RESONANCE IN THE SOLAR SYSTEM*

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While the title of this address implies limited applications of resonance phenomena, it is necessary, in order to develop those applications, to consider the foundations on which the theory of resonance rests. The foundations are partly physical and partly mathematical since we have to consider not only the phenomena but the symbolic representation of them. At the very beginning of the discussion it is seen that questions concerning the degree of accuracy of physical measurements are involved in a fundamental manner. A wide range of topics has thus to be brought into the argument and some considerable time must be spent on quite elementary details if the ideas to be developed are to be made clear. The physicist will recognize applications in many directions, but I shall confine the latter mainly to those which arise in the motions of bodies within the solar system.

In order to make clear the questions with which we have to deal, it is necessary to understand what we mean by *periodicity*. Take the case of simple harmonic motion defined by

$$x = a \sin (bt - c).$$

In all physical problems, a, b, c are measured quantities deduced directly or indirectly from observation. If small errors occur in a, c only, the change in x is always small, however great t may be. But a small error in b induces finite changes in x when t is sufficiently great. As our power of measuring b is always limited, the time during which we can predict the value of x is also limited. Further, the conditions under which mechanical systems operate are such

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