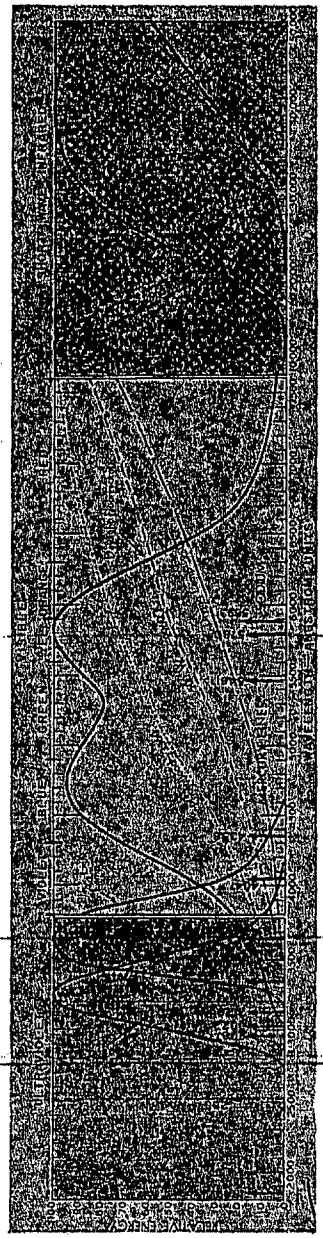

Figure 11. Spectral distribution of lamps. The continuous spectrums of the filament-type lamps peak in the infrared region, and have the highest visible energy (light) at the red end of the spectrum. Fluorescent lamps emit light in all parts of the visible spectrum, the predominance of color depending on the type of phosphor chosen. Mercury lamps radiate at four specific wave lengths in the visible region (noncontinuous spectrum). Color-improved mercury lamps have a phosphor added, which provides red light, lacking in the line spectrum of the straight mercury.

All such factors must be kept in mind when lighting recommendations are made. Economic aspects, of course, are important and may require some compromises. Nevertheless, unless proper weight is given to ease of seeing, visibility, and individual visual capabilities, light and lighting will not be accomplishing the primary purpose of providing quick, accurate, safe, and comfortable seeing.

VII. Light Sources

A. FILAMENT LAMPS

Filament lamps emit essentially black body radiation generated by an electrically heated filament. This radiation is continuous throughout the visible and near infrared regions of the electromagnetic spectrum[48] (Figure 11). The peak radiation is generally in the infrared region, only a portion of the energy being emitted in the visible region as light. Since this peak shifts toward the visible region as the filament is operated at a higher temperature, hotter operation provides a "whiter" light and makes the lamp a more efficient light source. However, it also increases the rate of evaporation of the filament, decreasing the life of the lamp. Therefore, in the design of incandescent light sources, such factors as economics and application of the lamp are considered in determining the most desirable compromise between efficiency and lamp life. For example, where lamps are inexpensive compared to the cost of electrical power, the shorter-life, higher-efficiency lamp should be employed. On the other hand, where lamps are costly or labor costs of replacing them are high, a longer life is more economical. For photographic projection lamp applications, where a large quantity of "white" light is needed, lamps are operated at relatively high efficiency with correspondingly shorter life (5 to 50 hours).

The first practical incandescent electric lamp was developed by Thomas A. Edison in 1879. It consisted of a filament of carbonized thread enclosed in a glass envelope from which the air had been evacuated. Since that date many improvements have been made through active research and development to obtain the incandescent lamp as it exists today. One of these milestones was the development of a filament made of tungsten wire, providing higher efficiency and longer lamp life. Lamp efficiency has been further increased through many developments, including the double and triple coiling of filaments, which reduces heat transfer away from the filament. More recently a new process of "Q-coating" has been devised to give almost perfect diffusion of light from the bulb with no sacrifice in efficiency. Control of light output has been obtained with the introduction of reflector lamps. For these lamps a glass bulb is formed to the desired contour and coated on the inside with a thin film of highly reflecting silver.

B. MERCURY LAMPS

Gaseous discharge lamps were made practical about 1900 with the development of the Cooper Hewitt low-pressure mercury-arc tube. This lamp is the prede-

[48] Lamp bulletin, *Bulletin* **LD-1,** Lamp Division, General Electric Co., October, 1950.