

KALMBACH, E. R.

1940. Economic status of the English Sparrow in the United States. U. S. Dept. Agric., Tech. Bull. 711.

SKUTCH, A. F.

1940. Some aspects of Central American bird-life. *Sci. Monthly*, 51: 409-418, 500-511.

WITHERBY, H. F., JOURDAIN, F. C. R., TICEHURST, N. F., AND TUCKER, B. W.

1938. *The Handbook of British Birds*. 5 vols. (London.)

Amani

Tanganyika Territory

THE PASSENGER PIGEON
AS OBSERVED BY THE REV. COTTON MATHER

BY FREDERIC T. LEWIS

THE early records of "countless multitudes"—"millions of millions"—of Passenger Pigeons in New England have been gathered by Edward H. Forbush and published in his 'Game Birds, Wild Fowl and Shore Birds' (Massachusetts State Board of Agriculture: 433-472, 1912), and again in his 'Birds of Massachusetts' (2: 54-82, 1927). From his wide reading Mr. Forbush cites, among others, the comments of Governor Dudley, of Governor John Winthrop, and Roger Williams (1643); but the more scientific observations by Cotton Mather have apparently been overlooked. They are found in a curious book—'The Christian Philosopher: a Collection of the Best Discoveries in Nature, with Religious Improvements. By Cotton Mather, D.D., and Fellow of the Royal Society. London; Printed for Eman. Matthews, at the Bible in Pater-Noster-Row. MDCCXXI.' That octavo of viii and 304 pages is well described by its author as a "rhapsody," designed to show "how innumerable are the *Appearances* of Nature which are above the Powers of *Mechanism*." Two very popular books served as his models—one by "the industrious Mr. Ray" [RAY, JOHN. 'The wisdom of God manifested in the works of the creation.' First ed., 1691 (London); 12th ed., 1759 (London); and others later]; the other by "the inquisitive Mr. Derham" [DERHAM, WILLIAM. 'Physico-theology: or, A demonstration of the being and attributes of God, from His works of creation.' First ed., 1713; 13th ed., 1768 (London); and several later]. "*Fratrum dulce par*" writes Dr. Mather, in acknowledging his great indebtedness to their works, "and I give thanks to Heaven for them."

True to form, 'The Christian Philosopher' deals with the whole realm of nature, and abounds in quotations from all the authorities.

Dr. Mather had an imposing library, and consulted "some scores of philosophers" on this occasion. "Most certainly there can be very little Pretence to an I, or Me, for what is done in these *Essays*." And more is the pity. Rarely can he say, as of a tapeworm "about one hundred and fifty foot long"—"*Hisce ipse vidi oculis*" ("I saw with my own eyes"; but "about 150 ft. long" apparently exceeds, several times over, the *authentic* measurements of single tapeworms from the human digestive tract).

Essay XXX, 'Of the Feathered,' is limited to nineteen pages, in which twenty authors are cited, from Aristotle and St. Basil to Coiter, Harvey, Ray, and Derham. Dr. Derham, indeed, had made "some nice microscopical observations" on the rows of little hooks which lock the barbs of a feather in perfect alignment. Although Derham figured them in his 'Physico-theology,' he thought it proper to relegate his own discovery to a footnote. SIR RICHARD OWEN [*Anatomy of Vertebrates*, 2: 233, 1866 (London)] remarks: "As the eloquent Paley well observes, 'every feather is a mechanical wonder'." Paley was impressed with Derham's discovery, and made the quoted comment in a book which Darwin once admired and knew almost by heart. [PALEY, WILLIAM. 'Natural theology,' 1802; 12th ed., 1809 (London); "some forty or more" editions by 1854, superseding Ray and Derham in the same field.] Mather, with a microscope of his own, could have verified that observation, and possibly did so. Yet he is content to write: "Let an Eye assisted with Glasses view the *textrine Art* of the *Plumage*, and as Mr. Derham justly says . . . (etc.)." There was evident need of Agassiz's advice, "Study nature, not books."

Among the native birds observed by the clergyman, the Passenger Pigeon alone was so familiar and remarkable that he brought it into his argument twice, and at some length. First Dr. Mather writes (p. 188):

"Among other Curiosities of *Nidification*, I will mention one that is observed in *Pidgeons* of my own Country. They build their *Nests* with little Sticks laid athwart one another, at such distances, that while they are so near together as to prevent the falling through of their *Eggs*, they are yet so far asunder, that the *cool Air* can come at their *Eggs*. And the REASON for this *Architecture* of their *Nests*! 'Tis this; their *Bodies* are much hotter than those of other *Birds*; and their *Eggs* would be perfectly addled by the *Heat* of their *Bodies* in the Incubation, if the *Nests* were not so built, that the *cool Air* might come at them to temper it."

This is more explicit than the comment of Albertus Magnus ('*De Animalibus*,' Lib. 8, tr. 2, cap. 3, c. 1250) that the nests of pigeons are slack because, having warm bodies, they have no great need of warm nests—an opinion duly credited to Albertus and handed down

by Aldrovandi. Dr. Mather had no thought of experimental verification. Credulously he recorded (p. 190) that "The Conveyance of what *Colours* we please to the Fowl that is hatching, by our painting of the *Eggs*, is a Curiosity." CONRAD GESNER, in his 'Historia Animalium' [Liber 3: 471, 1555 (Zürich); 1585 (Frankfurt)], had remarked: "We have read, in a certain German manuscript, that they say that chicks are hatched of the color with which the eggs to be incubated have been dyed." Aldrovandi ['Ornithologiae,' tomus alter: 225, 1600 (Bologna)] quotes "Ornithologus," perhaps derisively, for citing that vague and anonymous assertion.

As to the pigeons, Mather continues (p. 192):

"I will add a Curiosity relating to the *Pidgeons*, which annually visit my own Country in their *Seasons*, in such incredible numbers, that they have commonly been sold for *Two-pence* a dozen; yea, one Man has at one time surprized no less than *two hundred dozen* in his Barn, into which they have come for Food, and by shutting the door, he has had them all. Among these *Pidgeons*, the *Cocks* take care of the *young* ones for one part of the day, and the *Hens* for the other. When they are taken, we generally take but *one Sex* at a time. In the Crops of the *Cocks*, we find about the quantity of half a Gill of a Substance like a tender *Cheese-Curd*: the *Hens* have it not. This *Curd* flows naturally into their *Crops*, as *Milk* does into the *Dugs* of other Creatures. The *Hens* could not keep their *young* ones alive when first hatched; but the *Cocks* do fetch up this *thickned Milk*, and throw it into the *Bills* of their *young* ones, which are so nourished with it, that they grow faster, and fly sooner than any other Bird among us. None but the *Cocks* which have *young* ones to care for, have this *Curd* found in their *Crops*. Kill one of those *Cocks*, and all the *young* ones pine away to death in the *Nest*, notwithstanding all that their *Dams* can do for them. See *Sirs*, and be instructed!

*Masculus ipse fovet Foetus, atque incubat Ovis;
Conjugii servat foedera casta sui."*

(Father pigeon incubates eggs, and looks after his chickens,
Chastely observing his bond — faithful to conjugal vows.)

In the preceding passage Dr. Mather has made a note of some novelty and importance. Indeed, Aristotle in the 'Historia Animalium,' according to Sir D'Arcy Thompson's translation (Oxford, 1910, p. 613a) had written: "When the young are born, he [the cock] will take and masticate pieces of suitable food, will open the beaks of the fledglings, and inject these pieces, thus preparing them betimes to take food." But Sir D'Arcy notes that most manuscripts and editions have it "saltish clay" rather than "suitable food" that the cock injects. Pliny ('Natural History,' transl. by H. Rackham, Loeb Library ed., 3: 359) observes that when the hen pigeon is producing a brood, "she receives comfort and attendance from the cock. For the chicks at first they collect saltish earth in their throat and disgorge

it into their beaks, to get them into proper condition for food." Twelve centuries later, Albertus (*loc. cit.*) is somewhat more explicit. "When the chicks are young and small," he writes, "the cock comes, and taking the chick's beak into his own, he opens it and pours in an earthy salty substance, so that from the sharpness of the salt the crops of the chicks are opened, and their appetite is stimulated: then alternately in turn father and mother feed the chicks." In modern times the Passenger Pigeon's need for salt was observed by the Indian Chief Pokagon, who wrote: "Certain it is, while feeding their young they are frantic for salt. I have seen them pile on top of each other, about salt springs, two or more deep" [MERSHON, W. B. 'The Passenger Pigeon': 206, 1907 (New York)].

Harvey ('De gen. anim.': Ex. 7, 1651) noted that in the whole family of pigeons (wrongly adding rooks) there is a regurgitation, from the crop, of macerated and prepared food with which the young are nourished "just as infant quadrupeds are fed with milk." Joh. Conrad Peyer ('Merycologia': 27, 1685) quotes this statement from Harvey to bolster his slight evidence that there are ruminant birds.

Following Cotton Mather's much more satisfactory account, the next advance was made by John Hunter, so often considered "the discoverer of the curious phenomenon," though some mention Peyer. In a famous essay, illustrated with two quarto plates, one of the crop from a pigeon when it had no young ones, and the other from a male pigeon while the female was breeding, John Hunter likens the change in the latter to what happens in the udder of female Mammalia during uterine gestation [HUNTER, JOHN. 'Observations on certain parts of the animal oeconomy.' 1786 (London); 2nd ed., 1792. On a secretion in the crop of breeding pigeons for the nourishment of their young; p. 191-197 of 1st ed.; p. 235-241 of the 2nd]. He described the product in the pigeon as coagulating into a curd, "not as being literally so, but as resembling that more than any thing I know." In the crop of the cock pigeon at the time the young were hatching, Hunter found "pieces of white curd mixed with some of the common food of the pigeon, such as barley, beans, etc." But what is fed to the young bird is at first only curd. "About the third day, some of the common food is found mingled with it; as the pigeon grows older, the proportion of common food is increased; so that by the time it is seven, eight, or nine days old, the secretion of the curd ceases in the old ones, and of course no more will be found in the crop of the young." Had Dr. Mather known of such graded infant feeding, he would have transferred to this point his pious exclamation—"Great God, we are amazed!" (*cf.* p. 151).

The graded feeding has been confirmed [LUMLEY, W. F. 'Fulton's book of pigeons, edited by Lewis Wright.' London, 1895, as quoted in C. O. Whitman's 'Behavior of Pigeons,' 1919 (Carnegie Publ. 257, vol. 3). Cf. also BEAMS AND MEYER, The formation of pigeon "milk," *Physiol. Zool.*, 4: 491, 1931.] and the validity of every feature mentioned by Mather has now been determined. He was right in saying that, "when taken, we generally take but one sex at a time," since toward noon the hens leave their nests for food, air, and exercise, and the cocks take their place. "In a pigeon loft at about 2 o'clock, all the cock-birds are sitting"—the hens again in the evening and all the night. But the clergyman was in error in declaring that the hens do not produce the "thickened milk." Hunter found it in pigeons of both sexes, though the male "perhaps furnishes this nutriment in a degree still more abundant." Ordinarily there is no appreciable difference in the quantity produced by the two parents; and Dr. Oscar Riddle has had repeated instances of successful rearing of a pair of squabs by the female alone, or by the male alone, as a consequence of death or removal of one parent close to the time of hatching. Again Dr. Mather was right in asserting that because of the curd the young pigeons grow faster than other birds. Pigeons double their initial weight in three days; ducks (which grow rapidly) in six days; and poultry in nine days (KAUFMAN, L. 'Croissance du pigeon,' *Biol. gen.*, 3: 107, 1927).

Mather's bold comparison of the "tender cheese-curd" with milk is now well established. Hunter, indeed, found that pigeon milk lacked sugar; but it is only slightly less rich in proteins, fats, and ash than rabbit's milk (MLLE. W. DABROWSKA. 'Sur la composition chimique de la sécrétion lactée du jabot du pigeon.' *Compt. Rend. Soc. Biol.*, Paris, 110: 1091-1093, 1932). Histologically also, the crop secretion is comparable with milk, although it does not come from the detached outer ends of cells in branching glands, but from entire fatty cells desquamated from the free surface of a stratified epithelial field. Dr. Litwer, of Leningrad, has provided a full modern account of the process, with references to all the important preceding papers (*Zeitschr. Zellforsch. u. mikr. Anat.*, 3: 695-722, 1926).

But the most remarkable confirmation of the analogy between crop-milk and mammary milk has been provided by Dr. Riddle and his associates. After finding that one of the products of the anterior lobe of the hypophysis, which they later isolated and named *prolactin*, is the specific stimulus for the enlargement and functioning of the crop-glands in pigeons, they showed that the very same product activates

the mammary glands of mammals. When prolactin is discharged into the blood of pigeons of either sex, not only does the crop-gland develop to a functioning state, but parental brooding and self-denying care of eggs and young will then characterize the pigeon's behavior. (RIDDLE, OSCAR, AND BRAUCHER, P. F. 'Control of the special secretion of the crop-gland in pigeons by an anterior pituitary hormone.' *Amer. Jour. Physiol.*, 37: 617-625, 1931. RIDDLE, O.; BATES, R. W.; AND DYKSHORN, S. W. 'The preparation, identification and assay of prolactin.' *Ibid.*, 105: 191-216, 1933. RIDDLE, O. 'Prolactin.' *Sci. Monthly*, 47: 97-113, 1938. Also a personal communication for which the author is greatly indebted.)

If Cotton Mather had known the results of these latest hormone studies, would he have written his 'Christian Philosopher' to show the impotence of mechanism? Presumably he would reflect that the hypophysis is an appendage of the brain, and that the production and release of prolactin may not be as mechanical as an experimental injection. As Professor Whitman has said, "the birds certainly seem to understand what is going on." They may not be altogether predestined Calvinist birds. Since a mechanism is available for causing both parents to suckle their young, or for assigning that duty to either sex alone, there may be wisdom and purpose in the existing order in mammals and mankind. "Chance cannot govern it."

The Rev. Cotton Mather's observations are imperfect and antiquated, yet it is no small achievement to have anticipated John Hunter, while providing the best colonial account of the Passenger Pigeon, and suggesting a possible clue to its amazing abundance.

Harvard Medical School
Boston, Massachusetts

NOTES ON THE RACES OF THE WHITE-BREASTED NUTHATCH

BY JOHN W. ALDRICH

IN the course of identifying White-breasted Nuthatches (*Sitta carolinensis*) from the state of Washington, in connection with the Fish and Wildlife Service's investigations on the birds of that area, the writer has reviewed the geographical variation of this species over its entire range. Since some of the facts revealed by this study do not appear to have been made clear previously in the literature, it would seem worth while to present them here.

Through the courtesy of A. J. van Rossem, an excellent series of