

ASTRONOMY

Evidence Obtained that Space Between Stars Not Transparent

Absorption of Stellar Light by Matter May Make Stellar Distances Seem too Great, Says Astronomer

FROM A STUDY of far-away nebulae, some of the most distant objects that can be observed by astronomers, Prof. Edwin F. Carpenter, of the Steward Observatory of the University of Arizona, has obtained new and additional evidence that space between the stars is not entirely transparent.

Speaking before the meeting of the American Astronomical Society, in session at the Perkins Observatory of Ohio Wesleyan University, Prof. Carpenter told of his latest researches. Previously Dr. R. J. Trumpler, of the Lick Observatory, and Dr. Piet Van de Kamp, of the McCormick Observatory, found indications that part of a star's light may be absorbed during its journey through space.

The Milky Way system, or the Galaxy, includes the sun and all the stars that we can see. It is shaped like a grindstone, and we are not far from the center. As we look towards the edge of the grindstone, we see the stars more concentrated toward the sides, and this causes the Milky Way, which is shown by even a small telescope, to consist of myriads of stars. Beyond the limits of our Galaxy, however, are other similar systems, the so-called "extra-galactic nebulae," and these are what Prof. Carpenter has studied.

Would Afford Check

Dr. Trumpler's researches upon the absorption of light in the inter-stellar space led him to suppose that through the middle of our Galaxy there extends a layer of material that stops a portion of star light passing through it. Prof. Carpenter decided that the extra-galactic nebulae would afford a check upon such a theory as this.

When we look at these nebulae beyond the sides of the grindstone, their brilliancy would be scarcely affected, because their light would have to penetrate but a very small thickness of the absorbing cloud. No such nebulae can be seen in the actual direction of the Milky Way, but those near it would seem somewhat dimmed, because their

light would have to come through a considerable amount of the absorbing stuff. In a similar way, the sun appears fainter at sunset. The earth's atmosphere is the absorbing cloud. When the sun is close to the horizon its light has to penetrate much more atmosphere than at noon, and so it does not look as bright.

Prof. Carpenter found that the extra-galactic nebulae do show this effect. With measures of the diameters of these nebulae made by Dr. E. P. Hubble at Mt. Wilson Observatory, and of their total brightness by a European astronomer named Holetschek, he computed their apparent surface brightness. It was found that a nebula of a given size near the Milky Way is fainter than one of the same size in the part of the sky farthest from the Milky Way, the galactic poles.

"At 20 degrees from the Milky Way," said Prof. Carpenter, "where we should be looking through some three or four times as much material as there is in the direction of the galactic poles, the brightness decreases by nearly 40 per cent."

If such a layer of absorbing matter exists, it means that previous measures of distances in the direction of the Milky Way are much too great. Prof. Carpenter explained the reason. "When we know a star's actual candle-power," he said, "we use its apparent faintness as a measure of its distance, but if a part of the faintness must be attributed to the dimming cloud, the star's real distance must be less than formerly supposed."

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ENGINEERING

New Photo Tube Measures Temperature in Furnace

A NEW "photo tube" which looks into a furnace and measures the heat, has been described by Dr. L. R. Koller of Schenectady, N. Y. A current is set up in the tube by the light it "sees." The brightness of an object varies sixteen times as fast as its temperature; therefore the photo tube current



BAREBACK

Journal of Heredity

This wool-less sheep from Russia represents an interesting twist of heredity. Many mammals have hairlessness in their hereditary equipment—generally as a recessive character. That is, it is frequently overshadowed by the stronger "dominant" tendency to grow hair and only makes itself known in that small percentage of cases when it is inherited from both parents.

is a very sensitive means of measuring temperature.

The new pyrometer can measure temperatures as low as 1,000 degrees Centigrade, and has no upper limit, Dr. Koller said. It is instantaneous, and is not injured by the furnace or its contents. This is a very needful apparatus in these times of high temperatures in modern industrial processes. Lack of adequate means of measuring high temperatures in furnaces has handicapped their use.

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PHYSIOLOGY

Accepted Theory of Sense Of Balance May be Revised

THE GENERALLY accepted theory of how the sense of balance operates may have to be revised as a result of research reported by Dr. Franklin Fearing of Northwestern University.

Dr. Fearing has made a study of the behavior of birds after certain operations had been performed on the inner ear. Previous to the operation, the birds had been trained to follow a simple maze which required them to hop, perch, walk up an inclined plane, and to do other stunts that would show up any disturbance in their ability to maintain their equilibrium.

The birds showed no serious disturbances after the removal of from two to four centimeters of one of the semi-circular canals, although any flow of fluid through that part of the canal was then impossible. Such a flow has been supposed to produce the feeling of equilibrium or lack of it. On the other hand, removal of a single ampulla, the enlargement at the end of the canal, produced disturbances in the balancing behavior of the birds. The nature of these disturbances differed in the different birds.

Greatly Variable

"Contrary to the classical and contemporary reports of the results of this type of investigation, there is enormous variability both as to type and severity of the symptoms following surgical interference with the canals, but there appears to be but little constancy as to the time of appearance of the symptoms and the rate of recovery of the bird," Dr. Fearing reported. He added that there was evidence that the function became completely restored even in the case of birds showing the most severe type of symptoms.

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LARGEST OF HIS TIME

Such was the distinction of the Uintatherium, with three pairs of horns, that lived in North America 55,000,000 years ago. In great contrast are the tiny four-toed primitive horses which were about the size of a collie dog. They are known as Orohippus. This restoration of prehistoric life is a mural painting by Charles R. Knight, now on exhibition at Field Museum of Natural History, Chicago. It is one in a series of twenty-eight presented by Ernest R. Graham.

PHYSICS

New Method Measures Speed Of Electrons in Dense Solids

A METHOD used by astronomers to determine the velocity of stars has been applied in a slightly modified form to the atom to furnish the first direct evidence that electrons, negatively charged electrical portions of atoms, move about at high speeds within bodies which are solid.

The experiment, conducted at the California Institute of Technology by Dr. Jesse W. M. DuMond, research fellow, and Dr. Harry A. Kirkpatrick, teaching fellow in physics, was the second crucial test of activities of the electrons within the atom. The first test was reported last January.

In explaining the application of the Doppler effect to the experiment, Dr. DuMond declared that if the source of the light or sound is in motion the successive vibrating waves or ripples are crowded together on the forward side of the motion's direction, and spaced farther apart on the rearward side.

A similar phenomenon explains the fact that the sound from a train whistle approaching a stationary listener is of higher pitch than the sound of the same whistle when the train is receding from

the listener. In the same way, stars approaching an observer emit spectral lines shifted toward the violet end of the spectrum, whereas receding stars emit lines shifted toward the red.

When the electron scatters X-radiation a similar effect occurs. If that part of the radiation which is scattered at a definite angle to the incoming beam is observed with a spectroscope, the spectral line which was in the original radiation is found to be shifted toward longer wave-lengths and the spectral line is found to be broadened. The shift may be regarded analogically as a Doppler effect caused by the velocity of the electron recoiling away from the light under the impact that the light has given it. The increased breadth of the line may be regarded as a composite Doppler effect of the chaotic motion of all the electrons in the myriads of atoms scattering the X-radiation. Dr. DuMond set the average speed of the invisible electrons which make up solid matter at 1,500 miles per second for the case of carbon.

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