



end, long pause, begin again. Such a sequence would not occur randomly in a natural radio noise source, and would be immediately recognized by an extraterrestrial mathematician. It could serve as a beacon, in effect saying "We are here."

A much more complex message was transmitted from the radio telescope antenna at Arecibo, Puerto Rico, in November 1974. The antenna is hung over a bowl-shaped valley in the hill country, far from man-made noise sources. Shown in Figure 12.6, it has an area of 20 acres, more than all other radio telescopes put together. The message consisted of a series of on-off pulses, 1,679 of them, displayed in Figure 13.7, which, when arranged in the proper pattern, produces a picture. A smart extraterrestrial would know how to arrange them by noticing that 1,679 is the product of two prime numbers, 23 times 73. If they are arranged in 23 rows of 73 pulses each, they do not produce anything of obvious intelligence (Figure 13.8), but ordering them into 73 rows of 23 pulses each creates the pictogram as shown in Figure 13.9. (We have used the symbol \* for ones and a blank for zeros so the pattern shows up more clearly.) Notice the human figure at lines 46 to 55. The top of the pictogram, lines 1 to 4 reading from right to left, starts with the binary numbers from one to ten, followed by the atomic numbers for the elements of life and formulas for the organic molecules of life, all using binary numbers. At the bottom is the shape and size of the Arecibo radio telescope. In between is a diagram of the Solar System and the shape of a DNA helix.

This message was transmitted toward M13, a great globular cluster of about half a million stars in the constellation Hercules some 24,000 light years away. If beings are intelligent enough to pick up the message, they may be intelligent enough to decode it. If they send an answer back, travel time will be another 24,000 years, to be received by our descendents in the year 49,974! Who can tell where the human species will be at that time.

The Arecibo transmission was not so much an attempt to contact another civilization as it was an exploration of the possibilities in interstellar communication, getting scientists to think about what is involved and how to go about it.

Pioneer 10 and Pioneer 11, leaving the Solar System, carry metal plates with an engraved message from Earth (Figure 13.10). Each plate shows a human couple in front of an outline of the spacecraft, a diagram locating the Sun with respect to 14 pulsars, and a sketch of the Solar System showing the path of Pioneer.

The Voyager spacecraft carry recordings of pictures, voices, and a diagram message from Earth to any creature intelligent enough to intercept it and translate it. The recording is something like a videodisc which plays music (Bach, Beethoven, Chuck Berry, primitive drums), sounds

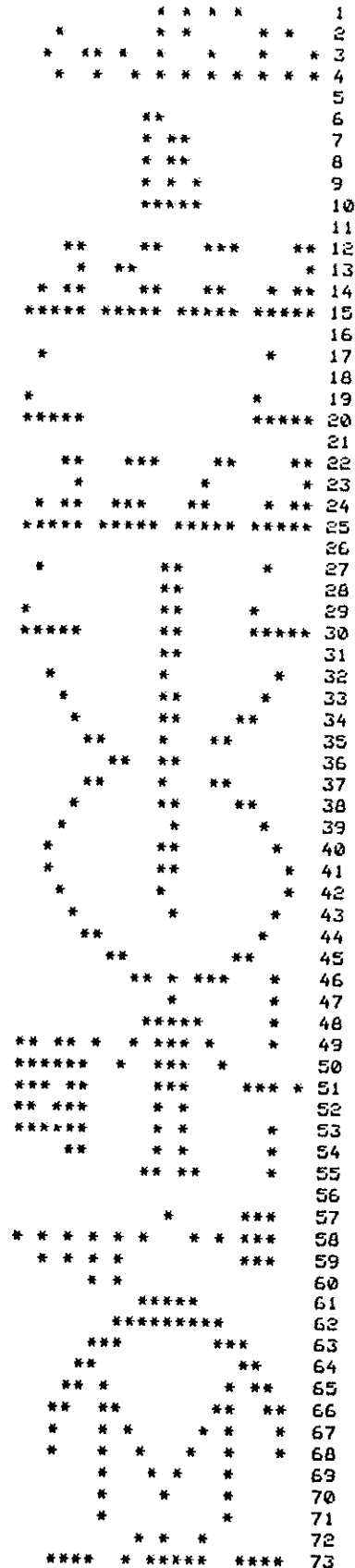
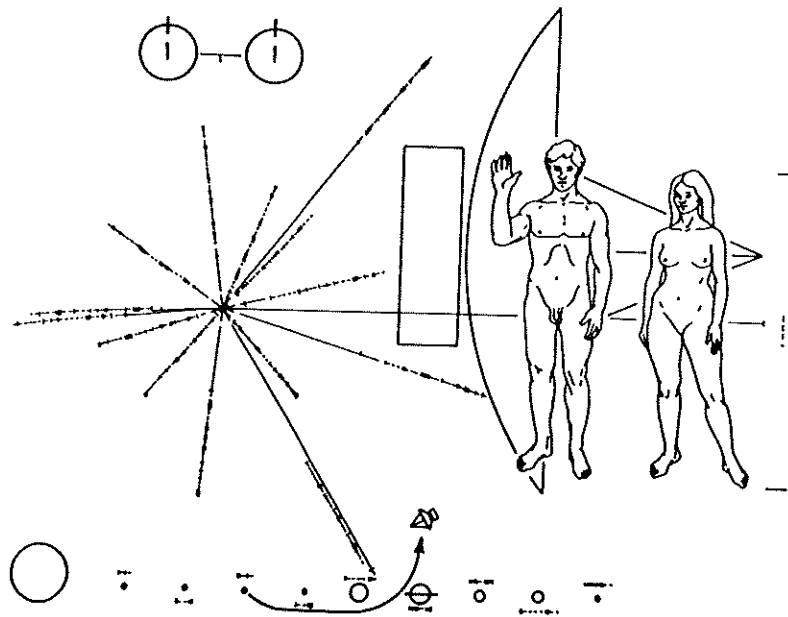
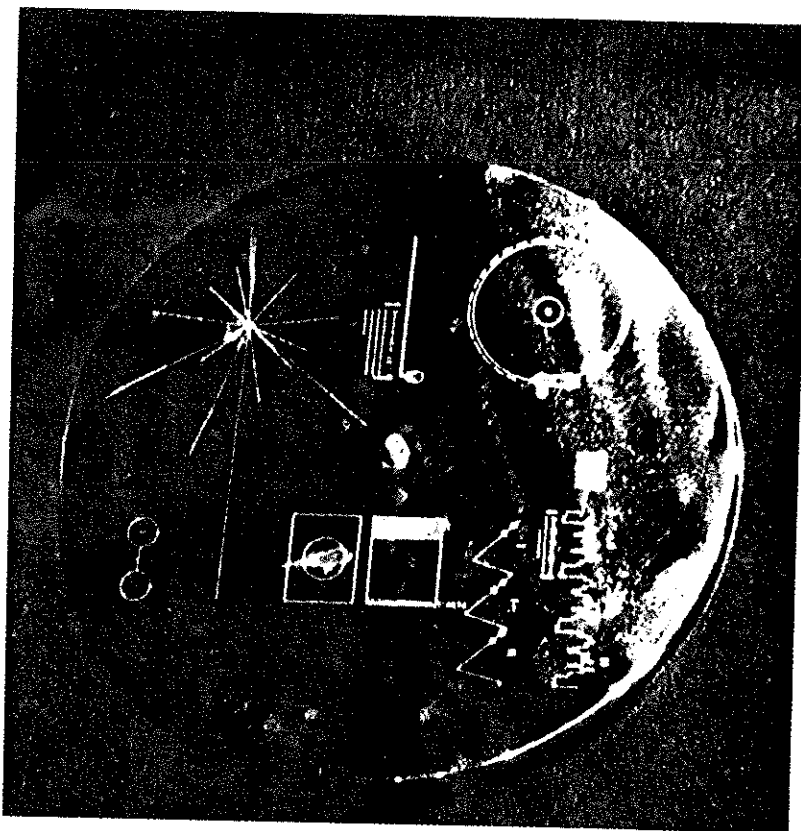


Figure 13.9 The Arecibo message correctly decoded.



**Figure 13.10** Plaque carried out of the Solar System on Pioneer 10 and 11 spacecraft. Short vertical lines and dashes are binary numbers. An extraterrestrial smart enough to catch the spacecraft should be smart enough to understand the numbers. *Courtesy of NASA.*



**Figure 13.11** Record attached to outside of Voyager spacecraft. It is protected by a cover carrying instructions on how to play it along with the pulsar map from Pioneer 10 and 11. In addition, a small sample of pure uranium-238 is attached; an extraterrestrial will be able to determine approximately when the spacecraft was launched using radiometric dating techniques. *Courtesy of NASA.*

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