trophe. If the positions of the planetary orbits, with respect to that of the earth, were to change much, the planets might sometimes come very near us, and thus exaggerate the effects of their attraction beyond calculable limits. Under such circumstances, we might have "years of unequal length, and seasons of capricious temperature, planets and moons of portentous size and aspect, glaring and disappearing at uncertain intervals;" tides like deluges, sweeping over whole continents; and, perhaps, the collision of two of the planets, and the consequent destruction of all organization on both of them.

Nor is it, on a common examination of the history of the solar system, at all clear that there is no tendency to indefinite derangement. The fact really is, that changes are taking place in the motions of the heavenly bodies, which have gone on progressively from the first dawn of science. The eccentricity of the earth's orbit has been diminishing from the earliest observations to our times. The moon has been moving quicker from the time of the first recorded eclipses, and is now in advance, by about four times her own breadth, of what her place would have been if it had not been affected by this acceleration. The obliquity of the ecliptic also is in a state of diminution, and is now about two-fifths of a degree less than it was in the time of Aristotle. Will these changes go on without limit or reaction? If so, we tend by natural causes to a termination of the present system of things: if not, by what adjustment or combination are we secured from such a tendency? Is the system *stable*, and if so, what is the condition on which its stability depends?

To answer these questions is far from easy. The mechanical problem which they involve is no less than this;—Having given the directions and velocities with which about thirty bodies are moving at one time, to find their places and motions after any number of ages; each of the bodies, all the while, attracting all the others, and being attracted by them all.

It may readily be imagined that this is a problem of extreme complexity, when it is considered that every new *configuration* or arrangement of the bodies will give rise to a new amount of action on each, and every new action to a new configuration. Accordingly, the mathematical investigation of such questions as the above was too difficult to be attempted in the earlier periods of the progress of Physical Astronomy. Newton did not undertake to demonstrate either the stability or the instability of the system. The decision of this point required a great number of preparatory steps and simplifications, and such progress in the invention and improvement of mathematical methods, as occupied the best mathematicians of Europe for the greater part of last century. But towards the end of that time, it was shown by Lagrange and Laplace that the arrangements of the solar system are stable: that in the long run, the orbits and motions remain unchanged; and that the changes in the orbits, which take place in shorter periods, never transgress certain very moderate limits. Each orbit undergoes deviations on this side and on that of its average state; but these deviations are never very great, and it finally recovers from them, so that the average is preserved. The planets produce perpetual perturbations in each other's motions, but these perturbations are not indefinitely progressive, they are periodical: they reach a *maximum* value and then diminish. The periods which this restoration requires are, for the most part, enormous; not less than thousands, and, in some instances, millions of years; and hence it is, that some of these apparent derangements have been going on in the same direction since the beginning of the history of the world. But the restoration is in the sequel as complete as the derangement; and in the meantime the disturbance never attains a sufficient amount seriously to alter the adaptations of the system.

The same examination of the subject by which this is proved, points out also the conditions on which this stability depends. "I have succeeded in demonstrating," says Laplace, "that whatever be the masses of the planets, in consequence of the fact that they all move in the same direction, in objects of small eccentricity, and slightly inclined to each other—their secular inequalities are periodical and included within narrow limits; so that the planetary system will only oscillate about a mean state, and will never deviate from it except by a very small quantity. The ellipses of the planets have been, and always will be, nearly circular. The ecliptic will never coincide with the equator, and the entire extent of the variation in its inclination cannot exceed three degrees."

There exists, therefore, it appears, in the solar system, a provision for the permanent regularity of its motions; and this provision is found in the fact that the orbits of the planets are nearly circular, and nearly in the same plane, and the motions of all in the same direction, namely, from west to east.

Now is it probable that the occurrence of these conditions of stability in the disposition of the solar system is the work of chance? Such a supposition appears to be quite inadmissible. Any one of the orbits might have had any eccentricity. In that of Mercury, where it is much the greatest, it is only one-fifth. How came it to pass that the orbits were not more elongated? A little more or a little less velocity in their original motions would have made them so. They might have had any inclination to the ecliptic from *no* degrees to 90 degrees. Mercury, which again deviates most widely, is inclined 7$\frac{1}{2}$ degrees, Venus 3$\frac{1}{4}$, Saturn 2$\frac{1}{2}$, Jupiter 1$\frac{1}{3}$, Mars 2. How came it that their motions are thus contained within such a narrow strip of the sky? One, or any number of them, might have moved from east to west. none of them does so. And these circumstances, which appear to be, each in particular, requisite for