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THE CONTRIBUTIONS OF ASTRONOMY TO CIVILIZATION

THE principal duty imposed upon the president of the Pacific Division is the delivery of an address at the annual meeting. In some respects this duty is an embarrassing one for the present incumbent. This is preeminently an astronomical occasion, and your president is not an astronomer. With no original message of his own, he can perhaps best fulfill his obligations by reminding those who are gathered here of some of the great contributions which astronomy has made to civilization.

If the earth were alone in the universe human life could not exist. With the sun to give essential warmth and light, life would be possible; but imagine if you can how the progress of mankind would have been retarded if there were no stars, or if the pioneers of astronomy had failed to discover how to use their apparently uniform rotation as a measure of the flow of time and the axis of this rotation as a standard of direction. The north star was a faithful guide to the traveler, and without it Columbus might well have hesitated to embark on his perilous journey in search of a new world. The first astronomers, without instruments, must first have noticed the rotation of the fixed stars about the axis passing through Polaris, then the orderly annual precession due to the motion of the earth in its orbit. The seemingly erratic motions of the planets must have puzzled them, but in time the orderly sequence of their motions with respect to the earth was recognized and correctly described in Ptolemy's theory of epicycles. As time went on, accumulated observations and deductions therefrom gradually made clear our relations to the solar system. Copernicus revived the bold guess made by others centuries before, that the earth and planets revolve about the sun. Galileo, with the enlarged field of vision due to the telescope, found reasons to support that guess, and Kepler formulated the laws which almost exactly describe the motions of the planets in elliptic orbits around the sun. Newton proved that the same force which causes bodies to fall to the earth, causes the moon to revolve about the earth and the earth about the sun. This discovery made celestial mechanics an exact science.

Mathematical astronomy has made it possible to establish standards of time and to make exact surveys of the earth, and enables the navigator to find his position and determine his direction at sea. When his observations are made impossible by cloud or