of the beam; f) measure the beam's intensity; g) achieve an evenly lit set and; h) contrast ration, background versus foreground.

- Establishing set, talent and camera positions and movement is discussed in detail in your pre-production planning meeting. It is simply not possible to begin lighting until the positions and movements have been agreed upon, worked out in the studio, blocked out on the plot and marked on the studio floor. If your desire is to have the primary subjects equally and evenly lit throughout the scene on every camera shot and from each angle, then a great deal of thought, pre-planning and work is necessary to do so. It is a waste of time, energy and a deceptive practice to attempt to light an area without knowing exact positions, heights and angles. Half-baked, sloppy lighting techniques are obvious to the moderately trained eye and minimize flexibility in camera movement (something which if first noticed while the production is underway or upon playback, in other words, too late).
- If a production has more than one set, design that lighting and plan your production shooting schedule to set those lights t separately if possible. Although, if the additional set is of a size or configuration which requires using the same area, but different lighting, position a second set of lights for that set. Composing instrument position, angle and coverage to do two <u>different</u> scenes usually doesn't work and wastes time in the long run.
- Plotting lighting instrument positions requires knowing the positions and movements of all the elements, the light instrument's footcandle output and coverage at specific throw distances and the quality of the light needed. Our studio's footcandle standard for key lighting a figure and face is 125 f/c and 64 f/c for back lighting. Fill-lights are positioned to partially fill-in shadow areas and provide base illumination for the set. Fill lights should not increase the foot-candle reading at the subject over that of the key light. As stated earlier in this section of lighting, the key, back and fill lights must be at certain angles, horizontally and vertically, with respect to the subject to properly light a typical scene. And knowing, that each light must be at the maximum on the dimmer for color temperature, there is usually only one "proper" position for each key, back and fill light. As you will find, there is some latitude in the "proper" light position, but it is always best to begin with the most proper theatrical position and make minor adjustments from there. Exact lighting is the only way to achieve quality, uniform and consistent image reproduction.

Mini-Mole 

Tiny-Mole 

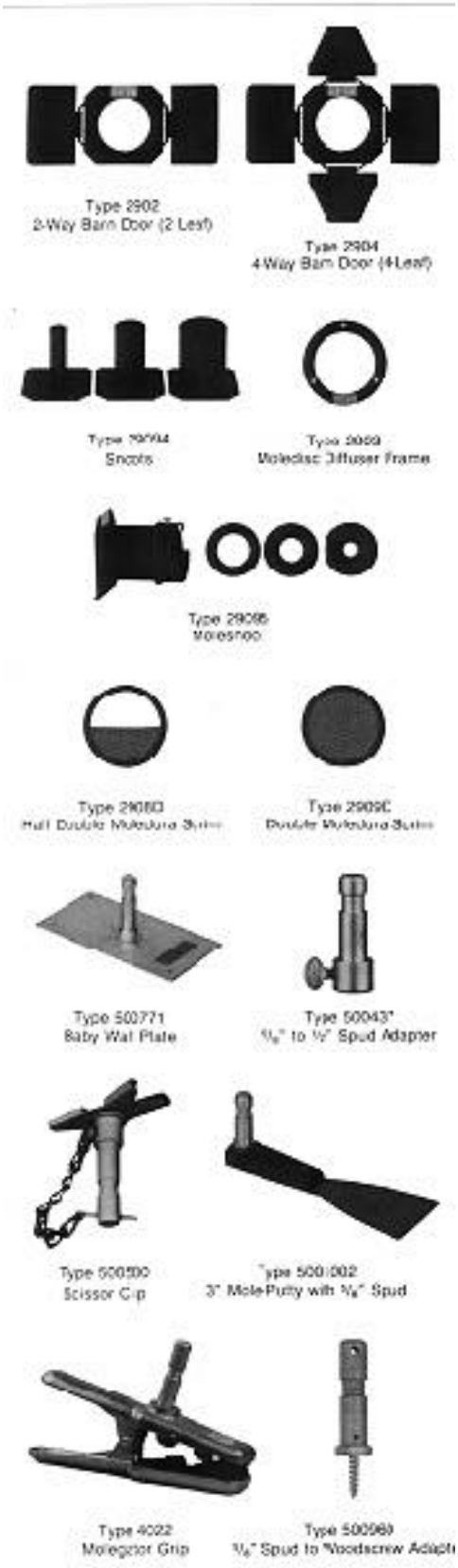
Altman 

Dimmer 

C stand, griphead
griparm

Cantrel Holder 

Cucoloris 



TIME FLIES LIKE AN ARROW
FRUIT FLIES LIKE BANANAS