THE AUTOMATIC MECHANICAL RECORDING OF
THE NESTING HABITS OF BIRDS

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NESTING, because it is one of the most conspicuous aspects of bird behaviour, has received attention from the very earliest days of bird watching, and a good deal of literature is available on the subject. The information about nesting behaviour which is wanting, however, is of the type of observation that is continuous for twenty-four hours in the day. No individual would be capable of sustaining a watch of this type on any nest for any length of time, and accuracy on any sustained effort of this nature would suffer, due to fatigue on the part of the observer. R. E. Moreau working on the nesting activities of the White Rumped Swift in Africa, came very near to a solution of the problem by employing relays of African observers to watch the nest and record the comings and goings of the birds. This type of observation is effective during daylight only, and thus has its limitations.

The solution to the problem lies in devising some automatic mechanical method of continuous recording. This has to be of a nature that will not disturb the normal activities of the bird in any way, and be adaptable to field conditions. Mechanical aids to the study of bird behaviour is not a novel idea. Rowan used mechanical methods to enforce activity on his birds during certain periods of darkness in his study of migratory impulses in juncos and crows at Edmonton, and physiologists and psychologists regularly use mechanical aids in the study of animal behaviour.

Kendeigh and Baldwin have described two methods for automatically recording nesting activity in wild birds. The first by means of inserting a thermocouple in the nest to be studied, and recording the changes in temperature, an indication of brooding activities was thus obtained. The second recordings were made by means of an electrical switch-perch placed at the mouth of the nest hole, or so arranged on open nests that the bird, by virtue of the fact that the nest was partially enclosed in wire-netting, had to alight on it to enter or leave the nest. This method gave substantially the same results as the electrical apparatus used by Marples and Gurr and described by them in the Emu. A sample of the recordings obtained with this apparatus is shown in the accompanying Plate 11.

This apparatus consisted of an electric switch-perch so placed that the bird was forced to alight on it before entering or leaving the nest, connection with a switch lever which made a mark on a physiological drum rotated by clockwork furnished one with a permanent record of the number of times the bird left the nest during the day, and at what time it did so.

This method gives a good deal of information, but the record suffers if the male bird uses the perch when visiting the female at the nest; the sequence is spilt and the record could be wrongly interpreted; also no indication is given of activity while on the nest.

The best records were obtained by the adaptation of Marey's tambour to the needs of the experiment. The suggestion and adaptation of the tambour were the work of Professor Marples, to whom credit must be given for the idea of utilising a pneumatic recording apparatus. This apparatus used in the nest of the blackbird (Turdus merula) recorded not only the leaving and returning to the nest of the brooding bird, but its movements on the nest; also, since the male blackbird does not incubate at all, no complications due to his visits to the nest occurred.

It consisted of a tambour made of copper and so constructed that it would fit snugly into the bottom of the blackbird's nest. The membrane of the tambour was of thin sheet rubber. The recorder consisted of a corresponding but smaller tambour connected to that in the nest by a length of rubber tube. To the base of each tambour was soldered a metal tube, the one on the nest long enough to protrude far enough out of the base of the nest for the connection of the rubber tube. The pointer was a movable aluminium lever with a tip of celluloid attached, so slung that a small arm, at right angles to it, supported it horizontally above the recorder tambour.

It will be seen that within the two tambours is contained a fixed volume of air, and any pressure on the membrane in the nest would cause a compression of air and a consequent movement of the membrane on the recorder tambour,
which in turn would excite the pointer. The recording of the movement was made on a drum connected by an axle to the hour hand of an alarum clock. The smoked papers with the recordings are, when completed, treated with varnish solution in the usual way.

Three nests were studied, No. 1 of which was conveniently placed in a hedge outside the window of my bedroom, and with the recording apparatus in the room and the nest in view, it was easy to correlate movements on the nest with recordings on the drum. In this way the types of recordings occasioned by different movements on the nest were interpreted, and when once learnt, nothing more was necessary than to keep the apparatus recording. The accompanying plate gives a representative sample of the type of tracing registered during the night, the broad line being caused by the breathing movements of the bird's breast. The occasional fine vertical lines being made when the bird eased itself up on the nest, and hence relieved the pressure on the nest tambour and so allowed the pointer tambour to sag and the pointer to drop.

The sample of daytime recording is of a typical incubation period, the off and on marks are shown three times here. When the bird leaves the nest the pointer falls and would stay down, giving a tracing like this: ___ were the tambours airtight, but since they are not, the pointer slowly recovers the middle line again. The pressure on the nest tambour when the bird returns inflates the pointer tambour, and the pointer is thrust up; but, again, because the tambours are airtight, the pointer soon falls and regains the middle line. The tracings between the on and off are caused by fidgeting and turning on the nest.

Space will not permit the giving of more than the broadest outline of the results obtained with the pneumatic recording apparatus. A detailed account of the results obtained is to be published at a later date. All statements given as to tendencies are, however, the result of critical analysis of the figures obtained and represent the results of more than a thousand hours of recording.

The most striking aspect of nesting behaviour when analysed in this manner is the regularity of the rhythm both of the period as a whole and of daily activity.

In considering the daily rhythm in the bird's activity, it was decided to divide the day into three periods. These were six-hour, four-hour, and six-hour periods, in that order. The reason for this being that the "active period" occupied roughly thirteen hours, falling between 0500 hrs. and 1800 hrs. Thus the middle four-hour period being completely within the active period was approximately equal to the four hours of active time in the first, and the four hours of active time in the last six-hour period. It was necessary to analyse sixteen hours to accommodate the earliest departure from the nest in the morning, and the latest return to the nest in the evening in all nests, and thus give a constant basis of comparison. When considered thus, there was a marked regular daily rhythm of activity, most in the first period, very little in the second period, and in the third period slightly less than in the first but much more than in the second.

The bird left the nest more frequently and stayed off for a greater length of time in the first period than in the other two periods, and the occasions off the nest and total time off the nest in the second period were the least of all.

When one considers that the only reason the bird leaves the nest during incubation is to feed itself (stretching and changing position to ease itself while sitting is freely indulged in on the nest, as is well seen by observing the record made between the off periods), this is a perfectly reasonable sequence of events.

The bird, after the long period during the night without food, is entirely empty in the morning. It requires frequent fillings of the crop to satisfy its hunger, this tapering off towards evening when the bird fills up with food again to carry itself through the night. This same tendency is shown in the blackbird in its nest-building activity, feeding in the non-breeding season, and to a certain extent in song.

Baldwin and Kendig, in their exhaustive investigations into the variation of weights of birds, show that the same conditions hold good for the feeding of forty-one species, mostly passerine, observed in natural conditions out of doors in North America.

By automatic mechanical methods the exact amount of time spent on the nest each day and number of visits to the nest are recorded, and the egg laying and onset of the incubation cycle can be critically studied. Time on the nest was found to increase from 7.01% to 58.04% to 75.28% to 86.99% of the active period over the four days of egg laying in nest No. 2 (88% being the approximate
percentage of active period spent on the nest throughout incubation). The bird did not spend the night on the nest after laying the first egg, but did thereafter.

The obvious advantage of the gradual onset of the incubation cycle is that it ensures that the clutch hatch out practically at the same time, thus giving the young birds an even chance in the struggle for food while in the nest.

Analysis of the incubation period as a whole showed that it divided into three four-day periods there was a tendency for closer sitting in the second period; that is, the incubation impulse reaches its maximum intensity between the fourth and ninth days of incubation. However, the variation is only in the nature of 2–3%, and the whole period is marked by a surprising degree of regularity. The question arises, "Is there any 'external' factor which would induce the bird to sit 'closer'—for instance, weather?"

According to the situation of the bird's nest, the weather would have varying ability to produce effects. To gauge the effects of the weather in nest No. 1, careful notes were kept of the general conditions pertaining daily during incubation. This nest was built in an Olearia rosea hedge and was thus sheltered from all but the most severe weather. By correlating weather conditions with percentage active period on the nest, it was found that they have no relationship to closeness of sitting.

When considering the length of day in relation to the birds' active period, one immediately asks the question, "Does light intensity have any effect on the time of first leaving and last returning to the nest?" The light intensity at a given time naturally varies from day to day, according to the amount of cloud overhead. By using the time at which the sun rises and sets, combined with the general weather conditions prevailing, one was able to gauge the light intensity sufficiently to indicate the general trend of the situation, revealing only the broadest relationship between the first leaving and last returning times to the sunrise and sunset. The same position in relation to dull and bright days held good.

The length of active period of the bird on the nest is influenced by the length of daylight, however, and does increase as the days draw out.

The incubation period in Nest 1 covers the period 19th September, 1943, to 30th September, 1943, and that of No. 2 covers the period 24th October, 1943, to 5th November, 1943. The average daily active period for the incubation period is 122.75 minutes, and 794.91 minutes in Nests 1 and 2 respectively, thus showing a definite relationship with the length of day.

It is my opinion that the process of egg laying, incubating and brooding and feeding is conditioned by "internal," that is, physiological or psychological factors, and that "external" factors (as described above) have only a very broad effect on the bird's behaviour.

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BIRDS OF MARTIN BAY, 1876-81

Compiled by W. J. Phillipps, Dominion Museum.

In the year 1870 a boatload of immigrants landed at Martin Bay. Prominent among this party was John Robertson, who took with him stores to found a shop and was postmaster and registrar of births, deaths and marriages to the new settlement. As the years passed and the settlement did not progress, John Robertson and his family for some years turned their attention to collecting specimens for the Otago Museum. Hundreds of birds were skinned and forwarded to Professor J. T. Parker, the Curator of the Museum. Many skeletons of birds