LEAFLET 30—August, 1930

THE NEW PLANET PLUTO

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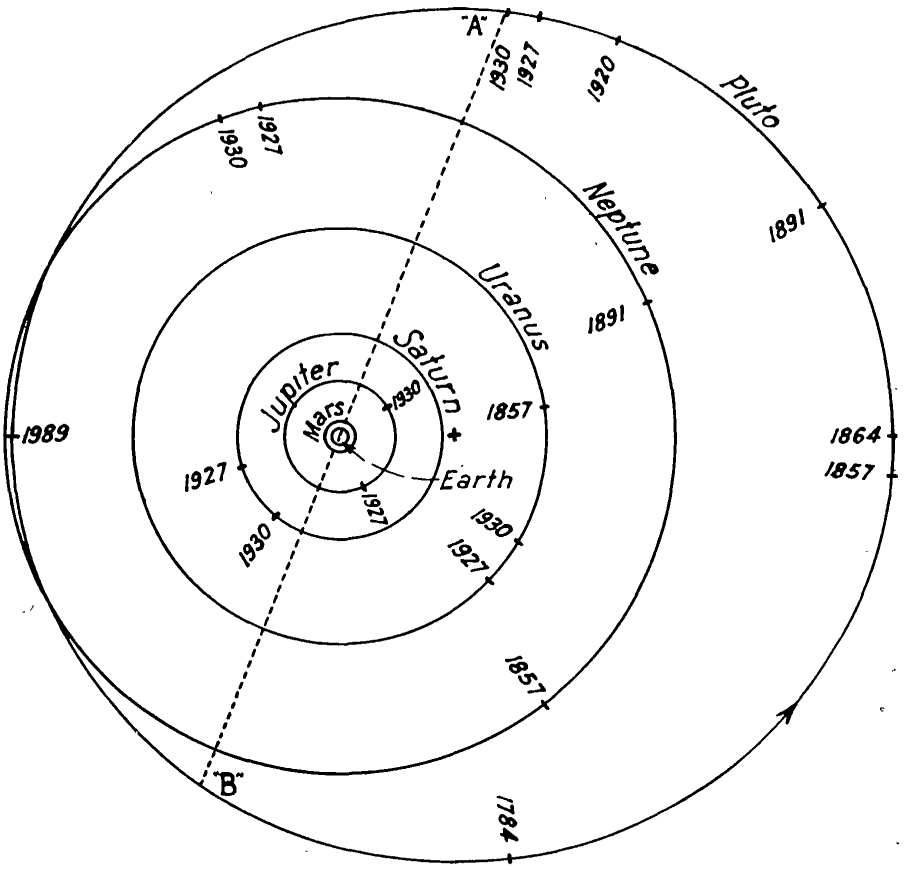

Illustration adapted from a diagram prepared by Mr. F. L. Whipple, showing the orbits of the planets Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. The innermost circle depicts the orbit of the Earth, 1 "astronomical unit," or 93,000,000 miles in radius. The planets all revolve around the Sun from west to east—that is, in a counter-clockwise direction. To make the representation of Pluto's orbit more realistic, the plane in which it is drawn should be rotated from left to right about the dotted line AB, through an angle of 17 degrees to the plane of the printed page. The orbits of all the other planets shown, lie nearly in a common plane, represented by that of the paper. The positions of the planets on various dates from 1784 to 1989 are marked. The center of Pluto's orbit is indicated by a cross, lying just to the right of the circle representing the orbit of Saturn, which is 9.5 "astronomical units" in radius.

THE new ultra-Neptunian planet, discovered photographically last March at the Lowell Observatory, has been appropriately named Pluto, in honor of the god of the regions of darkness. Since its detection, astronomers have been busy investigating the orbit of this recently found member of our system—that is, the path which it describes around the Sun in company with the other planets and in obedience to the law of gravitation. Much of our knowledge of a planet depends upon what we can find out about its orbit. Soon after preliminary orbits of the new planet had been computed, it was possible by their means to ascertain the wanderer's location with respect to the stars many years prior to its discovery. With a knowledge of where the planet should have been in times past, astronomers have been able literally to find traces of it on photographs taken for other purposes as long ago as the year 1919. By aid of these pre-discovery positions, derived from their photographic album of the sky, astronomers have been enabled to revise their calculations and to compute much more accurate orbits for the planet than were possible immediately after its discovery.

The following facts concerning the orbit of Pluto are taken from the results of the closely concordant investigations at the Students' Observatory, Berkeley, by Mr. E. C. Bower and Mr. F. L. Whipple, under the supervision of Director A. O. Leuschner and (independently and almost simultaneously) at the Mount Wilson Observatory by Dr. S. B. Nicholson and Mr. N. U. Mayall.

The orbit of Pluto, like the orbits of all the other planets, is an ellipse, but Pluto's orbit is considerably more elliptical than that of any other major planet in the solar system. The Sun is displaced a quarter of the way from the center of the orbit to the point on the orbit nearest the Sun, the so-called "perihelion point," a distance of more than 900 million miles. Whereas the orbital planes of all the other major planets lie within seven degrees of the plane of the Earth's orbit, or the "plane of the ecliptic," the orbit of Pluto is inclined fully seventeen degrees to that plane. The mean distance of the new planet from the Sun is nearly 40 "astronomical units," the "astronomical unit" being the mean distance of the Earth from the Sun, or roughly ninety-three million miles. Accordingly, a distance of forty astronomical units amounts in round numbers to 3,700,000,000 miles. The orbit of the planet is so

pronouncedly elliptical, however, that its distance from the Sun varies to the extent of some 1,800,000,000 miles, the minimum distance being equal to about 2,800,000,000 miles, or a trifle less than that of Neptune, and the maximum distance, to approximately 4,600,000,000 miles, or nearly sixty-five per cent greater than that of Neptune, hitherto the outermost known member of the planetary family. Like the other planets, however, Pluto revolves around the Sun from west to east—that is, in a counter-clockwise direction. It follows from the fact that the mean distance of this now remotest known planet is some 40 astronomical units, that its period of revolution around the Sun is about 250 of our years; hence a "year" on this lately discovered world is equal to two and a half centuries here on the Earth! It follows also that with respect to the stars, the planet, as viewed from the Sun, moves in a twelvemonth over a distance on the face of the sky not quite three times the angular diameter of the Moon. Pluto is now approaching the perihelion point in its orbit, or that closest to the Sun, but it will not pass that point until the year 1989, when it will be at a distance from the Sun only slightly less than that of Neptune (2,800,000,000 miles). Pluto will then be nearest to the Earth as well as to the Sun and in the most favorable position generally for observation from the Earth.

It is an interesting circumstance that if its orbit lay in the same plane as that of the orbit of Neptune, Pluto at perihelion would be slightly within the orbit of Neptune. As a result of the high mutual inclination of the orbital planes of the two planets, however, their orbits do not intersect at any point, although at its closest approach to the Sun, Pluto is actually a bit (approximately half an astronomical unit) nearer to the Sun than is Neptune.

The new planet is now of about the fourteenth stellar magnitude; that is, it is only about one sixteen-hundredth as bright as the faintest star comfortably visible to the naked eye on a clear, moonless night. A telescope at least ten inches in aperture is accordingly required to make the planet barely visible. In view of its intrinsic faintness, Pluto is probably much smaller than any of the giant planets—Jupiter, Saturn, Uranus, and Neptune—being possibly as small as Mercury (3,100 miles in diameter) and probably no larger than Mars (4,200 miles); certainly it is

much more nearly comparable in size and in mass to the four "terrestrial planets" than it is to the giant planets.

At its mean distance from the Sun—40 astronomical units—the surface temperature of Pluto can hardly be much higher than 380 degrees below zero Fahrenheit! This means that if there were any nitrogen and oxygen on the planet's surface, they would have to exist there not in the gaseous state as they do in the Earth's atmosphere, but in the solid form. Under such circumstances, on a world like Pluto, where the very air that we breathe would be frozen solid, anything even remotely analogous to life such as we know it would be impossible, as indeed it would be also on the giant globes, Jupiter, Saturn, Uranus, and Neptune.

An interesting question that at once arises is: Are there not other planets revolving around the Sun beyond the orbit of Neptune (ultra-Neptunian planets) and possibly some beyond the orbit of even Pluto itself (ultra-Plutonic planets)? We know that the Sun's gravitational sphere of control extends far beyond the orbit of Pluto. Now that a body of the evident dimensions and mass of Pluto has been revealed, is there any reason to suppose that there are not other, probably similarly constituted, members revolving around the Sun outside of the orbit of Neptune? Indeed, it may ultimately be found that the solar system consists of a number of zones, or families, of planets, one within the other. As a matter of fact, astronomers have recognized for more than a century that this system is composed successively of the families of the terrestrial planets, the minor planets, and the giant planets. Is it not likely that in Pluto there has come to light the *first* of a *series* of ultra-Neptunian bodies, the remaining members of which still await discovery but which are destined eventually to be detected?

Our conceptions of the vastness of the planetary system have been greatly expanded by the discovery of Pluto. We were wont to think of this system as being sixty astronomical units in extent; now we perceive that it is a third again as large, or eighty astronomical units in over-all diameter; of such dimensions, that light—the fastest moving entity in the physical universe, which travels *in vacuo* with a speed of more than 186,000 miles a second—requires some eleven hours to go from one extremity of the planetary domain to the other.