Note on the Orbital Planes of the Major Planets

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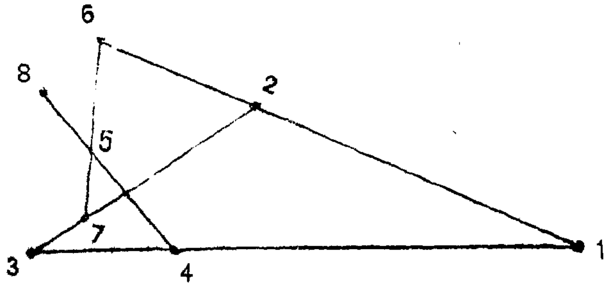
AT a recent meeting of the Royal Astronomical Society, a very remarkable fact was announced by Professor Plummer. Since an account of this new discovery has not yet found its way into scientific journals, still less into popular books, and since there are doubtless many members of the Astronomical Society of India who do not see the monthly notices of the Royal Astronomical Society, a short account may be of interest to the Society.

The result, which curiously enough had never been suspected before, is that the planes of the planetary orbits are concurrent three by three in five lines, *e.g.*, the orbital plane of Uranus passes through the line of intersection of the orbital planes of Saturn and Jupiter.



The result is represented diagrammatically in the above figure. If the planes are concurrent in threes, then it follows that their poles are collinear in threes. The numbered points in the figure represent the poles, the numbers referring to the order of the planets from the Sun, thus 1 represents Mercury, 3 the Earth, etc. Hence we see that the sets of planes which are concurrent are as follows :—

Earth,	Mars,	Mercury.
Earth,	Venus,	Uranus.
Mercury,	Venus,	Saturn.
Saturn,	Jupiter,	Uranus.
Mars,	Jupiter,	Neptune.

It will be noticed that each set of three involves two adjacent planets.

Analytically if Ω , Ω_2, Ω_3, i , i_2, i_3 are the nodal longitudes and inclinations of the orbital planes to any fixed plane of reference, then

Sin $(\Omega_1-\Omega_2) \cot i_3 + \sin (\Omega_2-\Omega_3) \cot \imath + \sin (\Omega_3-\Omega_1) \cot i_2 = o$ provided Ω, i_1, etc., refer to one of the sets of three given above. Now if the plane of the ecliptic is taken as the plane of reference and Ω_3, i_3 refer to the Earth, then the above relation becomes simply—

$$\text{Sin}\,(\Omega_1-\Omega_2)=o$$
$$\text{and}\ \therefore \Omega_1=\Omega_2.$$

Since this is true of any other orbital plane is taken as plane of reference we may express the result, thus :—

If any one of the orbital planes (except that of Neptune) is taken as plane of reference, then among the values of the ascending nodes of the other planets referred to this plane, there will always be two equal pairs. If the plane of Neptune is taken as the fundamental plane there will only be one pair of equal values.

A large number of similar relations can easily be found among the minor planets, but they are so numerous that there are bound to be pairs with equal nodal longitudes, and they are probably mere accidents, at any rate if considered with reference to the plane of the ecliptic, there might be good reason to anticipate something if they were referred to the plane of Jupiter's orbit.

For example, the following pairs are found to intersect the ecliptic in the same line—

Ceres (1),	Lutetia (21),
Juno (3)	Elpis (59),
Pallas (2),	Virginia (50),
etc.	etc.

The explanation of this remarkable result has yet to be found ; since the inclinations are all small and the equation given above shows that the cotangents of the inclinations are involved, which change very rapidly for small values of the argument, it is clear that a very nice adjustment is required between the elements Ω, i, of the various planets. Chance is quite out of the question ; mass does not seem to be concerned, since we have one set of 3 small planets, one of 3 large planets, two sets of 2 small and 1 large and one set of 2 large and 1 small. Similarly distance does not appear to be involved. Each set involves two adjacent planets and a third ; Professor Plummer has found a curious geometrical relation between the different sets, but it does not seem to carry us towards an explanation, probably when we can find some definite law (other than that just mentioned) which governs the association of the third planet with the other two, we shall have some prospects of discovering the physical law which is the basis of this geometrical relationship.

The Revolution of the Components of Zeta Ursae Majoris

By P. C. Bose.

The star in question is the middle star in the tail of Ursa Major. It is in reality composed of three stars—a pair called Mizar and another companion to them called Alcor or g in the map. There is another star of about the 8th magnitude near Mizar just a little to the right of the line joining the two stars and nearer to the smaller. These two stars of Mizar, I shall, for the sake of convenience, henceforth call ζ_1 and ζ_2 in order of magnitude—[*see* Fig. 1]. Sometime ago I happened to note this small star to which attention was drawn by a subsequent issue of the "monthly notices" of our Society. I am sorry to say that none of our many members could give me any information about it. I hunted the charts, but they were mute on this point, as charts in general do not deal with stars of magnitude lower than the 7th. It was about this time that I came across Admiral Smyth's excellent book "A Cycle of Celestial Objects," revised by Mr. George Chambers, F.R.A.S., up to 1881, in which the positions of 1604 double stars and nebulæ are given very accurately. I was baffled here also and I doubt whether this star was known to the author at the time the book was published, because there he mentions of a star of 8th magnitude discovered by a German Astronomer in 1723 in the vicinity of ζ to the south of Alcor and not the one I am talking about, and had this one been known it would not have passed without notice. The chief thing that drew my attention is the relative positions given there of ζ_1, ζ_2 and ζ—[*see* Fig. 2].

You see that the position of Alcor is to the right of the pair of Mizar, but if you see it now with your telescope you will see Alcor in a position almost in a line with ζ_1 and ζ_2.