European Starling Reproduction in Central New Mexico.—European Starlings (*Sturnus vulgaris*) were first found nesting in New Mexico in 1954 (Ligon 1961), and began nesting in Albuquerque in the summers of 1959–1962. They are now residents in Albuquerque (Hubbard 1970). I report here the results of a breeding study conducted at 2 sites in central New Mexico.

I placed nest boxes similar to Kessel's (1957) on trees on the University of New Mexico campus (Albuquerque), an urban area characterized by lawns and buildings. There I observed 39 clutches over a period of 4 breeding seasons (1978–1981). I placed similar boxes in trees near Los Lunas, an agrarian, riparian area 40.2 km south of Albuquerque. This part of the study lasted for 2 seasons (1979–1980) and involved 18 clutches. I recorded clutch and brood size and nestling weight at each nest. Because all birds were killed and examined for parasites prior to fledging (Moore 1983), data for older nestlings (Table 2) refer to birds that survived until parasite examination, at least 10 days. Early broods are those that hatched prior to 15 May, intermediate broods hatched 16 May–31 May, and late broods hatched after 31 May.

Site comparisons.—Average clutch size for Albuquerque was 4.1 ± .77 (SD) and for Los Lunas was 5.1 ± .96 (Table 1). In 1980, clutch size was significantly different between the sites for both early and late nests (Table 2; $P < .01$, *t*-test). Proportion of eggs hatching per clutch did not differ between Albuquerque (early $\bar{x} = 96.0 \pm 8.94$, n = 5; late $\bar{x} = 93.8 \pm 12.50$, n = 4) and Los Lunas (early $\bar{x} = 89.2 \pm 8.89$, n = 5; late $\bar{x} = 77.8 \pm 19.38$, n = 6; U-test) for either early or late broods. Survival data were not collected for all nests in early 1980, but in late 1980 there was no significant difference between number of older young per nest in Albuquerque ($\bar{x} = 1.4 \pm 1.14$, n = 5) and at Los Lunas ($\bar{x} = 2.5 \pm 1.97$, n = 6). For successful nests in early 1980, there was no significant difference in proportion of eggs yielding surviving young between Albuquerque ($\bar{x} = 68.3 \pm 16.07$, n = 3) and Los Lunas ($\bar{x} = 85.2 \pm 8.41$, n = 5; U-test). There was also no significant difference between day 14–15 nestling weights at this time (Albuquerque $\bar{x} = 75.0$ g ± 6.45, n = 10 from 3 nests; Los Lunas $\bar{x} = 74.1 \pm 3.27$, n = 8 from 2 nests; *t*-test), or in late 1979 (Albuquerque $\bar{x} = 53.7 \pm 7.08$, n = 16 from 4 nests; Los Lunas $\bar{x} = 51.8 \pm 9.55$, n = 12 from 3 nests; *t*-test). These results may be a function of small sample size however, and continued study is necessary before nest productivity can be accurately assessed for the two sites.

Seasonal and yearly comparisons.—In Albuquerque 1980–1981, there was no significant difference in clutch size between early ($\bar{x} = 3.9 \pm .67$, n = 12) and late nests ($\bar{x} = 3.7 \pm .49$, n = 7; *t*-test). The proportion of each clutch hatching did not differ for early ($\bar{x} = 90.5 \pm 12.83$, n = 13) or late clutches ($\bar{x} = 89.3 \pm 19.67$, n = 7; U-test). The percent of these Albuquerque hatchlings that survived for at least 10 days, however, was significantly larger in early broods ($\bar{x} = 67.5 \pm 23.72$, n = 10) than in late broods ($\bar{x} = 51.1 \pm 32.87$, n = 7; U-test). The seasonal difference observed in Los Lunas (early $\bar{x} = 96.0 \pm 8.94$, n = 5; late ($\bar{x} = 59.2 \pm 46.95$, n = 6; U-test) was not significant ($P > .05$), though this may be a function of small sample size.

For 1980–1981, day 14–15 nestlings in Albuquerque were significantly heavier in early broods ($\bar{x} = 72.5$ g ± 8.60, n = 23 from 7 nests) than late broods ($\bar{x} = 54.3 \pm 13.84$, n = 7 from 4 nests; $P < .001$, *t*-test). The hematophagic larvae of *Protocalliphora sialia* (Calliphoridae) were found in 2 of 3 nests in the late group, but in only 1 of 4 nests in the early group. In 1980, however, these larvae were much more abundant in intermediate

TABLE 1. Starling clutch size in central New Mexico.

	Number of nests/clutch size				
	3	4	5	6	7
Albuquerque	8	19	11	1	0
Los Lunas	1	3	8	5	1

TABLE 2. Nesting success of the Starling in central New Mexico.

	Clutch size $\bar{x} \pm SD$	# eggs hatched / # eggs laid	# young surviving to age 10 days / # eggs laid	# young surviving to age 10 days / # young hatched	% nests with at least one young reaching age 10 days
Albuquerque					
Early broods					
1980	3.8 ± 0.84 (5)[a]	94.7 (19)[a]	69.2 (13)[a]	75.0 (12)[a]	100.0 (3)[a]
1981	4.0 ± 0.58 (7)	87.5 (32)	50.0 (32)	57.1 (28)	87.5 (8)
Total	3.9 ± 0.18 (12)	90.2 (51)	55.6 (45)	62.5 (40)	90.9 (11)
Intermediate broods					
1978	4.5 ± 1.29 (4)	100.0 (18)	33.3 (18)	33.3 (18)	75.0 (4)
1979	5.0 ± 0.0 (4)	93.3 (15)	53.3 (15)	77.8 (9)	100.0 (4)
1980	4.3 ± 0.58 (3)	92.4 (13)	53.8 (13)	58.3 (12)	100.0 (3)
1981	3.0 ± 0.0 (2)	66.7 (6)	33.3 (6)	50.0 (4)	100.0 (2)
Total	4.4 ± 0.27 (13)	92.3 (52)	46.9 (49)	51.2 (43)	92.3 (13)
Late broods					
1978	4.0 (1)	75.0 (4)	0.0 (4)	0.0 (3)	0.0 (2)
1979	4.5 ± 0.55 (6)	92.7 (27)	48.1 (27)	52.0 (25)	66.7 (6)
1980	3.6 ± 0.55 (5)	94.4 (18)	38.9 (18)	41.2 (17)	80.0 (5)
1981	4.0 ± 0.0 (2)	75.0 (8)	50.0 (8)	67.0 (6)	100.0 (2)
Total	4.1 ± 0.16 (14)	89.5 (57)	42.1 (57)	47.1 (51)	66.7 (15)
Total for Albuquerque	4.1 ± 0.77 (39)	90.6 (160)	47.7 (151)	53.0 (134)	82.1 (39)
Los Lunas					
Early brood (1980)	5.6 ± 0.55 (5)	89.3 (28)	85.7 (28)	96.0 (25)	100.0 (5)
Intermediate brood (1980)	4.0 ± 1.00 (2)	87.5 (8)	50.0 (8)	57.1 (7)	50.0 (2)
Late brood					
1979	4.8 ± 0.45 (5)	95.0 (20)	40.0 (20)	42.1 (19)	40.0 (5)
1980	5.3 ± 1.21 (6)	75.0 (32)	46.9 (32)	64.3 (28)	71.4 (7)
Total for Los Lunas	5.1 ± 0.96 (18)	85.3 (88)	58.0 (88)	68.4 (79)	68.4 (19)

[a] The number in parentheses represents total number of clutches, eggs, young, and nests, respectively. The same organisms are not necessarily represented in every column of a given row, i.e., 5 clutches were used for clutch size data for Albuquerque early brood 1980, but only three contributed to nest success information.

and late Los Lunas nests (857 larvae in 100% of the 7 nests examined) than in Albuquerque nests at the same time (71 larvae in 2 of 6 nests examined), and no weight differences were observed. There was no obvious relationship between these diptera and percent surviving young from these nests. While *P. sialia* is known to be associated with ill effects in some instances, its influence on young birds is not well understood and appears to be highly variable (C. S. Gold, pers. comm.).

Comparisons with other studies.—The overall average clutch size for Albuquerque (Table 2) is as small as any reported from other studies (e.g., Lack 1948, Dunnet 1955, Kessel 1957, Westerterp 1973, Smith 1975, Gibo 1976, Crossner 1977, Gromadzki 1979). These values range from 4.1 to 5.1 (New York, second and first broods, respectively; Kessel 1957). In other studies, however, unlike Albuquerque, clutch size decreased with the progress of the breeding season (Dunnet 1955, Kessel 1957, Gromadzki 1979). The average number hatched in Albuquerque (3.7 ± .92, n = 40) and Los Lunas (4.4 ± .77, n = 18) are within the range reported by other workers. Proportion hatching at both sites (Table 2) is similar to that reported by Dunnet in Scotland (81–89%, 1955) and Kessel (86.6%, 1957), but lower than that reported by Smith (1975) in Utah (94.2%). My values for egg-to-older-nestling survival are probably larger than they might have been for true egg-to-fledging success because surviving young were counted several days before they actually would have fledged, yet for both sites these figures are substantially lower than fledging success reported by any worker except Gibo in Ontario (15.7%, 1976), who noted great variation depending upon habitat. Other reported egg-to-fledging values range from 64% (Dunnet 1955) to 93.5% in Poland (Gromadzki 1979). Overall nest success (at least one young surviving for 10 days minimum) in New Mexico was considerably higher than that reported by Gibo (1976, based on fledging) for some sites (21.8%, but 73.2% for suburban areas) and more similar to that reported by Kessel (78.6%, 1957).

Summary.—Starlings in Los Lunas produced larger clutches than those in Albuquerque. This did not yield significant between-site differences in number or weight of surviving young, a result that requires confirmation with larger sample sizes. While clutch size did not vary seasonally in Albuquerque, early broods had more surviving young. These birds were also heavier than young of late broods. Compared to reports from other localities, clutch size, especially for Albuquerque, and egg-to-older-nestling survival were notably low.

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A Portable Candler for Determining Fertility and Development of Birds' Eggs.— In most studies of nesting birds, percent fertility is not recorded and unhatched eggs are often assumed to contain dead embryos. Furthermore, it is sometimes desirable to know the stages of embryonic development to estimate laying or hatching dates.

Weller (J. Wildl. Manage. 20:111–113, 1956) discussed various unsatisfactory methods of determining fertility and recorded the development of duck embryos using the cardboard mailing tube devised by Evans (J. Wildl. Manage. 15:101–103, 1951). Also, Hanson (J. Wildl. Manage. 18:191–198, 1954) designed a battery-operated field candler, but expressed some doubt as to its use on dark, heavily-marked eggs. Since we found the cardboard mailing tube unsatisfactory for candling the often heavily-marked eggs of the

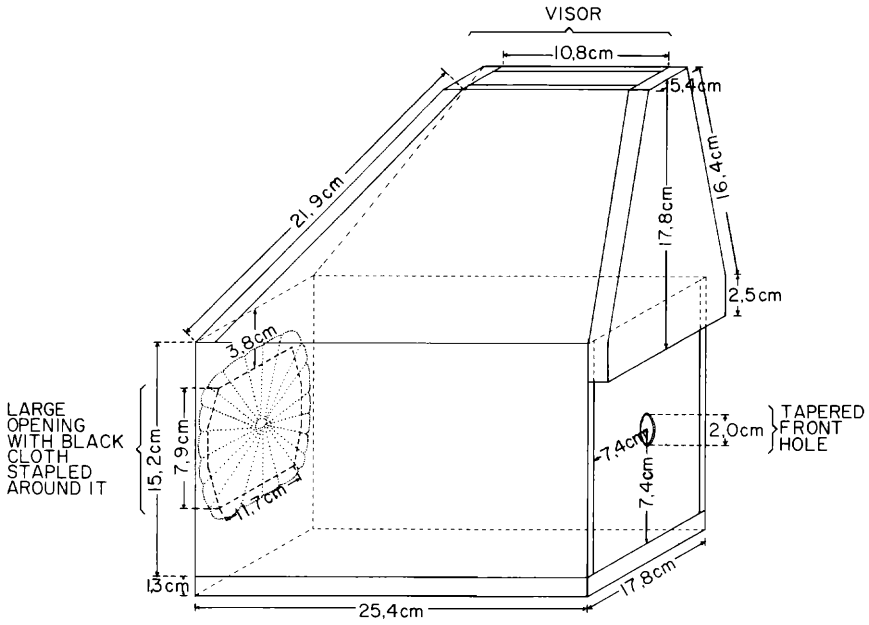

FIGURE 1. A portable candler constructed of 1.3 cm plywood for determining fertility and development of birds' eggs.