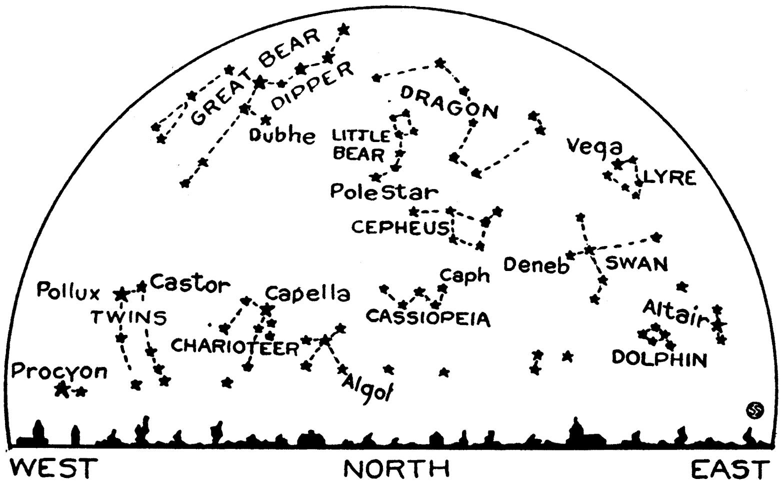
Blinking Stars Show Size of Universe

Astronomy

By James Stokley

In the evening sky now, and in the coming months, is one of the most famous of the astronomer's measuring sticks.

Look to the north sky. Low down is the W-shaped constellation of Cassiopeia. Above it, and a little to the right, is a somewhat distorted square of rather faint stars. Attached to the left side of the square is a triangle, formed partly of the two stars on the left side of the square. The lowest star in the square is known to astronomers as delta Cephei, and though it is not very bright, not bright enough to have a special name of its own, like Sirius or Betelgeuse, it is one of the most famous stars in the sky.



If you were to watch delta Cephei night after night, with a telescope equipped with a photometer to measure its brilliance, you would find that it is not constant. At one time you would find it is as bright as the 3.7 magnitude, then it fades away to the 4.6 magnitude. After 5.37 days have passed, it is again at magnitude 3.7, and so keeps up this regular variation.

Variable stars are not uncommon. In fact, there is a large body of amateur astronomers, the American Association of Variable Star Observers, that constantly keeps track of these celestial flashing signs. Variable star observation is one branch of astronomy where quantity is the important thing, even at the sacrifice of quality, or high precision. A large number of rather rough estimates of the brightness of these stars at various times is just as important as extremely accurate measurements of a smaller number.

But variable stars have different characteristics. Some vary regularly, up, then down, at the same rate. Some are irregular, and show variations in the time taken for the recurrence of maximum brightness. Delta Cephei, however, takes a day and a half to change from its minimum to maximum brightness, and the rest of the time, about three and three-fourths days, to return to minimum.

A number of stars that have the same characteristics as delta Cephei, not only in the way the brightness changes, but in numerous other respects, are known to the astronomers. As a class they are called Cepheid variables, after the type specimen.

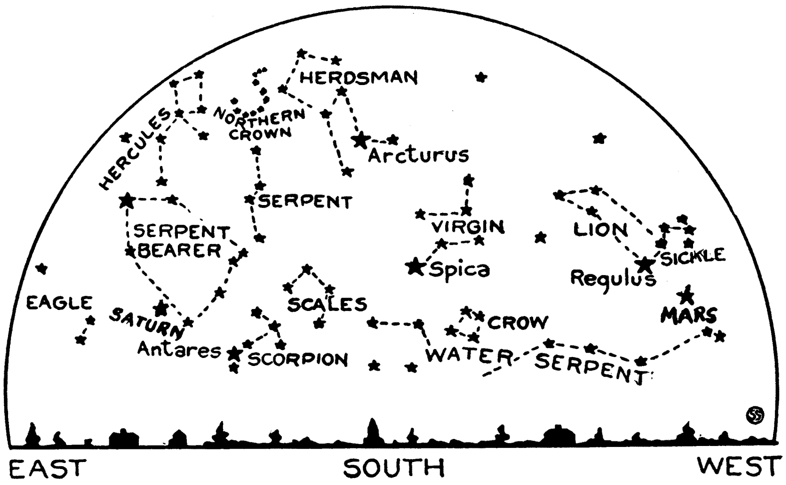
Just what causes this peculiar variation of the Cepheid is still unknown, but the most acceptable explanation seems to be one first suggested by Dr. Harlow Shapley, the distinguished director of the Harvard College Observatory, and later developed mathematically by the famous English astronomer, Prof. A. S. Eddington, of Cambridge. This is that the Cepheids are pulsating stars.

On a dark body, like the earth, the most important force that we are familiar with is that of gravitation. In a large and brilliant body like the sun, or a star, however, there are two others—the pressure outwards of the light from the star's interior and of the glowing gases of which it consists. In the normal star, the forces are equal and in opposite directions, so they balance and the star is in equilibrium.

Suppose, however, that something happens to compress the star a little. The force of gravitation would be greater, but the compression would heat the gases. The gas pressure would increase even more than the gravitational force, inwards, and so the star would expand to its original size. Inertia, however, would carry it past the point of equilibrium and then gravitation would again come into play and pull it back. In this way a series of pulsations would be set up that might continue indefinitely.

It was another Harvard astronomer, the late Miss Leavitt, who studied a group of some 1800 Cepheids in the southern sky in the Magellanic clouds. They are all presumably at about the same distance. Yet she found that they were, on the average, of quite different brightness, and that the brighter they were, the faster was the period in which they varied.

Dr. Shapley (*Turn to next page*)



HOLD THESE MAPS in front of you and face North or South. The upper or lower one will then show the stars of the June evening sky

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Germless Island in Polar Seas

Bacteriology

Found: the magic land where you cannot get ill. At least this fairy country is absolutely germ-free. It is well known that almost all diseases are caused by germs. On the northern island of Novaya Zemlya, you would run very slim chances to be knocked down with some disease.

Dr. A. F. Kazansky, a scientist of the Central Geophysical Observatory at Leningrad, is responsible for the discovery. Polar explorers had many times noted the remarkable purity of polar air. Accurate tests were lacking, however. So, when Dr. Kazansky went to spend a winter at the Soviet Geophysical Station, Matochkin Shar, on the lonely polar island, Novaya Zemlya, he was prepared to make the tests. The results he obtained were almost startling. Microbes were not to be found on this enchanted island. No matter what Dr. Kazansky tested—air, earth, water, dust, not a germ could be discovered. Even wild game shot by hunters were germ-free. Such exceptional purity is considered to be a record.

Many different ingenious tests were tried out in the attempt to hunt down some germs. Sterile dishes with an agar-agar jelly especially suitable for bacterial growth were left outdoors for several hours at a stretch. Then the dishes were placed in an incubator and warmed, to stimulate the germ life. In no cases were any microbe colonies found. Just for comparison it may be said that a similar dish with jelly, exposed for 15 minutes to city air, would grow over with germ colonies too numerous to count.

Another highly spectacular test conducted by Dr. Kazansky was as follows: Fresh juicy meat in an open glass jar was left out-doors, where air, dust and rain could reach it. For eight months it was exposed to the elements. Yet when Dr. Kazansky examined the meat again, no trace of rotting was found. The meat was as fresh as when packed in the jar, almost a year ago.

It is supposed that the exceptional purity of air on Novaya Zemlya may prove a great attraction to sanatoria. Many pulmonary patients, being very weak and an easy prey to infection, require pure fresh air. Polar sanatoria may prove to be ideal for them.

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Blinking Stars and Size of Universe—*Continued*

then worked this into what is now called the Leavitt-Shapley law, by which the brightness of a Cepheid may be found by simply measuring the time it takes to change in brightness, and this has proved a powerful measuring stick for astronomers, as any object containing Cepheids can be measured for distance.

Very recently the Cepheids have proved their usefulness in a somewhat different way. This time they have gauged the diameter of space itself.

Write the number 176 and after it put a row of 18 ciphers. Then you will have the number of miles that you will have to travel if you want to completely encircle the universe and get back where you started!

Vast as this figure appears, it is about a twentieth as large as scientists supposed a few years ago. It is based on a new value of the "radius of curvature of spacetime", as the astronomer calls it, that was announced by Dr. Ludwik Silberstein. Dr. Silberstein is a mathematician physicist connected with the research laboratory of the Eastman Kodak Company, and is considered as one of the world's leading authorities on these matters, which are closely connected with Einstein's theories.

According to Einstein and his school space is not infinite. The old idea that one could travel in a straight line forever is wrong, they say. As a matter of fact, there is no such thing as a straight line, and if a person should travel far enough and long enough in what seems to be a straight line, he would eventually find himself back at his starting point.

Yet, they also say, space is unlimited, and this is an illustration of how that may be. If a small insect lived on the surface of the globe and was unable to leave it, or to perceive anything else off its surface, he could travel indefinitely around it in any direction. He would never come to an end, yet his universe would be limited. Even if endowed with human intelligence, and he or his ancestors had never been able to perceive anything off the globe's surface, he would not be aware of the rest of the world about him.

Our universe, say the relativists, is similarly curved, in some fourth dimension, which the human race has so far been unable to perceive or comprehend. Apparently, we are free to move in any direction we choose, but actually there is at least one direction in which we cannot move, since we cannot comprehend it. If we could, then we could move in that direction.

But even though it cannot be comprehended, the scientist can get some faint glimmering of its existence, and estimate the size of this four-dimensional sphere in which we live. This is what Dr. Silberstein has done.

Using data pertaining to two separate groups of Cepheids, furnished by the Harvard College Observatory, Dr. Silberstein has made a new estimate of the radius of curvature of the universe, or "spacetime" as it is generally called. This radius is practically the same when calculated from a group of another kind of stars. It is about a wentieth as large as a previous estimate that he made in 1924, which was based on 18 globular star clusters and the Magellanic Clouds. The latter are clouds of stars seen in the southern hemisphere of the sky. Dr. Harlow Shapley is now working out some new material on these objects. Though not finished, it appears that his previous estimate of their distances, which Dr. Silberstein used, was too large. Therefore, and for other weighty reasons, Dr. Silberstein believes that his new determination of the radius is the more accurate.

The maps show the June evening skies. Two planets are now with us. In the western sky after sunset is Mars, rather faint, but recognizable by its steady red light. In the southeast is Saturn, fairly bright, and of a steady leaden color. Through even a small telescope, Saturn is one of the most remarkable sights in the heavens, for it is provided with a unique system of rings. A telescope magnifying perhaps fifty times will show these rings, and also the brightest of the moons that revolve around the planet.

A welcome event occurs on Friday, June 21, at 4:53 p. m., Eastern Standard Time. At that moment the sun is directly over the Tropic of Cancer, in its farthest north position of the year. Then, according to the astronomer's reckoning, summer commences.

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