BIOLOGICAL AND OOLOGICAL STUDIES OF THE MOLOTHRINE COWBIRDS (ICTERIDAE) OF ARGENTINA

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OBSERVATIONS amassed in eight years of field work in the provinces of Salta and Jujuy, northwestern Argentina, have yielded information on three species of *Molothrus* (*M. bonariensis, rufo-axillaris,* and *badius*) that supplements the data published by Friedmann (*The cowbirds.* Springfield, Illinois, Charles C. Thomas, 1929.) on the basis of his work in the central Argentine provinces.

The material here presented is divided in two sections. The first part, dealing with field observations, is by Hoy; the second, reporting on the results of studies of the eggs collected, is by Ottow.

PART I

Most of my cowbird observations are from the Lerma Valley and the environs of Salta city, at the elevation above sea level of 1,300 meters. The region is partly an open land, cultivated areas alternating with bush. The region is generally dry; the rainy period is late, normally in January and February, and the *campo* is not green before February and March. These weather conditions naturally influence the breeding season of the birds, which is also late. The most important nesting month seems to be March, with many species nesting for the first time and many rearing second broods. When the rainy period starts exceptionally early, as it did during the last few years, the breeding season starts a little earlier too.

The clutches of most land birds in the Salta highlands are rather small. Most common are three-egg clutches; sometimes there are two eggs; four eggs are a large clutch and five are rare, being common only for a few species such as *Pitangus sulphuratus*, the Great Kiskadee. This species seems to breed continuously during the whole summer, undisturbed by cowbirds.

It is almost impossible to find a "normal" (e.g., unparasitized) clutch of many species, whose breeding season coincides with that of the Shiny Cowbird, *Molothrus bonariensis,* from the end of October to early February; during this period one finds numerous abandoned nests containing cowbirds.

The three species of cowbirds are quite plentiful in the region, and maintain their numbers (Figure 1) in spite of the fact that many of their eggs are destroyed or abandoned.

Shiny Cowbird. *Molothrus bonariensis.*—At the beginning of the cowbirds' breeding season, the nesting host possibilities are few in Salta, and

hence many eggs are laid in old and forsaken nests. During this period, eggs of the Shiny Cowbird may also be found on the ground, perhaps four or five in each season. Friedmann (*op. cit.*: 86–87) found such eggs at the end of the season and thought one reason, similarly, was that the nesting birds were few. In the Salta highlands it is altogether different, with plenty of breeders at the end of the cowbirds' season.

Figure 1. Just out of the nest. Young *Molothrus badius* and *M. rufo-axillaris* have the same appearance at this stage.

What I have not found mentioned by any observer, is the fact that in the case of several host species the intruders' eggs are often evicted. Broken cowbird eggs are frequently seen beneath the nests of the ovenbird *Furnarius rufus*. I saw this also in some nests of the Widow Pepoaza, *Xolmis irupero*, using old nests of *Furnarius*. These cowbird eggs were laid before the eggs of the host, and were thrown out. Such cowbird eggs, evicted from *Furnarius* nests, are not to be confused with the recorded observations of overfilled *Furnarius* nests, where eggs fall out by accident and are found on the ground. In the Salta highlands I never saw many cowbird eggs in individual nests of *Furnarius*; commonly I saw one to three, more rarely four or five. According to my observations and experience of several years, I find no reason to think that the cowbirds experience any difficulty whatever in entering an ovenbird's nest. *Furnarius rufus* is a bigger bird than *M. bonariensis* and its nest is spacious, with a high

entrance and roof, and the cowbird can enter the nest erect. For that matter, *M. bonariensis* can enter a really small and narrow nest.

When parasitized by the cowbirds, many species easily forsake their nests: examples are *Embernagra platensis*, La Plata Ground Finch; *Saltatricula multicolor*, Many-colored Ground Sparrow; *Coryphospingus cucullatus*, Red-crested Finch; *Sicalis flaveola*, Saffron Finch; *Poospiza melanoleuca*, White and Gray Warbling Finch; and others. In the season of 1961, on 31 December, in a lagoon in the Lerma Valley I found a colony of *Agelaius ruficapillus*, the Red-headed Marsh Bird, most of whose nests were filled with cowbird eggs. In a small area of reeds there were about 20 nests, of which several were left from the last season, but almost all contained cowbird eggs. Most of the nests had only fragments of *Agelaius* eggs, or nothing at all, and the majority of the nests were abandoned. Most of the cowbird eggs were rotten or dried out; very few were still fresh. In all, the colony contained 94 eggs of the cowbirds, nearly all unsuccessful.

Xolmis irupero, *Furnarius rufus*, and the little "Espinero," *Asthenes baeri*, started the breeding season in the first week of November. All were parasitized by the cowbirds. In the middle of November the Red-fronted Thorn-bird, *Phacellodomus rufifrons*, started egg laying, but I never found this species parasitized by the Shiny Cowbird. Several authors have reported a like immunity for *Anumbius annumbi*, the Firewood Gatherer, in the south, and seem to be of the opinion that these thorny nests are out of the cowbirds' range of hosts. This is not the case. *Asthenes baeri* and *Phacellodomus rufifrons* both build the same type of nest, but as it is a smaller bird, *Asthenes baeri*'s nest is smaller, with a narrow entrance 30 cm or more in length, covered with spikes and thorns. It seems difficult to believe that a bird as big as the cowbird could enter it, but this really happens. The nest of *Phacellodomus* has a wider and shorter entrance, normally 15 to 20 cm in length, or even shorter, and later in the breeding season of *Molothrus badius*, this nest is most frequently used by that species of cowbird. In November 1961 I spent some time studying the nesting of *Phacellodomus*, which is a very active and efficient protector of its nest. The birds never leave the immediate neighborhood of the nest, and every intruding bird, cowbirds and others, was chased off immediately. On the contrary, the smaller *Asthenes baeri* is very shy at its nest, and may leave it for hours when disturbed; in such cases the nest is often parasitized.

In this same season I found a nest of the small furnariid *Cranioleuca pyrrhophia*, a new victim of the cowbirds, containing three newly-hatched young of the host and two incubated eggs of the cowbirds; this in Lerma Valley, 14 February 1961.

Molothrus bonariensis lays its eggs, as does *M. rufo-axillaris*, in the morning hours until about 1100–1200. On a November morning at 1000 I witnessed the egg laying of *M. bonariensis*. I heard a pair of *Asthenes baeri* chattering in an excited manner around their nest. Thinking the reason was my presence, I withdrew a short distance, but their excitement only grew more intense. After watching the birds for some minutes, I was surprised to see a female cowbird leave the nest and, with a loud flutter, take off. On the next day the *Asthenes* had abandoned the nest, which contained three fresh eggs of the host (two were destroyed) and one egg of the cowbird. Usually the *Asthenes* would not forsake the nest because of an egg or two of the cowbird. In some cases this host would incubate three, but I never saw it incubate four. If cowbird eggs were placed in the nest before any eggs of the host, the nest was invariably forsaken.

The destruction of eggs by the cowbird seems to be more a general habit than a functional part of the parasitical system, because the cowbirds continue destroying eggs after the breeding season as well as during it. It is common to find eggs destroyed in nests of March breeders, when the cowbird has finished breeding for the season. The Shiny Cowbird is an important destroyer of bird life in the environs of Salta city. Shells of an egg or two are often found near nests visited by the cowbirds. The cowbirds may eat these eggs, and in this way become used to ravaging nests after their own breeding season. Near Cachi, province of Salta, I watched a nest of the tanager *Thraupis bonariensis* during the three days of egg laying from 23 to 25 January 1957. On the 26th, after the incubating bird had left, a male Shiny Cowbird suddenly appeared, entered the nest, and in a moment destroyed all the three eggs by pecking holes in them.

On examining eggs of *M. bonariensis* taken from the same nest area, it is easy to pick out eggs so alike in shape and marking that one may suppose them to emanate from the same female. I have seen eggs of *M. bonariensis* by the hundreds, and to me it is remarkable how uniform the egg-types which come from the same area are. If, rarely, an atypical egg is found, it is really difficult to find another, similar one over a great area. For this reason I think that, if the atypical egg represents a specific female, the egg-laying birds have very much larger territories than supposed and that eggs which seem to be of the same female often only represent a common egg-type of the region and may have come from several birds. I sent for examination a clutch of 14 cowbird eggs (Figure 2, A) found in one nest of a mockingbird, *Mimus saturninus*, to Ottow. On the basis of differences in the thickness of the shells of these eggs, he thought that they probably represented 14 different females! This case in mentioned again, in Ottow's section of this paper.

During the season of 1959–60 I collected many specimens of this cowbird to note the condition of the gonads and to get an impression of the egg-laying season. A peculiar fact was the range in the state of the gonads. Of two specimens, collected at the same time, one was in an egg-laying state, and the other showed only a little advance over the resting, winter phase. The egg-laying time is highly individual and this may account for the long egg-laying season.

If one divides a long series of eggs of *M. bonariensis* into two groups, one from the first part of the season and the other from the last part, one finds the eggs from the late part of the season are more heavily marked.

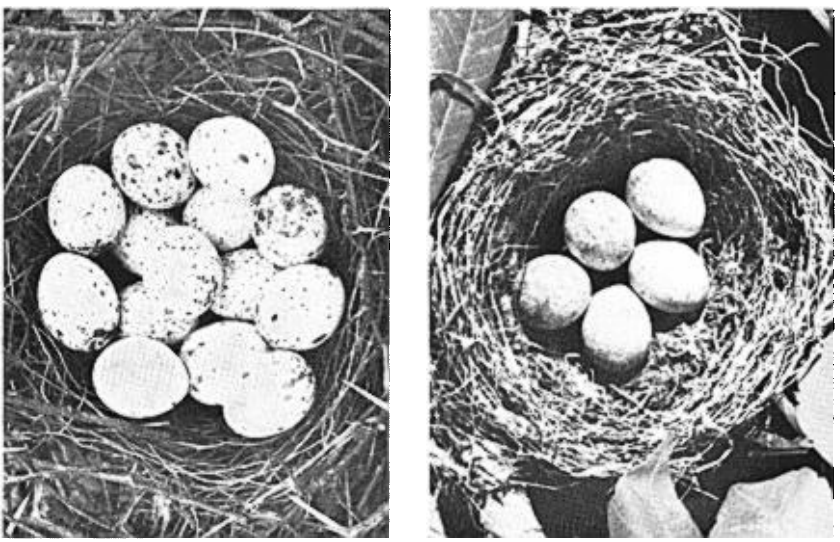

Figure 2. A (left). Fourteen eggs of *Molothrus bonariensis* in a nest of *Mimus saturninus*. It is thought that each egg represents a different female. B (right). A clutch of *Molothrus badius* in a nest thought to have been built by this species.

Screaming Cowbird. *Molothrus rufo-axillaris*.—My data on the habits of this species provide some remarkable additions to the previous records.

This cowbird is very numerous in the cultivated and bushy parts of the Salta region. It is almost always seen in pairs or in small flocks. In the breeding season it frequently parasitizes the large, clearly visible nests of the Red-fronted Thorn-bird *Phacellodomus rufifrons*. An unusually small or well-hidden nest of *M. badius* would get fewer eggs of *M. rufo-axillaris*, or might escape being parasitized. The smallest nests of *Phacellodomus* were not victimized by *M. rufo-axillaris*. These unusually small nests looked only like the beginnings of normal *Phacellodomus* nests, but

the birds, and later *Molothrus badius*, hatched their clutches in them without being disturbed by *M. rufo-axillaris*.

In February 1960 I found a pair of *M. badius* breeding in a nest of the woodpecker *Chrysoptilus melanochlorus*. These *M. badius* were not victimized by *M. rufo-axillaris*. In 1958 I found a nest, supposedly self-built, of *M. badius*, undisturbed by *M. rufo-axillaris*.

Judging from Friedmann's (*op. cit.*: 49) observations in the central provinces, a nest of *M. badius* would probably be victimized only by one pair of *rufo-axillaris*, and the female of the latter would most probably lay two eggs in the nest. In the provinces of Salta and Jujuy, a parasitized nest of *M. badius* generally contains from 6 to 20 eggs of *M. rufo-axillaris*. In nests containing many eggs, the majority are evicted from the nest-cup and many remain in thorny twigs around the cup and in the long entrance. Eggs thrown out are usually seen in the entrance and may be found beneath the nest. Most of these evicted eggs of *M. rufo-axillaris* are laid before the egg laying of *M. badius*. It is a curious fact that quite often *M. rufo-axillaris* begins egg laying in an empty nest of *M. badius*. Such "prematurely" laid eggs, however, are thrown out, judging from observations made in the present study. Receiving too many eggs of *M. rufo-axillaris* after its own breeding commences, *M. badius* will evict eggs from the overfilled nest-cup, just as it rejected the earlier laid eggs of the parasite. If it does not succeed in this, it will forsake the nest and find another. On such occasions, however, *M. rufo-axillaris* will continue laying in the nest. As does *M. bonariensis*, this cowbird sometimes lays its eggs in abandoned nests, and many are wasted in this way.

Friedmann (*loc. cit.*) never saw eggs of *M. rufo-axillaris* with a greenish or bluish tint. In Salta such types are common.

Bay-winged Cowbird. *Molothrus badius*.—The following observations add to the body of information available on this species.

I never managed to see that "fighting spirit" of the Bay-winged Cowbird observed by Friedmann and others. It may be that in the province of Salta it does not need to fight for a nest. In the areas surrounding Salta city *M. badius* breeds in nests of *Phacellodomus rufifrons, Asthenes baeri,* and *Furnarius rufus*. Other nests are used only exceptionally. The breeding seasons of the species mentioned begin the first half of November. *Furnarius rufus* may vary somewhat, but it normally has finished breeding, and empty nests are abundant, when *M. badius* begins breeding from the middle of February to the middle of March.

Perhaps *M. badius* does fight for the possession of a preferred nest, but I never managed to see it. On the contrary, I have seen several *badius* inspecting a *Phacellodomus* nest just before the nesting season, without any fighting. Next to the nest of *Phacellodomus*, the Bay-winged Cowbird

prefers nests of *Furnarius*, and I have seen it only occasionally using nests of *Asthenes baeri*. On these occasions it was always an old, broken nest of *Asthenes* that was used.

As mentioned above, on 20 February 1960 I found *badius* breeding in a nest of the woodpecker *Chrysoptilus melanochlorus*, and once I found a nest, supposedly self-built, of *badius*.

M. badius is, after all, extremely sociable, and is often to be seen in groups, not only when not breeding, but in the breeding season as well. This sociability may even occur beside or on the nest. This has been observed by other authors as well, including Hudson (*Birds of La Plata*. London, J. M. Dent and Sons, 1920. Two vols. See vol. I, pp. 113–114.), who wrote: "Their extreme sociability affects their breeding habits, for sometimes the flock does not break up in spring, and several females lay in one nest together . . . . One summer a flock of about ten Bay-wings took possession of [a Firewood Gatherer's] nest . . . and after a few days I took fourteen eggs from it." This observation is quite normal, but I think Hudson was mistaken about the eggs. These were probably a clutch of *badius*, with a number of *rufo-axillaris* eggs.

Friedmann (*op. cit.*: 10) tells of a curious incident in which on 13 January 1924, on an island in the Parana, he shot two *badius*, both females, from the same nest. In February 1957 I watched a large nest of *Phacellodomus* occupied by *M. badius*, in order to learn the sex and purpose of the visiting *badius* individuals. In the morning I collected four specimens, all females. On dissection, two were found to be in the egg-laying state, containing one and two eggs, respectively. The other two had finished their clutches. I think that these birds were not searching for a nest for their eggs, but were just visiting. It seems that a large, readily visible nest of *Phacellodomus* is an effective magnet for the female of *M. badius*, even when she is not laying eggs.

Mr. Pablo Girard, ornithologist of Tucumán, stated (*in* Friedmann, *op. cit.*: 11) that he had examined more than 60 nests of *badius* and never had seen eggs of different females in the same nest. According to my experiences, I would expect that in 60 clutches, there should be some *badius* eggs, at least single ones, laid by females additional to the 60 owners. I have examined quite a number of nests, and not infrequently found eggs of two females in the same nest. On one occasion I found eggs from three *badius* in the same nest. The additions to the clutches I have seen consist almost always of a single egg, but on the occasion mentioned above there were two eggs from two females added to the regular clutch of four, and the common addition of *M. rufo-axillaris* eggs.

I have found *badius* eggs in sets of one to five. The single eggs in empty nests I never saw incubated. *M. rufo-axillaris* would find them and add a

number of its own. This habit of laying only one egg and then forsaking it is a custom also of *Guira guira* the Guira Cuckoo, and *Coccyzus melacoryphus,* Azara's Cuckoo. I never saw such eggs incubated.

Several times I have seen *M. badius* complements of two eggs. The small sets were always incubated in normal fashion.

Sets of three eggs are quite often seen; four are most common; five are rare in Salta, seen only twice by me. I never saw a set of six, which is quite common in the southern provinces. Perhaps the altitude and the late season account for the small clutches. As mentioned, the clutch-size, or egg-number, of many species is smaller in the Salta highlands than in the lowland area.

To get an impression of the nesting season of *M. badius,* I made some observations in the breeding season in February and March 1960 and 1961. The breeding season in 1960 was early, owing to much and early rainfall. When I began my observations, in the middle of February, which normally is the beginning of the breeding season for *badius,* I found incubated eggs, and I was too late to see the birds occupy and take possession of the nests they used.

On the contrary, the summer of 1961 was dry and warm, and the breeding season about two weeks later than in 1960. When I began my observations in the middle of February the birds were already occupying nests. I did not observe any fighting among individuals of *M. badius,* although usually two to three pairs were around each nest. In two cases I saw individuals of *badius* try to take nests from *Phacellodomus*; in no case, however, did they succeed, although the furnariids had long been through breeding and had no eggs or young to protect.

NESTING OBSERVATIONS

I have included observations from earlier seasons when the clutch sizes they represent were not found in the 1960 sample and where the information presented is not repeated later.

NESTING SEASONS—1955–1960

Nest 1—10 March 1955. A *Phacellodomus* nest two meters above the ground contained 5 eggs of *badius* (4 of one female and 1 of another), and 14 eggs of *rufo-axillaris.* As usual, most of the *rufo-axillaris* eggs were thrown out of the nest-cup and several were visible in the entrance. All eggs were fresh.

Nest 2—25 February 1957. An unusually small *Phacellodomus* nest with only one nest-cup was found about 150 cm above the ground and in a ravine. It contained 3 fresh eggs of *badius* and 1 egg of *rufo-axillaris.* The female of *badius,* which I collected, did not contain any developed eggs.

Nest 3—10 March 1957. An old nest of *Asthenes baeri,* located 170 cm above the ground in a bush, contained 4 eggs of *badius* and 8 of *rufo-axillaris.* One egg of the former was atypical, being rounder than the others. All of the eggs had been incubated for a short time.

Nest 4—27 February 1958. A *badius* occupied a nest of *Phacellodomus* at the height of two meters. Two eggs of *badius* and 5 of *rufo-axillaris* were in the nest. (I shot the female *badius*, which was found to have finished her complement with the 2 eggs above-mentioned.)

Nest 5—16 March 1958. Until this time I had seen no nests built by *badius*, but I found a nest in the bushy *campo* of Lerma Valley, which I think was built by this species. The nest was on a horizontal branch 130 cm above ground and was well hidden in the bush. The nest was constructed very loosely and was made of fine roots with a lining of dried, short grass and small plants (see Figure 2, B). The outside diameter was 9.5 cm and the nest-cup was 7.5 cm in diameter and 3.5 cm deep. I assume it was constructed by *badius* because I do not know of any other species in this area (open *campo* with some bush) with a nest of this shape and with such loose construction. The nest contained 5 fresh eggs of the beautiful reddish type. It seemed to be a little late in the season for a normal clutch, but this was a great breeding month in the Lerma Valley. It was the first clutch of 5 eggs I had seen.

Nest 6—17 February 1960. I found a pair of *badius* in a *Furnarius* nest of last season. Watching the nest for one-half hour, I observed several pairs of *rufo-axillaris* around the nest. They did not disturb the *badius*, which visited the nest at short intervals. This seemed to be before egg-laying.

February 29. To examine the nest I cut out a piece above the nest-cup. Surprisingly the nest was empty, but at the entrance there was an evicted egg of *rufo-axillaris*. I took the egg and repaired the damage to the nest.

March 13. After a period of heavy rain the nest was still empty although the birds were present. Because of the damage and humidity the nest broke and was thus lost for further observation. The fact that these *badius* occupied the nest for a month without egg laying was curious, especially since the nesting season was ending. The nest may have been robbed, but if so, it probably would have been forsaken.

Nest 7—17 February 1960. I visited a well known nesting site of *Phacellodomus*. The old nest had disappeared, and was replaced by two small nests about 6 meters apart and at the height of about 10 meters. While I watched the place only one nest was visited by two pairs of *badius*. The nest seemed unusual. I had never seen a *Phacellodomus* nest at this height and of such shape and construction (very small and transparent). It seemed to be an unfinished nest. With no hiding place, the situation was not suitable for observation and the birds seemed to be a little disturbed by my presence. The nest was visited once by at least four pairs of *rufo-axillaris*, and several times by single pairs. One individual of *badius* was within the nest many times, while another perched nearby. Another pair of *badius* visited and both pairs tolerated each other. At a distance of about 50 meters four pairs of *rufo-axillaris* sat together silently. Suddenly one bird left and started straight for the nest, and the flock followed, screaming loudly. Around the nest there was a wild flutter and screaming, and the *badius* joined in the battle.

Such collective battles were always started by the *rufo-axillaris*. These birds seem to prevent each other from entering the nest. When a single pair appeared, there was never any excitement. At 0930 a pair came silently to the nest. A *badius* was sitting on the top of the nest preening, and showed no sign of being disturbed when one of the *rufo-axillaris* entered the nest. The other *rufo-axillaris* remained nearby. After 15 minutes the *rufo-axillaris* female left the nest and the pair took off. Five minutes later, one of the *badius* entered the nest and began incubating.

February 20. In the nest-tree there were several *badius*; four pairs of *rufo-axillaris*

were waiting as before, in the same bush. They made short visits to the nest-tree, but always the same collective battle ensued as described above. Again a single pair later appeared and the female entered. The *badius* seemed not to notice them. After 13 minutes the female left the nest and the pair disappeared.

At 1000 a *Guira guira* was heard arriving at the nest-tree with its trilling call. The next moment it was seen sitting on the nest with the *badius* fluttering around and chattering. When the cuckoo moved nearer to the entrance, I rose and was seen by the cuckoo, which disappeared.

At least one of the *badius* was always in the nest on short visits and other birds were often seen in the nest-tree. The other nest did not seem to be occupied.

February 24. It seemed that the *badius* had hatched. When examining the ground beneath the nest, I found shells of two hatched *badius* eggs. *Rufo-axillaris* were around as before, but none entered.

February 29. I took the nest down. As suspected, it was not of a *Phacellodomus* but of another big furnariid, unknown to me. The nest, opened, contained only two partly feathered young. The *Guira guira* had probably taken eggs and possibly young continuously (there undoubtedly had been some *rufo-axillaris* eggs laid in the nest).

Nest 8—13 March 1960. After two weeks I took down the other nest from the same tree as nest 7. It contained 4 fresh eggs of *badius* and 2 eggs of *rufo-axillaris*. Judging from the shells beneath the first nest, it may have been the same pair of *badius* with a new clutch. The nesting season of *rufo-axillaris* seemed to be at an end, although a few pairs were still around.

Nest 9—17 February 1960. In a little valley I found a *Phacellodomus* nest hanging four meters above the ground in a large tree, and in a good position for observation. The valley is very rich in bird life and *rufo-axillaris* were especially numerous. There were always several *badius* seen in the nest-tree, and often two or three were on the nest. (I have the impression that if *badius* visit other *badius'* nests it is only a kind of "sociability" as I never saw the birds fighting. The nest-birds chatter and the visitors answer in the same manner. Commonly there was only one visitor at a time, but occasionally there were several. I have seen as many as three pairs simultaneously.) *Rufo-axillaris* always appeared in pairs and often in small flocks of up to five pairs. These flocks usually sat silently in a nearby tree or bush and watched the movements of the *badius*. As with nest 7, when more than one pair of *rufo-axillaris* were present the flock prevented entrance into the nest of any member, but when a single pair appeared there was no fighting. The female *rufo-axillaris* would enter the nest and remain there for about 15 minutes. I watched this nest for some time but no *rufo-axillaris* entered the nest although there were some nearby.

February 20. At 0815 there were two pairs of *badius* and a single *rufo-axillaris* in the nest-tree. Farther up the slope three pairs of *rufo-axillaris* were in one tree. Some minutes after my arrival, a *rufo-axillaris* came out of the nest and left with its mate. At 0840 a pair of *rufo-axillaris* approached the nest directly and silently and one bird entered. One pair of *badius* appeared (for a little while none had been visible) and remained with the one *rufo-axillaris*. After 15 minutes the presumed female *rufo-axillaris* left the nest and the pair took off. One of the *badius* entered the nest and remained there. At 0900 when I left there were still several *badius* around.

February 24. I arrived at the nest about noon. In the high grass beneath the nest I found an evicted egg of *rufo-axillaris* and in the entrance another was visible. (Most of these evicted eggs are found stuck among the thorny nest material around the nest-cup and in the long entrance. Often there are several eggs on the ground beneath

the nest. In a fall of only two to three meters onto a grassy or soft, dusty ground, the eggs do not break.) Both *badius* were still around the nest and neither was incubating. Many *rufo-axillaris* were around.

February 29. I took the nest down. As supposed, there were many eggs. In the nest-cup were 4 eggs of *badius* (3 of one female and 1 of another) and 4 eggs of *rufo-axillaris*. Outside the nest-cup, mostly in the entrance, 10 more eggs of *rufo-axillaris* were found. In all, including the one on the ground, 19 eggs were counted (15 of *rufo-axillaris*, and 4 of *badius* from two females). The condition of the eggs indicated that incubation had begun.

Nest 10—19 February 1960. A *Phacellodomus* nest was found at a height of about four meters. No *badius* were present, but three pairs of *rufo-axillaris* were nearby watching the nest.

February 24. No birds were seen, but the nest contained 1 egg of *badius* and 3 of *rufo-axillaris*. (I have seen such abandoned nests before with only one egg of *badius* and supposed the nest-birds to be lost, but now I doubt that this is the case. In some nests of *badius* with many eggs, there is occasionally a single egg of another *badius* individual. According to my notes, it seems that one nest out of every five or six [15 to 20 per cent] with large clutches contains one egg of another *badius*. Perhaps a bird may lay one egg only, dropping it either into another *badius* nest or into an empty and unoccupied nest.)

Nest 11—29 February 1960. A *Phacellodomus* nest was found well-hidden in a ravine, at the height of six meters. There were four nest-cups, the lowest of which contained 5 eggs of *badius* and 3 of *rufo-axillaris*. This was only the second time I had seen a clutch of 5 eggs of *badius*. The well-hidden, and only slightly visible, position of the nest may account for the small number of eggs of *rufo-axillaris*. The *badius* eggs were the dark, marbled, glossy type. All eggs had been incubated for about a week.

Nest 12—13 March 1960. A *Phacellodomus* nest two meters up and above a ravine, contained four half-feathered young. While I examined the nest one pair of *badius* and two pairs of *rufo-axillaris* were nearby.

NESTING SEASON—1961

February 9. Most individuals of *badius* were occupying nests; around nests of *Phacellodomus* there were usually two to three pairs. They fluttered around a little, but I saw no fighting. Two pairs of *Phacellodomus* still occupied their nests and defended them very effectively. I watched one of these pairs for an hour. There were two nests two meters apart and the *badius* were interested in the smaller one (Number 13), but the owners did not permit any of them to come close. With loud protests, both swooped swiftly and dexterously at the nearest cowbird, which always escaped to a safer distance. Between the cowbirds there was no fighting. Once a cowbird flew directly to the entrance and slipped into the nest before the *Phacellodomus* could prevent it.

The situation at another site where a pair of *Phacellodomus* still occupied their nest (Number 14) was similar. The occupants successfully defended their possession against two intruding pairs of *badius*. Two other unoccupied nests were found which each had two pairs of *badius* in the vicinity. Again, I saw no fighting between the cowbirds.

On a high-hanging nest of *Phacellodomus* I shot a pair of *badius* and a *rufo-axillaris* female. The latter revealed four developed ova, the largest of which was missing only a shell. The *badius* female had no developed ova. The testes of the male measured six mm.

February 17. At nest 13, still occupied by *Phacellodomus*, there was only one pair of *badius* present. At nest 14, likewise, the *Phacellodomus* held their position. Another *Phacellodomus* nest (Number 15) was now occupied by *badius*. Beneath the nest were 5 evicted eggs of *rufo-axillaris* (2 were broken). The nest was empty.

Nest 16, a low-hanging (150 cm) nest of *Phacellodomus*, was occupied by *badius*. Beneath the nest was a broken egg of *rufo-axillaris*. In the entrance, sticking among the thorns and twigs, were 4 more eggs that had been thrown out. The nest was empty. I found a pair of *badius* occupying an open *Furnarius* nest (Number 17) and it contained 1 egg of *badius*. This nest was well-hidden, and I thought it might possibly escape the *rufo-axillaris*, which I only rarely saw at this place.

February 21. Nest 17 contained 4 eggs of *badius* and 1 of *rufo-axillaris*.

February 25. Nests 15 and 16 had full complements—both had 4 eggs of *badius* and 1 of *rufo-axillaris*. In nest 16 there were 3 evicted eggs (2 of *rufo-axillaris* and 1 of *badius*) stuck in the entrance. The *badius* perhaps threw out the eggs of *rufo-axillaris* together with their own first egg. With the 5 eggs before, there had now been 8 eggs thrown out of this nest. I placed 8 marked eggs of *rufo-axillaris* in the nest, which still contained the 5 above-mentioned eggs.

A breeding pair of *badius* was found in an open nest (Number 18) of *Furnarius*. The nest contained 4 fresh eggs of *badius* and 1 egg of *rufo-axillaris*. *Badius* were still in small flocks; few *rufo-axillaris* were seen.

February 28. Nests 13 and 14 were still in the possession of *Phacellodomus*, and since no *badius* were around, it seemed that they had gone. There were many empty nests of *Phacellodomus* and *Furnarius* in the neighborhood and therefore nesting possibilities were plentiful. Nest 15 had no additional eggs; the 5, already noted, were collected and found to have been incubated. In nest 16, 2 of the 8 marked eggs had been evicted and were found in the entrance. However, the nest was forsaken; the *badius* had moved into another nest of *Phacellodomus* about 15 meters away. The forsaken clutch had no additional eggs.

March 20. In nest 15 where I had collected a clutch of 5 (4 eggs of *badius* and 1 of *rufo-axillaris*) on 28 February, there was a single egg of *rufo-axillaris*.

As a result of my observations, the following summarizing statements can be made. The nesting season of *M. badius* and *M. rufo-axillaris* is from mid-February to mid-March. In many cases *M. rufo-axillaris* begins egg-laying before *M. badius*. As does *M. bonariensis*, *M. rufo-axillaris* lays its eggs in the nests before the egg-laying of *M. badius*, and in some instances, in empty, abandoned nests. Also, as with *M. bonariensis*, *M. rufo-axillaris* continues to lay in forsaken nests. As do the victims of *M. bonariensis*, *M. badius* evicts any eggs of *M. rufo-axillaris* laid in the nest before its own egg-laying has begun. When the nest-cup is filled with eggs, *M. badius* sometimes tries to evict *M. rufo-axillaris* eggs, but if it does not succeed, it may forsake the nest.

PART II

Along with detailed biological data, many clutches (including those mentioned above) of the three species of *Molothrus* studied were sent to me by Hoy for examination.

TABLE 1

DIMENSIONS AND WEIGHT OF THE SHELL, AND "Q" FOR EGGS OF *MOLOTHRUS BONARIENSIS* FROM TWO LOCALITIES

Locality	*N*	*Mean length (in mm)*	*Mean breadth (in mm)*	*Mean weight (in mg)*	*Mean "q" value*
Salta	28	24.2 (22.3–26.2)	19.4 (18.4–20.8)	380 (330–440)	1.25 (1.12–1.47)
Rio de Janeiro	67	21.3 (19.9–23.8)	17.3 (15.4–18.4)	260 (215–300)	1.39 (1.23–1.63)

Although the eggs of the Argentine molothri have been described many times, numerous authors have stated that the eggs of *M. badius* and *M. rufo-axillaris* are very difficult, if not impossible, to distinguish from each other. The knowledge of this matter is still imperfect, but such statements result, in part, from hitherto inadequate methods of investigation. The color, markings, and measurements of the length and breadth of the eggs are seldom sufficient for positive identification, because of the great range of variation that exists in these characters for these species.

In all parasitic species, egg measurements alone are quite insufficient, as it is well known that adaptations in their size may occur. When identifying these eggs, measurements both of size and of the weight (a function of thickness) of the shell are necessary, since they permit more reliable identification. In fact, for the three species of *Molothrus* here considered, it is practically always possible to make an identification based on these characters. The relative thickness of shells ("q") is determined by a formula devised by E. Rey (*Altes und Neues aus dem Haushalte des Kuckucks*. Leipzig, 1892.) where: the Rey quotient ("q") = the length of the egg (in mm) × the breadth of the egg (in mm)/the weight of the shell (in mg). Thus, the thicker and heavier the shell, the smaller is "q." I made a comparison of "q" for *M. badius* with *M. rufo-axillaris,* and of this same value for *M. bonariensis* from the region of Salta with that for individuals in other parts of the species' range.

Molothrus bonariensis.—Forty clutches from Salta and Rio de Janeiro were examined. Correctly, the literature indicates that the immense variation in the eggs of this species makes a simple general description impossible.

Conspicuous differences exist between eggs from Salta and eggs from other areas. Tables 1 and 2 provide detailed comparisons of eggs from Salta with eggs from the vicinity of Rio de Janeiro.

While the eggs from Rio de Janeiro show the "typical" variations in ground color, and suggest the many different types of eggs of this species, the eggs from Salta show only a slight variation, 96.4 per cent ranging

TABLE 2

NUMBER AND PERCENTAGE OF EGGS OF VARIOUS GROUND COLORS FOR *MOLOTHRUS BONARIENSIS* FROM TWO LOCALITIES

Ground color	*Salta*	*Rio de Janeiro*
White to bluish-white and bluish-green	27 (96.4 per cent)	30 (44.8 per cent)
Grayish-white	0	18 (26.9 per cent)
Yellowish-creamy	0	5 (7.5 per cent)
Light brownish	1 (3.6 per cent)	0
Light pink	0	14 (20.8 per cent)

from white to bluish-green. Eggs with a grayish, creamy, or pinkish ground color, quite common in other areas, are either totally absent or very rare in the Salta population. Unmarked, pure white eggs are common for this species in Uruguay and eastern Argentina, and are not unknown from Tucumán. They might be expected in Salta, but were absent from the sample. It is interesting that the population of Salta has such a uniform type of egg, a situation not observed in other populations of this species. Additionally, the eggs from Salta are considerably larger and heavier, and they also have a relatively thicker shell, indicated by the lower "q" value.

Hellmayr (*Catalogue of birds of the Americas. Field Mus. Nat. Hist., Zool. Ser.*, vol. 13, pt. 10, 1937. See pp. 57–64.) considered the birds from Salta and from Rio de Janeiro to belong to the same race, *Molothrus bonariensis bonariensis*. However, there is as much difference in weight and size between the eggs from these two localities as there is between the eggs of the populations of Rio de Janeiro and Trinidad (*M. b. minimus*). Also, the birds from Salta seem to be considerably larger than the birds from Rio de Janeiro. It might be worthwhile to examine these birds further to determine whether the populations from Salta and Rio de Janeiro belong to the same race, or whether, in fact, they are separable.

In *M. bonariensis* there is a tendency towards eggs approaching the spherical. The larger eggs of this species are the most nearly spherical (a correlation between size and shape may exist), and such eggs are very common. This spherical shape is so conspicuous that one is tempted to conclude that it has some particular adaptive advantage. Usually several females lay their eggs in the same nest, and they generally puncture the eggs already present. This destruction is primarily directed against the host's eggs, but if there are eggs of other *M. bonariensis*, these will often be punctured too. It might be that the rounded eggs are more resistant to the pecking beaks, which might be more frequently deflected by a more uniformly curved and structurally stronger surface.

TABLE 3

NUMBER AND PERCENTAGE OF EGGS OF VARIOUS GROUND COLORS AND MARKINGS OF *MOLOTHRUS RUFO-AXILLARIS*

Ground color	*N*	*Per cent*	*Color of markings*	*N*	*Per cent*
White to creamy	25	41.0	Reddish-brown	38	62.3
Grayish-white	7	11.5	Brown	21	34.4
Pinkish-white	12	19.7	Greenish-brown	2	3.3
Light brownish	5	8.1			
Greenish-gray to bluish-green	12	19.7			

If several eggs of *M. bonariensis* are found in the same nest it is difficult to tell from their appearance how many females have laid them. Because of the uniformity of the eggs of the Salta population, one might mistakenly group the most similar eggs as being from one female. However, the dimensions and weight of the shell and the value of "q" may be greatly different for eggs of similar appearance. If "q" is relatively constant for a given female, eggs very similar in appearance would have to be considered as being from different females. So considered, it appears that one female often lays two eggs in the same nest, but in no case could I find any more than two eggs from one female. In one case, 14 eggs of *M. bonariensis* from a nest of *Mimus saturninus* in Salta, were possibly laid by 14 different females (see Figure 2, A).

Molothrus rufo-axillaris.—In this species, which, among other species, parasitizes *M. badius*, the eggs vary more in ground color than found in

TABLE 4

COMPARISON OF EGGS OF *MOLOTHRUS BADIUS* AND *M. RUFO-AXILLARIS*

Character	M. badius	M. rufo-axillaris
Number	43	61
Mean length (in mm)	24.0 (21.0–25.4)	22.4 (20.7–24.1)
Mean breadth (in mm)	18.1 (16.5–19.1)	17.6 (16.7–18.6)
Mean weight (in mg)	270 (230–305)	310 (270–350)
"q"	1.62 (1.49–1.79)	1.28 (1.15–1.50)
Shape	More slender and elongate	More rounded
Ground color	Mainly grayish-white, often white and pinkish-white, rarely bluish-green	Mainly white to creamy-white, often pinkish-white and bluish-green, rarely brownish
Markings	More sharply accentuated and more scattered	More vague and unaccentuated
Color and size of spots	Mainly reddish tinged, less frequently brownish tinged, mainly rather small	Mainly reddish-brown tinged, rarely brown tinged, generally larger
Color of underlying spots	Gray, often less striking	Gray, generally more striking

TABLE 5

NUMBER AND PERCENTAGE OF FEMALES OF *MOLOTHRUS BADIUS* HAVING EGGS OF GIVEN GROUND COLORS AND MARKINGS

Ground color	*N*	*Per cent*	*Color of markings*	*N*	*Per cent*
White	2	14.3	Reddish-brown	6	42.8
Grayish-white	9	64.3	Light red	2	14.3
Pinkish-white	2	14.3	Pinkish-gray	1	7.1
Bluish-green	1	7.1	Light brown	5	35.8

M. badius. There are, among the eggs from Salta, several with greenish-gray and bluish-green ground color, types previously not found for this species (Table 3). In all, 61 eggs were examined and measured (Table 4).

An analysis of the 10 composite clutches collected, considering all of the characters studied, shows that up to 12 females of *M. rufo-axillaris* may parasitize the same nest of *badius*. Also, in three cases, a single female of *M. rufo-axillaris* laid two eggs in the same nest of *M. badius*. In one case it seems that three eggs were laid in one nest by one female *rufo-axillaris*.

The eggs of *M. rufo-axillaris* evicted by *badius* differ in no way from those found in the nest-cup, representing all types known for the species.

Molothrus badius.—The eggs of this, the only species of the genus that incubates its own eggs and rears its own young, also show considerable variation in ground color and markings (Table 5). In all, 43 eggs of 14 females were examined and measured (Table 4).

In two of 12 clutches there seems to have been one egg from a second female of *badius*. Apparently a *badius* female lays her eggs in another's nest more often than hitherto supposed. This fact is interesting, since *badius* represents the most primitive *Molothrus*, a form approaching that from which the parasitic species of the group could have descended. Such single eggs of other females can be confused by an inexperienced collector with eggs of *M. rufo-axillaris*. It is therefore necessary to measure, weigh, and calculate "q" for all eggs in clutches with eggs from more than one female. I think it is then possible with some degree of certainty to separate eggs of various females of *badius* and *rufo-axillaris*.

Table 4 compares various characteristics of the eggs of *M. badius* and *M. rufo-axillaris*. The weights of the shells overlap to some extent, but the "q" values show almost no overlap. The importance of "q" as a discriminating character of eggs of these two species should be stressed. *M. rufo-axillaris* eggs have an average "q" value of 1.28 while for *M. badius* this value is 1.62. These findings are in accordance with Friedmann's observation (*op. cit.*: 48–49) that "the eggs of the Screaming Cowbird are usually less brittle, and are harder to pierce . . . than those of the Bay-wing."

DISCUSSION

It has been thought that the molothri developed an especially thick-shelled egg as an adaptation to the parasitic habit (in the same way as have many parasitic cuckoos). An examination of the eggs of many non-parasitic icterids (*Icterus, Agelaius, Caccicus, Xanthornus*) shows that in these species the weight of the shell is about 5.5 to 6.8 per cent of the weight of the fresh egg, and that "q" varies from 1.67 to 2.12. In the parasitic icterids (*M. rufo-axillaris, bonariensis*, and *ater*; *Tangavius*; and *Psomocolax oryzivorus*) the weight of the shell varies from 7.5 to 8.7 per cent of the weight of the fresh egg, and "q" varies from 0.99 to 1.60. The shell of the egg of the parasitic forms is therefore relatively thicker and heavier. *M. badius*, which incubates, should, in weight of the shell and "q," resemble the nonparasitic icterids, but it does not. In *M. badius*, which is, according to Friedmann (*Host relations of the parasitic cowbirds, U. S. Natl. Mus., Bull.* 233, 1963. See p. 26.), "the most primitive of the existing cowbirds," the shell is 7.8 per cent of the fresh egg weight, and "q" is 1.32 to 1.62. Thus *M. badius* agrees with the parasitic icterids in the thickness of the shell. It seems therefore that the thickness of the shell in the parasitic icterids is probably not an adaptation to parasitic habits. The thickness of the shell in certain icterids is perhaps a phylogenetically old character which may be associated with the hanging nests of some members of this group. For example, *Xanthornus decumanus* has a relatively heavy shell (6.8 per cent of the fresh egg weight) and a low "q" value (1.14)—values that closely approach those for the parasitic species. The fact that their eggs have a thick shell is of great advantage to parasitic species, but it seems that thick shells are not necessarily adaptations to the parasitic habit.

Eggs of *M. badius* are usually elongate, whereas in *M. rufo-axillaris* rounded eggs are fairly common. The presumed biological significance of spherical eggs has been suggested above for *M. bonariensis* (the spherical eggs may be less likely to be punctured by other birds). Spherical eggs are fairly common in *Tangavius aeneus*, although not as common as they are in *M. bonariensis*, and rounded eggs occasionally occur in *M. ater* (at least they are more common than for passerines in general). The habit of puncturing is known in both *Tangavius* and *M. ater*.

Ground color and the character of the markings is most uniform in *M. badius*, but the various ground colors present in this species may show what evolutionary possibilities were early available. The eggs of *M. rufo-axillaris* show that many of these possibilities have been utilized since the ground color is more variable and the character of the markings more diverse. In *M. bonariensis* the ground color varies extremely, and the markings may exhibit much variability. In *M. bonariensis* the type of egg

is surprisingly uniform in certain parts of the large breeding range, as demonstrated by the eggs from Salta. The pure white, unmarked egg of this species is likewise restricted to a certain part of the range, but occurs in one-third to one-half of all females. The white type of egg is not an adaptation to any host with white eggs, and seems to offer no biological advantage, but apparently it is not disadvantageous either. Starting with variable eggs, the molothri seem not to have developed adaptations to eggs of some of their hosts, but have arrived, in some populations, at a uniform type of egg. On the other hand, the cuckoos started with a plain, unmarked egg, covered with a chalky film, and in some species developed fairly complete adaptations (e.g., resemblance) to the eggs of their hosts. In *Tapera* the egg matches the eggs of the hosts, because the hosts chosen have white unmarked eggs. The egg of *Tapera naevia* still represents the primitive egg of the nonparasitic cuckoos. The conditions in the molothri have hitherto offered no indication as to how the adaptation of the egg, to resemble that of the host, of cuckoos may have developed, but they may stimulate thought on the subject.

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