THE SOLAR ECLIPSE AND BIRD SONG

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The shades of night which accompany an eclipse of the sun have always intrigued mankind and caused him to pause, if only for a moment, to contemplate the mystery, the magic, the grandeur, and the extent of the universe of which he is a part.

Although this interest in solar eclipses has a long history and has given rise to fantastic tales, it is probable that no eclipse ever had as much publicity and public interest as did the eclipse which was total on a narrow path across the State of Maine on 20 July 1963 at about 5:30 PM, EDT. For weeks and even months before this eclipse, scientific, semi-popular, and popular magazines and newspapers devoted space to its occurrence. The government of Maine quite outdid itself in taking advantage of a unique opportunity to attract scientists wishing to make a serious study of the phenomenon, as well as vacationing tourists who were urged to spend their mid-summer holiday in Maine and to observe with millions of others one of the greatest natural spectacles of the twentieth century to occur in or near a densely-populated area and at a time when many people would be out-of-doors.

Light and Its Relation to Bird Song

While it is well known that many birds respond to the light changes in early morning and in the evening by beginning or ending their songs, Armstrong (1963) in an excellent chapter on "The Influence of Light, Weather and Temperature on Song" reminds us that many factors influence song and that it is the total effect of these several factors which we must consider.

A solar eclipse causes variation in light intensity somewhat similar to that of approaching dusk or dawn and usually brings sudden changes in temperature. The eclipse does not influence many of the factors which affect bird song—for example, time of year, and physiological condition of the bird—and this no doubt accounts for many different reports of the eclipse by various observers. It is also probable that the sudden interruption of an established diurnal routine is more confusing to some species or individuals than to others. All these possibilities for variation in the cause and effect on the singing behavior of birds at the time of an eclipse tend to keep the value of any observation on response to an eclipse a strictly local affair and must lead us to expect very general conclusions rather than specific results which would enable us to predict with accuracy the response of a given species or individual.

Figure 1. At Corinna, Maine, in the afternoon of 20 July 1963 prior to the solar eclipse. The senior author points to his location on an eclipse map and makes preliminary notes into the microphone to test the sound-recording equipment.

Eclipse Versus Normal Dusk and Dawn

From past experiences with an eclipse we were aware of the tremendous pressure under which one must make observations in the sixty or so seconds of totality. Although, technically, all minutes are equal spans of time, our immediate reaction was that the event of totality lasted not more than twenty seconds.

Another factor, seldom appreciated, is that the natural response of the human eye, and the bird's eye too, tends to lessen the response to the approaching darkness so that, when totality comes, one gets more the impression of turning off a light rather than that of the gradual normal twilight. Totality comes, or did come to us, as more of a shock than we are accustomed to experience at dusk. It is probable that a part of our minute of totality was spent in accommodating our eyes to the sudden decrease of light. This experience suggests that, for a future eclipse, it would be wise to attempt to accommodate the eyes to very low light levels for at least a half-hour before totality by using very dark glasses, such as worn by individuals who work in darkrooms and then go out into bright light, and by removing the glasses at the instant of totality.

The partial explanation for this response which seemed to us to make the approach to darkness of the eclipse so different from the normal approach of twilight is the characteristic response of the eye to varying light intensities. All senses are approximately logarithmic rather than linear in their responses. This means, essentially, that in reducing the light intensity from a million candle power to a half-million our response would be evaluated as having approximately the same import as changing the intensity from one candle power to one-half. This type of response is not only important but is really an advantage because it greatly extends the range of light intensities in which we can see well. We can appreciate this readily when we recall our ability to perceive objects and even some details in a dimly-lighted darkroom, and yet not be blinded by the full light of the sun.

During a normal sunset the decrease in light intensity is gradual and fairly linear with respect to time. There is no sudden, sharp decrease in intensity even when the sun sinks below the horizon because the earth's atmosphere greatly modifies the intensity and acts as a diffusion medium or even a source of light after the sun has set. During an eclipse, especially when the sun is well above the horizon, conditions are very different. In the first place, the decrease in light intensity accelerates with time, and the final disappearance of the sun's disc behind the disc of the moon is one of the most strikingly sudden events in nature. Secondly, the earth's atmosphere, away from the horizon, has much less of a diffusing effect on the light because the thickness of the atmosphere which the light must penetrate is so much less. Nevertheless, it is true that much light is reflected to an observer from atmosphere outside the path of the eclipse. This light greatly modifies the darkness so that the total light intensity during totality is approximately twice that of a full moon.

From these considerations of the response of the eye to changes in light intensity, and the various factors which control and modify the decrease in the rate at which darkness descends during an eclipse, we can see that the twilight resulting from an eclipse, when experienced under perfect conditions, is much different from the twilight experienced at sunset. We must remember, however, that the presence of clouds greatly modifies both the phenomenon of the eclipse and of normal sunset.

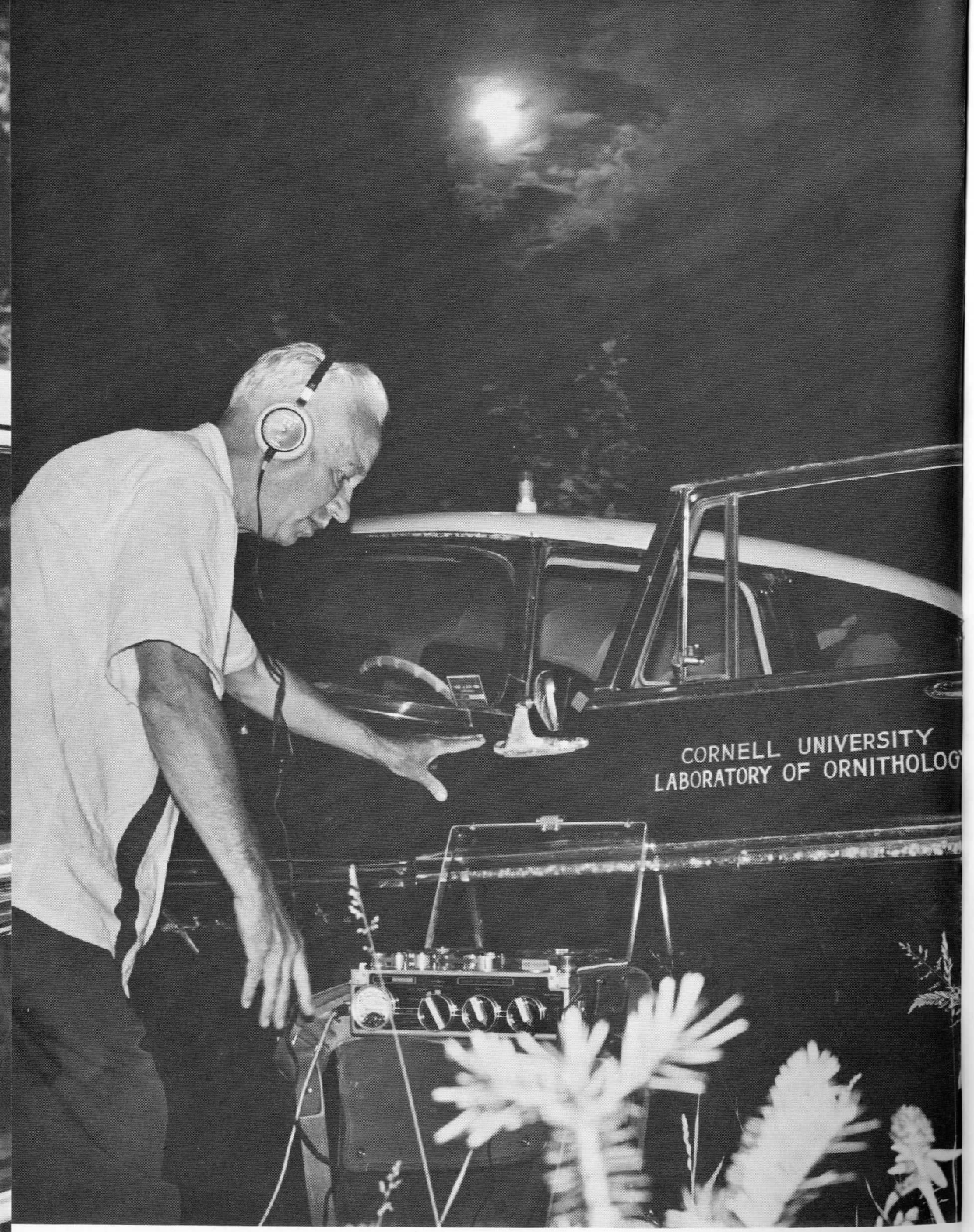

Figure 2. An hour before the eclipse. The sound-recording equipment, with a non-directional microphone on top of the car, is ready. Clouds threaten to mar the view of the eclipse.

The 1963 Eclipse Expedition to Maine

Until about a week before the event it did not appear possible that we could get away to observe the phenomenon and even if we could we realized that we could spend only the one day (the day of the eclipse) in locating a station for the observations and in getting acquainted with the singing birds of the locality—specifically, those individuals within hearing range of our particular station.

The trip north from Brunswick, Maine, which we left in mid-morning was uneventful though hardly encouraging. Intermittent sunshine and cloudy weather, with occasional showers or even hard downpours, made us realize that only unusual good fortune would result in our having an unobstructed view of the sun in the late afternoon. The radio stations of the state carried almost nothing but news of the impending eclipse. Mostly, they made an effort to be hopeful about the weather but there was the realization that the possibilities were precarious. Big concentrations of meteorologists and other scientists were at Orono and on Mt. Desert Island, places selected by experts as having the best chance for fair weather.

Our requirements were considerably different from those of most observers. First, we wanted singing birds of as many species as possible. Second, we wanted as little man-made interfering noise as possible. Of course we, too, hoped for good visibility but this requirement was not paramount. Our needs ruled out all places where there would be crowds and for this reason we deliberately steered away from the much-talked-about centers of activity.

Shortly before noon on the day of the eclipse we were in the middle of the band of totality in the little town of Corinna about 30 miles west of Orono. A local hunter whom we met at a gas station suggested a wild area "with lots of birds"—a river bottom, crossed only by a dirt road on which he guaranteed there would be little traffic. The area was about two miles south of Corinna and we spent the next few hours exploring, listening for birds, and checking the natural openings through which we hoped to see the sun at the time of the big event. Our choice of spots could hardly have been better. Typical birds of the Canadian Zone were there and singing—Olive-sided Flycatcher *(Nuttallornis borealis),* Hermit Thrush *(Hylocichla guttata),* Swainson's Thrush *(H. ustulata),* Veery *(H. fuscescens),* Myrtle Warbler *(Dendroica coronata),* Slate-colored Junco *(Junco hyemalis),* White-throated Sparrow *(Zonotrichia albicollis)*—as were the Red-eyed Vireo *(Viveo olivaceus)* and American Goldfinch *(Spinus tristis).*

We found an old logging road running off the dirt road to the east. Although this was not intended for cars, we were able to make our way along it with care to an opening where we had a good view of the sky to the west when looking upward at angles of from 15 to 35 degrees. Here we set up our sound and photographic equipment with a non-directional microphone mounted above the center of the car and with the recorder on an improvised table at the side of the car. We tested, made vocal notes on the tape, and performed dry-runs exactly as we would do in the brief minute of totality. We noted the birds singing and even recorded a bit of song. Because we had decided not to use a parabolic reflector which picks up sound from only one direction, all sounds were weak and not of good quality although they were recognizable; and these recordings made before, during, and after the eclipse have given us the opportunity to re-live and re-evaluate our experiences many times. The important thing is that we can do this again without the feeling of pressure under which we worked at the time.

Figure 3. Using a 30-centimeter lens to project the bright image of the partly-eclipsed sun on a box of magnetic tape, the senior author follows the progress of the eclipse.

The results of our recordings are somewhat disappointing if viewed only from an entertainment point of view. As the darkness descended, bird song fell off noticeably but some species, according to our recordings, never did stop completely. The *per-chic-o-ree* of the Goldfinch was heard clearly in the middle of totality; the Hermit Thrush and Swainson's Thrush sang weakly during the darkness; a Veery called.

Other observers, in more open areas, reported flocking activities. A radio report said that Starlings *(Sturnus vulgaris)* flew towards established roosts.

Miss Marjorie Rusk of Syracuse, New York, who was south of Mt. Katahdin, Maine, where the eclipse was 98-99 per cent total, reported the Common Nighthawk *(Chordeiles minor)* calling and a White-throated Sparrow singing throughout the eclipse, and the Swainson's Thrush giving scold notes.

Mr. Carl Hiller of Marblehead Neck, Massachusetts, reported that, as it got dark, gulls left their feeding grounds and headed for their roosting or nesting areas but turned around as soon as the light returned.

Mrs. Margaret H. Hundley (1964), reporting her observations on the reactions of birds to the eclipse, included a list of four species we recorded. She writes: "For about three or four minutes during the time of least light, except for an occasional call, all songs ceased except for *Turdus migratorius* [Robin] and *Hylocichla ustulata* [Swainson's Thrush]. The latter continued singing as loudly as before darkness."

Figure 4. Totality. The foreground is lighted by photoflash.

No one with whom we talked reported Whip-poor-wills *(Caprimulgus vociferus)* singing but it would seem natural to expect that they would do so.

Perhaps no two lists of birds heard before, during, and after the eclipse would be anywhere near similar. Certainly the lists I have seen are very different. There is no question but that song was greatly reduced during totality, and considerably reduced in the period 15 minutes before and 15 minutes after totality. On our list the first voice we heard after totality was the little peeper, *Hyla crucifer*. This was unexpected and was heard only once. Among the birds, the White-throated Sparrow songs, the Hermit Thrush calls and songs, and the Swainson's Thrush songs were soon back to normal frequency.

Perhaps the most profitable results of our brief expedition were some ideas as to how to conduct such a study in the future. The next total solar eclipse in North America will be visible in Florida, Georgia, and the Carolinas on 7 March 1970. Ideally one should start well in advance of this eclipse by selecting an area known for its quietness and abundance of bird life and song and, for at least a week before the eclipse, make observations and recordings there. If possible, a number of good observers should take part and, for several days before the eclipse, hold discussions based on bird songs recorded under normal conditions. Then, following the event, they could compare the results, heard immediately before and after and during the eclipse, with conditions observed under similar light (measured by a photometer) at dawn and dusk on the days immediately preceding and following the eclipse.

Such a study, requiring both time and care, would presumably have to be done by enthusiasts rather than by paid observers. However, it would be exciting and would repay the observers by enabling them to add a bit more to our knowledge of birds during the phenomenon of a total eclipse.

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