Conversation Pieces

Technically intriguing items from TRW, guaranteed to add luster to your conversation and amaze your friends.

It Takes A Very Big Thing To Make A Very Small Thing

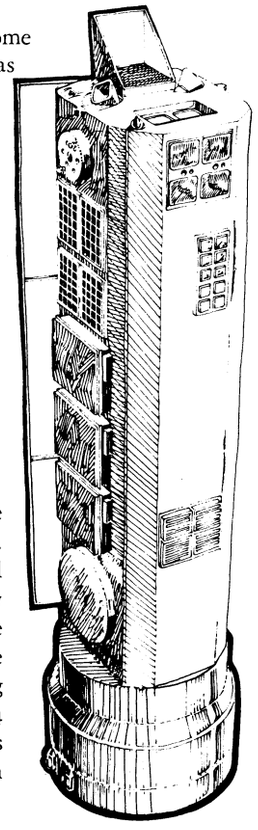
When they're not actually living together in tight quarters, those positively charged particles called protons can't stand one another's presence. If you try to bring two of them together, they fly apart at a great rate. Yet the carbon in your body has six protons sharing the small apartment of its nucleus, and the oxygen you are breathing has eight. Eighty protons are crammed together in the nucleus of a heavy element like Mercury, while the nuclei of the heaviest elements entertain lavish parties of more than 100. How were these mutually repelling protons assembled in the small compass of a nucleus? What force in nature is strong enough to have squeezed such inimical particles into such a tiny space?

The answer seems to lie in the stars. Stars are huge chemical factories within which matter is made. The great temperatures and pressures found inside stars drive together the nuclei of light elements like hydrogen (which contains a single proton) to form the heavier elements. The process is called *nucleosynthesis*. Our own star, the Sun, for example, fuses four hydrogen protons together and makes helium. At a later stage in its life, it will begin building other elements from the helium like carbon, then oxygen and neon. Eventually, it will make magnesium, silicon, and, finally, iron.

Many stars stop there and end their lives as "white dwarfs." In some, however, the process continues to even heavier elements. A few make all of the elements. These erupt in gigantic explosions called supernovae and hurl out the matter they have made in great clouds or nebulae. Some scientists believe that this matter eventually gathers together to form planets. All of the matter that makes up the Earth and its inhabitants, for example, may well be stardust. (Incidentally, Sir Arthur Eddington, not Hoagy Carmichael, is responsible for this insight.)

As the stars drive the nuclei of the elements together in thermonuclear reactions, a small fraction of their mass is converted to energy. Part of this energy comes forth as visible light, making the stars shine. Other parts of it stream forth as invisible radiation—X-rays, gamma rays, radio waves, heat, and so on. These energy by-products are valuable information, for they indicate what the stars are making, how old they are, how far away they are, and a number of other things.

Beginning in 1975, NASA's High Energy Astronomical Observatory (HEAO) will collect data on the high energy electromagnetic output of stars and the nuclei and electrons they sometimes eject (known to us as cosmic rays). It will give us fundamental information on some very important questions such as how matter is made, how old and how big the universe is, and where our planet may have come from.



To intercept these relatively rare high energy particles and short wave lengths, you need large, heavy detectors. Thus HEAO is big. In fact, it's three stories high and weighs around 10 tons. TRW is building it for the Marshall Space Flight Center.

We're very happy to be associated with this program. Because stars are a primal source of matter and energy (and hence you and me), we think HEAO is one of the most scientifically fascinating programs to come along in a long time. After HEAO goes up, we'll keep you posted on what the stars tell us.

For further information, write on your company letterhead to:

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