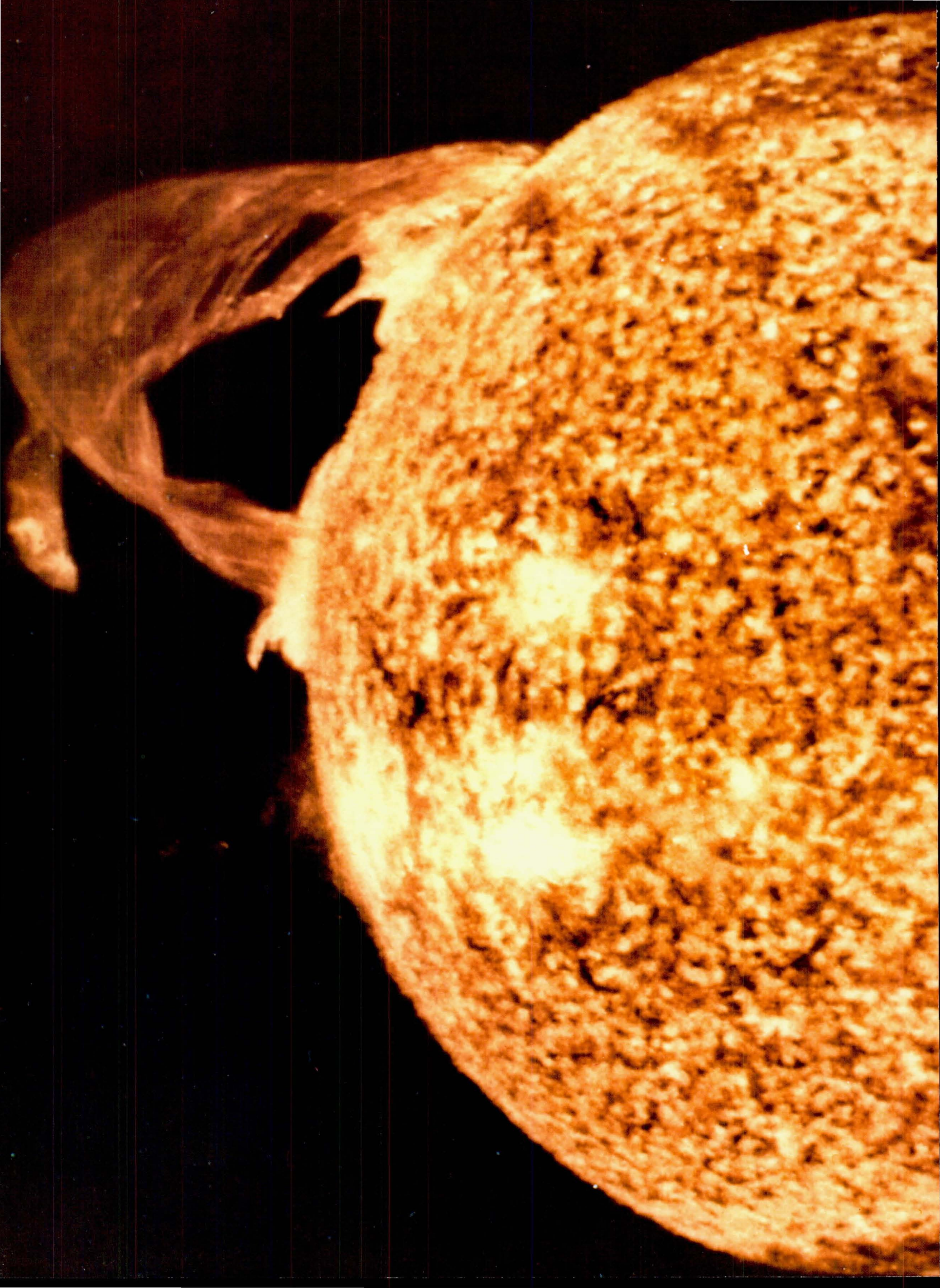




THE SUN AND EARTH IN SPACE

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***Gigantic prominence.** An ultraviolet telescope aboard Skylab photographed this huge erupting prominence, one of the largest seen in a decade, as it lifted off the Sun on December 19, 1973. The ultraviolet radiation was produced by electrified helium atoms at a temperature of about 70,000° C.*

The Sun and Us

Nothing is more important to us on Earth than the Sun. Without the Sun's heat and light, the Earth would be a lifeless ball of ice-coated rock. The Sun warms our seas, stirs our atmosphere, generates our weather patterns, and gives energy to the growing green plants that provide the food and oxygen for life on Earth.

We know the Sun through its heat and light, but other, less obvious aspects of the Sun affect Earth and society. Energetic atomic particles and X-rays from *solar flares* and other disturbances on the Sun often affect radio waves traveling the Earth's ionosphere, causing interference and even blackouts of long-distance radio communications. Disturbances of the Earth's magnetic field by solar phenomena sometimes induce huge voltage fluctuations in power lines, threatening to black out cities. Even such seemingly unrelated activities as the flight of homing pigeons, transatlantic cable traffic, and the control of oil flow in the Alaska pipeline apparently are interfered with by magnetic disturbances caused by events on the Sun. Thus, understanding these changes—and the solar events that cause them—is important for scientific, social, and economic reasons.

We have long recognized the importance of the Sun and watched it closely. Primitive people worshiped the Sun and were afraid when it

would disappear during an eclipse. Since the early seventeenth century, scientists have studied it with telescopes, analyzing the light and heat that manage to penetrate our absorbing, turbulent atmosphere. Finally, we have launched solar instruments—and ourselves—into space, to view the Sun and its awesome eruptions in their every aspect.

Once, when we looked at the Sun by the visible light that reaches the ground, it seemed an average, rather stable star. It was not exactly constant, but it seemed to vary in a fairly regular fashion, with a cycle of sunspots that comes and goes in about eleven years. Now the Space Age has given us an entirely different picture of the Sun. From space we have seen the Sun in other forms of light—ultraviolet, X-rays, and gamma rays—that never reach the ground. This radiation turns out to be far more responsive to flare eruptions and other so-called solar activity.

We now see the Sun as a place of violent disturbances, with wild and sudden movements above and below its visible surface. In addition, the influence of solar activity seems to extend to much greater distances than we had believed possible. New studies of long series of historical records reveal that the Sun has varied in the past in strange and unexplained ways. Scientists wonder how such variations might affect the future climate on Earth.

We have obtained a clearer picture about the scope of the Sun's effects. Its magnetic field stretches through interplanetary space to the outer limits of the solar system. Steady streams and intense storms of atomic particles blow outward from the Sun, often encountering the atmospheres of our Earth and the other planets.

The spectacular photos of the Earth from space show only part of the picture. Instruments carried on satellites reveal a wide variety of invisible phenomena—lines of magnetic force, atomic particles, electric currents, and a huge *geocorona* of hydrogen atoms—surrounding the Earth. Each is as complex and changing as the visible face of the globe. The Earth's magnetic field extends tens of thousands of miles into space, and many different streams of electrons and protons circulate within it. Huge electric currents flow around the Earth, affecting their high-altitude surroundings as well as our environment at ground level.

Space observations have greatly expanded our ability to look at the Sun, at interplanetary space, and at the immediate surroundings of the Earth itself. We can now "see" many phenomena that are completely undetectable from the Earth's surface, and we now have a much better, more complete and more coherent picture of how events in one part of our solar system relate to activity in another.