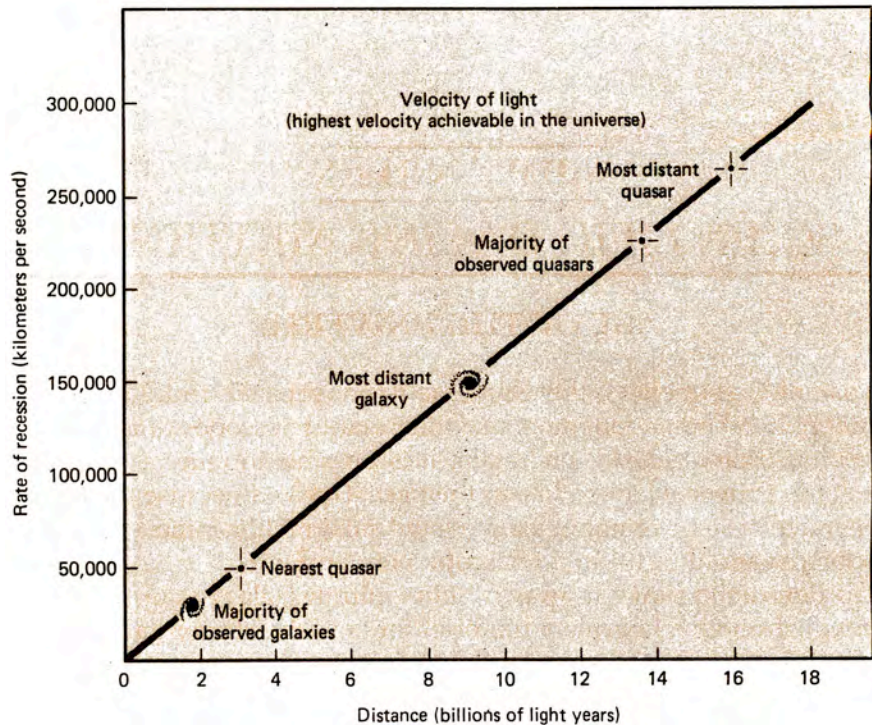


FIGURE A1.1.

The increasing rate of recession of galaxies and quasars with increasing distance. The velocity of light provides an upper limit for the distance (about 18 billion light years) that an object can be from us, and hence for an assumed time (about 18 billion years) since the Universe began.



spectrum and calculate its speed and distance.

The most distant objects we can observe in deep space are quasars (quasi-stellar objects). These are not huge galaxies but rather small star-like objects that are abnormally bright. They are thought to represent an early phase of the Universe when matter was in a different state and much closer together than at present. The most distant *quasar* that has been observed is possibly as far away as 16 billion light years. It should be noted that not all astronomers are in agreement that the objects called quasars are being correctly interpreted. Quasars may be simply strange events in the nuclei of galaxies or other unexplained phenomena. However, if the observations are indeed retreating star-like objects and their measurement is correct, we can deduce that the Universe is at least 16 billion years old and probably somewhat older.

Radioactive decay rates are also used to determine an approximate age for the Universe. The radioactive isotope used is the rare rhenium 187 which decays to stable osmium 187. Independent studies of the concentrations of these isotopes in meteorites at the