Morando (6) considered higher tesseral harmonics R_{mn} determined by Kozai as far as $m, n = 4$. He followed Hori's treatment of the motion of an artificial satellite with critical inclination by applying von Zeipel's method. The equilibrium positions obtained for $I = 0$ are from R_{22}, R_{31}, R_{33}, R_{42}, R_{44}. The equilibrium positions for $I \neq 0$ and e small are obtained for each harmonic R_{22}, R_{33}, R_{44}. Morando (7) also discussed the case of resonance in the form 24 hours $\times$ p/q where p and q are relatively prime integers.

Roy (8) writes me that he has completed a study of the usefulness of interplanetary orbits for probes, the periods of which are commensurable with one year.

Weimer (9) discussed the stability of synchronous orbits of a sphere and an ellipsoid under mutual gravitation. A synchronous orbit is one for which the rotational period of the ellipsoid is equal to its orbital period. A stationary orbit is one in which the sphere appears stationary as seen from the ellipsoid. It is found that the only stationary orbit is that for which either the major axis or the minor axis of the equator of the ellipsoid is pointing always towards the sphere. He also examined the condition for stability of these stationary orbits.

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Lunar probe

Kozai (1) applied his theory on the motion of an asteroid with high inclination and eccentricity to the motion of a lunar orbiter. The Moon is regarded as a tri-axial ellipsoid, the major axis of the equator being directed towards the Earth according to Jeffreys (2). The disturbing function consists of secular and short-period terms due to the oblateness of the Moon, bi-monthly and short-period terms due to the tri-axiality, and secular and periodic terms due to the Earth. The Earth's luni-centric orbit is assumed to be circular in the plane of the Moon's equator. If the orbiter is far from the Moon's surface, then a stable equilibrium solution exists. If it is a bit near, then there is an unstable equilibrium point. When the distance from the Moon's surface is far enough, a lunar orbiter has a good chance to impact the Moon's surface. Kozai seems to be in favour of the meteor impact hypothesis for the generation of the lunar craters from this point.

Huang (2) at first discussed the escape of an artificial Earth satellite from the Earth only on the basis of the Jacobi integral. Then he studied (3) numerically on an electronic computer the ideal orbits of a space vehicle for various Moon probes under the approximation of the restricted three-body problem: orbits which enclose the Earth and the Moon, which have periods commensurable with the period of the Moon, and which pass at relatively short distance from the Earth as well as from the Moon for a number of times. He computed (4) two families of periodic orbits that enclose both the Earth and the Moon in the plane of the Earth-Moon orbit. The stability of such orbits is also discussed.

In order to obtain an analytical series expansion for a Moon probe enclosing both the Moon and the Earth inside its orbit by describing a trajectory in the form of the figure o or of the figure 8, Lagerstrom and Kevorkian (5) have tried to match two different asymptotic solutions, one for a Moon satellite and the other for an Earth satellite, in a similar manner to the method of fit of two asymptotic solutions, one for the inside of an atom and the other for a distant point, in quantum-mechanical computation of the wave functions for an electron configuration.

Kevorkian (6) discussed, as a preliminary to this fresh idea, a uniformly valid asymptotic representation to the motion of a satellite in the vicinity of a planet within the framework of the restricted three-body problem. It is shown that, depending on the proximity of the satellite to the planet, there exist two distinct sets of approximations to the restricted three-body equations. For satellite orbits where the gravitational attraction of the planet is of the same order as the centrifugal and Coriolis forces due to the planet's motion around the Sun, one is led to Hill's equations for the motion of the Moon. For orbits which are close enough to the planet for the gravitational attraction of the planet to be the dominant force, a similar set of equations is obtained for which the intermediary orbit is Keplerian in a non-rotating frame centred at the planet. Kevorkian shows that, by choosing the co-ordinates with respect to which the intermediary orbit remains stationary in the mean, one is able to derive a uniformly valid asymptotic solution to the approximation equations.

According to a letter from Roy, he is engaged in studying the orbit of a close artificial satellite of the Moon under the action of the Moon's gravitational potential and the gravitational field of the Sun and the Earth. Forga in Paris is also working on the motion of a Moon satellite.

The motion of an imaginary artificial Moon satellite has been studied by Chebotarev, Brumberg and Kirpichnikov (7) by using a numerical method. Brumberg (8) has formulated a general analytical theory of the artificial Moon satellite motion by taking the non-sphericity of the Moon into account, up to the first order in the periodic perturbations and up to the second order in the secular perturbation. Lemekhova (9) has used Delaunay's method for studying the motion of an artificial Moon satellite. Periodic orbits close to a circular orbit for an artificial Moon satellite have been developed by Aksenov and Demin (10) for the perturbations due to the Earth and the Moon, the Moon's figure not being taken into account.

Brumberg (11) has presented a new technique for finding an orbit with the optimum energy for the two-impulse transfer of a rocket from one given point of the phase space of co-ordinates and velocities to another pre-assigned point. He has also presented (12) the formulae for solving the boundary value problem by the method of steepest descent for the action integral, and given a numerical example of determining a non-disturbed interplanetary trajectory.

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