The Abbreviated Inner Primaries of Nestling Woodpeckers.—Under this title Chapin (Auk, 38: 531–552, 1921) placed on record his interesting discovery that in the juvenal plumage of many species of woodpeckers the first, or the first and second (i. e. inner) primaries are but a fraction of the adult size. These abbreviated primaries are molted early in the post-juvenal molt and replaced by feathers of normal size before the young birds leave the nest.

Out of 30 species examined, 9 were found to have two inner primaries reduced, 15 showed reduction of one, 1 species had a narrowed but not shortened first primary, and no reduction was found in 5 species.

Chapin discussed the probable significance of the abbreviated condition and concluded that, "It is probably an adaptation of some utility during early life in the limited space of the nesting hollow." J. T. Nichols suggested that the gap in the wing would allow the nest mates to thrust their heads readily through one another's wings and thus be better able to obtain food. A photograph of a nestling Flicker (*Colaptes auratus*) doing so was presented as evidence for this explanation.

A pertinent question, which Chapin asked, was why "do not other young birds reared in cavities in trees possess this same character?" The purpose of this paper is to offer an answer to this question and to suggest a possible mechanism and reason for the apparently random occurrence of the abbreviated inner primaries of nestling woodpeckers.

First, why should woodpeckers be the only hole-nesting birds to evolve reduced inner primaries in the juvenal plumage? The answer is, I suggest, associated with the fact that, unlike most birds, woodpeckers have a complete post-juvenal molt, in which the remiges are replaced, and which begins before the young bird leaves the nest cavity. The inner primaries are the ones involved because the primary molt sequence proceeds from inner toward outer, i.e., is centrifugal. Since the wings are not utilized until fledging occurs there is no selection pressure present during the nestling period to develop the flight feathers of the juvenal plumage *except those which otherwise would not have time to be dropped and replaced before fledging.* Since the post-juvenal molt begins before fledging, it is possible in some species for one or two of the juvenal inner primaries to be dropped and regrown before they are needed. Fledging apparently occurs at about the time that the inner primaries reach full size. In species which do not have a complete post-juvenal molt this arrangement could not evolve since the wing feathers would not be replaced during the post-juvenal molt. But why, one may ask, should this arrangement develop? Would it not be equally advantageous if the juvenal primaries grew to full size during the nestling period and were later replaced during the post-juvenal molt occurring after fledging? To answer this it is necessary to discover an advantage associated with having reduced inner primaries during the nestling period. Mr. Nichols' suggestion that the gap in the wing enables nest mates to raise their heads through one another's wings for feeding is certainly one advantage. As additional factors the following are suggested.

Since the inner one or two juvenal primaries are dropped and regrown to full size before being needed for flight there is no selection pressure present to cause these feathers to grow to full size. Selection against their full growth is derived from the fact that their absence or reduction lessens the physiological drain associated with feather growth, probably makes it easier for the nestling to fold the wing, and, to some degree, reduces the crowding in the limited confines of the nesting cavity. The first of these three possibilities is probably the most important; the metabolic saving resulting from not growing a useless feather should be of considerable importance.

As an answer to the second question, concerning the seeming randomness of occurrence of the abbreviated condition, the following is suggested. Since the fledgling requires an efficient airfoil for flight, selection would be against young which were fledged with a gap in the wing. The number of feathers involved and the extent of the reduction of the juvenal inner primaries is, therefore, probably correlated with the relationship between the time of fledging and the speed of the post-juvenal primary molt. The abbreviated condition of the inner primaries is an advantage to the nestling which becomes a disadvantage to the fledgling. The balance between these factors results in the apparently random variations found among different species in the extent of the abbreviated condition. In the sapsuckers (*Sphyrapicus*), the Lewis Woodpecker (*Asyndesmus lewis*), and the White-bellied Woodpecker (*Leuconerpes candidus*), Chapin found that there is no reduction in the size of the juvenal inner primaries. In these species it is likely that the post-juvenal molt does not begin soon enough to permit the juvenal inner primaries to be abbreviated during the nestling period but dropped and regrown before fledging. Chapin (*op. cit.*, p. 545) notes that a young Lewis Woodpecker, with a full-grown wing, showed, "no sign either of reduction of the inner primaries or of a beginning of post-juvenal molt." This seems to be admissible evidence in favor of the hypothesis offered above. Some statements by Bent, although not supported by incontestable evidence, suggest that the post-juvenal molt in the Lewis Woodpecker and the sapsuckers may not begin until after fledging. He states (Bull. U. S. Natl. Mus. 174: 229, 1939) that the post-juvenal molt of the Lewis Woodpecker begins in September, some two or three months after fledging and (p. 132) that the post-juvenal molt in the Yellow-bellied Sapsucker (*S. varius*) is accomplished by a series of partial molts which may begin in July, after fledging, and last until early spring.

Similarly, the species with one abbreviated inner primary are apparently those in which the post-juvenal molt begins early enough to allow time for one primary to be dropped and regrown while the species with two abbreviated juvenal inner primaries have a relatively still earlier post-juvenal molt. As previously noted, this hypothesis also explains why the inner primaries are the ones involved—simply because the primary molt begins with the inner primary and proceeds outward.

If this hypothesis is correct why should not other species having a complete post-juvenal molt have evolved a similar arrangement? A quick survey of available references containing information on molts does not reveal any other species in which the post-juvenal molt begins before fledging (Witherby, *et al.*, Handbook Brit. Birds, 1944; Dwight, Ann. N. Y. Acad. Sci., 13: 73–360, 1900). The reason why woodpeckers should be unique in this respect (if indeed they are) is probably related to their long period of nestling life. It is well known that the woodpeckers, and their relatives the toucans, honey-guides, and barbets, have relatively short incubation periods but exceptionally long periods of nestling development before fledging.

It seems possible then, that the abbreviated inner primaries of nestling woodpeckers are an adaptation to nest life, which also provides a metabolic saving, and that the evolution of this condition has been possible because of the unique combination of a complete post-juvenal molt, beginning with the inner primaries, and an unusually long period of nestling life.—CHARLES G. SIBLEY, *Department of Conservation, Cornell University, Ithaca, New York.*

The Loss of Teeth in Birds.—The fact that birds have lost their teeth during the course of evolution is well known but the adaptive advantages which prompted this loss are not known. Nearly every avian feature is concerned in some way with