ASTRONOMY

Camera Study of Meteors

Photographs of "shooting stars" are expected to provide much new information about the ionosphere, weather variations and the climate of the world.

➤ PICTURES of "shooting stars" have shown that the density of the atmosphere 45 miles or so above the earth increases in summer and decreases in winter. This new discovery was announced to the American Astronomical Society meeting in New Haven, Conn., by Dr. Fred L. Whipple of the Harvard College Observatory.

Meteors are high-velocity projectiles, but unlike V-2 rockets, they begin their flight in outer space and become trapped in our atmosphere, where they boil away high above the earth. The flash of light by which we know of their passing originates high in the atmosphere, in the same area now being reached by rockets.

More information about the densities and temperatures of this area 50-100 miles above the earth, and how they vary with the seasons, is thus vitally needed if we are to make maximum use of this "proving ground" for rockets and other high-velocity projectiles.

Density of the upper atmosphere is lowest in the northern hemisphere in late January and highest in early August, Dr. Whipple found. Thus, it is correlated with the average ground temperature, and changes with the seasons rather than with the sun.

Local variations of temperature have little or no effect on the atmosphere's density at this height, his studies indicated. Nor are storm fronts responsible for changes in density, as previously thought.

This Harvard photographic study of meteors, which has produced definite results after only a few months of observing, is sponsored by the Bureau of Ordnance of the Department of the Navy. The reduction of observations is being carried out by the M.I.T. Center of Analysis under the direction of Drs. Z. Kopal and L. Jacchia. The first photographs last August were taken simultaneously from two mobile caravans located just north of the Mexican border and near the city of Las Cruces, N. Mex. This is the first mobile photographic observatory to be used to study meteors.

These meteor photographs are also expected to provide new information about the nature and role of the ionosphere, upper layer of the earth's atmosphere which bounces radio waves back to the earth and enables us to hear distant radio signals, about weather variations and the climate of the world.

Separate stations and the use of two cameras make it possible to measure the height of meteor trails within a few feet and chart their paths more accurately. From this, scientists can determine the density of the atmosphere 50 to 75 miles up.

The assembling and most of the construction of the new type observatories was done by two young veterans, Harlan J. Smith and Richard E. McCrosky. They were assisted on the photographic work by Phillip Carroll, Jr. Mr. Smith was a Science Talent Search Winner in 1942. Three pairs of small photographic cameras equipped with rotating shutters operate at the two stations to photograph meteors simultaneously.

Two large cameras are being built specially to trap the faint, fleeting light of "shooting stars," those bits of cosmic dust that rush into our atmosphere and perish high above the earth.

These super-duper Schmidt-type cameras are expected to be completed and put into operation in about a year, Dr. Whipple announced.

Designed by Dr. James G. Baker, they will view a wide field and record the flight of meteors much fainter than those now observed.

The speeds of meteors and the fact that their appearance cannot be predicted makes them hard to photograph. Only the bright ones show up on most plates.

"These large cameras are expected to extend the magnitude range of photographic meteors approximately four magnitudes below the limits now set with conventional lenses, that is, not far from the average limit of visual observations," Dr. Whipple stated.

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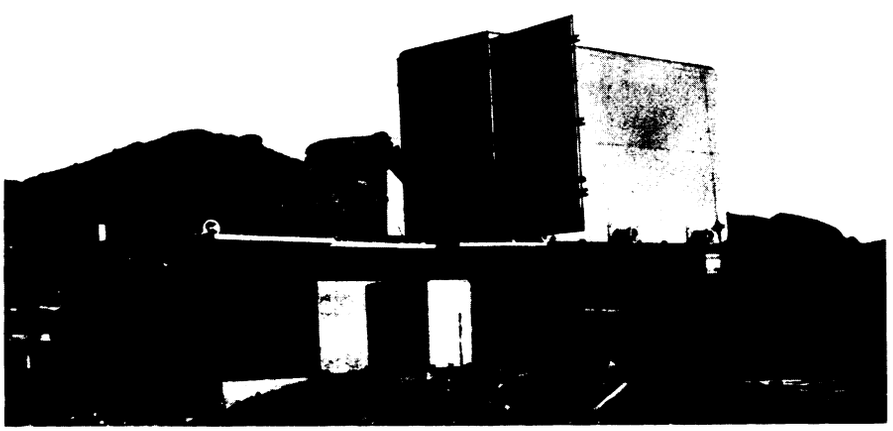

METEOR PHOTOGRAPHY—The three cameras housed in this trailer, and a similar set 16 miles away, constitute Harvard's newest astronomical observatory and the first mobile observatories for photographing meteors. They are located in southern New Mexico near Las Cruces.

ASTRONOMY

Antenna 50 Feet Across To Pick Up Solar Noise

➤ AN ANTENNA 50 feet in diameter, to be used with a very sensitive radio receiver in detecting radio signals from either the sun or cosmic space, was described at the meeting of the American Astronomical Society in New Haven, Conn., by John P. Hagen of the Naval Research Laboratory.

This enormous instrument, to be ready to go into operation within a year or so, will be the largest precision instrument of its kind. With it the exact location and size of the area from which the cosmic static is originating may be determined more precisely.

Now in the process of being built, this enormous "dish" is being made of cast aluminum and its parabolic surface will be machined after casting. The whole will be mounted equatorially on a pier, with the training mechanism a converted gun mount. This has the necessary precisely machined gears and also the necessary strength to hold this antenna under ad-

verse weather conditions.

Groups working in the relatively new field of radio astronomy, as listed by Mr. Hagen, include:

In the United States—the National Bureau of Standards, the Naval Research Laboratory and Cornell University.

In Canada—the National Research Council.

In England—the Operational Research Group of the Ministry of Supply, the Admiralty Signal Establishment, Cambridge University and the National Physical Laboratory.

In Australia—the Council for Scientific and Industrial Research.

In France—Ecole Normale Superiere at Paris, and the Institut de Astrophysique de Paris.

Research is also being conducted in Russia as occasional reports are received from that country.

Dr. Ralph E. Williamson of David Dunlap Observatory, University of Toronto, Canada, also took part in this symposium on micro-wave astronomy. His report dealt with radio emission from the sun.

Science News Letter, January 8, 1949

PRESIDENT-ELECT OF AAAS—Dr. Roger Adams, head of the department of chemistry at the University of Illinois, will become president in 1950 of the American Association for the Advancement of Science. He will succeed Dr. Elvin Stakman.

ASTRONOMY

Two-Star System Found

➤ THE third most massive system of double stars known has been found by Dr. Joseph A. Pearce of the Dominion Astrophysical Observatory, Victoria, British Columbia, Canada.

The two stars that revolve around each other are about 34 and 28 times as massive as the sun, Dr. Pearce reported to members of the American Astronomical Society meeting at Yale University in New Haven, Conn.

Extremely hot, these stars have surface temperatures of about 36,000 degrees Centigrade study of their found-out light shows. In intrinsic brightness, each is roughly 40,000 times as bright as the sun.

This double star, known to astronomers simply as HD215835, is nearly 7,000 light years from the earth, or over 41 million billion miles away. It is part of a cluster of stars.

The two stars race around each other at a speed of about 125 miles per second, whereas the earth goes around the sun at only 18 miles per second. Once each two days 2½ hours, they completely revolve around each other.

One reason for their high speed of revolution is that the two stars are so near each other, considering their vast sizes. Each has a diameter about nine times that of our sun—the larger measures 8,380,000 miles across. Yet the surfaces of these stars are within 8,000,000 miles of each other.

This double star system ought to show regular, periodic changes in light, Dr. Pearce pointed out. As one star revolves around the other, it should partially eclipse the one behind it and cut down the total light received from this two-star team.

To check this analysis Dr. Gerald Kron of Lick Observatory of the University of California is using a photoelectric cell on a telescope at Lick to record very accurately the brightness of HD215835.

A similar massive double star system also was reported by Dr. Sergei Gaposchkin of Harvard Observatory. He finds the star HD193611 to be a double of identical component stars, each with a mass 14 times that of the sun and about 12,000,000 miles in diameter. This star was also first observed by astronomers at the Dominion Astrophysical Observatory.

Science News Letter, January 8, 1949

ASTRONOMY

Radar Spots Fast Meteors

➤ FAST-MOVING meteors streaking through the earth's atmosphere are more likely than slow ones to be detected by low-frequency radar, astronomers and physicists of Harvard Observatory have found.

William Liller of Harvard Observatory reported at the American Astronomical Society meeting at Yale University in New Haven, Conn., on his statistical analysis of 160,000 meteor bursts recorded during the last part of 1946 and most of 1947 by J. A. Pierce, Cruft Laboratory, Harvard University, with a nondirectional, 3.5 megacycle transmitter. The study was made in conjunction with the Harvard photographic meteor program sponsored by the Bureau of Ordnance, Department of the Navy.

Fastest-moving meteors are known to be in the Perseid and Orionid showers, their velocities ranging about 38 and 42 miles per second, respectively. For every 10 meteors seen visually during the Orionid shower, Mr. Liller found 110 radar reflections. Slowest showers are the Geminids; for these only 35 meteors were detected by radar in an hour, as against 60 seen visually on the average.

When a pin-size bit of cosmic dust darts into the earth's atmosphere at a speed anywhere from 15 to 45 miles per second, friction with the air causes it to become very hot, so it leaves a trail of glowing gas particles which look like a "falling star."

This trail of gas is also ionized, and long after the visible light of the meteor has faded, the electrified trail of the meteor may reflect radio waves of certain frequencies. Early study of meteors by radar, especially in England, employed short-wave radio of such frequencies as 72.4 megacycles; the Harvard observations are with radio waves over 20 times as long.

These meteors are observed at altitudes near and above 60 miles, about the same height as the day-time "radio roof." This radio roof at certain times of the day prevented accurate measurements of the meteor frequencies by the Cruft Laboratory equipment, but did not prevent observation of parts of some of the best-known meteor showers, such as the Perseids in August, the Leonids in November, and the Geminids in December.

Visual observations long ago showed that fast-moving meteors leave bright trains in the sky more frequently than do the slower ones. It seems reasonable to assume that by the same mechanism these same meteors give stronger radio reflections.

Furthermore, the fast-moving meteors appear at greater heights where they can produce ionized tracks which endure longer and where the tracks are able to expand to the large size necessary to reflect radio waves of a frequency of 3.5 megacycles and still have an ion density large enough to reflect these waves.

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The most destructive animal to cattle, sheep, game animals, horses, swine and poultry in the United States is the *coyote;* more damage is done by the dog-like coyotes each year than by all other predatory animals put together.