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Concluding Remarks

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Concluding remarks

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This Discussion Meeting was the first to review the many very interesting aspects of the rotation of bodies in the Solar System. During this session, the 200th anniversary of the death occurred of one of the greatest of all mathematicians, L. Euler, who, among other contributors to both pure and applied mathematics, established the laws of the rotation of solid bodies. Euler was born at Basle on 15 April 1707 and died at St Petersburg (Leningrad) on 18 September 1783. He worked as an Associate of the Academy of Sciences at St Petersburg on the invitation of Catherine the Great, with a period in Berlin as a Member of the Academy of Sciences on the invitation of Frederick the Great. Virtually all the papers given at this Discussion Meeting illustrate the fundamental principles he first enunciated.

Studies of the variations of the Earth's rotation, the discovery of which is a most interesting chapter of astronomy, have become a most important clue for understanding the motions in the Earth's core responsible for generating the geomagnetic field and its secular variation, and now the shorter term variations accurately determined from modern techniques seem likely to similarly contribute to understanding the atmospheric general circulation. The rotation rate of Mars determined by astronomers from surface markings has been followed for over a century, but shows no such variations, partly because the methods so far available are not very accurate and partly because the core of Mars cannot be large.

The determination of the rotation of Venus and Jupiter posed great problems because of their atmospheres, but the records of rotation of the various markings of Jupiter – atmospheric features – have been followed by amateur astronomers since early last century and provide a most important record of the complex rotation of its atmosphere, now, of course, seen in great detail in the beautiful pictures of Voyager 1 and 2. Radio astronomy has provided new methods of following the rotation of these planets. The dekameter radio noise from Jupiter's atmosphere emitted in pulses from certain longitudes, presumably associated with features of its magnetic field, and the decimeter noise from electrons spiralling around its magnetic lines of force in the magnetosphere, both have yielded records of rotation periods since about 1950. The periods agree and would appear to be the rotation period of the metallic hydrogen core, where the field is generated by dynamo action, and so far at least show no measurable change with time.

Ground based radar showed the rotation of Venus to be retrograde and by following brighter spots on the surface for some years rather accurate values of its period (243 days) were found. But perhaps the most beautiful result of this technique was the discovery that the rotation period of Mercury was not equal to the orbital period (88 days), as had been assumed by analogy with the Moon's synchronous rotation around the Earth and which had been thought to be in accord with the optical observations of its surface markings, which were difficult to observe, going back to the last century. The demonstrations by G. Colombo and others that this period of rotation was exactly two thirds of the orbital period and that it could be explained if the planet's rotation had been slowly decelerated by tidal friction until it was caught in its present state sometime in the past, through having a non-hydrostatic figure, must be regarded as one of the most beautiful results of planetary physics.

The anomalously long rotation periods of Mercury, Venus and the synchronous rotation of satellites of other planets are the result of the decelerating torques of tidal friction, arising from departures of solid bodies of the Solar System from perfect elasticity. Indeed the understanding of these processes in terms of solid state physics is an increasingly important field of research. The rotation periods of Mars and the major planets, where such processes have been unimportant, are almost certainly their primeval ones. We can conclude from the fact that their rotation periods differ only by a factor of less than 2, though their other fundamental properties vary by orders of magnitude, that this has bearing on the fundamental question of the origin of the Solar System. In fact this and other planetary rotation phenomena are, with the chemical data on the relative abundances of the elements and isotopes, the fundamental evidence on which a theory of the origin of the Solar System will eventually rest.

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