

Since my previous note, the specimens of *Asterias rubens* used in the ordinary classwork of this Department have been carefully examined to see if further examples occurred and several have been found.

In my first note I recorded two out of twenty-five specimens which had this abnormality, and since then another eighty specimens have been examined of which four had ten Tiedemann's bodies. It would appear, therefore, that this condition may be expected in about 6 per cent of specimens, a slightly lower percentage than was previously suggested.

I should be glad to receive information as to whether this condition has been found by others. Negative reports would be as interesting as positive ones. The source of supply would also be a matter of interest.

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<sup>1</sup> *Ann. Mag. Nat. Hist.*, xi, 8, 61 (1941).

## Observations on Bird Behaviour

WITH regard to the letters about birds pecking at windows and apparently attacking their own reflexions, it seems, judging from the reports of Dr. Britton, Messrs. Stephenson and Stewart, and Miss Frances Pitt, that this behaviour is considered to be confined mainly, if not entirely, to cock birds. At least, no mention is made in the correspondence of females behaving in this manner.

At present, there is a hen chaffinch in my garden that frequently pecks at the dining-room window. She has been doing this for five days now, and her pecking periods are astonishingly regular: 8.45–9.5 a.m., 11.30–11.50 a.m., 3.10–3.20 p.m., 3.45–4 p.m.; during these periods, but not of course continually during the period, she will peck at the window. At other times, even though she may be at the bird table near the window, she ignores the glass. The dining-room is a long room with three big windows, each latticed. The same window and the same pane of glass is chosen each time. There can, in this case, be no question of territory defence.

The habit is widespread among birds. I have records of its occurrence in blackbirds, song-thrushes, missel-thrushes, house-sparrows, robins, chaffinches, greenfinches, pied wagtails, grey wagtails, blue-tits, great-tits, cole-tits, spotted flycatchers, starlings and jackdaws. Miss Pitt's record of a dipper is most interesting.

I can offer no explanation of the behaviour. I do not think that territory has anything to do with it—at least in the vast majority of cases. In one case, however, I think the tapping was intelligent behaviour designed to attract the attention of the humans in the room. During the very cold spell of early 1940, we would put food out on various tables round the house (I was then living near Winchester) and especially on a long plank running outside the billiard room. A great-tit frequented this 'table' and would drive all other birds, including a robin, away. If the plank was bare, he would stand and chirp and then fly at the window, striking it sharply, then back to chirp, then fly to strike, and so on. When food was put out he stopped. This particular bird was very tame—tamer than any of the others, most of which

would feed from the hand—and would fly to and sit on my shoulder, remaining there even if I walked indoors, but leaving if anyone approached.

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E. M. Stephenson and Chas. Stewart describe certain actions of a sparrow in what many students of animal behaviour would call somewhat anthropomorphic terms<sup>1</sup>. They then remark that: "It is usually stated that all bird behaviour is instinctive. Much of it can, of course, be adequately described by this term. It seems inadequate, however, to speak as though the whole of animal behaviour . . . can be classified under one of two terms—instinct or intelligence. Such stultified and obsolete terminology has long since been advanced upon by the psychologist dealing with human behaviour." But, by most modern animal psychologists such stultified and obsolete terminology is not employed. It seems, moreover, doubtful whether the study of animal behaviour would necessarily be advanced if, as suggested, investigators used "terms for all the grades of specific psychic phenomena", whether the word 'psychic' be used 'legitimately' or not.

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<sup>1</sup> *Nature*, 154, 801 (1944).

## Open Packing of Spheres

SOME automatic and continuous coal-weighing apparatus make use of the experimental fact that graded-to-size coal weighs the same per unit volume whatever the size of the lumps; hence a cubic foot of large lump coal weighs the same as a cubic foot of small lump coal.

This is easily proved. Let  $n$  be the number of spheres in one foot length; then if there are  $n^2$  spheres in each layer, the total number of spheres in 1 cub. ft. is  $n^3$  and the radius of each sphere is  $\frac{1}{2n}$  ft.

and its volume is  $\frac{4}{3}\pi\left(\frac{1}{2n}\right)^3 = \frac{\pi}{6n^3}$  cub. ft., and as there are  $n^3$  spheres, the total volume of the spheres in 1 cub. ft. is  $\frac{\pi}{6} = 0.524$ ; that is, a little more than half is coal, and less than half is voids. As neither  $n$  nor  $r$  occurs in the expression for the volume, the number and size of the spheres do not affect the weight per cubic foot. This holds good only for the packing implied. If the closest packing is adopted, then the percentage of solids (density) increases as the size of the spheres decreases.

If the packing is such that one sphere touches eight others, then it can be shown that for spheres 1 in. in diameter, the total number in a 10-in. cube is 1,205, and the ratio of the volume of the spheres to a 10-in. cube is 0.631; while if the spheres are 2 in. in diameter, the total number is 132 and the density is 0.553; and if there are 40 spheres in the 10-in. edge, the total number of spheres is 87,388 and the density is 0.715.

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