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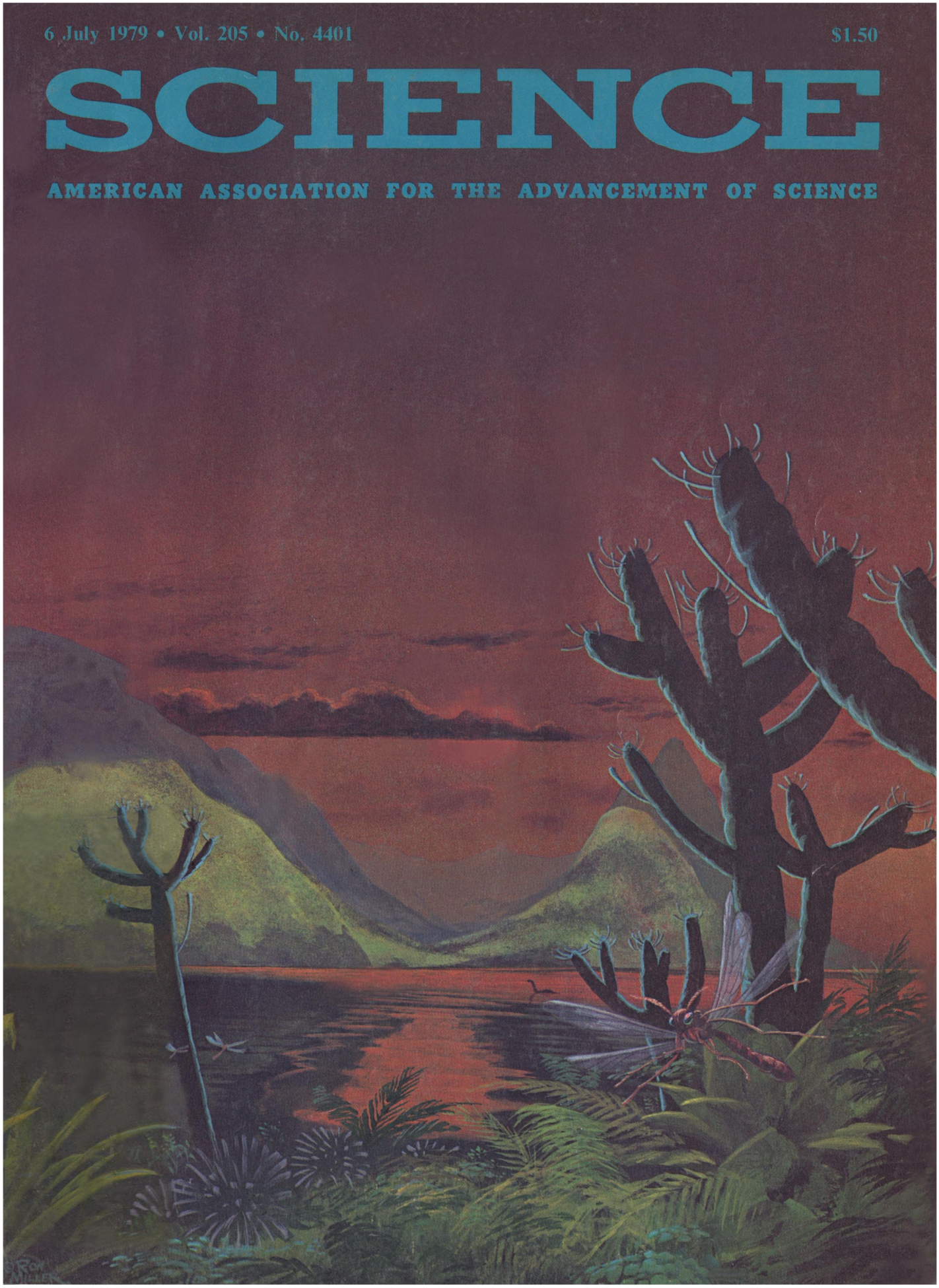
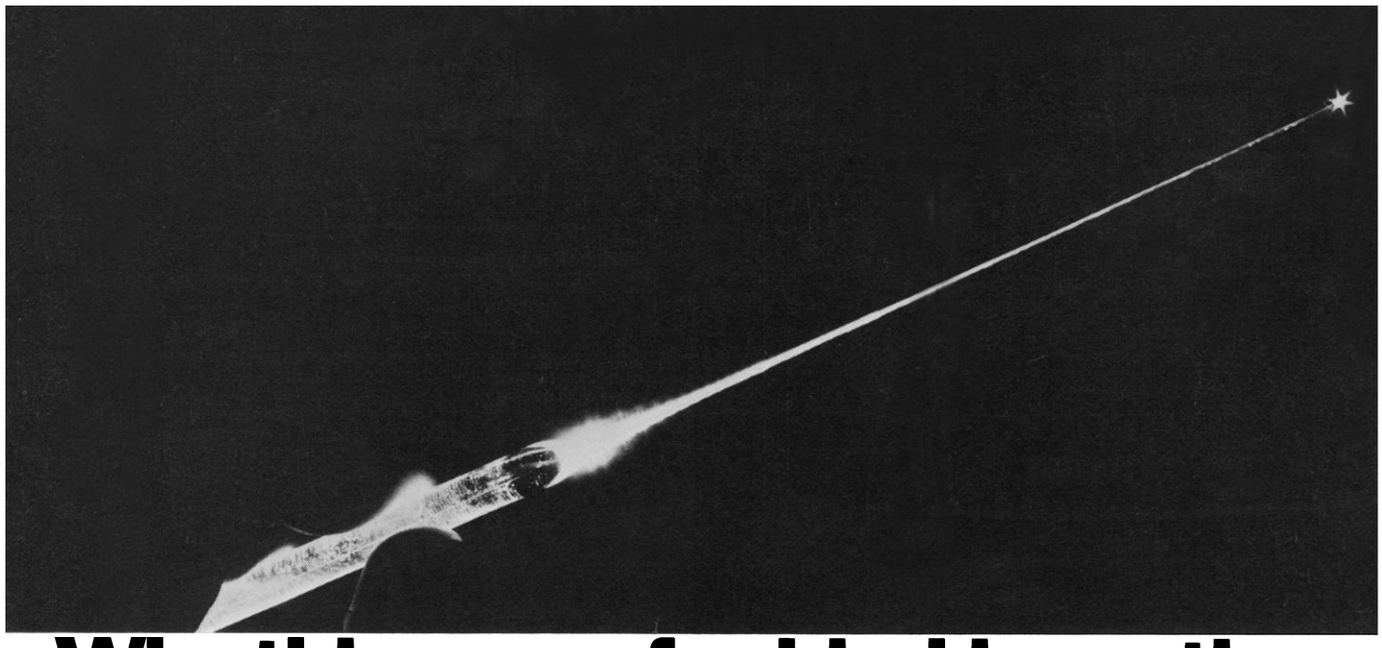
SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE





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COVER

Artist's view of Venus based on ideas of some scientists in the first half of the 20th century. Competing theories pictured Venus as a hot, lifeless desert or as a cool, moist, habitable planet. High mountains, swamps, vast oceans, and dense water clouds were postulated. Venus was widely thought to be similar in development to Earth in the Paleozoic era. See page 41. [Painting by Ron Miller, Woodbridge, Virginia]

6 July 1979, Volume 205, Number 4401 **SCIENCE**

Venus

The earlier romantic and the newer realistic views of Venus are in sharp contrast. This difference is typical of many situations that scientists deal with. They often find themselves in the position of demolishing illusions. On the other hand, the objectivity of scientists is usually narrowly confined, and even in their professional activities, illusion or self-delusion often surface. This is especially true when the information is limited and the area of possible speculation is large. For example, an ill-based belief in the possibility of life on Venus, the moon, and Mars was sufficiently strong for some scientists to alarm the public and force special precautions in the return of astronauts and samples from the moon.

In ancient times there were few constraints on imagination about Venus, and the very name of the planet reflected this. Later, it became evident that Venus was a body about the same size as Earth, that it had an atmosphere, and that it was cloud-covered. Nobel Laureate Svante Arrhenius believed that the planet supported luxuriant vegetation. His views are shared by others.

By 1960 Earth-based astronomers had determined that the atmosphere of Venus consisted principally of CO_2 with little H_2O evident. Nevertheless, confidence in the possibility of life on Venus persisted in some quarters.

Exploration of the moon and planets has left no room for little green men or microbes elsewhere in the solar system. This is especially true of Venus. Temperatures at the planet's surface range up to 400°C. The dense atmosphere consists mainly of CO_2 with an atmospheric pressure of 90 kilograms per square centimeter (90 times the total on Earth). The second most abundant component is nitrogen (about 3 percent). Water vapor is a minor constituent, being present in about the same concentration as SO_2 (of the order of 1000 parts per million). Other forms of sulfur include elemental sulfur and carbon oxysulfide. The atmosphere is acid and toxic, and the clouds probably consist largely of droplets of H_2SO_4.

Despite contrasts between their atmospheres, Earth and Venus share some important features. The abundances of nitrogen relative to the masses of the planets are comparable. The same is true of the amounts of CO_2 if one takes into account the amounts present in carbonate rocks on Earth. Within experimental error, the $^{13}C/^{12}C$ ratios are alike. The amounts of ^{40}Ar derived from decay of ^{40}K are also comparable, indicating similar contents of potassium in the two bodies.

In the current issue of *Science*, Pollack and Black discuss some of the compositional features of the atmospheres of Venus, Earth, and Mars. They also examine three hypotheses that have been advanced for the origin and evolution of these atmospheres. The view that best fits the available data is the grain-accretion hypothesis: Grains of material containing potential volatiles such as nitrogen and H_2O were accumulated into planetesimals that subsequently accreted to form planets. Later, as a result of internal heating, volatiles reached the surface. Since the amounts of CO_2 and N_2 which have reached the surface on Venus and Earth are comparable, it is possible that similar amounts of water likewise were outgassed. But little H_2O is present today in the atmosphere of Venus, and this absence must be explained. In any event, the comparative absence of water on Venus has profoundly affected weathering, the incorporation of CO_2 into solid carbonates, and the contrasting greenhouse effects on the two planets.

The results obtained from American and Soviet missions to Venus leave little room for romance. The same is true of missions to the moon and the other planets. Those who have yearned for evidence that forms of life exist on other bodies of the solar system have been disappointed. But their frustration is to a degree balanced by a positive factor. Exploration of our solar system is a triumph of human ingenuity—a triumph shared by all humans.

—PHILIP H. ABELSON

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