of Scott's Oriole from Colorado. West. Birds 8:157–158.
ROGERS, T. H. 1969. Northern Rocky Mountain–Intermountain region. Audubon Field Notes 23:501.
SMITH, M. 1959. Redlands Christmas bird count. Audubon Field Notes 13:252.
WEBSTER, F. 1981. South Texas region. Am. Birds 35: 203.
WILLIAMS, F. 1970. Southern Great Plains region. Am. Birds 24:65.
WILLIAMS, F. 1977. Southern Great Plains region. Am. Birds 31:196.
WILLIAMS, F. 1981. Southern Great Plains region. Am. Birds 35:200.
WILLIAMS, F. 1983. Southern Great Plains region. Am. Birds 37:198.
WITZEMAN, J. 1982. Southwest region. Am. Birds 36: 319.

3016 45th Street, Metairie, Louisiana 70001. Received 18 April 1983. Final acceptance 13 March 1984.

The Condor 86:348–352

PROBABLE IDENTITY OF PURPORTED ROUGH-LEGGED HAWK NESTS IN THE WESTERN U.S. AND CANADA

MARC J. BECHARD

AND

C. STUART HOUSTON

The oological record of the Rough-legged Hawk (*Buteo lagopus*) is puzzling. This panboreal species breeds north of 60°N latitude in tundra and taiga (Brown and Amadon 1968). In North America, it nests from coastal and arctic Alaska, east through the northern Yukon, coastal and interior Northwest Territories, to Quebec and Labrador, where it breeds in northern and coastal areas (Godfrey 1966, Zarn 1975, AOU 1983). In years when microtine rodents are abundant, these hawks are thought to irrupt farther south and to nest in small numbers in northern Manitoba (Taverner and Sutton 1934), southeastern Quebec and Newfoundland, but never as far south as North Dakota and Montana. Nonetheless, at the turn of the century, oologists reported finding Rough-legged Hawks nesting in Colorado, Montana, and North Dakota, a full 1,000 km south of their presently accepted breeding range (Arnold 1895, 1897; Davy 1930a, b). Some of these records have been explained as incorrectly identified Ferruginous Hawk (*B. regalis*) nests (Taverner 1919). This seemed logical as Ferruginous Hawks were then commonly referred to as "ferruginous rough-legs" or simply as "rough-legs," and they were common in areas where the more suspect nests were reported.

Apparently, none of the eggs of the purported Rough-legged Hawk nests was closely examined and compared to those of other *Buteo* species to determine if they were in fact laid by Ferruginous Hawks. Herein, we make this comparison and attempt to clarify the record for the distribution of the Rough-legged Hawk in North America before the Great Plains were settled.

We contacted museums with the 20 largest collections of North American bird eggs (Kiff 1979) and obtained data for 146 sets of eggs collected in North America between 1850 and 1954 that were labelled as those of the Rough-legged Hawk. Of these, 74 sets came from places north of 60°N (Fig. 1), mostly in coastal and interior Northwest Territories. Twenty-nine sets were collected during the 1860s by Roderick MacFarlane, chief factor for the Hudson's Bay Company post at Fort Anderson. Travelling extensively in the Northwest Territories, he collected at least 70 sets of Rough-legged Hawk eggs, many of which he described in detail (MacFarlane 1891, Mair and MacFarlane 1908) and sent to the Smithsonian Institution, where they are presently kept.

Seventy-two sets came from locations south of 60°N. Of these, 45 were from northern Quebec, Labrador and coastal Alaska, and were within the accepted breeding range of the Rough-legged Hawk. The remaining 27 sets were collected west of Hudson Bay (Table 1). Ten sets were collected between latitudes 58 and 60°N and 17 were collected south of 54°N. All except one of the sets in the first group were collected from the shores of Hudson Bay near Churchill, Manitoba, and most were collected by Frank L. Farley. Eight of the sets in the second group were collected by Edward Arnold and Walter Raine, two of the most prolific collectors of western raptor eggs (Houston 1981, Houston and Bechard 1982). They recorded sets from File Hills, Crescent Lake, and Quill Lake, Saskatchewan and from the Little Red Deer River in Alberta. The other sets were collected by a number of less well-known oologists who, except for E. Pope, a known egg faker (Kiff, pers. comm.), were otherwise reliable oologists on the Northern Great Plains around the turn of the century.

All of the sets were collected in May or June, and clutch size averaged 3.2 ± .40 (± 1 SE, $n = 9$ nests) and 2.8 ± .24 ($n = 14$ nests) eggs for the sets collected between 58 and 60°N and south of 54°N latitudes, respectively. The nests from places between 58 and 60°N latitude were built on rocky ledges and outcrops. Nests in the more southern group were built in trees such as willows and cottonwoods at an average height of 8.57 ± .37 m ($n = 8$ nests). No notation on data slips with any of the sets mentioned dung or bones, which are typically found in the nests of Ferruginous Hawks, and all of the eggs were whitish with brown spots and blotches.

If the eggs collected south of the 60th parallel were not those of the Rough-legged Hawk, of what species were they? The Red-tailed Hawk (*Buteo jamaicensis*) is the only other buteo that would have nested between 58 and 60°N latitude and near Fort Alexander, Manitoba. Elsewhere south of 54°N latitude, there are three possible alternatives: the Red-tailed Hawk, the Ferruginous Hawk, and the Swainson's Hawk (*B. swainsoni*). We compared nest data and egg characteristics of the purported Rough-legged Hawk nests with those known to be rough-leg and the three alternative species. Since all four species may nest in trees and have clutches of similar size, we could not make an identification from information on nest placement and egg numbers alone. The heavy superficial markings on Ferruginous Hawk eggs aided in eliminating that species as a possible alternative, but, because all these buteos lay eggs with some degree of marking (Reed 1904, Bent 1937), egg coloration alone was not conclusive. The

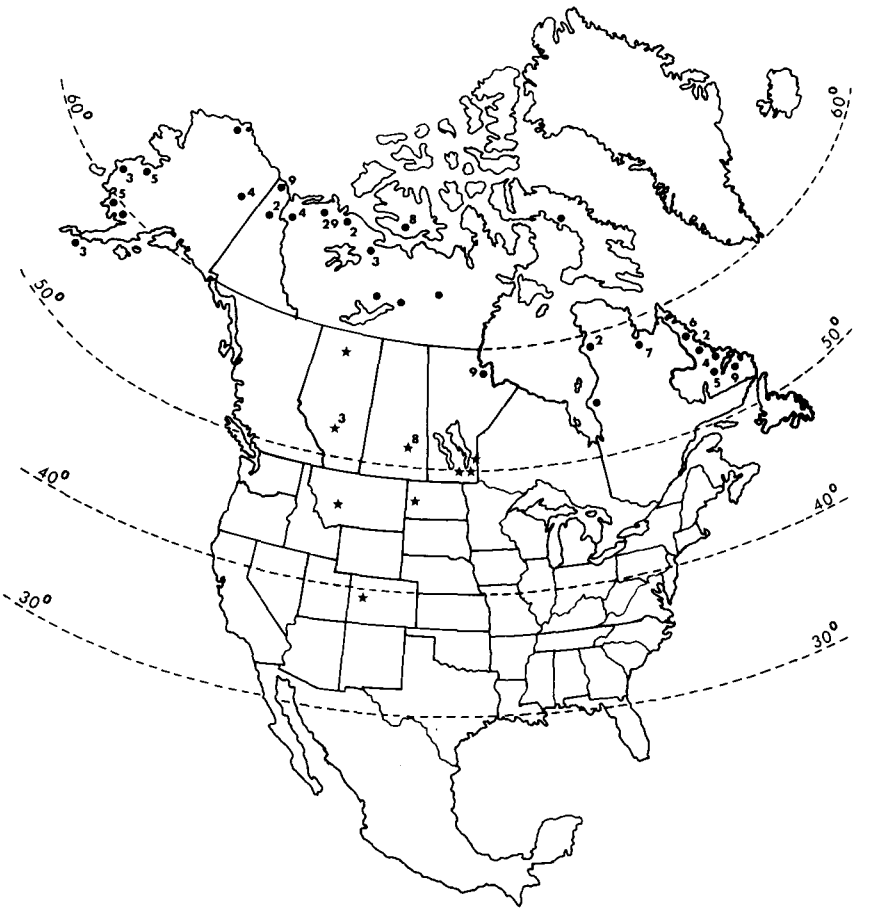

FIGURE 1. Rough-legged Hawk egg sets collected in North America. For locations with more than one record, the number of egg sets is indicated. Dots represent probably valid Rough-legged Hawk nests; stars represent probably misidentified nest sites.

most helpful means to identification proved to be comparisons of egg measurements, based on length and breadth data obtained from 20 eggs of each of the four species (Table 2). Differences between these measurements and those of the purported Rough-legged Hawk sets were analyzed statistically using a Student's t-test at the 0.001 significance level. Recognizing that hawk eggs vary between individuals and locations (Bowles and Decker 1931), we randomly selected only one egg from each of 20 sets for measurement (Preston 1968). Furthermore, only sets collected in North Dakota and Saskatchewan or, in the case of the Rough-legged Hawks in the Northwest Territories, by MacFarlane and others were used. We felt that these measures eliminated any bias in our comparisons resulting from individual and geographic variations in egg size.

Our values were similar to average measurements and ranges reported by Reed (1904), Bent (1937), and Schönwetter (1960–1967) for locations throughout western Canada and the U.S., so we assumed they were representative of each species. Averaging 56.37 ± .35 × 44.75 ± .21 mm, rough-leg eggs were significantly smaller than those of Red-tailed ($t_{\text{length}} = 6.78$, $t_{\text{breadth}} = 5.04$, $P < 0.001$) and Ferruginous ($t_{\text{length}} = 14.32$, $t_{\text{breadth}} = 12.68$, $P < 0.001$) hawks. Compared with Swainson's Hawk eggs, they differed in breadth ($t = 4.56$, $P < 0.001$) but not in length ($t = 0.57$, $P > 0.05$). We felt, therefore, that using a combination of length and breadth measurements and information on nest placement and egg markings, we could distinguish the eggs of Rough-legged Hawks from those of the other three species.

Length and breadth measurements of the eggs collected between latitudes 58 and 60°N ranged from 53.5–60.2 × 41.8–48.1 mm ($\bar{x} = 56.73 \pm .33 \times 44.19 \pm .29$, $n = 28$). Except for the set collected in northern Alberta, the measurements fit those of the Rough-legged Hawk ($t_{\text{length}} = 0.51$, $t_{\text{breadth}} = 1.76$, $P > 0.05$), but not the Red-tailed Hawk ($t_{\text{length}} = 8.09$, $t_{\text{breadth}} = 7.12$). Judging from the data on egg size and nest placement, we concluded, therefore, that the eggs collected near Churchill, Manitoba had in fact been laid by Rough-legged Hawks. Owing to its early collection date and large eggs, we judged the set collected in northern Alberta to be a misidentified Red-tailed Hawk clutch.

The eggs collected south of 54°N ranged in size from 48.0–64.6 × 34.0–48.1 mm ($\bar{x} = 56.70 \pm .42 \times 44.36 \pm .36$, $n = 42$). Except for the sets collected near Helena, Montana and in Stark County, North Dakota, all were far too small to have been laid by Ferruginous Hawks ($t_{\text{length}} = 16.42$, $t_{\text{breadth}} = 14.00$). Of the remaining sets, all eggs, except those in the set from Fort Alexander, Manitoba, were smaller than Red-tailed Hawk eggs ($t_{\text{length}} = 6.67$, $t_{\text{breadth}} = 4.55$), but they did not differ in length or breadth from those of either Rough-legged ($t_{\text{length}} = 0.48$, $t_{\text{breadth}} = 0.67$) or Swainson's ($t_{\text{length}} = 1.19$, $t_{\text{breadth}} = 0.66$, $P > 0.05$) hawks. The eggs had fewer markings than Ferruginous Hawk eggs and they came from nests built at heights least typical of Red-tailed Hawks; therefore, we concluded that

TABLE 1. Rough-legged Hawk egg sets collected south of 60°N latitude in western North America.

Date	Location	Collector	Museum*	Measurements (mm)
Egg sets collected between 58 and 60°N latitude				
7 June 1873	Fort Churchill, Manitoba	W. W. Kirkby	NMNH	53.5 × 43.2
3 May 1904	Northern Alberta	E. Manson	WFVZ	59.7 × 46.6
				60.2 × 45.9
12 June 1907	Churchill, Manitoba	J. Duncan	UCB	59.8 × 45.2
				58.8 × 42.5
				57.0 × 44.3
				55.5 × 42.5
23 June 1933	Churchill, Manitoba	A. C. Twomey	WFVZ	57.0 × 48.1
				57.4 × 46.2
				58.4 × 45.2
9 June 1936	Churchill, Manitoba	F. L. Farley	AMNH	56.0 × 43.0
				55.0 × 43.0
10 June 1936	Churchill, Manitoba	F. L. Farley	WFVZ	56.4 × 44.3
				57.2 × 43.8
				58.1 × 43.2
14 June 1936	Churchill, Manitoba	F. L. Farley	DM	57.4 × 44.5
				58.1 × 46.0
				55.5 × 45.4
13 June 1948	Churchill, Manitoba	F. L. Farley	WFVZ	55.0 × 42.8
				54.6 × 41.8
				53.8 × 42.4
				55.6 × 42.6
				56.2 × 42.7
15 June 1948	Fort Churchill, Manitoba	F. L. Farley	SBCM	
14 June 1954	Churchill, Manitoba	H. W. Brandt	CM	55.8 × 44.9
				58.0 × 43.9
				55.9 × 44.2
				56.4 × 44.2
				56.3 × 44.9
Egg sets collected south of 54°N latitude				
1 June 1885	Fort Alexander, Manitoba	W. W. Worthington	AMNH	59.0 × 48.0
				58.0 × 47.0
				57.0 × 46.0
22 May 1886	Lake Winnipeg, Manitoba	L. D. Schultz	WFVZ	53.6 × 42.1
				56.4 × 42.1
				55.7 × 44.3
				57.5 × 45.2
2 May 1890	Helena, Montana	G. Soule	FMNH	64.6 × 43.3
29 May 1892	Qu'Appelle River, Saskatchewan	W. H. Hoskins	WFVZ	57.8 × 47.0
3 June 1893	Selkirk, Manitoba	R. Watson	NMNH	55.9 × 43.7
				57.9 × 44.0
31 May 1895	Fort Qu'Appelle, Saskatchewan	E. Arnold	WFVZ	56.7 × 43.5
				55.6 × 44.5
25 May 1896	Red Deer, Alberta	G. F. Dippie	AMNH	56.0 × 46.0
				52.0 × 45.0
				48.0 × 34.0
8 June 1896	Quill Lake, Saskatchewan	E. Arnold	NMNH	57.7 × 45.0
				58.9 × 46.0
27 May 1897	File Hills, Saskatchewan	E. Arnold	WFVZ	57.8 × 45.5
				56.2 × 46.2
31 May 1897	File Hills, Saskatchewan	E. Arnold	AMNH	58.0 × 45.0
				57.0 × 45.0
				56.0 × 44.0
				53.0 × 44.0
6 May 1898	Stark Co., North Dakota	R. Dodd	WFVZ	60.8 × 48.1
				54.7 × 46.1
				60.3 × 46.1
				58.0 × 47.0
20 May 1900	Striking Water, Saskatchewan	E. Arnold	FMNH	55.7 × 43.3
				54.3 × 42.7
				57.7 × 41.6

TABLE 1. Continued.

Date	Location	Collector	Museum*	Measurements (mm)
2 June 1901	Crescent Lake, Saskatchewan	W. Raine	WFVZ	56.3 × 43.4 59.5 × 43.7 59.2 × 44.3 59.3 × 45.3
1 June 1906	Little Red Deer River, Alberta	W. Raine	UCB	
28 May 1910	Little Red Deer River, Alberta	W. Raine	DM	55.4 × 43.0 51.6 × 42.5 55.3 × 43.2
25 June 1911	Rifle, Colorado	E. Pope	NMNH	56.7 × 45.6 57.7 × 44.7 54.8 × 44.1
1917	Saskatchewan	Unknown	ROM	57.5 × 42.0

* Key to museum abbreviations: National Museum of Natural History, Smithsonian Institution (NMNH); American Museum of Natural History (AMNH); Western Foundation of Vertebrate Zoology (WFVZ); Museum of Vertebrate Zoology, University of California at Berkeley (UCB); Delaware Museum (DM); San Bernardino County Museum (SBCM); Carnegie Museum (CM); Field Museum of Natural History (FMNH); Royal Ontario Museum (ROM).

if they had not been laid by rough-legs, they must have been laid by Swainson's Hawks.

Our results indicate that, except for the egg sets collected near Churchill, Manitoba, none of the purported rough-leg nests reported south of the 60th parallel were valid. Contrary to previous arguments, only two of the egg sets collected south of 54°N came from incorrectly identified Ferruginous Hawk nests, which explains why none of the collectors reported finding dung or bones in the nests. Except for the nest reported by E. Pope and the set collected by W. Worthington at Fort Alexander, Manitoba, the remainder of the nests were probably misidentified Swainson's Hawk nests. Although adult Rough-legged Hawks are normally distinct from the three other species, even experienced ornithologists have had difficulty distinguishing among melanistic forms of buteos. Even A. C. Bent shared this difficulty and reported a Rough-legged Hawk nest in North Dakota (Bent 1901), a statement that he later retracted, admitting that the nest had actually been that of a Ferruginous Hawk (Bent 1907). Since Coues (1894) stressed the darkness of many individuals of the "American Rough-legged Buzzard," and since the eggs of Swainson's and Rough-legged hawks are similar in size and color, it would have been easy to misidentify a dark form of the Swainson's Hawk as a Rough-legged Hawk.

The egg set from northern Alberta also seems questionable. MacFarlane (1891), Godfrey (1966), and Salt and Salt (1976) did not list the Rough-legged Hawk as breeding in either Alberta or Saskatchewan, but they did list the Red-tailed Hawk. It is more likely, then, that this set was taken from a misidentified Red-tailed Hawk nest. The nest was built near the top of a fir tree, much like a typical rough-leg tree nest. If the birds had half-feathered tarsi as do some Red-tailed Hawks, E. Manson could have been easily fooled.

In contrast, the rough-leg nests recorded in northeastern Manitoba are not only valid, but they double the published record for this species in the region. Only a few active and formerly active nests on cliffs along the shore of Hudson Bay have been recorded (Taverner and Sutton 1934, Grinnell and Palmer 1941, Godfrey 1966, Jehl and Smith 1970). Because only a handful of nests were located over the 100 year period that oologists were active, it is likely that the hawks nested then, as now, only in years when microtines were abundant.

We are convinced that Rough-legged Hawks have not nested as far south as southern Saskatchewan, North Dakota, and Montana. Although the eggs supposedly of that species in these areas cannot be positively identified, the available data indicate that they are actually those of Swainson's Hawks. Therefore, range descriptions showing Rough-legged Hawks breeding in interior Northwest Ter-

TABLE 2. Length and breadth measurements (mm) of known Swainson's Hawk (SH), Rough-legged Hawk (RLH), Red-tailed Hawk (RTH), and Ferruginous Hawk (FH) eggs. Means (± 1 SE) in this study based on sample sizes of 20 eggs per species.

Source		SH	RLH	RTH	FH
This study[a]	Mean	57.1 ± .5 × 44.4 ± .4	56.4 ± .3 × 44.7 ± .2	59.9 ± .4 × 46.6 ± .2	62.6 ± .4 × 48.3 ± .5
	Range	51.5–60.0 × 41.2–46.7	53.2–63.0 × 41.0–46.9	56.2–63.4 × 45.6–49.8	57.2–65.4 × 47.0–50.2
Schönwetter (1960–1967)	Mean	56.6 × 44.1	56.3 × 44.8	59.5 × 47.2	62.2 × 48.6
	Range	50–62 × 39.5–47.5	51.5–64.0 × 41.5–48.5	55.0–66.0 × 44.0–51.0	56–67.5 × 45.6–51.3
Bent (1937)	Mean	56.5 × 44.0	56.6 × 44.9	59.2 × 46.4	61.2 × 48.0
	Range	50.0–62.0 × 39.5–47.5	42.0–62.0 × 38.0–48.5	53.0–64.5 × 43.5–49.6	56.0–67.5 × 45.6–51.3
Reed (1904)	Mean	55.9 × 43.2	57.2 × 44.5	59.7 × 46.7	66.0 × 50.8

[a] Measurements used in comparisons with purported Rough-legged Hawk eggs.

ritories as far south as Great Slave and Artillery lakes and irrupting south of the 60th parallel along the shores of Hudson Bay seem correct.

We extend our thanks to Lloyd Kiff (Western Foundation of Vertebrate Zoology), David Willard (Field Museum of Natural History), James Dean (National Museum of Natural History), D. M. Niles (Delaware Museum) John Bull (American Museum of Natural History), B. Hastings (Museum of Vertebrate Zoology), Henri Ouellet, (National Museums of Canada), and R. R. James (Royal Ontario Museum) for their help.

LITERATURE CITED

AMERICAN ORNITHOLOGISTS' UNION. 1983. Checklist of North American birds. 6th ed. American Ornithologists' Union, Washington, DC.

ARNOLD, E. 1895. An outing in Assiniboia. Oologist 12: 150–151, 161–163, 168–170.

ARNOLD, E. 1897. A trip to Assiniboia. Osprey 2:13.

BENT, A. C. 1901. Nesting of the American Rough-legged Hawk in North Dakota. Auk 18:393–394.

BENT, A. C. 1907. The American Rough-legged Hawk breeding in North Dakota. Auk 24:213.

BENT, A. C. 1937. Life histories of North American birds of prey. Pt. 1. U.S. Natl. Mus. Bull. 167.

BOWLES, J. H., AND F. R. DECKER. 1931. The ferruginous rough-leg in Washington. Murrelet 12:65–70.

BROWN, L., AND D. AMADON. 1968. Eagles, hawks and falcons of the world. McGraw-Hill, New York.

COUES, E. 1894. Key to North American birds. 4th ed. Estes and Laurial, Boston.

DAVY, G. L. 1930a. Nesting of the Ferruginous Rough-leg Hawk in northern North Dakota. Oologist 47:14–18.

DAVY, G. L. 1930b. The American Rough-legged Hawk within the United States. Oologist 47:22.

GODFREY, W. E. 1966. Birds of Canada. Natl. Mus. of Canada, Bull. 203, Biol. Ser. #73.

GRINNELL, L. I., AND R. S. PALMER. 1941. Notes on the bird life of Churchill, Manitoba. Can. Field-Nat. 55: 49.

HOUSTON, C. S. 1981. An assessment of Walter Raine and his Saskatchewan records. Blue Jay 39:168–181.

HOUSTON, C. S., AND M. J. BECHARD. 1982. Edward Arnold, enthusiastic oologist. Blue Jay 40:184–192.

JEHL, J. R., AND B. A. SMITH. 1970. Birds of the Churchill region, Manitoba. Manit. Mus. Man Nature Spec. Publ. #1.

KIFF, L. F. 1979. Bird egg collections in North America. Auk 96:746–755.

MACFARLANE, R. 1891. Notes on and list of birds and eggs collected in arctic America, 1861–1866. Proc. U.S. Natl. Mus. 14:413–446.

MAIR, C., AND R. MACFARLANE. 1908. Through the Mackenzie Basin. A narrative of the Athabasca and Peace River Treaty Expedition of 1899. William Briggs, Toronto.

PRESTON, F. W. 1968. The shapes of bird's eggs: mathematical aspects. Auk 85:454–463.

REED, C. A. 1904. North American birds' eggs. Doubleday, New York.

SALT, W. R., AND J. R. SALT. 1976. The birds of Alberta. Hunty Publ., Edmonton.

SCHÖNWETTER, M. 1960–1967. Handbuch der Oologie. (W. Meise, [ed.]) Akad. Verlag, Berlin.

TAVERNER, P. A. 1919. Birds of Red Deer River, Alberta. Auk 36:1–21, 248–265.

TAVERNER, P. A., AND G. M. SUTTON. 1934. The birds of Churchill, Manitoba. Ann. Carnegie Mus. 23:1–83.

ZARN, M. 1975. Habitat management series for unique and endangered species, the Rough-legged Hawk. U.S. Bureau of Land Management, Denver.

Biology Department, Boise State University, 1910 University Drive, Boise, Idaho 83725. Address of second author: 863 University Drive, Saskatoon, Saskatchewan, Canada S7N 0J8. Received 7 November 1983. Final acceptance 14 April 1984.

The Condor 86:352–353

TWIN EMBRYOS IN A PEREGRINE FALCON EGG

OLIVER H. PATTEE

WILLIAM G. MATTOX

AND

WILLIAM S. SEEGAR

Romanoff and Romanoff (1972) suggested that twinning is as common in birds as other vertebrates, arising either from eggs with double yolks, eggs with one yolk and two blastoderms, or eggs with one yolk and one blastoderm. Examples are common in chickens whereas such incidents in wild species are rare. Berger (1953) reported examples of twinning in the American Goldfinch (*Carduelis tristis*) and the Song Sparrow (*Melospiza melodia*); Lokemoen and Sharp (1981) found twinning in Gadwalls (*Anas strepera*). Twinning has been suggested to be stimulated by stress (Sarvella 1975), such as in the chilling of Mallard (*Anas platyrhynchos*) eggs (Batt et al. 1975) or by inducing hypothermia in adult White Leghorn Chickens (*Gallus gallus* var. *domesticus*; Sturkie 1946). Regardless of the cause, the incidence of twinning in wild species is evidently rare.

As part of the junior authors' survey of reproductive success in Greenland Peregrine Falcons (*Falco peregrinus*), unhatched eggs are salvaged and submitted to the Patuxent Wildlife Research Center, Laurel, Maryland, for chemical analysis to ascertain pesticide residue levels. In preparing eggs collected in 1981, we found that one of the six eggs contained two well-developed embryos. Twinning in raptors has not previously been reported, and this is the first case of twinning we have seen in 90 Peregrine Falcon eggs. No other instances of twinning have been seen in the about 1,500 eggs from other raptors handled by the senior author.

The egg in question was collected on 2 August 1981 in Greenland from Dome Cliff (66°56′N, 51°10′W) and opened at Laurel on 15 November 1981. As compared with other Greenland Peregrine Falcon eggs ($n = 8$), this one was longer