converting organic waste products, such as sawdust, into a sugar solution for the culture of edible yeasts. Such a technique, if suitably developed, might provide much-needed proteins for those millions who, at present, have to subsist on an unbalanced diet of cereals. And the goal of another of these projects would be the synthesis of chlorophyll, the substance which permits the growing plant to use the sun's energy to convert air and water into carbohydrates. Up to the present, the rulers of the world have been ready to lavish time, energy, money and brains upon the development of atomic and biological weapons; it might be a good thing to use the resources of applied science for the relief of the world's hunger and the removal of one of the principal causes of war.

Natural monopolies in raw materials are even more politically dangerous than natural monopolies in food. When located in the territory of a strong nation, deposits of minerals necessary to industry are a standing temptation to the abuse of military and economic power; when located in that of a weak nation, they are a standing temptation to aggression from abroad. Research should be deliberately organized for the purpose of discovering universally available substitutes for these relatively rare and most unevenly distributed minerals. If successful, such research would have two beneficial results; it would break the natural monopolies which are so politically dangerous; and it would help our industrial civilization to shift from its precarious basis in the exploitation of rapidly wasting assets to a more secure, a more nearly permanent foundation.

The Threat to World Peace

We now come to the problem of atomic energy. Though we would like to assume (and it would be a pretty large assumption) that henceforward atomic energy will be used exclusively to provide power for peacetime industry and agriculture, all the time the temptation to use the new source of energy for political purposes, in war or revolution, would beckon every ambitious adventurer, every fanatic and idealist. "Lead us not," we pray, "into temptation"—for the good reason that, whenever temptation is strong enough and persistent enough, we almost invariably succumb to it.

Industrial civilization is based upon the exploitation of wasting assets by means of man-power and the power generated by coal, oil, gas and falling water. If successfully harnessed, atomic energy will increase the available power to an enormous extent. From this two results may be anticipated, one unfavorable, the other favorable. To begin with, we may expect that increased power will lead to the more effective exploitation and consequently to the more rapid exhaustion of the more easily available supplies of such indispensable minerals as iron, tin, copper, zinc and the like. Atomic energy will permit us to enjoy the prosperity of the spendthrift who lives gloriously for a few years on inherited capital. If this were all that could be expected, the discovery of atomic energy would be wholly disastrous. But fortunately this is not the whole story. Given an indefinite amount of cheap power, it will become economically possible to exploit deposits whose low concentration of desirable minerals renders them, under present conditions, practically worthless. In other words, the harnessing of atomic power is likely to accelerate the dissipation of what may be called our high-grade capital; but it should postpone the final onset of bankruptcy by making available to industry the low-grade capital which it now costs us too much to spend. In combination with a reasonable population policy, a reasonable policy for the use of atomic energy might permit some better version of our industrial civilization to achieve stability and a certain permanence.

Applied science can be used in the fight for liberty, no less effectively than in the fight for peace. Let us assume, for example, that a means will be discovered for substantially increasing the supply of food. This would have the same kind of result as the discovery of a second New World. It would make life easier for the inhabitants of overcrowded countries and, by doing so, it would remove the necessity for some of the "centralized and peremptory social controls", which must always be imposed when the pressure of population upon resources become excessive.

Meanwhile, every day brings its quota of some 55,000 new human beings to a planet which, in the same period of time, has lost through erosion almost the same number of acres of productive land and goodness knows how many tons of irreplaceable minerals. Whatever may be happening to the superficial crisis, to the crisis on the political, or industrial or financial levels, that which underlies it persists and deepens. The current, almost explosive growth in world population began about two centuries ago and will continue, in all probability, for at least another 100 years. So far as we know, nothing quite like it has ever happened before. We are faced by a problem which has no earlier precedent. To discover and, having discovered, to apply the remedial measures is going to be exceedingly difficult. And the longer we delay, the greater the difficulty will be.

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ASTRONOMY

Total Eclipse of Moon

The first eclipse of the year will occur on the night of April 12. Saturn will be the only planet visible next month in the evening skies.

By JAMES STOKLEY

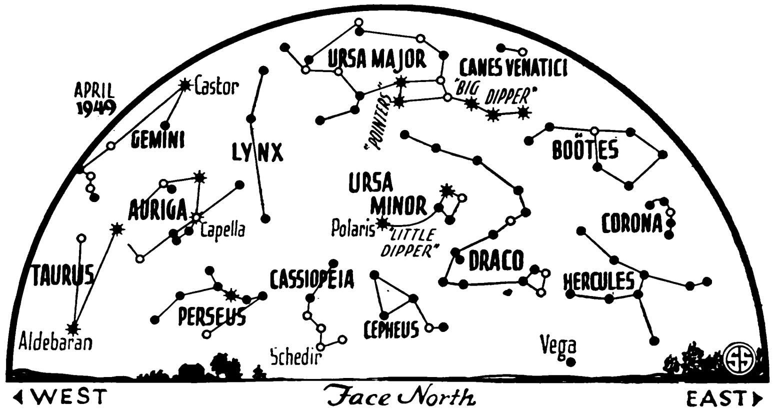
➤ THE most interesting astronomical event of April is a total eclipse of the moon, which occurs early in the night of Tuesday, April 12, and is visible throughout North America. This is the first eclipse of 1949 and one of two eclipses which occur in April, but the second will not be seen from this part of the world.

The second is a partial eclipse of the sun, which comes on April 28 and will be visible over practically all of Europe, northwestern Africa, Greenland, Iceland, Baffin Land, the North Atlantic Ocean and the Arctic regions, including the northernmost part of Siberia. Where it is at its maximum, only 60% of the solar diameter will be hidden by the moon. That is, the inner part of the lunar shadow, where the sun would be totally eclipsed, does not touch the earth at all.

The evening skies in April bring only one planet, Saturn, which stands high in the south very close to the star Regulus, in the constellation of Leo, the lion. Its position is shown on the accompanying maps, which depict the heavens as they appear about 10:00 p.m. at the beginning of the month and an hour earlier at the middle. Saturn is just twice as bright as Regulus, and shines with a steadier light. This is because of the fact that it is a planet, shining by reflected sunlight, rather than a star, as Regulus is, a distant sun emitting light itself.

In Leo is a smaller star-group called the sickle, with Regulus at the end of the handle. The blade of the sickle forms the lion's head, while Denebola, farther east and part of a little triangle of stars, is the animal's tail.

Next to Leo, to the left, is the rather long constellation of Virgo, the Virgin, in which we find the star called Spica. On the other side of the lion is Cancer, the crab, not a very conspicuous group though it is part of



the zodiac, the path through which the sun, moon and planets appear to move. But next to Cancer we come to Gemini, the twins, with the first magnitule star Pollux.

Below Gemini is Orion, the warrior, which was so conspicuous in winter evening skies, but is now about to disappear from view. Betelgeuse, in this figure, is also of the first magnitude, as is Sirius the dog-star, in Canis Major, the great dog, which stands to the left, close to the southwestern horizon. To the right of Orion can be seen all that now remains visible of Taurus, the bull, with Aldebaran as the brightest star. A little higher is Auriga, the charioteer, with Capella.

High in the east, near Virgo, is Bootes, the bear-driver, of which brilliant Arcturus is part. Extending upwards from this constellation is the very well-known "great dipper," part of Ursa Major, the great bear. The dipper is now inverted. In the bowl are the two stars known as the pointers, which show the direction of Polaris, the pole star. Winding around the eastern side of the little dipper, of which Polaris is part, we see the figure of Draco, the dragon, whose head brings us to the group of Hercules. Below this constellation Lyra, the lyre, is coming into view, but it is so low that only the star Vega is shown. By summer this group will be high overhead in the evening, and Vega will outshine all other stars that are visible.

Though Saturn is the only planet now seen during evening hours, Jupiter appears after midnight, in the constellation of Capricornus. The other naked-eye planets, Mercury, Venus and Mars, are all so nearly in the same direction as the sun in April that they are not visible.

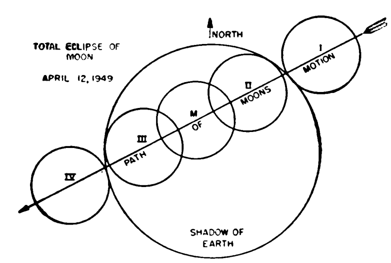
Since the earth and the moon alike have no light of their own, but are illuminated by the sun, they cast shadows in the direction away from the sun. Since they fall generally into empty space, however, the shadows are not evident until something gets into them. When the moon's shadow falls on the earth, we have an eclipse of the sun; while a lunar eclipse happens when the moon enters the earth's shadow, as it does in April.

These shadows are in two parts. There is an inner region, called the umbra, where the shadow-casting body completely obscures the sun. Around this is an outer part, called the penumbra, where the sun is only partly hidden. In the case of the eclipse of the sun on April 28, it is the penumbra that falls on the earth, while the umbra never reaches it at all.

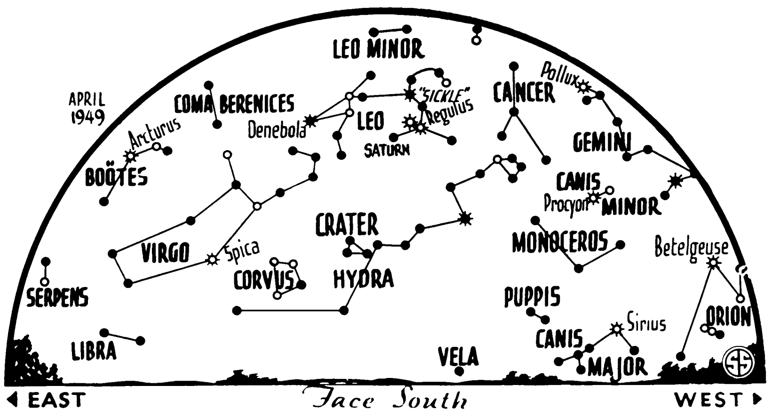
An eclipse of the sun must occur when the moon is new, for then it is in the same direction as the sun from the earth. Similarly, a lunar eclipse must occur at full moon, for only then is it in the opposite direction from the sun, and thus able to enter the earth's shadow. We do not, however, have a solar eclipse every time the moon is new and one of the moon every time it is full, because it generally passes above or below the line joining the sun and earth. Then at new moon, the lunar shadow falls into space, rather than on earth, and at full moon that body passes outside the earth's shadow. Twice every month, however, the moon is at a position called a "node," when it passes through the plane of the earth's orbit around the sun. When one of these nodes happens to come at new or full moon we have an eclipse.

On the evening of April 12, the full moon will be shining in the sky, at full brilliance, until after 8:32 p.m., EST. Then it starts to enter the penumbra of the earth's shadow, but nothing will be noticed until perhaps half an hour or so later, when the light of the moon seems somewhat dimmed. By then the earth will be cutting off a considerable part of the sun's illumination.

The accompanying diagram shows the principal phases of the eclipse proper.



At 9:28 p.m., EST, as shown at 1, the southeastern edge of the moon will make its first contact with the dark core of the shadow, represented by the large



☼ ✱ ○ • SYMBOLS FOR STARS IN ORDER OF BRIGHTNESS

circle. Just an hour later, at 10:28 p.m., the moon will be in the position indicated by II, and the total eclipse will begin. At 11.11 p.m., EST, the eclipse will be at its middle, as shown at M. III shows the end of the total eclipse, as the eastern edge of the moon starts to emerge from the umbra, at 11:54 p.m. Just as it took an hour to enter the umbra, it takes an hour to leave. At 12:54 a.m., EST, on April 13, the moon is in position IV, and the eclipse is over. At 1:51 a.m. the moon will be completely out of the penumbra, shining with undiminished light.

Between I and II, and between III and IV, the curved shadow of the earth will be seen creeping across the lunar disk. Even at M, when the eclipse is at its height, the moon will not be completely dark, but will shine with a coppery-red light. The reason for this is that the layer of air around the earth acts as a prism and refracts some of the sunlight into the shadow. As this light passes through the atmosphere, some of its blue rays are scattered, and these give the sky over those regions its blue color. With so much blue light removed, the rays which penetrate are predominantly red. It is a similar effect that gives the setting sun its red color, but the effect is even more pronounced with the eclipse, for then the rays have passed through twice as long a path in the atmosphere as those which reach us at sunset. Thus, it is a red light which falls on the moon during a total eclipse.

Time Table for April

April	EST	
3	5:00 p. m.	Planet Neptune directly opposite sun and nearest earth; distance 2,721,000,000 miles. (Not visible to naked eye.)
6	8:01 a. m.	Moon in first quarter
9	8:26 a. m.	Moon passes Saturn
12	4:00 a. m.	Moon nearest; distance 222,500 miles
	11:08 p. m.	Moon full and in total eclipse
19	10:15 p. m.	Moon passes Jupiter
	10:27 p. m.	Moon in last quarter
21	early a. m.	Meteors from direction of constellation of Lyra
24	5:00 p. m.	Moon farthest; distance 252,200 miles
28	3:02 a. m.	New moon, partial eclipse of sun visible in Europe and Arctic regions

Subtract one hour for CT, two hours for MT, and three for PT.

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INVENTION

New Device Measures Ripeness in Fruit

➤ TESTING the ripeness of fruits and vegetables has long been done by rule-of-thumb—or rather, by rule-of-thumbnail. The tester simply pressed a thumbnail against the specimen, and guessed how hard or how soft it was.

Now Dr. Edward Ross of the State College of Washington has put such testing on a mechanized, exactly measurable basis. In his testing machine a small piston, powered by a compressed gas from an ordinary commercial cyclinder, pushes a rounded brass tip five thirty-seconds of an inch in diameter to a depth of one thirty-second of an inch into the skin of the fruit. The force needed is read off directly on the dial of a gauge.

Description and diagram of Dr. Ross' device is published in the journal, SCIENCE (Feb. 25).

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CHEMISTRY-ASTRONOMY

New Photographic Emulsion Will Help in Study of Sun

➤ A PHOTOGRAPHIC emulsion sensitive to light far into the ultraviolet may prove useful for studying the sun from rockets sent high into our atmosphere. The emulsion was developed for identifying atoms or chemicals by analyzing their radiant energies.

Called a "vacuum ultraviolet" emulsion, the material was described to the Optical Society of America meeting in New York by Arthur L. Schoen and Edwin S. Hodge of Kodak Research Laboratories. The new emulsion has extremely close-packed silver grains with very little gelatin.

Ultraviolet rays of the sun are intense at high altitudes where the new emulsion may be used, for at this altitude these rays have not been filtered out by the earth's atmosphere. To test the emulsion here on earth, air was pumped out of a vacuum spectrograph and the emulsion, placed in the vacuum, was exposed to a high intensity spark, rich in ultraviolet radiation.

Science News Letter, March 26, 1949

Words in Science—HYDROPONICS

➤ ORIGINALLY meaning gardening in water instead of earth, hydroponics is now applied to any sort of soilless gardening whether the plants are grown in tanks of water, or in sand, gravel, vermiculite, sawdust or any other sterile material. You pronounce the word high-dro-pon-icks.

In hydroponics, fertilizer chemicals in suitable proportions are provided to the plants. From these the plants manufacture their own foods. Through hydroponics, it has been possible to grow flourishing gardens on barren volcanic islands where even the water has to be distilled from the sea, and not a grain of real soil was available.

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