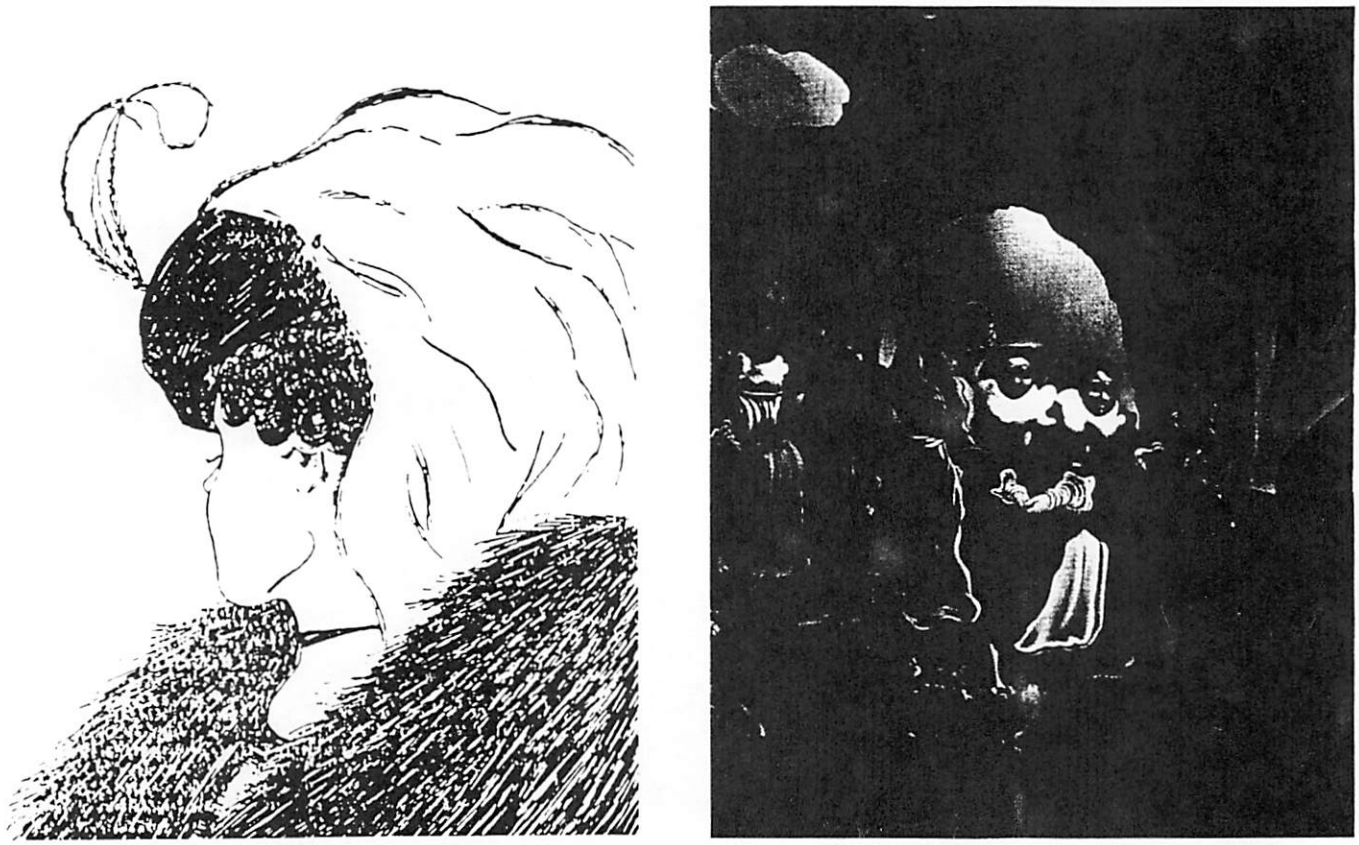
phor for the concept of wave-particle duality is presented in Figure 9-16. What we see in these pictures depends, in part, on how we look at them. Also note that we see either one image or the other in each picture, but not both simultaneously. This same property is involved in the wave-particle duality concept. In effect, the electron has two faces—a wave face and a particle face. The two electron faces are mutually exclusive in that they are never seen simultaneously in a single experiment. We see either the wave face or the particle face, but not both together. In general, which face we see depends on the type of experiment we are performing.

It is interesting to note that it was J. J. Thomson who first showed, in 1895, that the electron is a subatomic particle; and it was G. P. Thomson who, along with others, first showed experimentally, in 1926, that the electron could act as a wave. The two Thomsons were father and son. The father received a Nobel Prize in 1906 for showing that the electron is a particle, and the son received a Nobel Prize in 1937 for showing that it is a wave.



(a) (b)

Figure 9-16 (a) Young lady and old witch. The nose and left eye of the old witch are, respectively, the chin and left ear of the young lady. A necklace on the young lady is formed by the mouth of the old witch. This cartoon was created by M. E. Hill and was originally published in *Puck* in 1915. (b) A portion of the painting by Salvador Dali entitled *Slave Market with the Disappearing Bust of Voltaire*, oil on canvas, 1940. The bust of Voltaire is best perceived from a distance. Reproduced by permission of the Salvador Dali Museum, St. Petersburg, Florida. [From J. Bernstein and S. S. Shalk, *Journal of Chemical Education* 61:339 (1988).]