ART. XXXIV.—*Relation of the plane of Jupiter's orbit to the mean-plane of four hundred and one minor planet orbits;*
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ABOUT nine years ago (this Journal, III, xxxi, p. 319) I called attention in a brief note to the fact that the mean-plane of the orbits of the then known two hundred and fifty-one minor planets was inclined to the plane of Jupiter's orbit by a very small angle. In fact no minor planet out of the whole 251 had its plane so near to the mean-plane as did the planet Jupiter. Since that time we have added to the list of planets between Mars and Jupiter one hundred and fifty newly discovered ones, and it seems worth while to find whether the same relation of the large planet to the entire group of four hundred and one small ones holds true.

The plane of an orbit is determined by the longitude of the ascending node and the inclination, and its place may be represented to the eye by a plot in which the inclination is the radius vector and the longitude of the node is the polar angle. The point thus plotted is of course the pole of the plane.

The mean-plane of the 401 planes, regarding each plane as a unit, may be determined with sufficient accuracy for the present purpose by the formulas for computing the center of gravity of the 401 points plotted, viz :

$$401 I \cos \Omega = \sum i \cos \Omega, \text{ and } 401 I \sin \Omega = \sum i \sin \Omega :$$

where i and Ω are the inclination and longitude of ascending node of any orbit, and I and Ω are the same functions of the mean-plane of all the orbits. Computing I and Ω for the 401 orbits as given in the *Annuaire du Bureau des Longitudes* for 1895, adding three later orbits from the *Astronomische Nachrichten*, we have

$$I = 0^{\circ}93, \text{ and } \Omega = 109^{\circ}3.$$

The corresponding quantities for Jupiter are

$$i = 1^{\circ}31, \Omega = 98^{\circ}9,$$

so that the inclination of the mean plane to Jupiter's plane is $0^{\circ}43$. The three minor planets whose planes are nearest to the mean-plane are 1893 Y, (27) and (149). These planes make angles with the mean-plane severally equal to $0^{\circ}65$, $0^{\circ}74$, and $0^{\circ}77$. The planet 1893 Y, was photographically discovered and has not yet a place in the numbered series of planets. Its plane will doubtless be much changed when the

orbit is definitely known, and it may or may not be found to be nearer the mean-plane than at present.*

The reason for the relation of Jupiter's plane to the minor planet planes is evident. The secular perturbation of the orbit of a minor planet by Jupiter is such that the inclination of the orbit plane is not greatly changed, but the node has a constant motion. The pole of the planet's plane therefore is constantly describing a curve, not widely departing from a circle, around the pole of Jupiter's plane. This motion is greater for some minor planets than for others. Hence whatever be the distribution of the poles at one epoch, the tendency of the secular perturbation by Jupiter is to finally distribute the minor-planet poles symmetrically around the pole of Jupiter's plane.