Light and light sources

Light, the basis for all vision, is an element of our lives that we take for granted. We are so familiar with brightness, darkness and the spectrum of visible colours that another form of perception in a different frequency range and with different colour sensitivity is difficult for us to imagine. Visible light is in fact just a small part of an essentially broader spectrum of electromagnetic waves, which range from cosmic rays to radio waves.

It is not just by chance that the 380 to 780 nm range forms the basis for our vision, i.e. "visible light". It is this very range that we have at our disposal as solar radiation on earth in relatively uniform amounts and can therefore serve as a reliable basis for our perception.

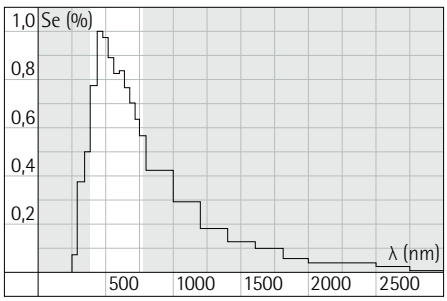
The human eye therefore utilises the part of the spectrum of electromagnetic waves available to gather information about the world around us. It perceives the amount and distribution of the light that is radiated or reflected from objects to gain information about their existence or their quality; it also perceives the colour of this light to acquire additional information about these objects.

The human eye is adjusted to the only light source that has been available for millions of years – the sun. The eye is therefore at its most sensitive in the area in which we experience maximum solar radiation. Our perception of colour is therefore also attuned to the continuous spectrum of sunlight.

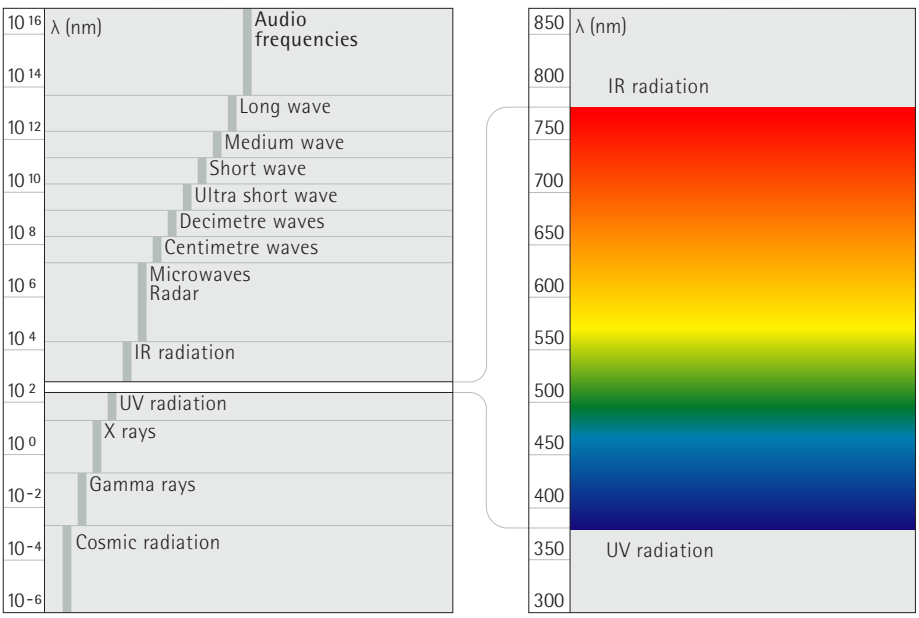
The first artificial light source was the flame of fire, in which glowing particles of carbon produce light that, like sunlight, has a continuous spectrum. For a long time the production of light was based on this principle, which exploited flaming torches and kindling, then the candle and the oil lamp and gas light to an increasingly effective degree.

With the development of the incandescent mantle for gas lighting in the second half of the 19th century the principle of the self luminous flame became outdated; in its place we find a material that can be made to glow by heating – the flame was now only needed to produce the required temperature. Incandescent gas light was accompanied practically simultaneously by the development of electric arc and incandescent lamps, which were joined at the end of the 19th century by discharge lamps.

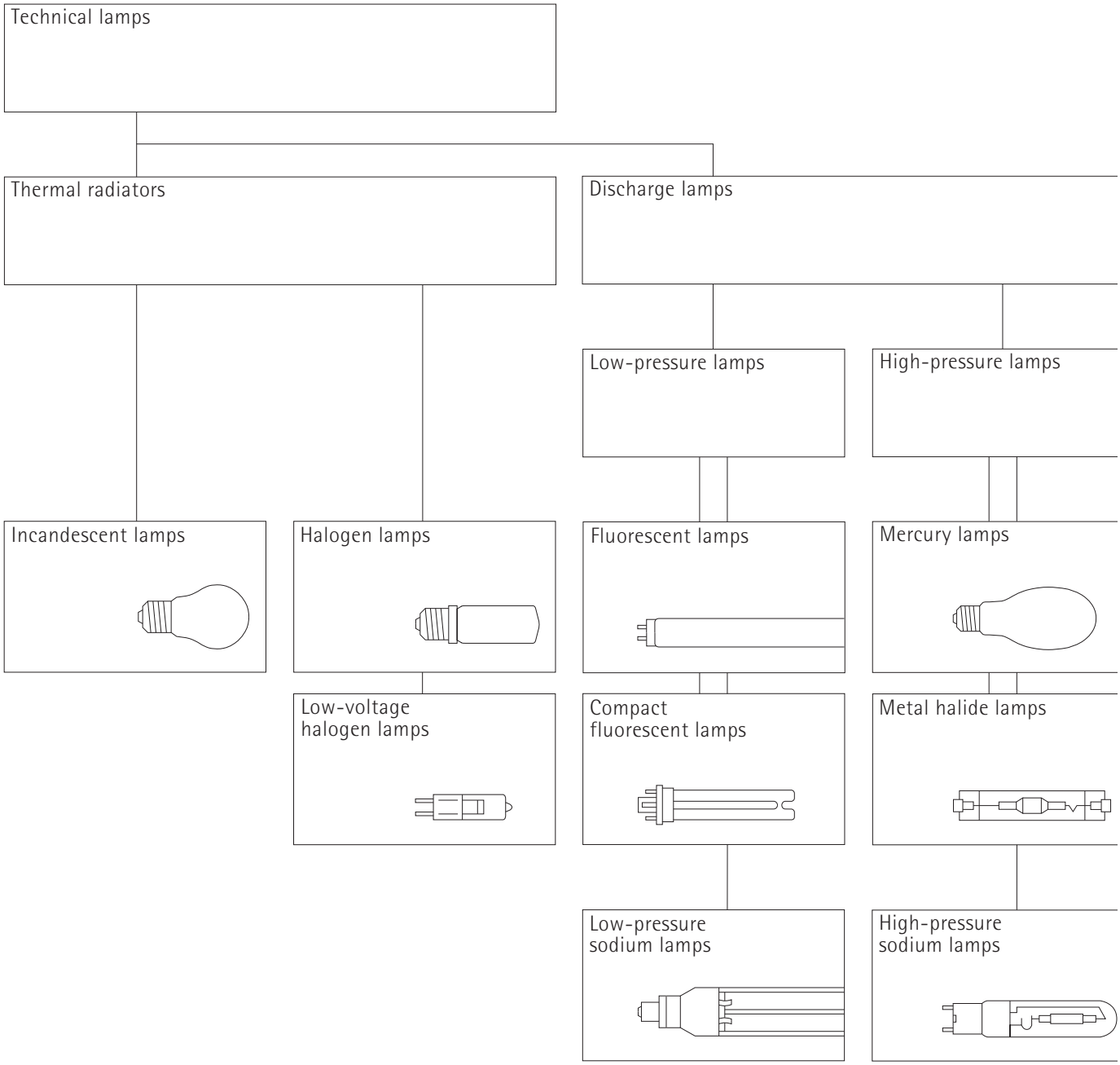
In the 1930s gas light had practically been completely replaced by a whole range of electric light sources,whose operation provides the bases for all modern light sources. Electric light sources can be divided into two main groups, which differ according to the processes applied to convert electrical energy into light. One group comprises the thermal radiators, they include incandescent lamps and halogen lamps. The second group comprises the discharge lamps; they include a wide range of light sources, e.g. all forms of fluorescent lamps, mercury or sodium discharge lamps and metal halide lamps.



Relative spectral distribution S_e (λ) of solar radiation (sunlight and sky light) with a pronounced emission maximum in the visible range.



Ranges of electromagnetic radiation. The spectrum of visible radiation comprises the narrow band between 380 and 780 nm.



Representation of the different kinds of electric light sources according to the means of their light production. In the case of technical lamps the main distinction is between thermal radiators and discharge lamps. Discharge lamps are further subdivided into high-pressure and low-pressure lamps. Current developments show a marked trend towards the development of compact light sources such as low-voltage halogen lamps, compact fluorescent lamps and metal halide lamps.