
Astronomy: Its Uses Past and Present.

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There are many who, knowing little of astronomy, regard it as a science without any practical uses. They think it a science of speculation and theories, and one which gives us no material aid in our struggle for higher civilization. In some respects, this may be true; yet there is a practical side to astronomy which is of great use to present civilization, and which has been an important factor in past progress.

In the determination of time, astronomy is our sole reliance. The clocks of this nation are regulated by daily observations made at Washington and telegraphed over the country. That this regulation is important, a little reflection will make clear. Though not necessary, it is of great convenience in domestic and social life, enabling us, among other things, to make and fulfill appointments at the proper time. In business life it enables us to regulate working hours. In railroad traffic, it furnishes the means of running trains on schedule time, where an error of a few minutes would often result in destruction of life and property.

Where astronomy is little understood, the idea of time and the manner of recording it are very rude. The savages of to-day usually count

the time by "moons". So it was with the ancients until their knowledge so far advanced that they were able to use the year. But their means were not sufficiently accurate for them to determine correctly the length of the year. Hence we find great errors in their calendars, and some of these, even among civilized nations, were not obliterated until comparatively recent times.

Another important use of astronomy is in its relation to the science of geography. It is necessary that astronomical knowledge be used in surveying and mapping any considerable portion of the earth's surface. As one person says: "No map deserves the name on which the position of important points has not been astronomically determined." Latitude and longitude, necessary features of a good map must be thus ascertained. The boundaries of townships, counties, states, and even nations, which have in many instances been subjects of bitter dispute, can, by astronomical observation, be located with mathematical accuracy. In this respect and in the correct mapping of the earth's surface, astronomy is of great use.

These two factors, correct time and accurate maps, are of vast importance to commerce and

navigation. Here it is that astronomy serves its greatest material usefulness. As Proctor says: "The whole system of commerce depends on the accuracy with which astronomers at Greenwich and other national observatories note the apparent motion of the stars." Commerce depends, too, on the accurate maps of the continents and islands, without which the ship upon the sea could not tell how near it was to the land upon which it might be wrecked, or the bay in which it wished to anchor. With the proper astronomical tables and instruments the position of a ship can be determined within a few miles. Then by referring to maps, the required direction to proceed can be ascertained. It is chiefly owing to the great advance in astronomy that commerce upon the seas has reached such great extension. The ancients, not having sufficient astronomical knowledge, could not and did not navigate the ocean with as much safety and to such an extent as we do at the present day.

Astronomy further shows itself important in its relation to other sciences. In physical geography, it explains the cause of the tides. In meteorology, it gives an explanation of the annual showers of meteors; shows a relation

of the aurora borealis to sun spots and conjunctions of the planets, and promises an explanation, at least in part, of the cause of the storm centers that pass over this continent from west to east.

In geology it gives us by the nebular hypothesis, the probable origin of the earth. In physics it furnishes two distinct methods of determining the velocity of light. In ancient history through the records of eclipses and other astronomical phenomena, it furnishes a means of determining ancient dates.

Outside its strictly material uses and its aid to other sciences, astronomy performs its highest function as a study for the culture of the mind. The study of mathematics is recommended as a mind trainer. Geometry is said to be especially good to cultivate the reasoning powers, and mathematics in general are useful to discipline the mind in accuracy. The study of the natural sciences, such as botany, zoology, and geology, are useful to cultivate the powers of observation so that we may better see and understand the phenomena occurring around us, and thus more fully enjoy this life amid Nature's surroundings. But for upbuilding, for broadening and strengthening the

mind, the study of astronomy is without a peer. The mathematics it requires demands the greatest of accuracy. As illustrative of this, one instance will suffice. It was observed that the planet Uranus varied from its calculated positions two seconds ($2''$) more than could be accounted for by the attraction of the planets then known. This slight variation, which, to the popular mind, would seem insignificant, led to the discovery of the planet Neptune — a discovery that was of greater magnitude and required more mental power than the discovery of Columbus.

But aside from the mathematics, which are of a very complicated order, and the mathematical training it gives, astronomy possesses qualities of mental culture far superior to botany, zoology, or even geology, its nearest rival. Simply as an observation science, it, more than any other, tends to raise those who study it from narrow-mindedness, and to strengthen and broaden their intellects. The mind that weighs the planets, computes the years required for light to reach us from some fixed star, calculates the orbit of a comet, discovers laws of the universe, and contemplates the mysteries and magnitude of the infinite space, must have mental powers that raise it

above narrow-minded worldliness to more elevated and purer heights of mental culture. In this connexion, no better can be done than quote from Edward Everett, who, in speaking of astronomy says: "No other science furnishes such a palpable embodiment of the abstractions which lie at the foundation of our intellectual system; the great ideas of time, and space, and extension, and magnitude, and number, and motion, and power. How grand the conception of the ages required for several of the secular equations of the solar system; of distances from which the light of a fixed star would not reach us in twenty millions of years; of magnitudes, compared with which the earth is but a foot-ball; of starry hosts, suns like our own, numberless as the sands on the shore; of worlds and systems shooting through the infinite spaces, with a velocity compared with which the cannon ball is a wayworn, heavy-paced traveler!"

Many of the present uses of astronomy have been in operation during the past, and the effect of the study upon the minds has been an important factor in past progress. The ancients were very superstitious. Many worshipped the sun and moon. When an eclipse occurred, there was great fear among

the people. When a comet appeared in the sky, their minds were filled with awe. Clouded by such superstitions and attributing everything to the gods, the minds of men could not make rapid progress in civilization. But when astronomers inquired into these apparently strange phenomena and revealed the fact that they were but in accordance with laws, superstition was trodden down, fear banished, and the minds of the people freed to search after truth in their struggle for higher civilization.

But in its effort to reveal facts for the aid of science and civilization, astronomy came into conflict with religion. This was most marked during the fifteenth and sixteenth centuries. Copernicus advanced the theory that the sun was the center of planetary motion. This aroused the religious haters and they tried to prevent the theory from spreading. They argued that it was contrary to the teachings of the Scriptures and claimed that the Ptolemaic theory was the only true one. Galileo taught facts which the popes of Rome thought dangerous to religion. He was imprisoned, tortured, and forced to renounce his doctrines. So the conflict went on. But in the end Science won. Astronomy came out victor in proof of the oft quoted phrase

that "Truth crushed to earth will rise again". Though astronomy did win, it came out of the struggle years behind the advancement it would have attained had not religion interfered. Though religion lost, it was in the end purified and elevated. Facts must ever go hand in hand with religion. They but reveal the power, the infinite greatness and wisdom of the Creator. And astronomical facts especially, covering as they do, the infinite universe, revealing its magnificent creations, its incomprehensible velocities, its eternity of existence, elevate us and bring us to a fuller appreciation of the Power that exists within and controls all.

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