

enon as the extreme paleness of the moon's light when seen during the day. But there is a much more interesting word in this passage, the word, "uneffectual" as applied to the "fire" or light of the worm. Surely Shakespeare means to convey the notion that the "fire" of the glow-worm is uneffectual because it is unaccompanied by heat. Now, the fact has been established only quite recently that when organisms emit light, it is by an oxidative process known as chemiluminescence, in which the chemical energy is used directly for conversion to light-energy without passing through the stage of heat. In this sense, then, the light of the glow-worm is an uneffectual fire, because being accompanied by no heat it could set fire to nothing. Fire which will not set fire to anything is indeed uneffectual.

It need hardly be pointed out that it is only Nature that has succeeded in producing light without heat. Mankind has never yet achieved what man so greatly desires, a source of light without an accompanying very high temperature, for the heat generated along with the light is wasted energy as far as illuminating purposes are concerned. The spectrum of animal light shows it to be devoid of vibrations both towards the red and the violet end of the spectrum; it is therefore chemically inert, which is another aspect of its ineffectiveness.

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