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Introductory Remarks

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Introductory remarks

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One of the most obvious features of the Solar System is that everything in it is rotating in one way or another. Any observer might simply be curious as to how all these bodies come to be spinning as they appear to be. But in classical mechanics – which for the most part is the only sort of mechanics with which we shall be concerned for the purposes of this discussion – spin is normally defined relative to an inertial frame. As such it is an 'absolute' feature, denoting a link with the rest of the Universe. So the observer's curiosity concerns what must be very significant properties of the system; its pursuit may be expected to earn very significant rewards. The contributions to be presented promise to justify this expectation.

All the rotations in the Solar System must of course depend ultimately on the mechanism of its formation. It would be all too easy to devote a disproportionately large part of the programme to this one topic. Equally, it would be ridiculous to include nothing about the origin of the System. As it is, two papers will deal with aspects in which rotation plays a dominant role; no doubt, however, there must throughout be many allusions to problems of origins.

Another theme that might have become dominant is magnetism in the Solar System. For rotation and convection in conducting material in the System must in general produce dynamo action; the resulting magnetic flux must then in general result in some transfer of angular momentum. Such effects are presumably widespread. One paper will deal with their general aspects; particular applications will figure more or less prominently in several others.

At the present time, so far as its own behaviour is concerned, the Sun itself can be regarded as an effectively isolated system. But because of its past history, its internal motions may still not have attained a steady state. From standpoints of recent observations and theory, we shall hear about inter-relations of oscillatory and rotatory motions, of these with magnetic effects, and about what they reveal regarding the solar interior.

Also important for the redistribution of angular momentum in astronomical systems is tidal interaction. It has, of course, been a classic topic of Solar System mechanics, but the scope of its study is being extended continually. Several aspects will emerge for review.

Down the ages until our own century, the rotating Earth was man's most accurate time-keeper. Now for a long while, however, the study of fluctuations in the rotation has been a subject for intensive study, with ever-increasing precision in measurement and analysis, and more extensive collation and analysis of historical astronomical records being exploited. We shall hear about some of the latest developments in these studies, many depending on large-scale international cooperation, and about some of their manifold geophysical applications as well as their connection with the mechanics of the atmosphere.

Satellite and other observations of the atmosphere of the Earth, and space-mission observations of the atmospheres of other planets, have led to an enormous increase in the comparative study of all these atmospheres. As all of it comes under the general heading of

the fast-growing important subject of the dynamics of rotating fluids, it must obviously figure in a meeting like this.

Much of our field is pervaded – for want of a better word – by a re-awakened interest in the classical problems of the rotation of a rigid body with a given density distribution moving in a given gravitational field, or the rotations of two such bodies in orbit about each other, or (as with a comet-nucleus) the motion of such a body under both gravitational and non-gravitational forces. There will be several papers dealing with these problems in the cases of planets, satellites, asteroids and comets. Finally, we shall come back to Earth with an application of the same general notions, with magnetic forces also playing a role, to the internal motions of our own planet.

These preliminary remarks, although not quite following the layout of the programme, are an attempt to demonstrate that our discussion is rendered coherent by the study of the operation of a few familiar physical mechanisms of very general applicability. The objectives are the better understanding of the working of the Solar System, and a better hope of discovering more about its origin.

We may look forward to hearing in Professor Runcorn's closing review whether in these two days we shall have moved nearer to these objectives.

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