

NOTES ON THE UNIQUE METHODS OF NIDIFICATION
OF THE AUSTRALIAN MALLEE-FOWL (*LEIPOA*
OCELLATA) WITH ORIGINAL DATA SUPPLIED
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Plates XIV-XVI.

Introduction.—The chief object of the writer in presenting this paper, is that the data obtained by Mr. Bruce W. Leake, R. A. O. U., of "Cardonia" Kellerberrin, Western Australia, in connection with the methods of incubation of the Mound Building Mallee-Fowl of Australia, might be preserved in some scientific journal, he having courteously allowed me to quote from his written notes. But before dealing with the data supplied by him I will give a few extracts from my own paper "Notes on the Mound-Building Birds of Australia" published in "The Ibis" for October, 1922, pp. 702-709. These notes on *Leipoa* were not only my personal observations but also data supplied to me by my correspondents. The Mallee-Fowl inhabits almost exclusively the vast tracts of the drier parts of Australia which are covered with various species of the dwarf, branching forms of eucalypti known as mallee, as well as large bushes or dwarf trees representing several other genera.

All the opportunities that I have personally had of examining the nesting-mounds of this bird have been in the extensive belt of Mallee lying on both sides of the river Murray in South Australia.

The birds usually select a sandy rise and commence the nesting-mound by excavating a hole; in the case of the one I examined in this stage, the excavation was about eighteen inches deep and about six feet across. For some reason the birds had forsaken this spot at this stage and made a nesting-mound on another sandy rise some distance away. In reference to the digging of the hole for the foundation of the future mound, Mr. G. H. Mann wrote me: "From my observations it seems that they scratch out a hole early in the winter and then fill it up with a cone-

shaped heap of dry leaves and sticks; these they cover with sand about the end of the winter."

Mr. J. E. Lewis Machell, of the Education Department, Adelaide, wrote: "Nest, fifteen feet in diameter and about two feet six inches high, situated in an open space in a scrub of so-called 'broom' (*Melaleuca uncinata*) with occasional mallee; soil sandy. Composition of nesting-mound, central portion decaying leaves and vegetation covered with sand. There is a depression in the center, the eggs are laid around the rim of this hollow. Before making the nest a small hollow is scraped out; the one I mentioned was only about five inches deep and two feet six inches wide, and was filled with leaves and twigs.

"The eggs did not appear to be laid down as far as the leaves. Many were standing on end, but not all. I may have disturbed them when opening up the nest. The sand was fairly dry where the eggs were, but not as dry as in other parts of the nest . . . About 10 A.M. (when the sun was shining directly on the nest), the male and female appeared on the mound. The female stayed, but the male disappeared into the scrub again to do 'sentry-go.' Well, Mrs. Mallee-Fowl began to open out the egg-chamber; every few minutes she would pause and appear to settle her neck and breast against the sides of the egg-chamber.

"The sand was cleared away until there was about an inch left covering the eggs, then the male joined her and both disappeared. On visiting the nest at 4 P.M. (the shadows were just on the nest), I found that the sand had been replaced."

Mr. T. P. Bellchambers of South Australia wrote me: "All covering material is mixed with desiccated leaves. For sunning purposes, i.e. 'solar heat', the nest is opened almost to the level of the eggs—this may be done as often as five days out of seven. The refilling is a gradual process and takes all day, as it is replaced in layers as soon as it gets hot. The male does all the hard graft, grasps and throws all the material behind him."

Leake's notes.—Mr. Leake supplies data to show that in 1869 the Mallee-Fowls were numerous in the Kellerberrin District, and were often shot for food by the settlers. The birds became scarce during the three years ending in 1879, a period of low rainfall, and during the cycle of dry years 1894 to 1902, when the average

rain fall was 10.5 inches, the birds became practically extinct in that district. The rainfall has increased since 1915 and averaged about 15.25 inches for the ensuing twelve years. During this period the birds returned to that district in considerable numbers; Mr. Leake suggests that this may have been partly due to the drought conditions prevailing in the Murchison District much further north. In September 1925 he spent some time searching for Mallee-Fowl nests but only found four old mounds, but to quote his own words: "A few days later Mr. Noye, who is very observant of bird life, told me that he had two years before seen a nest with broken egg shells. On examining this old nest, fresh scratchings were at once seen all around the nest, which was in the same stage as shown in Plate XIV, fig. 3. The birds had not commenced laying. The nest was situated in a sandy piece of soil immediately adjoining some old rabbit burrows. The bushes were not thick immediately around the nest, but a little further back, dense scrub surrounded it entirely. On October 17 when the first egg was found the circumference of the nest at the base was 37 ft., and the height from the ground level to top of mound in the centre was 2 ft. 6 in. The egg is a beautiful pinkish color when freshly laid measuring 3.5 x 2.5 in., and was placed perpendicularly some eighteen inches below the top of the mound, the big end being upwards. A visit on October 24, revealed two more eggs."

I had always understood that the incubation period was about forty days, and being anxious to secure the young, I decided to make a nesting mound near Cardonia, about twelve miles distant from the nest, and transfer the eggs. I had heard of two cases where nests were wire netted to endeavour to secure the young, but these had died in the egg shells, due, no doubt, to the parent birds not being able to open out the nests. A sandy spot for an artificial nesting mound was chosen in my orchard a few chains from the house.

Making the nesting mound.—I had previously carefully examined old nests, also the new one. A hole was made in the sandy soil, one foot deep and two feet wide. This was filled up with jam-tree leaves (*Acacia acuminata*) and other rubbish raked up from beneath the trees. On these leaves water was poured till the



UPPER.—MOUND OPENED BY BIRDS AFTER RAIN.
MIDDLE.—CLOSER VIEW (STAKE INSERTED FOR MEASURING).
LOWER.—MOUND FILLED WITH LEAVES, ETC.

hole was filled. This operation was repeated several times during the day, as the leaves gradually absorbed the water and the rest soaked away. Tubs were procured and more leaves were placed in these and soaked in water all day. During the day the leaves absorbed a quantity of water, and towards the evening the hole two feet wide was built up six inches above the ground with soaked leaves. Around this heap another circle of wet leaves about twelve inches thick was packed and brought up one foot three inches higher than the first heap, no more leaves being put on top of this. A chamber which I reduced from two feet to twenty inches wide and one foot three inches deep, was thus left, this being for the reception of the eggs. The sand was then shovelled all over and around the leaves and piled up to the height of a foot and a half above the egg chamber, a small mesh netting three feet high was put around the base of the mound and around this netting a bush fence to break the winds, was built over three feet in height.

The bird's nesting mound.—The Mallee-Fowl continued laying eggs at the rate approximately of two per week, and I marked these with the date, as they were laid. Their egg chamber was twenty inches wide and the eggs were laid about three inches apart in irregular formation and all on almost the same level. Sometimes an egg would be noticed on a slant and perhaps the next visit would disclose it quite upright. The eggs were all marked with scratches from the birds' feet. On one occasion early in November I was digging out the nest when a movement was heard in the bushes, and on looking up the parent bird could be seen approaching. It looked very handsome but rather bedraggled about the tail and end of wings. It advanced to within ten yards and watched me for a few minutes, then went away and came up from another direction and did the same thing. Three days later I was much surprised to find a layer of sticks right across the nest about six inches below the top of the mound. The birds had evidently looked on me as an intruder and were endeavouring to prevent my getting the eggs. One of these was found broken in the nest. This was the only time during the season that sticks were put across the nest and an egg broken.

Temperatures and transference of eggs.—On November 15, on

which date my mound had been made three weeks and the wet leaves had become heated, I tested the egg-chamber with a thermometer and it registered 90 degrees Fahrenheit. The next day I tested the birds' mound and it registered the same temperature. There did not appear to be much humid heat in their egg-chamber, the leaves and rubbish being only in a slightly mouldy condition which I think was due to a very light rainfall (only 28 points fell in August and 113 in September) and the material had not been thoroughly soaked. On November 21 I transferred six eggs, to my mound leaving only two in the nest, care was taken to keep the eggs warm and on their ends during the journey of twelve miles. On testing the birds' mound during the operation, the thermometer soared to 98 degrees, and the only conclusion I could come to was that the birds had, just previous to my visit, opened out the mound and let down some hot sand from the top. One hot morning a few days later I found the birds' mound flattened off at the top as shown in Plate XV, fig. 2, and this was repeatedly done on bright warm days; on cold dull days the mound was always higher as in Plate XV, fig. 1.

I placed the six eggs carefully in my nest almost touching the warm leaves at the bottom of the nesting-chamber and covering it all up with sand to a depth of eighteen inches above the eggs. Plate XV, fig. 3 shows how the mound then appeared, the temperature still being 90 degrees. The weather was cool at the time and two days later just before sundown I opened out the mound and found that the temperature had fallen to 87 degrees. I filled a box with hot sand from the surface of the mound, this registered 99 degrees, and after removing all the eggs and sand from the egg-chamber, I poured in the heated sand, replaced the eggs and covered with the balance of the heated sand. This operation was repeated every second or third afternoon, or if very busy occasionally after tea. Once a shower of rain fell with damp weather following so that I could not get hot sand for four days and the temperature of the egg-chamber fell to 83 degrees, the lowest record during the period of incubation. The temperature of the egg-chamber was continually tested and it was found to vary from 94 to 104 degrees according to the weather at the time. I never attempted anything warmer than 104 degrees. December

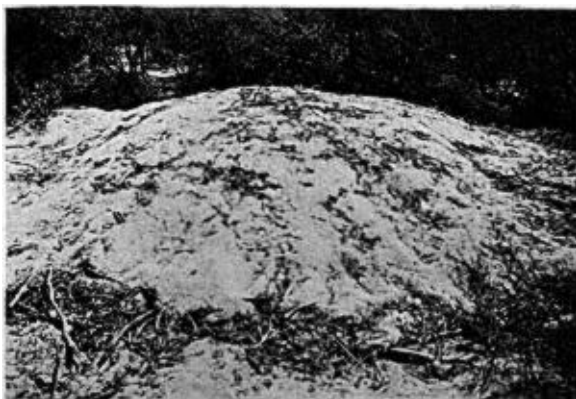
and January brought some very hot days, the average temperature at Kellerberrin being 96 degrees during the latter month. One morning at seven o'clock I flattened the top off, as the birds did to their mound, leaving about a foot of sand above the eggs, late in the afternoon the thermometer registered 95 degrees in the egg-chamber and after filling it up again the mound was raised high to keep in the heat during the night; this method I continued to follow on succeeding warm days registering in the shade 92 to 102 degrees, and found that the egg-chamber would invariably register 93 to 96 degrees and it was only when two or three cold days followed each other that I was obliged to put hot sand on the eggs. Even on cool days the sand right on top of the mound would be warm enough to replace that below, which was gradually being reduced. In any case I always scooped out the sand every second or third day to see how the eggs were and at the same time record the temperature. Plate XVI, fig. 1, shows the egg-chamber opened.

Period of incubation.—Previously I have stated that when I transferred the six eggs two were left in the nest and subsequently the bird laid two more, thus making a total of eleven including the one found broken in the mound. The first nine eggs were laid on an average of about two per week, then there was a gap and the last two were laid approximately on November 26 and December 26, respectively, the first laid was smaller than the other but the coloring of the latter was less bright.

The four remaining eggs were transferred to my nest on December 12, making with those already there a total of ten. By this time the heated leaves below and surrounding the egg chamber had become almost dry and the eggs were practically incubating in the hot sand fed by the sun's rays. Eight weeks had passed from the time the first egg had been laid and it looked as if the eggs had been rendered useless by my amateur methods. On breaking one, however, the chick was found to be alive and within a few days of hatching. On the morning of December 21, a chick was found in the mound and it must have been only a few minutes previously that it had broken up the shell into small pieces. It stood in an upright position, just as it would have been if the egg was still intact. The chick was very damp, almost

wet, and covered with a slimy substance which would be a natural protection to the feathers when scrambling through the hot sand; the young bird was taken out and partly covered with warm sand, until it was quite dry, which was in about an hour. It did not seem satisfied unless it had its beak partly buried in the sand, and its legs bent tightly up against its body. When dry it gave some vigorous kicks and endeavoured to get away if held, making at times a gurgling sound, it would run a little way then squat like a young Plover. On examination it was found to be plump, fully feathered, including small, well developed wings and a short, stumpy tail; the coloring very similar to a Ground Lark (*Anthus australis*), and shape like a Quail. It was placed in a netted aviary and most of the day was spent just squatting. In the evening just before twilight it became quite alert, ran about and once flew to a height of three feet, evidently seeking a bush to settle on to spend the night. The next day it drank some water, ate some seeds and scratched the ground first with one foot and then the other and became lively again in the evening (see Plate XVI, fig. 2). On December 26 about 10 A.M. a second chick was found, dry and fresh looking, in the netted enclosure around the mound. It had hatched out and after being dried by the hot sand surrounding it, had scrambled up through the mound; by the mark where it had emerged the course taken was almost perpendicular. This young Mallee-Fowl was placed with the chick hatched five days previously, the latter ruffled its feathers, spread out its wings and would not go near the fresh arrival, it taking two days for it to get accustomed to the newcomer. This must show that the young birds lead an altogether independent existence and never even know their parents.

By January 8 more chicks had hatched out; then I was away from home for a week. During my absence the mound was flattened off in the morning and piled high again late in the afternoon, but it was not opened out. When I opened out the nest on my return one chick was found dead in the egg chamber, the shell not having broken into fragments small enough to release it. The egg-chamber registered 95 degrees, and this was the only occasion that the mound was not opened out every second or third day. To me it seemed to show that exposure of the eggs to the



UPPER.—MOUND AFTER FIRST EGGS WERE LAID.
MIDDLE.—TOP FLATTENED OFF ON WARM DAY.
LOWER.—ARTIFICIAL MOUND MADE AT CARDONIA.

air must play an important part, as the sand was still loose on top and around the egg. On January 31 another chick was found in the netted enclosure. My son had difficulty in catching it, and twice it flew nearly over the three foot netting. The remaining two eggs proved to be addled. The period of incubation varied from 59 to 63 days. Of the six chicks two unfortunately died at the beginning of January through my not knowing the proper food to rear them on. Three of these were a little lighter in color than the others, they were all quiet and could be easily caught and handled until they were two weeks old, after which they became timid and did not like being touched. At the age of three and four weeks the bronze feathers gradually grew in amongst the other feathers and an altogether new tail developed. After a time greyish feathers and black stripe down the throat and the breast also appeared.

Call notes.—These Mallee-Fowls, now over a year old, make three different notes. One which they utter when young is soft and low, the second is like a human being belching in the throat backwards, and the third is a boom like a tame Pigeon, only much deeper and louder; this latter note is not made until they are nine months old. When making this sound, it appears to be hard work: as the body expands the head is bent right down near the ground and almost between the legs. At this age, over a year, the sexes are still indistinguishable and they possess a restless energy which together with their sturdy build and powerful legs and feet, makes them well fitted for the stupendous task of constructing and working their nesting-mounds.

Every evening as dusk is falling, they run about the aviary rapidly and often fly to the top and cling to the roof netting which is six feet above ground.

The parent birds did not appear to notice that there were no eggs in their nest after the last two had been removed on December 12 and continued working the nest right through that month and also January. On February 9 on approaching the nest a Mallee-Fowl was noticed there; and creeping up I got within a few yards without its seeing me. The time was about 4:30 P.M. on a very hot day, the sun beat mercilessly down on the sandy nest, the bird was raising the mound by scratching the sand

first with one foot and then with the other and gradually working around the nest, all the time making the belching note similar to that made by mine in captivity. The bird would scratch for about five minutes, then walk right down off the mound panting, and squat down in a hole three or four inches deep, made by it for this purpose. After a short rest it would resume its efforts and when again in need of a spell it would some times disappear down the opposite side of the mound, where there was another rest hole. After watching for some time, I approached when it was resting and it disappeared like a flash.

Can the Mallee-Fowl live in their natural state without water? Being partly insectivorous they can obtain a deal of moisture that way, but that any bird can work in the heat on the burning sand like this one does and live without water, seems impossible. I have waited at a soak in my paddock not far from the nest to see if they drink there, from late in the afternoon till dark, and again have been there at dawn, but without any sign of the Mallee-Fowls. According to my informants they do drink at times, but I cannot agree with those who suppose that they do so under cover of darkness, because they cannot see any better than a domestic fowl at night. Old nests are often found many miles from water but as a rule in this district they are within a mile or so of granite rocks; after a very light shower the birds could always get a drink there if they wanted one.

My tame birds drink water but do not require it so frequently as Finches, Parrots and Pigeons. They have a great liking for succulent food such as grapes and watermelon and perhaps when wild they get moisture from the juicy cookine-root and the fleshy Parakeelya (*Calandrina*), growing along the salt lakes and to a lesser extent elsewhere.

Discussion.—Mr. Leake's observations help to fill some of the gaps in our knowledge of the methods of nidification of the Mallee-Fowl, and his success in imitating so closely the habits of these birds as to successfully hatch and rear the young without any assistance from the parent birds, is I believe quite unique. But I differ from him in his impression that the vegetable matter that is incorporated in the nesting material serves in some, although probably only in a small, degree, to raise the temperature of the

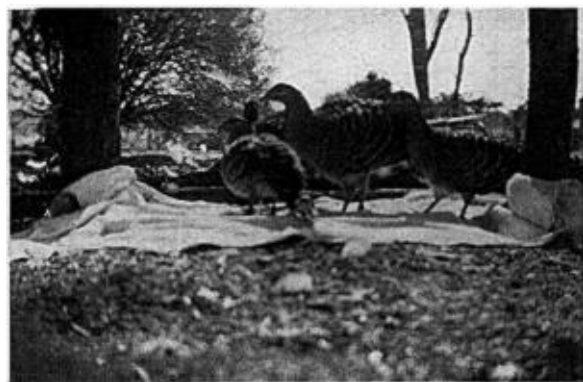
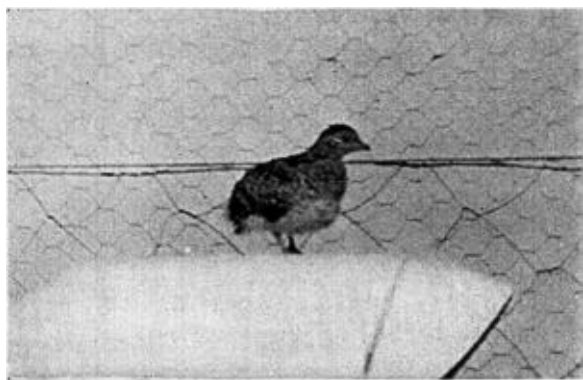
mass. My experience in the dryer parts of Australia is, that the heat generated by massed vegetable material is of short duration and I am confident that the limited amount and inadequacy of the vegetable material used by the *Leipoa*, is quite ineffective in this direction and cannot contribute to the raising of the temperature of the nesting mound. The truth of this conclusion will be still more evident when it is remembered that the deposition of the eggs extends over several months without the addition of any more vegetable material. Mr. Leake concurs with other observers that the main factor in the incubation of the eggs is in the conservation of "sun-heat" by the piling up heated sand above the eggs. I can confidently affirm in respect to the nests opened by myself in the dry Mallee country in South Australia, that the meagre amount of vegetable matter incorporated in the sand of the nesting-mound, could add nothing by fermentation to the temperature of the nest. To return to Mr. Leake's notes, it will be seen that during his absence for one week following January 8, the nest was not opened up to the penetration of the sun's rays, and on his return "one chick was found dead in the egg chamber;" also he mentions two cases in which the nests had been netted in, so that the parent birds were unable to have access to the nest, with the result that all the chicks failed to hatch and were found dead in the eggs. It is evident that Mr. Leake's success was entirely due to his care in utilizing sun heat; it will be noted that on November 15 Mr. Leake records that the artificial nest of his own construction, then only three weeks old, was the same temperature as that of the birds' nest that had been in use for a long period.

One then asks the question why do the Mallee-Fowl collect the meagre amount of leaves and twigs available to them in the dry country in which they live? Does this vegetable matter serve any useful purpose? I suggest that there is a possibility that it may serve the purpose of drainage, should a heavy rain occur, which at the nesting season is somewhat unusual. I am, however, more inclined to believe that it serves little if any useful purpose, that it is in fact, purely a vestigial habit. In my earlier paper (l. c.), I pointed out that the interior of the Australian continent, although now so dry, possessed in the distant past a tropical or

subtropical climate with heavy rainfall, and that the dwarf eucalypti known as "mallee" are probably aberrant representatives of an ancient forest.

I submit that we are justified in assuming that the ancestors of the present Mallee-Fowl, like their congeners *Megapodius* and *Alectura*, used to obtain the needed heat for the successful incubation of their eggs by means of fermenting vegetable matter. That the present method of utilizing sun heat, is a case of remarkable adaptation made necessary by changed ecological conditions. That instead of its present method of nidification being a primitive habit—a relic of its reptilian ancestry as some writers have suggested, it is really a highly specialized habit of comparatively recent adoption.

Care of young.—I do not like to conclude this paper without supplying a personal observation under this heading. All observers agree that the young of the *Leipoa* are hatched well feathered and able both to run and fly, in fact to fend for themselves. It has always seemed strange to me that the parent birds should exercise such insistent care and oversight during the incubation period and then, as some writers have supposed, entirely neglect their young. The following observation suggests the existence of some parental oversight. In October 1927 the writer made a trip down the Government Rabbit Proof Fence from Yalgoo to Ajana in the Murchison District of Western Australia. The trip occupied one week, the party consisted of two, the Government Inspector and the writer and the conveyance was a camel buggy. Only two settlers' houses were seen during the journey and unfortunately the two camels strayed away so effectually that they were lost for over twenty-four hours and it fell to my lot to start at early dawn to walk along the fence for seven or eight miles to the only homestead, probably, within a hundred miles, to get assistance in the search for the straying beasts. During that early morning walk I saw a number of Kangaroos, Euro and Emus and as I neared one of the bends in the fence I noticed an adult Mallee-Fowl on my side of the fence and a young one, perhaps a quarter grown, of the same species on the other side. I was walking at a good pace and think I must have been about thirty yards away when the adult bird walked to the young one, the fence



UPPER.—EGG CHAMBER OPENED UP TO SHOW POSITION OF EGGS.
MIDDLE.—CHICK LESS THAN A DAY OLD.
LOWER.—MALE FOWLS THREE TO FOUR MONTHS OLD.

dividing the two, and in doing so came a few yards nearer to me; the two birds appeared to almost touch beaks through the wire netting and the adult seemed to say something to the juvenile, for while before it had been most anxious to get through the fence to the parent bird, immediately the contact had been made, it turned round and ran with great rapidity at right angles to the fence; the adult bird then turned round and slowly and sedately followed the fence in the same direction as that in which I was traveling, I being able to reduce the distance between us by continuing my pace of about four miles an hour, but as soon as the young bird was out of sight, the old one turned off at a rapid pace into the scrub.

There were two things that specially interested me in connection with this incident. (a) The adult bird conveyed a warning to the young one. If vocal I did not hear the sound, but it might have been by contact, for the parent bird actually came towards me in its effort to reach the juvenile and convey the needed warning. (b) The leisurely movement of the adult bird was quite a new experience to the writer, for heretofore when disturbed they have run off at speed. I could not do other than conclude that the leisurely movement was to occupy my attention and allow the young one sufficient time to get safely away.

"Wittunga," Blackwood, South Australia.