ARISTOTLE AND THE CHICK EMBRYO

At *Historia Animalium* 561^{b}27, during the course of his account of chick embryology, Aristotle notes (Bekker's text):

> *περὶ δὲ τὴν εἰκοστὴν ἤδη φθέγγεταί τε κινούμενος ἔσωθεν, ἐάν τις κινῇ διελών, καὶ ἤδη δασὺς γίνεται, ὅταν ὑπὲρ τὰς εἴκοσιν ἡ ἐκκόλαψις γίγνηται τῶν ᾠῶν.*

27. ἤδη: ἢ A^{a}
28. ἄν τις κινῇ D^{a}: ἀντικινεῖ PE^{a}: ἐάν τις θιγῇ Aub.–Wim.
28. ὅταν ὑπέρ: ὅταν δ' ὑπερβῇ Pikkolos
29. ἡ ἐκκόλαψις γίνεται A^{a}: γίγνηται ἡ ἐκκόλαψις PD^{a}E^{a}

D'Arcy Thompson (Oxford, 1910) translated this passage as follows:

> About the twentieth day, if you open the egg and touch the chick, it moves inside and chirps, and it is already coming to be covered in down when, after the twentieth day is past, the chick begins to break the shell.

More recently Pierre Louis, using the same text with one minor exception (29. *ἡ ἐκκόλαψις γίνηται τῶν ᾠῶν*), has given us the following version in the Budé Collection (Paris, 1964–9):

> Vers le vingtième jour le poussin se met déjà à pépier en remuant à l'intérieur, si on le bouge après avoir ouvert la coquille, et il est déjà couvert de duvet quand, après vingt jours, l'éclosion se produit.

Both Thompson and Louis note the parallel passage in Pliny (*Natural History* 10. 74), although Louis errs with his actual reference (10. 74, not 10. 174). This passage reads:

> vicensimo die si moveatur ovum, iam viventis intra putamen vox auditur. ab eodem tempore plumescit, ita positus ut caput supra dextrum pedem habeat . . .

It is the purpose of this short paper to challenge the version of Louis and Thompson and to suggest a new translation based on modern work in the field of chick embryology.

I

As it stands Bekker's text contains a number of problems, both textual and embryological:

1. First there is the phrase *ἐάν τις κινῇ διελών*. This involves someone moving the egg and cutting the egg in two, at which point the chick embryo is said to make a sound from within the shell. The problem associated with this reading is that anyone who examines a fertile chicken's (*Gallus gallus*) egg after twenty days' incubation can hear the so-called 'clicking' of the chick without going to the trouble of breaking open the shell. Moreover, since the chick embryo occupies virtually the whole of the egg by the twentieth day of incubation it seems strange to remark that the chick can be heard making a vocal sound from *within* the shell if the shell has already been broken in two. On a strictly grammatical basis also the force of *διελών* is that of a participle with action

prior to the verb κινῇ, i.e. that (as Thompson translates) someone cuts open the shell and then moves the chick. I myself have tried this operation several times during the course of controlled experiments with incubated chicken's eggs and found that in every case the chick will *move itself* when the shell is broken open after about twenty days' incubation and will immediately start to chirp *of its own accord.* It seems strange therefore if Aristotle states here that the operator should move the chick and then it will begin to chirp, as if it would not do so without being touched or moved. This same criticism can also be applied to Aubert and Wimmer's suggestion (Leipzig, 1868, adopted by Thompson) that θιγῇ instead of κινῇ should be read, for the problem remains that the chick is said to chirp after the shell has been broken and after being touched, whereas in reality the chick can be heard 'clicking' while still inside the intact shell and when the shell is broken open needs no inducement to begin chirping. On the same basis also the PE[a] manuscript reading (where a connection has to be supplied linking ἀντικινεῖ and ἔσωθεν) is contrary to what can be observed and heard. Finally, the passage in Pliny says nothing about an operator opening the egg shell and touching the chick, but rather implies that the chick is within the shell (*intra putamen*) when its noise is heard—which cannot mean that the shell has been broken. In view of all these points therefore it seems illogical and unlikely that Aristotle wrote the phrase ἐάν τις κινῇ διελών, and it can reasonably be assumed that the words were added by a glossator to explain the participle κινούμενος. That this glossator had not performed the experiment with the chick embryo here described is manifest when he uses the word διελών and adds the notion of cutting the shell in two—which is completely contrary to what we can assume Aristotle meant.

2. The second problem associated with the sentence involves the connection and meaning of the phrases καὶ ἤδη . . . τῶν ᾠῶν. If τε after φθέγγεται is coupled with καὶ ἤδη . . . then there are two distinct clauses—the first describing what the normal chick embryo does at about twenty days' incubation, i.e. it makes a vocal sound as it moves, and the second describing an abnormal incubation period of more than twenty days (abnormal, that is, in the light of modern knowledge), when the chick embryo is said to be 'already becoming covered in down'. Is this distinction valid? The short answer is that from a modern biological viewpoint it does not appear so, since a chick embryo can be observed with the naked eye to be covered in down as early as twelve days' incubation. Thus to say that a chick embryo *only* comes to be covered with down in an abnormal incubation period of over twenty days is false. If Aristotle therefore de-shelled chicken eggs at various stages of incubation, e.g. three, ten, and fifteen days, as seems evident from the account in the *Historia Animalium* and *De Generatione Animalium*, then he must have seen that such an account was false. Since there seems no possible motive for adhering to such a false account, we must conclude that Aristotle did not in fact draw the distinction between normal (twenty days') and abnormal (more than twenty days') incubation and did not write that a chick 'already becomes hairy' when more than twenty days of incubation have passed. If this reasoning is correct then the suspect phrase in the sentence must be the clause ὅταν . . . ᾠῶν, and in fact we can find some evidence that this latter phrase is the work of a glossator when we examine the word ἡ ἐκκόλαψις; this is the only occasion in all Greek literature on which the word appears, and although it is just possible that

Aristotle may have written it, it would seem much more likely that it was coined for this particular passage by a glossator as he (mis)interpreted the meaning of the clause. Possibly indeed the phrase *ab eodem tempore plumescit* in Pliny was the basis of such a misunderstanding, *ab eodem tempore* merely translating the Aristotelian Greek of ἤδη and certainly not being used in any sense of contrast with the normal 20/21-day incubation period. Once again therefore it seems reasonable to deduce that the clause ὅταν . . . is a gloss.

II

On this basis therefore it seems logical to excise both the clauses ἐάν τις κινῇ διελών and ὅταν . . . ᾠῶν. This means that we are left with the reading:

περὶ δὲ τὴν εἰκοστὴν ἤδη φθέγγεταί τε κινούμενος ἔσωθεν
καὶ ἤδη δασὺς γίνεται.

This can now be translated:

> Already at about the twentieth day the young chick as it moves makes a vocal sound from within the shell and it has already become hairy.

Although there is still a certain amount of conflict between 'becoming hairy' and 'making a vocal sound' the sentence now accords with observable fact. Moreover 'clicking' and movement by the young chick within the shell are associated in exactly the manner in which we find the process occurring in nature. This interpretation in addition now accords with Pliny's statement that 'clicking' is heard from within the shell, i.e. while the shell is still intact.

III

What more can the passage tell us? To answer this we must first examine modern work on 'clicking'. The latest review occurs in an article by M. A. Vince in *Bird Vocalizations* (ed. R. A. Hinde, Cambridge, 1969); she shows that the sound or click is first heard from the chick (*Gallus gallus*) embryos when lung ventilation begins as, or just before, the embryo's 'shell tooth' breaks through the inner shell membrane separating it from the air space at the end of the shell. P. M. Driver (*Ibis*, cix [1967], 434–7) has recently shown also that the 'clicks' appear to come from within the embryo and coincide with the rhythmic pulsation of the bird.

With these details in mind we can now ask our questions on Aristotle's views; first we must inquire what sort of movement he envisaged would produce the responsive click; the most likely answer is movement by a human operator taking up the egg in his hand. Collias (*Auk.* lxix [1952], 127–59) indeed claims that incubated eggs which are moved in the palm of the hand will give 'pleasure notes'. This seems to tally with Aristotle's phraseology and might therefore be suggested. Secondly we must ask, what is the sound which Aristotle envisaged the young chick as making before hatching? The word he uses in the passage which I have translated is φθέγγεσθαι—to make a vocal sound. This same word is also used to describe the actions of the newly hatched chicks right at the end of the account of chick embryology in the *Historia Animalium*. It reads (562^{a}17, Bekker's text):

περὶ δὲ τὸν χρόνον τὸν πρότερον ῥηθέντα καθεύδει μὲν ὁ νεοττός, ἐγείρεται δὲ καὶ ἀναβλέπει κινούμενος καὶ φθέγγεται· καὶ ἡ καρδία ἅμα τῷ ὀμφαλῷ ἀναφυσᾷ ὡς ἀναπνέοντος.

The close association here between making a vocal sound and respiration seems too much of a coincidence, and one wonders whether in fact Aristotle believed that the noise he heard from within the shell was really the heart or navel beating, or whether he supposed that the 'clicking' was the noise of the bill of the young chick on the outer shell. The use of the word φθέγγεσθαι suggests the former, since it is always associated in Aristotle with vocal sound production.

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