

altered by changes in the curve [of surmised pollution effects]" and that estimates of global pollution effects are "conservative." Local pollution effects, not considered, would be far more severe.

Other details of the models have been criticized, but much of the criticism is not convincing. "Population, capital and pollution grow exponentially in all (sic) models," say Allen Kneese and Ronald Ridker of Resources for the Future in a review of *Limits* in the Washington Post, "but technologies for expanding resources and controlling pollution are permitted to grow, if at all, only in discrete increments." There is no reason to assume these correctives would grow any other way but in discrete increments. Current exponential growth of population, industry and pollution requires virtually no innovations; left to themselves they will certainly keep growing, like Topsy, till they reach natural limits. The technological correctives will not grow without help, if at all. They require a high, and perhaps unachievable, degree of devotion of capital to research and development, of availability of highly trained researchers, of innovation and new discovery. Maybe these will all become available. Or maybe only magic will produce them.

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There is another argument, espoused by the authors of "Blueprint" and stressed by the executive committee of the Club of Rome, as well. "The crux of the matter," say the six members of the committee, "is not only whether the human species will survive, but even more whether it can survive without falling into a state of worthless existence."

This raises an entirely new area of discussion. The critics of modern civilizations say many men already are in a state of "worthless existence" through technological excesses, through crowding in cities, through unbridled aggression and competition. Undoubtedly, socio-psychological features of society are connected to the material features through their own feedback loops, says Jay W. Forrester, Meadows' mentor at MIT. The study of these connections offers a vast new field for behavioral science research.

And the implications for human values will be immense. Said Elliott Richardson, Secretary of Health, Education and Welfare, at the March 2 symposium: "We would like at least to believe if we must contemplate an equilibrium in which growth is ruled out, let it be an equilibrium in which equality has not forced the destruction of freedom and liberty." There are those who are saying now that a society in which every man and woman is regarded as having equal human value is the only society that is really free. □

April's western sky brilliant

by James Stokley

Venus, now approaching greatest brilliance, dominates the western sky in April. It remains visible for about four hours after sunset. Mars and Saturn are nearby, but much fainter. They are so low their light is dimmed by absorption as it passes through earth's atmosphere. On the 16th the crescent moon will pass close to all three planets, making a striking display.

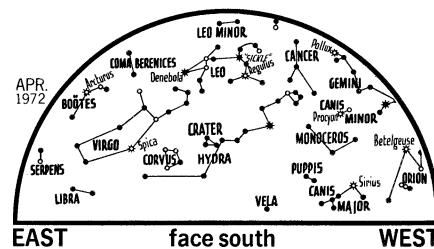
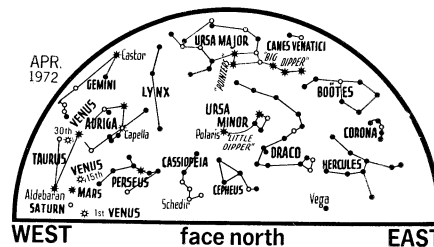
The maps show the skies at 10 p.m., local standard time on April 1, 9 p.m. on the 15th, and 9 p.m. (daylight saving time) on the 30th. The positions of Venus, Saturn and Mars are shown for April 15. Those of Venus, which is moving rapidly across the sky, are also shown for the 1st and 30th.

Soon after midnight, as April begins, Jupiter rises. It is about one-seventh as bright as Venus. The moon, then at last quarter, will pass south of Jupiter on April 6.

Venus has sometimes been called the earth's twin. This was principally because the two planets are nearly the same size: Earth's diameter is 7,927 miles, Venus' 7,526 miles. No other pair of planets in the solar system compare so closely. The mean distance of Venus from the sun is 67.2 million miles—25.7 million miles closer than the earth.

Until recent years practically nothing was known about surface conditions on Venus, because it is continually covered by clouds, which optical telescopes cannot penetrate. But the telescope does show that Venus changes phase like the moon. Although you can't see through the clouds that shroud Venus, astronomers have been able to penetrate them in recent years with radar (SN: 2/12/72, p. 102). A brief pulse of radio waves is accurately aimed at the planet, which sends back an echo. Precise measurement of the time for the echo to return (perhaps eight minutes) tells the distance, because radio waves, like those of visible light travel about 186,000 miles per second.

When Venus is as brilliant as it will be during the coming weeks, you may be able to see it cast a distinct shadow. This will, however, require favorable conditions. You will need an otherwise dark sky, no lights around you, and a light surface on which to see the shadow. And you must have been in the dark long enough—perhaps 15 or 20 minutes—for your eyes to become



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WEST EAST
face north
EAST WEST
face south
☆ ★ ○ ● Symbols for stars in order of brightness

adapted to such faint illumination.

On April 1 Venus will be 71 million miles away, considerably closer than the sun's distance of 92.9 million miles. Thus we can see less than half of the bright hemisphere, and it is in a crescent phase. As it approaches even closer it will appear bigger and brighter. In May it will be about 20 percent brighter than in April.

Then it will continue to enlarge but the crescent will become narrower and narrower so it will lose brightness. In early June it will be about a third fainter than now and will set very soon after sunset, making it hard to see. On June 17 it will pass between sun and earth and in July will be to the west of the sun. Rising before sunrise, it will be a brilliant "morning star" at dawn in late summer. □

CELESTIAL TIMETABLE		
April EST		
1	2:00 am	Moon farthest, distance 252,350 miles
		Mars passes north of Saturn
5	12:00 pm	Moon passes south of Jupiter
6	6:44 pm	Moon in last quarter
7	7:00 pm	Venus farthest east of sun
8	6:00 am	Venus passes north of Saturn
11	10:00 pm	Mars passes north of Aldebaran
13	3:31 pm	New moon
14	1:00 pm	Moon nearest, distance 222,000 miles
	9:00 pm	Venus passes north of Aldebaran
16	9:00 am	Moon passes north of Saturn
	9:00 pm	Moon passes south of Venus
	11:00 pm	Moon passes north of Mars
20	7:45 am	Moon in first quarter
22	3:00 pm	Venus passed north of Mars
28	5:00 am	Moon farthest, distance 252,550 miles
	7:00 am	Mercury farthest west of sun
	7:44 am	Full moon