# The Great Aurora of September 22-23

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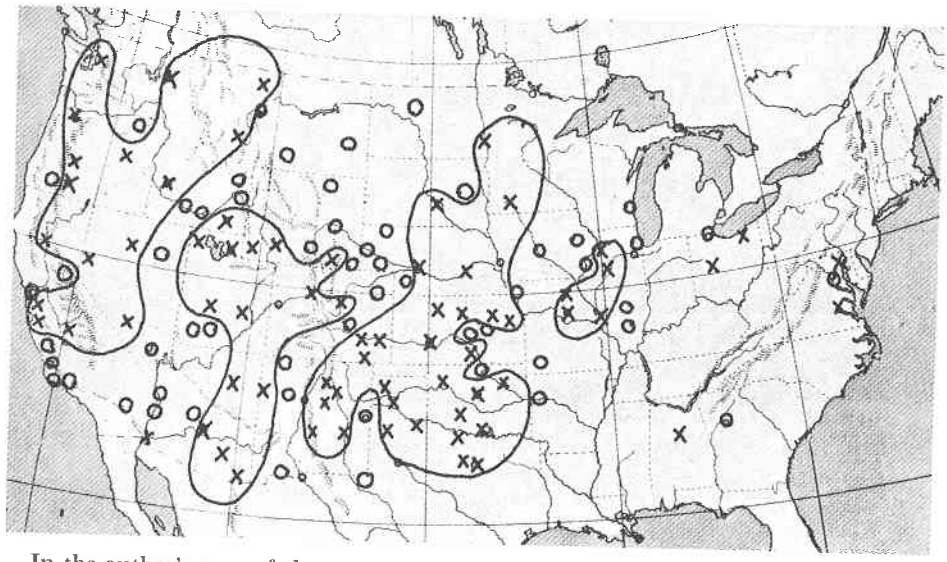
AN INTENSE and widespread auroral storm began early in the evening of Sunday, September 22, 1957, and lasted until the predawn hours of the following day. At the peak of its activity, near 10 p.m. Mountain standard time, auroral observations were being made from coast to coast and all of the way from the Mexican border up to the Canadian line and possibly still farther north. In this summary all times cited are MST.

The diffuse reddish glow, typical of relatively rare low-latitude aurorae, was seen in Tucson, Arizona, at about 7 p.m. and then disappeared, only to reappear near 10 p.m., the time of nationwide maximum intensity. R. S. Shaw, of Tucson, has provided an excellent report of visual observations from the northern edge of the city, where artificial lights were nearly absent. A coppery red glow, from northwest to almost due east, was visible at about 9:45 p.m. above the Santa Catalina Mountains, some 10 miles away. Suddenly, at about 9:50, within only a few seconds the upper edge of this glow very rapidly ascended to an altitude of over 35 degrees, as estimated from Polaris, and remained there until the display faded near 10 o'clock. Occasional yellowish-white vertical rays emanated from near magnetic north, but apparently did not march laterally as such rays frequently do.

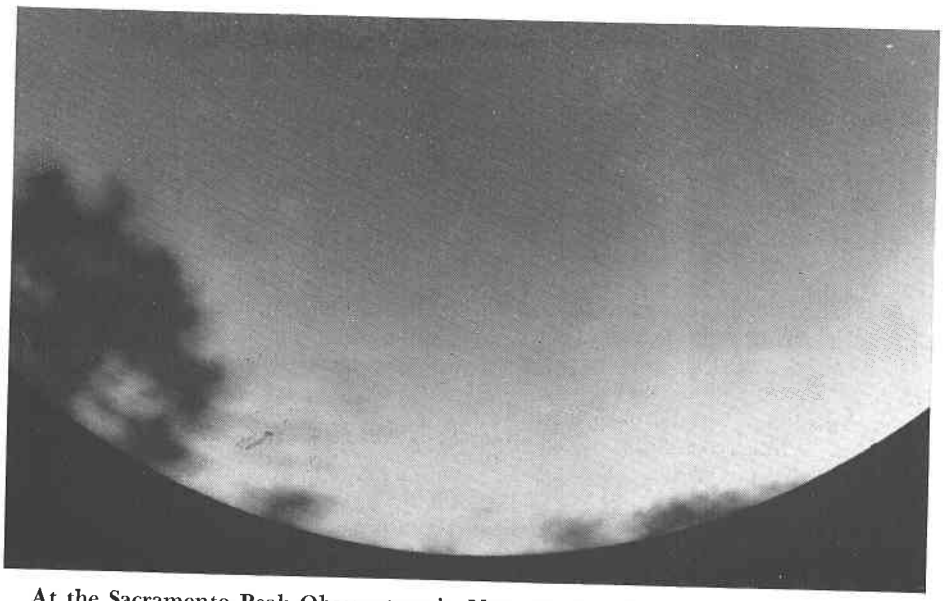
During inquiries to determine whether this display was limited to our Arizona area, I ultimately learned of a source of information of which I had been previously unaware—the informal special reports of aurora observations, labeled by the codeword AURBO, which are encoded at the end of the hourly airways weather reports, disseminated by teletype throughout the country. My discovery of this source of data was unfortunately belated, and on the evening of the 23rd it took a diligent search through two large waste barrels, with the energetic aid of J. C. Killian of the Civil Aeronautics Administration's Tucson office, to retrieve the key teletype sequences containing the auroral data.



In the author's map of the great auroral storm of September 22-23, 1957, crosses mark sightings at 10 p.m. Mountain standard time; circles are stations not reporting aurora. The north-south elongation of the zones of visibility may indicate the influence of the earth's magnetic field.

After filtering out sought-for sequences from bits of lunches and reams of yellow paper, only to discover that I had failed to hunt for the 11 p.m. data, I hesitated to ask Mr. Killian's renewed help in once again dumping and combing through the barrels. My reluctance, however, was quickly removed by his accusation that I seemed not to be showing the scientist's proverbial perseverance in getting the data at all costs, and together we found the missing hour's records in the depths of the well-filled barrels. The complete set of reports has permitted a reasonably full examination of the time development and the geographic coverage of this particular storm, so the scavenging seems now to have been worth while.

The accompanying map shows the pattern of auroral observations relayed at 10 p.m. MST by Weather Bureau and CAA stations at a total of about 260 points over the country. The teletype data available in the Tucson office includes most stations in the West but only a fraction of the eastern ones. This unevenness happened to be not too serious in the present case, since a very large area of overcast skies lay behind a cold front extending from southern Texas, along the Appalachians, and into New England; only scattered stations in that area could see



**At the Sacramento Peak Observatory in New Mexico, Guenther Schwartz photographed the September 22nd aurora, using a Baker super-Schmidt meteor camera, only a portion of its 55-degree field being shown here. This 15-second exposure on Tri-X film was made at 10:49 p.m. Mountain standard time. Until then, trees masked the aurora, low in the northeast. "The arc that was visible was very reddish in color, the rays primarily whitish with a green tinge," Mr. Schwartz noted in his record book. Air Force Cambridge Research Center photograph.**

the aurora anyway. By contrast, the western states were dominated by the sky-clearing action of the subsidence of air in a large anticyclone centered over Colorado on the evening of the 22nd; thus the West enjoyed a good opportunity for viewing this large auroral storm. The first teletyped accounts of auroral sightings came at 8 p.m., an hour after the earliest observations in Tucson, reached a maximum of 73 stations reporting aurora at 10 p.m., fell a bit near midnight, recovered slightly at 1 a.m., and ended after 4 a.m. on September 23rd.

Crosses on the map show all stations where aurorae were reported, and circles indicate places for which I found reports of completely clear skies at 10 p.m., but where no notation of aurora was included. Unfortunately the regulations for reporting aurorae at airways stations are such that we cannot conclude that every circle on the chart marks a spot where aurora was positively absent at that time. As part of a further study of this storm, I am now making special inquiries at some 20 selected circled stations. More information from them will help interpret the odd elongation of the zones reporting the 10 o'clock aurorae, an elongation that seems roughly to parallel the magnetic meridians.

Of the 73 stations recording aurorae at 10 p.m., the farthest south was Douglas, Arizona, in latitude about 31° north. Grand Island, Nebraska, holds the distinction of reporting aurorae at every hourly observation from 8 p.m. to the close at 4 a.m.

The daily routine by which this airways data is processed makes it extremely difficult to extract information such as here summarized, if one tries it more than about one day after an auroral storm. This is because these auroral reports are not entered on the easily processed punch cards which the Weather Bureau uses for standard data. Instead, they are entered by hand on a certain form (WBAN 10-B) that is ultimately filed in the archives by station rather than by hour, thus precluding easy synoptic analysis. Happily, however, the data are in convenient form if secured from any airways station before the original teletype sheets are thrown away (a daily disposal problem at such stations).

To my knowledge, no systematic study of these hourly airways reports of aurorae is now being carried out. The IGY auroral program being conducted by D. S. Kimball and C. W. Gartlein with Weather Bureau co-operation is, for example, drawing on only some 85 principal Weather Bureau stations, whereas there are about 500 airways stations in the country. Despite the less carefully controlled conditions of observation and recording in the case of the airways reports, I do believe that these provide interesting opportunities for study by amateur astronomers who live where teletype stations are maintained. The current peak of solar activity makes this year and the next especially good for such efforts.

# LETTERS

Sir:

Page 333 of the May, 1957, *Sky and Telescope* reported the work of John S. Rinehart on the ablation or wastage of meteoritic bodies during their flight through the earth's atmosphere. My studies of this problem are presented in the book *Foundations of Meteoritics,* Moscow, 1955, and in the German journal *Chemie der Erde, 18,* 56-88, 1956.

From the properties of individual specimens of the Sikhote-Alin and other meteoritic showers, the following rule was established: If a specimen shows the earmarks of stable orientation during flight (roughly conical shape, flow marks on the front which have about 1/10 the diameter of the meteorite), then the rear surface has one of two kinds of structure—either with fully developed but much larger flow marks, or having sharp-edged irregularities.

The significance of these two types comes from the fact that there is little or no ablation at the rear surface of a meteorite falling with stable orientation. Suppose that the original meteoritic body broke up during its flight, and that a fragment preserved constant orientation during its remaining fall. Then its rear surface, if part of the original exterior, would show the large flow marks of the original body. On the other hand, if the rear face of the fragment were a surface of fracture, it would show the sharp irregularities of the fracture.

This reasoning may be applied to the photographs of the Cabin Creek meteorite that were published with the *Sky and Telescope* account of Dr. Rinehart's work. The approximately conical shape and the flow marks on its front show that flight was stable. But the back bears typical flow marks that are much larger than 1/10 the specimen's size. Hence we conclude that the Cabin Creek meteorite is only a fragment of an original body two or three times larger, perhaps 90 inches in diameter, to judge from the size of the rear flow marks.

Also, this rear surface formed part of the exterior of the original body. Therefore this specimen gives an excellent opportunity for studying the change in chemical composition with depth below the original surface. Such analyses give information on the influence of cosmic radiation on the formation of isotopes, including helium of mass three, in the meteorite.

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Sir:

While searching for Comet Mrkos on August 4th, we observed a phenomenon apparently related to the green flash. The western horizon was cloudless but hazy, and the setting sun deep red. We turned a mounted 3-inch 21x terrestrial refractor on the sun as it neared the horizon. Owing to layering of the air, the sun's limb appeared slightly notched; as the sun set, pairs of corresponding notches moved upward across the disk, pinching off small "bubbles" from the top.

Each bubble gradually turned orange, yellow, and finally pale green before it faded out, the whole process taking up to three seconds. By comparison with the telescopic disks of Venus and Jupiter, we estimated that the bubbles were about half a minute of arc in diameter. The upper limb of the sun also showed a yellow-green fringe, considerably narrower than the bubbles. Neither bubbles nor fringe could be seen in hand-held 7-power binoculars.

The green color seemed real; the observations of Venus and Jupiter showed it was not due to chromatic aberration in the telescope, and the gradual nature of the color and brightness changes rules out an explanation by eye fatigue.

On the following night the sky was clearer at sunset, the sun was brighter, and nothing unusual was observed.

W. E. HOWARD, III,
and A. T. YOUNG
Harvard College Observatory
Cambridge 38, Mass.

Sir:

On page 494 of the August issue, Edgar Everhart describes sidereal drives for telescopes, and proposes the accurate gear train 1 r.p.m. × 20/66 × 14/56 × 34/37 × 1/100. The identical ratio can be obtained from the train 1 r.p.m. × 5/55 × 17/37 × 1/60, which is easier to construct because it requires fewer gears. Both trains are available in standard Boston gears. My train has a 5-tooth pinion and 20-pitch change gears.

ROBERT M. AYERS
1374 S. Branch Pkwy.
Springfield, Mass.

Sir:

The caption under the photograph of Jupiter on page 397 of the June issue contains an error. The prominent feature at the upper left is a disturbance in the south tropical zone, and not the red spot hollow. Mr. Botham's photograph on March 8, 1956, was taken when the longitude of the central meridian was 224° (System II). On that date the following end of the dusky disturbance was at longitude 215°, while the center of the red spot hollow was at 301°. Hence the latter feature was too near the following limb to be seen on the photograph.

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