

## CLASSICS OF SCIENCE:

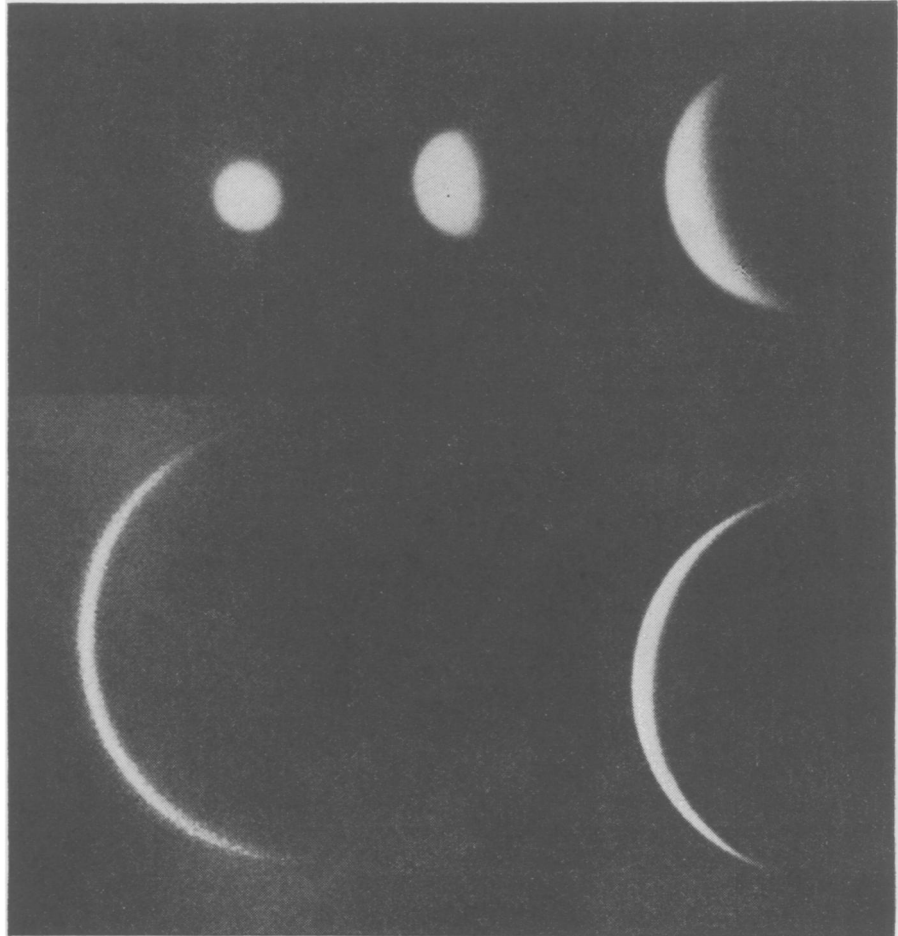
Galileo sees the Phases of Venus  
*Astronomy*

Venus is the lower and more brilliant of the two planets shining near the horizon in the western evening sky. The other is Jupiter. Venus is brightest when near the earth, in spite of the fact that it appears then in crescent phase. At present it looks through the telescope like the lower right-hand picture. It is very difficult to observe the phases through an ordinary field glass, although, with a powerful glass clamped solidly, it is sometimes possible to see that the image is not a perfect disk. The Classics Editor would be glad to learn from any amateur who has seen Venus' phases the conditions of observation and the power of his glass.

*DIOPTRICS*, by Johann Kepler, (Galileo's letter quoted in the Preface), Augsburg, 1611; translated by Edward Stafford Carlos, London, 1880.

*Letter from Galileo*

"It is time for me to disclose the method of reading the letters which some weeks since I sent you as an anagram. It is time now, I mean, after I have become quite certain about the matter, so much so that I have no longer even a shadow of doubt. You must know then that about three months ago, when the star of Venus could be seen, I began to look at it through a telescope with great attention, so that I might grasp with my physical senses an idea which I was entertaining as certain. At first then you must know the planet Venus appeared of a perfectly circular form, accurately so, and bounded by a distinct edge, but very small; this figure Venus kept until it began to approach its greatest distance from the sun, and meanwhile the apparent size of its orb kept on increasing. From that time it began to lose its roundness on the eastern side, which was turned away from the sun, and in a few days it contracted its visible portion into an exact semicircle; that figure lasted without the smallest alteration until it began to return towards the sun where it leaves the tangent drawn to its epicycle. At this time it loses the semicircular form more and more, and keeps on diminishing that figure until its conjunction, when it will wane to a very thin crescent. After completing its passage past the sun, it will appear to us, at its appearance as a morning star, as only sickle-shaped, turning a very thin crescent away from the sun; afterwards the crescent will fill up more and more until the planet reaches its greatest distance from the sun, in which position it will appear semicircular, and that figure will last for many days without appreciable variation. Then by degrees, from being semicircular it will change to a full orb, and will keep that perfectly circular figure for several months, but at this instant the



THE PHASES OF VENUS as shown in a series of photographs made at the Lowell Observatory, at Flagstaff, Arizona. All these pictures are on the same scale, the planet appears larger when in the crescent phase because then it is about 120,000,000 miles nearer to us

diameter of the orb of Venus is about five times as large as that which it showed at its first appearance as an evening star.

"From the observation of these wonderful phenomena we are supplied with a determination most conclusive, and appealing to the evidence of our senses, of two very important problems, which up to this day were discussed by the greatest intellects with different conclusions. One is that the planets are bodies not self-luminous (if we may entertain the same views about Mercury as we do about Venus). The second is that we are absolutely compelled to say that Venus (and Mercury also) revolves round the sun, as so also all the rest of the planets. A truth believed indeed by the Pythagorean school, by Copernicus, and by Kepler, but never proved in the case of Venus and Mercury. Kepler therefore and the rest of the

school of Copernicus have good reason for boasting that they have shown themselves good philosophers, and that their belief was not devoid of foundation; however much it has been their lot, and may hereafter be their lot, to be regarded by the philosophers of our times, who philosophise on paper, with an universal agreement, as men of no intellect, and little better than absolute fools.

"The words which I sent with their letters transposed, and which said,

*Haec immatura a me jam frustra leguntur, o. y.*

When reduced to their proper order, read thus,

*Cynthiae figuras aemulatur mater amorum:*

The mother of the Loves rivals the phases of Cynthia: that is,

*Venus imitates the phases of the Moon.*

Three days ago (*Turn to next page*)

## Phases of Venus—Continued

I observed an eclipse of the moon, but not anything worthy of special notice occurred in it. Only the edge of the shadow appeared indistinct, blurred, and hazy; the cause of the phenomenon no doubt is that the shadow has its origin at the earth, at a great distance from the body of the moon.

"I have some other particulars, but I am prevented by time from writing about them, etc."

So writes Galileo.

### Kepler's Comment

What now, dear reader, shall we make out of our telescope? Shall we make a Mercury's magic-wand to cross the liquid ether with, and, like Lucian, lead a colony to the uninhabited evening star, allured by the sweetness of the place? or shall we make it a Cupid's arrow, which, entering by our eyes, has pierced our inmost mind, and fired us with a love of Venus? For what language is too strong for the marvelous beauty of this orb, if, having no light of its own, it can attain simply by the borrowed light of the sun to such splendour, as Jupiter has not, nor the Moon, though enjoying a proximity to the sun as close as Venus; for if the moon's light be compared with the light of Venus, it will be seen to be certainly greater on account of the apparent magnitude of the moon, but, in comparison with the light of Venus, dull, dead, and leaden. O truly golden Venus! Will any one doubt any more that the whole orb of Venus is wrought most smoothly out of pure unalloyed gold, since its surface, when only placed in the sunlight, reflects a splendour so intense! And here let me add my experiments about the alteration of the light of Venus on blinking the eye, which I have examined in the part of my Astronomy which treats of Optics. Reasoning will be able to conclude nothing else but this, that the orb of Venus turns on its own axis with an exceedingly swift rotation, displaying one after another different parts of its surface which are more or less capable of retaining the sun's light.

**Galileo Galilei** (1564-1642) had been observing the heavens through his new telescope for about a year when he wrote this letter to his enthusiastic German admirer. The next year, 1611, when Kepler's "Dioptrics" was published, found Galileo in Rome, with his telescope set up in the Quirinal Palace gardens, laughing uproariously at the theological bigots who refused to look through it for fear they might see the sights he described.

**Johann Kepler** (1571-1630) in 1610 received a present of one of Galileo's tele-

scopes, and set about improving it. He worked out the system of lenses known ever since as the "astronomical" or inverting telescope. Galileo's, which shows the image right-side-up, is now used chiefly in field- and opera-glasses. Kepler published his ideas on telescope making in 1611 under the title "Dioptrics," and in the preface printed the letter from Galileo describing the phases of Venus and his comments on it. In the same year, Kepler lost his favorite child by smallpox, his wife by typhus fever, and his patron by imprisonment and subsequent death. It is a striking illustration of living conditions of his time that only two of his twelve children lived to grow up.

**Venus** is the second planet from the sun and the nearest to the earth. We see it as "morning star" and "evening star," and it is sometimes so bright that it can be seen by the naked eye in full daylight. Its mean distance from the sun is 67,170,000 miles. Its furthest distance from the earth is 160,000,000 miles, while at its nearest approach it comes nearer us than any other heavenly body except our moon. The diameter, surface, volume, mass and density of Venus are almost exactly the same as those of the earth, which makes that planet a favorite colonizing place with astronomical romancers for adventurous super-aviators from our planet. Yet it is doubtful whether such travellers would feel perfectly at home there. Their year is  $7\frac{1}{2}$  of our months. The length of the day is uncertain and very difficult to estimate, as the surface is covered with clouds and it is

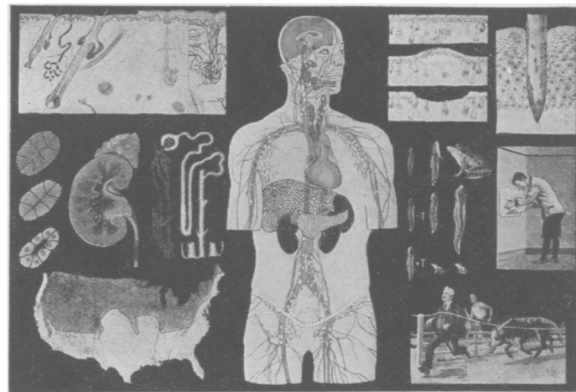
doubtful whether any permanent markings have ever been seen. The abundant atmosphere would be pleasing to an earth-dweller, and the clouds would screen the unpleasant effect of twice as much sunlight and heat as we are accustomed to. But the two possibilities that the surface is entirely covered by water and that Venus always keeps the same face to the sun would ruin the planet according to our ideas of a place to live. Even if these calamities are not true of our sister planet, the fact that the splendor of the heavens, particularly the brilliant spectacle of the earth-moon binary planet so near-by are shut out, would make us feel that the Venus-dwellers are a very insular and narrow-minded race.

*Science News-Letter, March 23, 1929*

On the average, older children in a family are less intelligent than younger children, an investigation of 1,500 families indicates.

Venezuela is entirely within the torrid zone and has a tropic climate, but the temperature ranges from hot to temperate to cold at the different altitude levels.

A bas-relief panel of lions, unearthed at Beisan, is pronounced by archaeologists the finest sculpture ever found in Palestine and the equal of the best Egyptian art.



**W9 Secretion and Excretion.** Some questions readily answered for the pupil by this chart: What and where are the endocrine, digestive, excretory and lymphatic glands? What purposes of defense does the strategic grouping of the latter indicate? What lessons of moderation and health habits are learned from the glands? What health habits assist the glands in functioning properly?

The salivary glands, liver and pancreas have been studied for generations. The endocrine glands, the thyroid, parathyroid, pineal, pituitary and suprarenal are presented with the freshness of a revolutionizing idea. How a gland through the production of hormones can vitally affect, build up or change distant parts of the body offers fascinating problems for further study. The function of thyroid is illustrated in the metamorphosis of the frog, the suprarenal is capable of calling on great reserves of strength in emergencies. The lack of iodine in the goiter region of the United States indicates a treatment recommended for this condition.

The mechanism by which excretion is accomplished is shown by a study of the kidney and of the skin. The temperature control of the body through the skin and the protection against injury and infection are illustrated.

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