Monday, August 31, 2020

The scintillation of the stars.

A star produces light, while a planet reflects that of Sun.

It is very bright: when night falls and it is visible above the horizon, Venus shines brighter than all the stars!

As it is near the Sun, it reflects its light a lot.

A planet is so much closer to us that at the limit of the atmosphere the whole forms a disc more than a meter wide

(about twenty meters in the case of the planet Jupiter)

The light of the planet that reaches us comes from hundreds of different paths in this set and it is therefore unlikely that many of them will be disturbed in the same way at the same instant.

In reality the eye perceives only an average over a large number of light rays so that the degree of disturbance is much lower and the planet appears as a fixed point.

The stars, even the least brilliant, appear to us to be agitated by incessant and rapid variations in brightness and coloring: they sparkle.

This phenomenon, which is visible to the naked eye and which everyone has observed, only received a plausible explanation during the 19th century: variations in the refractive indices of the layers of air traversed by light. .

If we consider all the rays of different colors and refrangibilities, which emanate from a star and come to determine in the eye of the observer, by their superposition, the image of this star, we see that each of them must have followed through the atmosphere a particular trajectory, determined by its own refrangibility, and since, on the other hand, the various regions of this atmosphere undergo continual variations of density, temperature and humidity, which modify, from one point to another, the refractive power, the relative intensity of the various rays is found, at each moment, attenuated for some, reinforced for others, which produces, from one moment to the next other, the variations observed in the brightness and in the coloring.

The observation agrees moreover with the theory as to the preponderant influence exerted by the atmosphere on the scintillation.

Thus, on high peaks where the air layer is thin, the stars sparkle much less, it is the same, for the same place, when they are at the zenith.

On the contrary, the scintillation is noticeably stronger in winter, when the rain approaches, while the atmosphere is more charged with vapors and more agitated.

The physical constitution of the star, or more precisely the spectrum which results from it, plays, for its part, a certain role in the production of the phenomenon.

It follows, in this regard, from the numerous observations that the stars whose spectrum presents a double system of dark bands and black lines and to which correspond, between their rays, due to the dispersion of these in the atmosphere, the most numerous and most marked vacancies, scintillate less than stars with fine spectral lines and much less than those whose spectrum shows only four dark lines and for which the gaps are very few.

Unlike stars, planets do not sparkle.

The reason is that their disc has a sensible apparent diameter and sends to the Earth from every point of its surface a light which, if isolated, like that of the star, a simple point in the sky, would present the character of the scintillation, but which, not being isolated, is perceived by the observer at the same time as the rays coming from other points on the surface.

The effect produced by the juxtaposition of all these elementary images, some of which have a stronger luster, others a lesser than the average luster, is the same as if each of said images had an invariable luster.

If a planet sparkles if it comes to be seen in conditions where the dimensions of its disk become very small: this is the case of Venus when it shows only a narrow crescent.

François Arago is a French astronomer, physicist and statesman, He determines, for example, the diameter of planets and explains among other things the scintillation of stars using the phenomenon of interference.

Noticed by Monge and Laplace, in 1805 he was appointed secretary-librarian of the Paris Observatory.

In 1806, he was sent to Spain, to Mallorca with Jean-Baptiste Biot to continue the reading of the meridian of Paris.

Caught in the war in Spain, while he was alone in a triangulation operation, he was taken prisoner.

Interned at Bellver Castle, he escaped several times, and managed to reach Paris where he entered as a hero in 1809.

This allowed him to be elected member of the Academy of Sciences on September 18, 1809, at only twenty-three years.

The same year, he was chosen by Monge to replace him as professor of analytical geometry at the École Polytechnique.

At the same time, he continued his career at the Paris Observatory, which reports to the Bureau des longitudes.

After having been secretary-librarian, he was appointed deputy member of the Bureau in 1807.

He became a full member in 1822, on the death of Delambre.

In 1834, he took the title, the creation of which he had proposed to the Bureau, of director of observations at the Paris Observatory, headed by astronomer Alexis Bouvard.

When Bouvard died in 1843, he became director of the Observatory and remained so until his death.

Arago, initially a follower of the corpuscular theory of light, is convinced by the wave theory of his colleague Fresnel, that he helps to carry out his experiments at the Observatory or to present his results to the Academy of Sciences.

Together with Biot, he determines the refractive index of air and other gases.

In 1825, he was commissioned with Dulong to determine the pressure of water vapor at pressures exceeding 3 MPa, or 30 atm.

His other studies are devoted to Astronomy, magnetism and the polarization of light.

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Jack-of-all-trades, he takes part in experiments to measure the speed of sound and studies pressure vessels.

He had the first artesian well in Paris dug by Louis-Georges Mulot, in the courtyard of the Grenelle slaughterhouse, in the current 15th arrondissement.

He inspired Foucault with his experiment with rotating mirrors, which then made it possible to measure the speed of light with precision.

Aware of the potential importance of the process in Astronomy, he promoted the then nascent photography by supporting the daguerreotype developed by Louis Daguerre: in January 1839, he presented to the Académie des Sciences and the Académie des Beaux-Arts united the first shots.

Arago is a formidable orator, capable of defeating the most brilliant opponents.

He is also a pedagogue and a great popularizer of Science.

In order to publicize the work of the Academy of Sciences, in 1835 he created the Reports of the Academy of Sciences, which still exist.

Before him, there was no written transcript of Academy sessions.

From 1813 to 1846, he also gave a public course in popular Astronomy.

It is these courses which give birth to his popular Astronomy in four volumes, published posthumously in 1854.

In the Warning which opens the first volume, Arago explains his project as follows: I maintain that it is possible to explain usefully the astronomy, without diminishing it, I almost said without degrading it, so as to make its highest conceptions accessible to people almost foreign to mathematics.

HISTORICAL AND PHYSICAL ASPECTS.

The Scintillation of the Stars.

Bigourdan SAF note presented to the Academy of Sciences.

The Astronomy Nasa data system Harvard edu.

Instrumental undulations of celestial images produced by the atmosphere, movements and irregularities of its various layers.

Phenomenon of Scintillation and oscillations:

Scintillation is a very complicated phenomenon which, to the naked eye, consists of a rapid variations of flashes, colors, apparent sizes accompanied by divergent rays seeming to rise from the star.

It only resides in the eye of the observer but the changes of shards and colors are real.

Posted by Veronica IN DREAM at 4:19 PM