are scarce. Lizards of the genera *Urosaurus*, *Sceloporus*, *Cnemidophorous*, and *Phrynosoma* were plentiful throughout the area where the sparrow hunting took place. We have seen lizards moving about both before and after the Roadrunner's captures. It would seem that House Sparrows and other small passerines are at times easier to capture than are the nimble lizards we customarily think of as Roadrunner food.

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AMERICAN KESTREL, *FALCO SPARVERIUS*, EXHIBITS RELIC NEST BUILDING BEHAVIOR

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It is generally accepted that members of the genus *Falco* do not build nests as such, but may occupy the old nests of other species, or merely make a shallow scrape in the debris of a ledge or on the ground. This is generally true for American Kestrels (*Falco sparverius*) with the exception that kestrels frequently lay their eggs in hollows excavated by woodpeckers. Bent (U.S. Natl. Mus., Bull. 167, 1937) states that kestrels habitually use their chosen cavity as they find it. They add little if any nesting material, and lay their eggs either on the bare floor or on whatever the previous occupant has left behind.

In the course of breeding experiments with the American Kestrel under confinement, several female kestrels exhibited what appeared to be nest building behavior. During the last week of March 1969 a captive female kestrel laid four eggs in a modified natural log cavity. After the last egg had been laid and the female began to incubate, it was noticed that the nest materials had been rearranged. The scrape had been deepened, forming a well shaped cup about two inches deep; wood chips forming the litter at the bottom of the cavity were placed horizontally and tangentially around the eggs, giving the appearance of a well ordered nest. At this point I removed all the chips lining the cup and placed them with a few others in a pile six inches away from the eggs. By the following day all the chips had been placed back into the cup by the hawk, and nearly all were again aligned with their long axis to the horizontal.

Later when two other female kestrels were laying eggs, wood chips about $1 \times \frac{1}{8}$ inch were placed in their nest boxes to see if they followed the same pattern. During egg laying no manipulation of the chips occurred, but, as soon as incubation started, the birds arranged the chips to form a well ordered cup.

The fact that kestrels lay pigmented eggs, while most cavity nesters lay white eggs, has led to the notion that kestrels may have only recently evolved to the habit of nesting in hollows, and that during the past they used open nests of some type. The evidence that kestrels have considerable skill in manipulating nesting material, as indicated by this study, tends to support the idea that kestrels may have at one time built their own nests, or at least remodeled the stick nests of other species. It should also be noted that kestrels have sometimes utilized the old nests of magpies, and that the European Kestrel, *Falco tinnunculus*, a close relative of the American Kestrel, often lays in the open nests of rooks.

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TEMPERATURE MEASUREMENTS AT THE NEST OF THE DESERT LARK (*AMMOMANES DESERTI DESERTI*)

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The Desert Lark (*Ammomanes deserti deserti*) is a small, sparrow-sized bird which occurs in desert areas of North Africa, Arabia, and east to India (Meinertzhagen, Birds of Arabia. Oliver and Boyd, Edinburgh. 1954). It is mainly a seed-eater, but it also includes insects in its diet. It nests on the ground, usually in early spring, but occupied nests may be found as late as the end of May.

The nest is interesting because its orientation and structure seem helpful in avoiding high mid-day temperature extremes in the nest, and also appear adjusted to take advantage of early morning sun and late afternoon wind to provide favorable incubation conditions while the female is absent for foraging. Microclimatic measurements were made in two nests in order to obtain information about temperature conditions in the nest as compared with ground surface and air temperature. The two nests were located in the Central Negev of Israel near Avdat (30° 47′ N, 34° 46′ E). This is close to the northern distribution limit of the Desert Lark.

All four nests observed in this area were facing north and were shaded against the mid-day sun by a bush (1 nest) or an overhanging stone (3 nests). Nest number one (see fig. 1) was situated on a rather steep north-facing rocky slope in a shallow depression under an overhanging stone. It was lined with the long and hairy seeds of *Geranium* sp. to a thickness of 1–2 cm. The inner diameter of the cup-shaped nest was about 10 cm, and its depth, 5.5 cm. The overhanging stone acted as a "roof," leaving the east, north, and west sides open to free air-flow. A semicircle of small stones—a pebble glacis—was built on the open sides of the nest, forming a wall up to 4 cm high, enclosing the nest to its full height.

Nest number two was situated on a more gentle north-facing slope. The area was covered by smaller stones and the vegetation coverage was denser than near nest number one. The nest was built in a depression on the northern side of an *Artemisia* bush about 30 cm high. The encircling wall of pebbles and the lining were similar to those of the first nest, but the wall encircled the nest on all sides, and there was no overhanging stone. Two more nests under overhanging stones had the same general characteristics as nest number one.

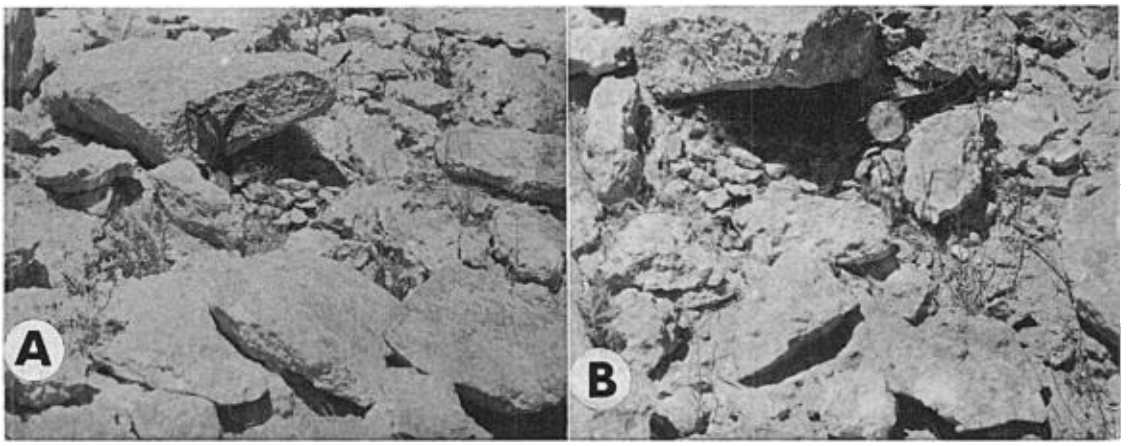

FIGURE 1. Nest (number 1) of the Desert Lark photographed at 11:00. A, camera facing straight west; B, camera facing straight south. The pebble wall and the complete shading of the nest are visible in both photographs.

MEASURING EQUIPMENT AND TECHNIQUE

All measurements were made immediately after the nests were abandoned. This avoided disturbances during incubation and permitted an evaluation of the contribution of physical factors to the temperature conditions in the nest.

For temperatures inside the nest, a thermistor probe was used (Yellow Springs, U.S.A., Teletherm-istor model 42 SC). The instrument was repeatedly calibrated and found to remain accurate within ± 0.2°C. The probe was in contact with the lining on the floor of the nest and always in the shade. Air temperatures at 5 cm height were recorded with platinum resistor thermometers (De-Gussa, Germany) housed in specially designed field screens, built by the Israeli Meteorological Department at Beit-Dagan. Ground surface temperatures were read by means of a minimum alcohol thermometer, placed on the ground with its bulb in firm contact with the ground. Air-flow at 10 cm height was read by means of a sensitive anemometer ("Fuess," Germany). All readings were made hourly.

NEST TEMPERATURES

The most striking observation is the rapid rise in nest temperature that occurs immediately after sunrise (table 1, fig. 2). This is the time when the female has been observed to leave the nest, and when it can be expected that the bird will usually leave to begin feeding in the morning. Thus the early morning sun contributes towards keeping the nest warm during this absence of the female. It is probably important to the water balance of the bird that, in the very early hours of the morning, the seeds contain a great deal more absorbed moisture than later in the day, and it may even be an essential factor in its water balance.

TABLE 1. Temperatures (°C) in empty nests of the Desert Lark from pre-dawn until 6:40; characteristically, the female can be expected to be absent for foraging shortly after sunrise.

	Nest no. 2, 29 May 1968			Nest no. 2, 12 June 1968			Nest no. 1, 5 June 1968		
Time	Nest floor	Ground surface	Air 5 cm	Nest floor	Ground surface	Air 5 cm	Nest floor	Ground surface	Air 5 cm
04:40	13.4	12.5	11.9	16.0	13.8	11.9	20.8	18.5	20.0
Sunrise		05:00			04:58			04:47	
05:40	19.8	16.1	16.9	19.1	18.1	16.0	23.1	21.7	23.9
06:40	31.0	18.0[b]	22.7	30.6	24.9	20.8	31.2	28.0	27.9
Δt[a]	17.6	5.5	10.8	14.6	11.1	8.9	10.4	9.5	7.9

[a] Δt = rise in temperature from 04:40 to 06:40.
[b] At the moment of reading thermometer was in shade.

TABLE 2. Maximum and minimum temperatures (°C) in empty nests of the Desert Lark, derived from hourly measurements.

	Nest floor		Ground surface		Air 5 cm	
	Max.	Min.	Max.	Min.	Max.	Min.
Nest no. 2, 28–29 May 1968	40.2	13.4	40.8	12.5	32.5	11.9
Nest no. 2, 11–12 June 1968	36.7	15.0	48.2	13.8	33.5	11.3
Nest no. 1, 4–5 June 1968	39.0	20.8	43.8	18.2	34.8	19.2

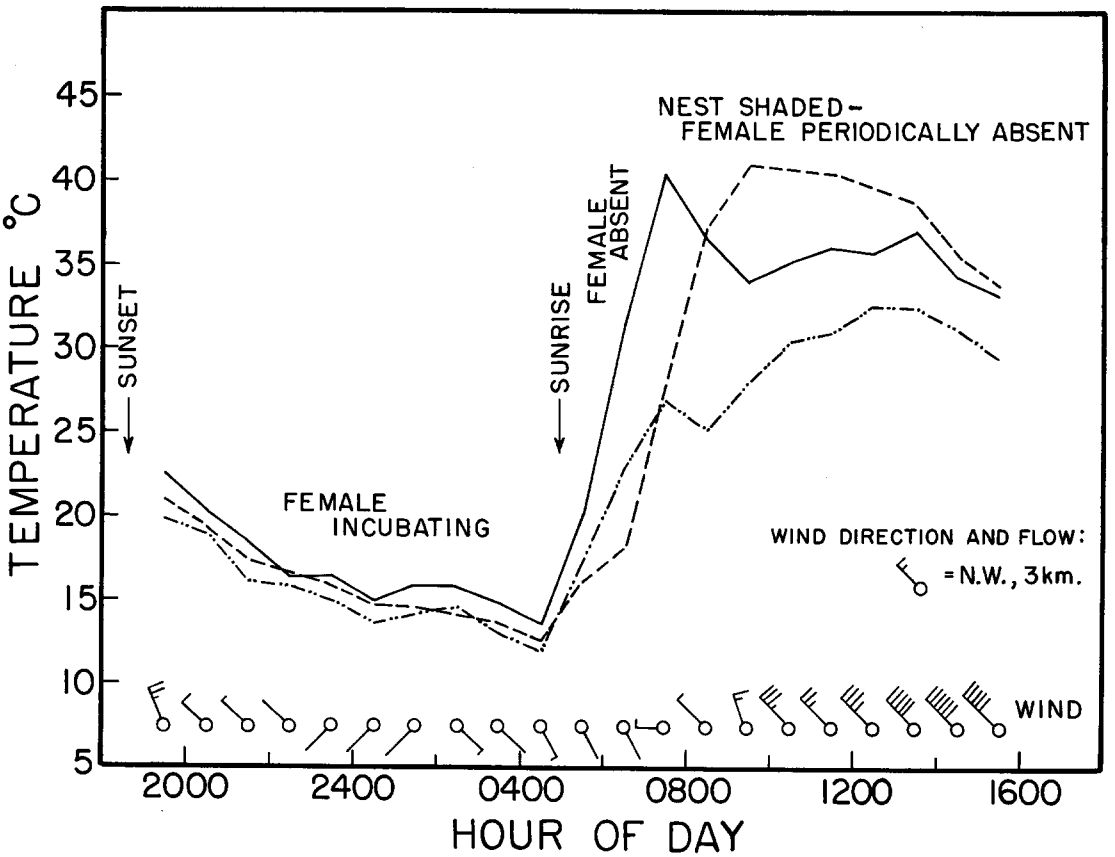

FIGURE 2. Daily temperature record at nest number two of Desert Lark. Solid line = nest floor; dash line = ground-surface; dash-dot line = air at 5 cm height. Measurements were made in empty nest after successful completion of incubation; indications of female's activity are based on observations made when nest was active.

A similar finding was reported by Taylor (Nature 219:181–182, 1968) in East Africa, where the higher relative humidity at night greatly increases the water content of the plant material on which wild ungulates feed.

The daily pattern of nest temperatures seems to be dictated by the orientation and design of the nest, and can be described as follows. In the early morning, rays of the sun reach the nest for a brief period, thus achieving a rapid warming while the female is away feeding. Shortly afterwards the nest is shaded, and heating to damaging temperatures is avoided. The maximum day temperatures in the nest always remained below ground surface temperatures (table 2). During the day, and in particularly in the afternoon, predominating northwesterly winds contribute to air movement over the nest and keep nest temperatures favorable. At sunrise there was usually little air movement (wind speed ~ 0.1 m/sec); the air movement increased during the day and was highest during the hot afternoon. Wind directions between north and west were most frequent (85.2 per cent of all hourly readings) and the total air-flow from these directions comprised 90.9 per cent of total air-flow (wind speed in km/hr $\times$ time in hrs). In the evenings, when the sun again hits the nest, excessive heating is prevented by the now stronger air movement. At night, the observed minimum nest temperatures (measured in the empty nests) remained above minimum ground surface and air temperatures (see table 2).

The wall of pebbles which surrounds the nest may contribute to the heat balance of the nest area, but more careful measurements would be needed to establish the extent to which this is the case. Apparently the nest may be self-incubating for several hours of the day. (Usual incubation temperatures of passerines are about 34°C; Huggins, Ecology 22:151, 1941.) Other functions that have been ascribed to the pebble wall include camouflage, strengthening of the nest, and possibly decoration (Etchécopar and Hüe, The Birds of North Africa. Oliver and Boyd, London. 1967). In any event, the orientation and design of the Desert Lark's nest contribute towards a favorable completion of incubation in a most hostile environment.

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