

Quasars pose many problems for cosmology, particularly those cases where an apparently nearby galaxy is linked with a seemingly distinct quasar, as here where quasar Markarian 205 (the circular object) is close to the galaxy NGC 4319.

would nevertheless show up quite clearly. Yet Michelson and Morley could detect no shift. They thought this might be because the Earth was moving with the aether, and to check this they repeated the experiment six months later when the Earth would be moving in the opposite direction. Further repeats of the experiment also gave a nil result, and although various explanations were offered, none was satisfactory.

The aether did not seem to exist. Yet even more significant was that the result showed that the velocity of light was invariable – it did not matter how one moved relative to the source emitting it, the value was always the same.

This invariance of the velocity of light – indeed of

all electromagnetic radiation – goes against our usual physical experience. For instance, consider two high speed trains moving towards each other (on separate tracks!). If both, say, are travelling at 240 km per hour, the velocity at which they are approaching each other is 480 km per hour. Supposing someone throws a ball out of the window of a carriage towards the other train at a speed of 20 km per hour, this will meet the other train at a speed of 500 km per hour (Fig. 8.2). This is straightforward enough – we just add the velocities to come to our final result. But if instead of throwing a ball someone leans out of the window and shines a torch, light will escape from it at a velocity of 300 000 km per s, and it will reach the approaching train at 300 000 km per s *not* at

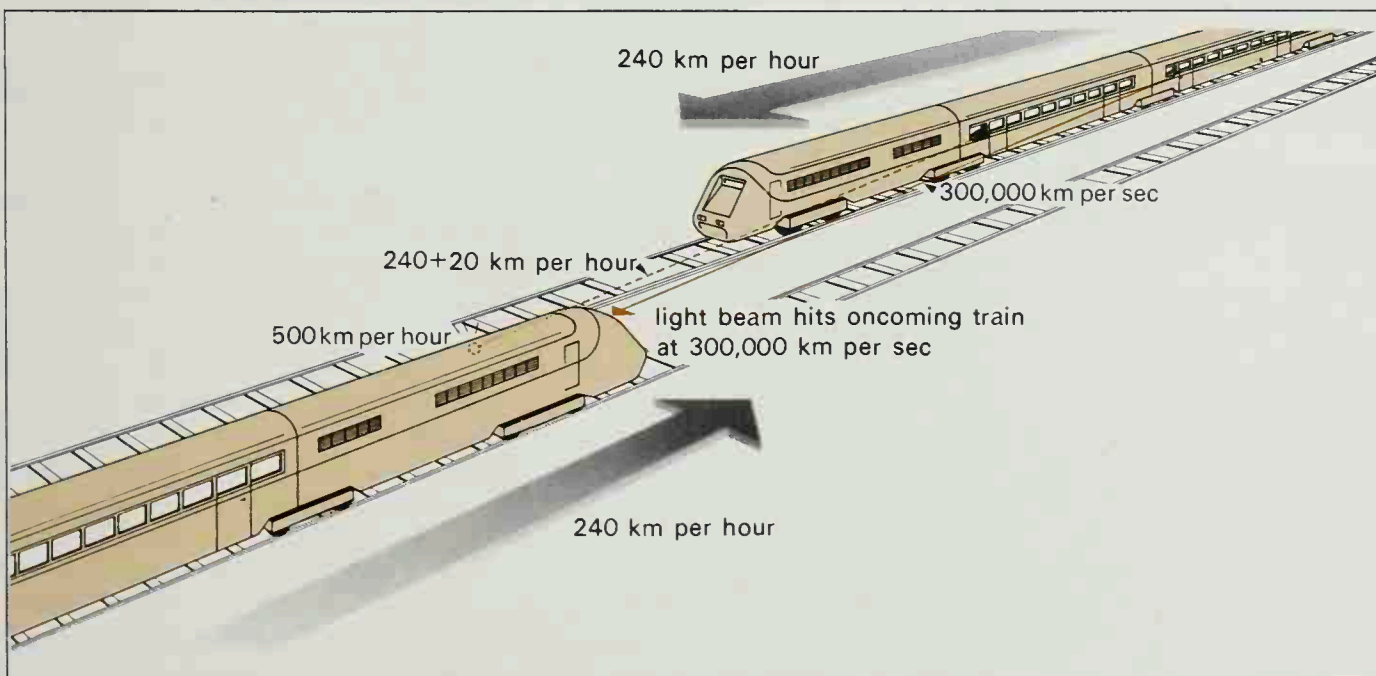


Fig. 8.2  
A ball thrown at a speed of 20 km per hour from one high speed train travelling at 240 km per hour to another high speed train travelling in the opposite direction at 240 km per hour, will meet the second train at  $240 + 240 + 20 = 500$  km per hour. But the beam of light from a torch emitted at the speed of light (approx. 300 000 km per sec) will still meet the oncoming train at speed of light.