The publication of No. 2 of the Proceedings for 1869 was announced.

Oct. 12*th.*

The President DR. HAYES, in the Chair.

Twenty-eight members present.

The following paper was presented for publication: "On the Law of Development in the flowers of Ambrosia artemisiæfolia." By Thomas Meehan.

The death of Mr. Frederick Klett was announced.

Oct. 19*th.*

DR. BRIDGES in the Chair.

Fifteen members present.

Oct. 26*th.*

The President, DR. HAYES, in the Chair.

Twenty-six members present.

The monthly report of the Biological and Microscopical Section was presented.

On favorable report of the Committees, the following papers were ordered to be published:

On variation in the Genus ÆGIOTHUS.*

BY ELLIOTT COUES, A.M., PH.D.

Study of this genus will show a series of facts apparently of some general application, on the question of the mutual relations, if not actually of the origin, of the various forms, usually held to be species, that compose associations of corresponding grade. It is not to be supposed that this genus has labored under any peculiar or isolated conditions, or been subject to any special laws of development that have resulted in the state of things that is found to obtain. Whatever these conditions and laws may have been, they are presumably—in fact, almost certainly—equally operative upon more or less allied groups. Though it seemed to the writer, at one time, that there was something peculiar in the kind of variation to which Red-polls are subject, later investigations render it probable that such is not the case. Analysis, therefore, of the phenomena of this one group, carried into details, may be the means of deducing some generalizations not wanting in import.

It is not proposed to consider how the genus *Ægiothus* became what it is,—that is, by what means it secured individual existence as an entity distinct from all surrounds, differentiated by certain characters from the most nearly and most remotely allied types; that is a question of the origin of genera,† foreign to the present subject. We are to take the genus as it now is, and study characters of the grade next below generic, in the hope of tracing some of the laws that have been effective in sorting out, among the birds of the group, the precise features they are found to possess.

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* See these Proceedings, Nov. 1861, p. 373, et seq.; and Feb. 1862, p. 40.
† See Cope, Proc. Acad. Nat. Sci. Philad., Oct., 1868.

It is immaterial what name is given to the several assemblages of individuals that make up the genus. Some authorities admit but one, or at most two, "species"; others six or eight. With a common standard of reference, both parties cannot be right. If there be such a standard in nature, not dependent upon the minds of ornithologists, the difference clearly results from the fluctuating position that the latter have assigned to it; and a human fallacy, one way or the other, is implied. If, on the contrary, no such standard exists, one of the above mentioned views is as true as the other. As will be seen in the sequel, the probability is that the latter proposition comes nearest the truth. At any rate, during this discussion, until some conclusions are reached, the terms "variety," "race," and "species" will be used interchangeably, as may be most convenient for the designation of such groups as it may be necessary to speak of,—not in the conventional sense that these words have gained. And by the term "*Ægiothus*" I wish to be understood as referring, not to the abstract idea of the genus so designated, but collectively to the million or more individual birds that are to-day living upon the earth, as the concrete expression of the genus they constitute.

It is demonstrable, I believe, that these birds constitute a genus; that is, that they are separable from all other birds whatsoever, by a set of characters of higher grade than those by which they have up to this time been differentiated among themselves. There is no break or flaw in the bird by which it is possible to circumscribe them. There is no shading into or graduating towards this or that allied generic group. No bird has yet been discovered of which it cannot be predicated, without qualification, that it either is, or is not, one of the *Ægiothi*. If it is, it will be found to exhibit the following combination of characters; and no bird, not presenting just this combination, is an *Ægiothus*:

The culmen barely or not curved, as long as the middle toe without its claw, and not over four-tenths of an inch long; the upper mandible beset at base with retrorse plumules, more or less concealing the nostrils; the lower mandible without ridges; the point of the wing formed by four primaries, of nearly or absolutely equal lengths; the length of the wing from carpus to tip barely exceeding one-half the total length from tip of bill to end of tail; the tail four-fifths to five-sixths of the length, forked, with broad, rounded feathers; the middle toe without its claw not over two-thirds as long as the tarsus; the hind claw longer than its digit; the crown of the head some shade of crimson; the colors of the back not in well-defined areas; the rump lighter colored than the rest of the upper parts; the adult male with the breast of some shade of red, and the throat unstreaked.

It is common to speak of the "type of a genus," and in this instance *A. linarius* is generally held to be such. But it is evident that if the above characters of the genus were to be drawn exclusively from this species, they would be rather specific than generic, and would require qualification. A diagnosis drawn as closely from *linarius* alone as the foregoing is drawn from the six or eight forms together, would exclude at least two,—*rostratus* and *canescens*. In fact, if such expression be allowable, it may be said that *linarius* rather exaggerates than typifies *Ægiothus*; that is, makes *Ægiothus* out to be more different from other birds than it really is; for *rostratus*, for instance, in the features of size and shape of bill, more nearly resemble *Linota* or *Leucosticte* than *linarius* does. It is only by weighing all the phases of the genus together, taking an average, and weighing this against other averages, that a diagnosis of the genus can be obtained. Upon this method I have framed the foregoing definition, which I believe applies to *Ægiothus* alone; and, as has been premised, it is highly satisfactory to find that the subject in hand may be so definitely limited. I see no "type" of this genus, except in an ideal—certainly no known existing—bird, that combines the attributes of all, without presenting exclusively the special characters of any, of the species.

If there was ever a time when all the then existing *Ægiothi* resembled each other as closely as those now called "*linarius*" do,—in other words, if the ge-

nus was ever unispecific, and has since by whatever causes been made otherwise by differentiation of several phases, then *linarius* was perhaps the actual type of the genus. But as at such time the genus was then rather forming than formed, it is more probable that the characters of *linarius* (*i. e.*, of *Ægiothus* in its entirety) were *then* specific only in relation to such types as *Linota*, *Leucosticte*, *Chrysomitris*, &c. So at any given moment in bird-life, a generic type or plan is an ideal induction of ours, rather than a material existence.

It is true, nevertheless, that at present *linarius* is the most common and widely distributed aspect of *Ægiothus*, and that it comprehends a larger per centum of *Ægiothus* than any other form. Were it the only phase of *Ægiothus* now living, we could handle the genus in much the same manner as we shall have occasion to with consideration of other forms. I shall for the present assume that *linarius* is *Ægiothus*, and see if it is possible, upon this hypothesis, to account for the balance of *Ægiothus* that are now living more rationally and naturally than they can be accounted for upon any other premise.

It is specifically characteristic of the "typical" (*i. e.*, normal, or most usual and general) *linarius* to be, 1, under six and not under five inches long; 2, with a wing 2·75—3·00 inches long; 3, a tail 2·25—2·65 inches long; 4, a tarsus equal to the middle toe and its claw; 5, a bill compressed-conic, very acute, with not appreciably curved culmen, and never wholly yellow or wholly blackish; 6, the light and dark streaks of the back about equal in amount, and mingled with an intermediate color; 7, the rump never wholly unstreaked, yet always lighter than the back; 8, the male sex indicated by a bright color on the breast and rump that is between deep crimson and pale rose, yet not reaching, under mature conditions, either of these extremes.

It is to be observed, in the first place, that a large per cent.—perhaps ·50 or more—of *Ægiothus* have preserved these special conditions inviolate. Upon these birds neither geographical regions, latitude, longitude, climate, or any other perturbating influences have exercised the slightest appreciable effect. Specimens from all parts of Europe, from Hudson's Bay, New York, Southern States, Kansas, Oregon, Sitka (and Asia?), may be found as closely resembling each other as birds from the same nest ever do. In short, there are no differences. As similar *Ægiothi* as I ever compared were from, respectively, Germany and the Rocky Mountains; and probably more than half the specimens at present existing in all the collections in the world will be found thus correlated. So it is a fact that, whatever influences have been brought to bear upon *Ægiothus*, tending to produce, or producing its differentiation or forking into several recognizable channels, such influences have been *nil* in effect upon most individuals.

This is the first broad fact to be remembered. It is not an isolated one. On the contrary, it is one of a parallel series of large extent. In the cases of a number of boreal and arctic types, as *Nyctea*, *Surnia*, *Pinicola*, *Ampelis* sp., and *Plectrophanes* sp., among land birds, and still more among natatores, as the glacial *Lavidæ*, *Anatidæ*, *Alcidæ*, &c., we find the Nearctic the same as the Palæarctic; and generally, the more nearly circum-polar types are, the more likely it is, *cæteris paribus*, that distinctions between these two regions will be reduced to zero. It is to be observed, further, that *linarius*, besides being in longitude the most widely dispersed phase of *Ægiothus*, is at the same time the most restless element of its genus. It has properly no special abiding place; its movements are irregular, almost spasmodic; it is found as far north as most, if not any, other forms; and, at least in the United States, ranges further south than any. I think it probable that the clue to its singular constancy is to be found in this fact: individuals not being subjected through series of generations to precisely the same climatic and other influences, in consequence of which the equilibrium, so to speak, is preserved, and variation in this or that special direction opposed. This inference seems just, and is corroborated by the fact, about to appear, that the more geographically re-

stricted a certain per cent. of *Ægiothus* is, the more decidedly and extremely does such per cent. differ from the rest.

I. To take up this point next: A certain part of *Ægiothus*—perhaps only one or two per cent.—now live, and probably always have lived, in Greenland. A few years ago this fraction of the genus received from Mr. Gould the name of "*canescens*," in reference to a certain condition of plumage. By this word we may summarily imply the fact that these birds differ from *linarius* in the following particulars: 1, larger size, averaging six inches in length, with wings and tail to correspond; 2, a less compressed, less acute, more regularly conic bill, differently colored, with heavier nasal plumules; 3, not correspondingly enlarged feet, the toes, especially, being relatively shorter; 4, marked deficiency in coloring matter of the feathers, which makes the whole plumage a more hoary-whitish, leaves the rump pure white, reduces the streaking of the under parts, and lightens the red of the adult ♂ to a pale rosy. These are simply observed *facts*, not open to cavil. It is also a fact that these physical condition of Greenland *Ægiothus* represent the extreme of differentiation that *Ægiothus* has yet attained; for no known bird of the genus differs so much from the common standard, *linarius* as *canescens* does. These facts are to be reasoned upon in connection with the following considerations:

As just stated, *canescens* is the most local, as well as the most boreal, demonstration of the genus. It is confined to Greenland; at least, it only reaches its characteristic manifestation in that country. Though quoted from North America, the citation is held, upon the best of grounds, to be erroneous. It is recorded from Northern Europe; I have seen no typical specimens from such localities; if really occurring, they can scarcely be regarded as more than adventitious. All other styles of *Ægiothus* range over more ground than this one; if then, according to any laws whatsoever, extraneous influences effect permutation of individual characters after a sufficient number of generations, we should expect such causes to be more efficiently operative in the case of the Greenland birds than in any other. Such is found to have been the case. *Canescens* has for an indefinite time been subjected to certain special, if not exceptional, conditions, with the witnessed result as above detailed; which is tantamount to a demonstration of the assertion already made, that the most local *Ægiothi* are the most specialized ones.

The fact of this greatest differentiation settled, we have next to inquire how far the particular *kind* of modification that has been brought about is amenable to certain laws that have been found of extensive applicability. I think that, with perhaps one exception, all the distinctive features that *canescens* presents are explainable by reference to some of these known laws.

An increase of size, coincidently with increase of latitude, has been shown by Baird* and others to be of wide application in the cases of species ranging over many degrees of latitude. It is unnecessary to cite examples. The case of *canescens* vs. *linarius* is a parallel one. If it be objected that in this case we are dealing with two distinct "species," instead of variations in a single species, it is to be replied that the "specific" distinctness of *canescens* is precisely the point at issue, not a proven theorem. Moreover, it is to be observed that this distinction in size is one especially marking, not birds that migrate over a great extent of country, but those resident species, individuals of which are comparatively stationary, some living north, others south. It is here that the law comes most clearly into play, and *canescens* is the only set of individuals that conforms to this requirement; the others (with possibly one exception) are more or less migratory. So we can see why *linarius* taken at Hudson's Bay and in Carolina should be of the same size, while *canescens* surpasses their dimensions.

Whether as effect of climate, adaptative modification, or pure incidence (but more reasonably the former), the fact remains that a large number of genera

* Baird, B. N. A., passim, and Am. Journ. Sci, and Arts, 1866, p. 20.

more or less arctic present white forms. Among mammals it is only necessary to allude to *Ursus*, *Canis*, *Lepus*, &c. Among birds may be cited the *Lagopus* from the *Tetraoninæ*, *Hierofulco* and *Nyctea* among raptores, and in the present family of the *Fringillidæ* certain species of *Plectrophanes*. Looking to water-birds, it is observed that in the large cosmopolitan genus *Larus*, nearly if not all the tropical and temperate zone species of which have the back black or blue, and the primaries crossed with black, the glacial species (*e. g.*, *glaucus*, *leucopterus*, &c.) have not this color on the wings, and the mantle is very pale, or even white, as in the case of *L. hutchinsii;* the exclusively boreal Larine genus *Pagophila* is all white. It is the same with the most boreal geese, as *hyperboreas*, *rossii*, &c. Among *Procellariidæ* the most glacial genus, *Fulmarus*, is the palest; and an antarctic species, *Thalassoica antarctica*, is similarly paler than most of its allies. The modifications of color that the Greenland *Ægiothi* have sustained are exactly homologous. This is too evident to call for argument. Moreover, besides the whitening of color, it is a matter of common observation that pelage of mammals and plumage of birds is likely to be increased or otherwise modified in cold regions, or even at colder seasons of the year, for an evident purpose. The covering of the skin is increased in two ways: by thickening over parts already covered, and by extension over parts ordinarily naked. The feet of the Ptarmigan, of the Snowy Owl, of the Northern Hare, are good illustrations of the last. Now in *canescens* we see both these methods in play. There is a peculiar soft thick mollipitose condition of the plumage, not seen in other species, and the little modified feathers that surround the base of the upper mandible are lengthened and thickened till they form a dense ruff concealing the nostrils. It may be also remarked, by the way, that this ruff is one of the diagnostic characters of a large group, although a true subfamily, of *Fringillidæ*, many if not most of the species of which are more or less boreal birds.

One other feature of *canescens*,—the want of enlargement of the feet in correspondence with increase in other dimensions,—I shall revert to in another connection.

As the case stands with *canescens*, few if any ornithologists would deny this fraction of *Ægiothus* "specific" rank. But if the laws that we have just been noticing have any meaning,—if they are not mere word-formulas, shadowy and insubstantial,—there is no reason to suppose that *canescens* was not at one time *linarius;* nor that, if the physical barriers—the geographical restrictions—that now hedge it about were taken away, and it were permitted free migration and unrestrained commingling with other *Ægiothi*, it would not revert to *linarius* in the same length of time, or less, that was required for its aberration.

It seems to me that the special conditions and relations of *Ægiothus canescens* give it forcible bearing upon the generic question of the origin of species; and it is evident on which side it stands as witness.

II. A correlation of species in the matter of size, other than that just spoken of as dependent upon latitude, is frequent among birds. It may be accompanied by apparently unimportant, and certainly not very noticeable, differences in color, proportions of parts, &c.; a correspondent variation of the bill being among the more common This law, so to speak, reaches a maximum, as the writer has shown,* in certain pygopodous birds. In the families *Colymbidæ* and *Podicipidæ*, in fact, it is possible to range the species in two parallel series, one of which is the counterpart of the other in case of almost every species, in nearly everything but size. Thus there is a larger (*C. Adamsii*) and smaller (*C. torquatus*) Loon; a larger (*articus*) and smaller (*pacificus*) Black-throated Diver; a larger (*holboëlli*) and smaller (*griseigena*) Red-necked Grebe, and so on. The three North American species, so called, of *Accipiter*, are admirable illustrations. Examples without number could be advanced, but

* Proc. Acad. Nat. Sci. Philad. 1862, p. 228.

these will suffice. In all these instances the foregoing law of increase in size with *latitude* has no part; for these birds always may be, and, as a matter of fact, usually are, more or less associated. The genus *Ægiothus* is also obnoxious to this special kind of variation, which remains as yet unexplained.

There are in Europe, and probably also in America, two races, or varieties, of Redpolls, that differ from the ordinary style of *Ægiothus* in little except size. One is smaller, the other larger. The latter has, in addition, a somewhat (but barely appreciably) larger and more yellowish bill than average *linarius;* but none of these points, even that of size, are sufficiently marked to be obvious and unmistakeable except in the extreme they have as yet reached; that is, intermediate individuals now living complete a gradation back to *linarius*. This form is called *Ægiothus holboëlli*, after Bœhm; it has been on record but a few years. It is found in northern and western Europe, associated with *linarius;* and I have seen identical samples from Canada. The smaller race has been longer known. Though usually credited, as *Fringilla rufescens*, to Vieillot, somewhere about 1817, it was an old entry in the books at that date. Brisson describes it with his usual accuracy; Müller has it in his Supplement, of 1776, as *F. cabaret*. Although authors speak of a notable amount of rufous in the plumage, over and above that commonly exhibited by *linarius*, there is reason to suspect that this is exaggerated. Very young *linarius* is largely rufous; and it is credible that, age for age, and season for season, the difference in the colors of *rufescens* and *linarius* is not very tangible. Difference in size, then, is the main if not the only point in this, as in the former case; and *rufescens*, as surely as *holboëlli*, grades in this respect with *linarius*.

Were these larger and smaller birds separated from each other and from *linarius* by geographical range, and particularly by a difference in latitude, we could argue more plausibly concerning them. In such case, even the slight difference that exists might be traced to some cause, and be really of more consequence, in a classificatory point of view, than it now appears to be. In the larger bill of *holboëlli* we might see the operation of the same *class* of causes (however obscure their special determination may be) as those that, *e. g.*, have sharpened the bills of all the White-bellied Nuthatches west of a certain meridian, enlarged the Florida Crows' bills, turned the California Magpies' bills yellow, strengthened the claws of the Arizona black Pipilos, drawn out the tails of western Mocking Thrushes, put warts on the bill of *Anser rossii*, and produced a thousand modifications corresponding in degree, though so different in kind. As the case stands, we are totally in the dark. We had best, perhaps, content ourselves with bare statement of the fact that a certain per cent. of *Ægiothi* have proven susceptible to some special unknown influences, and have consequently undergone certain modifications that the rest, though similarly exposed, have successfully resisted. If we go further, it must be upon speculative grounds. We may conjecture that these two races are forming species; that they began to be differentiated within the last few thousand years, more or less; and that in the process of time they will either become permanently distinct, the differences that they have become possessed of being of advantage to them; or that they will eventually revert to an original standard, such differences proving useless. A supposition as little likely to be substantiated as refuted, except by analogical reasoning.

At present, ornithologists are very properly indisposed to look upon *rufescens* and *holboëlli* as anything more than "varieties" of *linarius*, and as not even very satisfactorily defined varieties. But I hold it to be demonstrable that the characters that separate these birds from *linarius* are of the same kind (though of different degree, or intensity, so to speak) as those distinguishing the Greenland Red-polls from *linarius*. The characters of all the *Ægiothi*, once reduced, as they can be, to the same level, and shown to differ only by varying force of expression, I see no means of distinguishing any set of the birds from the rest, *as species*. Intermediate links of the chain are easily found,—links that bind the whole so firmly that there is no break in the series between the

smallest and darkest, and largest and lightest sets of individuals as yet discovered. To prove this I must bring forward the curious variations that *Ægiothus* has sustained in northern North America.

III. I discovered in Labrador, in 1860, and soon after published a description of, a small Red-poll that I called *fuscescens* on account of its color. Specimens had before, however, been collected, and I am inclined to think this form is the one figured by Audubon for the common species; but *fuscescens* is, as far as known, its earliest designation. These Red-polls have since been traced quite across the continent, in British America, to Sitka; specimens are contained in nearly all the collections from the interior. With this extensive range in longitude, the birds' latitudinal dispersion is rather unusually limited. They appear to be mostly confined to boreal America, rarely entering the United States, and then only along its northern border; at least, I have seen no good examples taken further south. Throughout British and Russian America they are liable to be associated with true *linarius* at any point. In Labrador, however, they are the prevailing, if not the only form. They are also associated in the interior and on the west coast with another "species," to be noticed presently. It is difficult to estimate their numbers relative to those of the two other species; perhaps they are one for ten or twenty, or even in less proportion. These birds differ from *linarius* in, 1, smaller size, though this is not very evident except on striking averages; 2, in relatively and absolutely larger, heavier, and wholly blackish bill, furnished with unusually short and sparse plumules; 3, in color, which is above dusky, scarcely relieved by lighter streaks, the rump only a trifle lighter than the rest of the upper parts, the sides very heavily streaked with dusky, and the red of the male breast intense crimson.

The form is not to my knowledge found in Europe. Whatever causes have operated to produce this special modification in *linarius*, they have not been effective in Europe, and have moreover in America only affected a small per cent. of the total number of individuals. The resulting changes I cannot attempt to explain. Besides being not referable to any known general laws, they are in direct opposition to these. Climate, geographical position, &c., should, as we saw so satisfactorily in the case of *canescens*, have enlarged and blanched these birds, and given them heavier plumules, whereas we have the contrary condition. We might suppose, indeed, that the wide dispersion and irregular movements of the Dusky Red-polls may have interfered with the equable operation of the laws just alluded to, but this does not account for the diametrically opposite result attained.

The relations of this style to typical *linarius* may be briefly exposed. So far as known, it is decidedly more different from the latter than either of the two forms last considered are. Out of several hundred specimens examined, there are a few that cannot be referred without a query to either species; these are all from the interior of British America, and most of them are immature individuals. Except in these rare instances, the line between the two kinds is distinctly drawn. There is just a possibility that these dusky birds represent a *seasonal* aspect of *linarius;* but almost everything is against the suggestion. On this supposition, the dusky birds ought to be found, at times, wherever *linarius* occurs,—which is not the case, as far as known. The difference in the average size, and particularly in the size and slope of the bill, is not satisfactorily disposed of in this way.

If I were to venture an hypothesis in this case, I should be inclined to frame one looking to such a class of causes, as, for example, that which has operated in the Colorado desert in bleaching birds. As is well known, several birds chiefly confined to that region are paler and grayer than their congeners (conspecies?) elsewhere. An influence of this class, working in an opposite direction, may have modified a certain fraction of northern *Ægiothus*, such as character of the forest or shrubbery mainly inhabited by these birds, the

nature of the food obtained there, &c. I noticed nothing, however, in Labrador, that seemed sufficient for such end. It would be interesting to have information upon this point from observers in the interior of Arctic America.

If *canescens* has been shown to have probably been at one time *linarius*, and subsequently modified, as we have seen, by the operation of known laws, I see no reason for supposing that *fuscescens* is more distinct because we cannot so readily trace the laws under which it has been made what it is. We have only to take for granted, in this case, either a later departure from the common standard, or, what is more probable, a less regular, continuous, and consentaneous operation of modifying influences. In *rufescens* and *holboëlli* the effect of these influences is as yet barely apparent; in *fuscescens* it is already very evident.

In Greenland, side by side with the blanched mollipilose *canescens*, we have a few singular *Ægiothi*. It seems as if they had sprung like offshoots from *fuscescens*, and there in Greenland, stationary or nearly so, and isolated, the law of latitude had come into play to enlarge them; but that further interference with fuscescent features had not been experienced. These *Ægiothi*, that I call *rostratus*, are: 1, as large as, or scarcely less than *canescens* (about six inches long); 2, with a bill that is even an exaggeration of that of *fuscescens*, being still larger, thicker, more turgid, with short plumules, and black in color; 3, with the colors of *fuscescens*, the heavy stripes on the side being sometimes carried quite across the belly. There appear to be fewer of these than of any other *Ægiothus*; I have not seen a dozen in all, and none except from Greenland. One or two of these are appreciably lighter than the rest, and in fact, shape of bill and total size apart, rather recall dull plumaged *linarius*. I scarcely know what to make of this form, after accounting for its size as above, and prefer to leave it with this simple statement of fact. In a classificatory point of view, it appears to hold somewhat the relation to *fuscescens* that *canescens* (or possibly rather only *holboëlli*) does to *linarius*. Though I did not reach such opinion in my monograph of 1861, I should now, in spite of its several very obvious peculiarities, consider its characters, in relation to those of *fuscescens* or *liniarius*, as of less systematic value than those of any "species" except *rufescens* and *holboëlli*. The small number of specimens at my command will not allow me to expose the precise degree in which it graduates towards *fuscescens*; but it is probable that some such assimilation occurs, and that nothing but the birds' isolation in Greenland prevents them from shading insensibly into *fuscescens*.

IV. Perhaps the most interesting modification of *Ægiothus* remains to be noticed; I refer to what I call *exilipes*. Audubon figures it by mistake for *canescens*, which I presume he never saw; and Elliot has recently given another illustration. It is the "mealy red-poll" of American, but not of European, writers. The peculiarities of *exilipes* do not occur, so far as known, in Asia, Europe, or Greenland, but they are characteristic of a large number—perhaps the majority—of boreal and arctic American *Ægiothus*. These modified *Ægiothi* do not come so far south as *linarius* does; in general they may be said to be confined to British and Russian America, though some appear to occasionally pass the northern boundaries of the United States in winter. They are very generally dispersed, being contained in almost every collection sent from the interior and the north-west coast, but are perhaps more abundant westward. They are migratory, if irregularly so. They sometimes seem, judging from collections, to be the only form in some localities, but more generally they are associated, if not at the same season of the year, with *linarius* and *fuscescens*,—sometimes both. It seems as if there were a wave of *linarius* swaying north and south, between certain parallels of latitude; another of *exilipes* between certain higher parallels; yet the two regularly meeting on common ground, and each sending and preying still further in the direction of the other.

The characters of *exilipes* are these: 1, size of *linarius*; 2, colors (very

nearly) of *canescens;* 3, a smaller, more regularly conic bill than *linarius*, generally rather dusky than yellow, and with extremely heavy plumules; 4, remarkably small feet, produced mainly by absolute shortening of the toes. We have here a unique assemblage of characters; the modification that this per centum of *Ægiothus* have undergone is not just like that of any other. Climate, apparently, has, as in the case of *canescens*, done what might have been expected in respect to color: it has bleached the tints into the semblance of those of *canescens*, taken away the stripes from the rump, leaving this largely and purely white, and reduced those on the sides to a minimum; whitened the edges of the wing and tail feathers; made the rosy paler, and thickened the nasal plumules. Latitude, on the other hand, has not effected any perceptible increase in size. This is curious, viewed beside the case of *rostratus*, in which size is increased, but color unaffected. Superadded to these changes is the singular modification of the feet.

As is well known, absolute size of these members, and relative proportions of the toes to each other, as well as to the length of tarsus, are among the more constant features that birds present. Only a narrow margin seems to be allowed, in the same species, for variation in these respects. In fact, looking over the annals of ornithology, one is struck with the number of proposed species called "longipes," "brevipes," "brachydactylus," etc., that have subsequently been shown to be only accidental, or very partial modifications, not holding good as a general rule. There are a great number of synonyms of this particular class, needing no more than this allusion. At the same time, it is equally well known that certain closely allied birds do really differ in precisely this particular,—sometimes with other peculiarities superadded, sometimes with scarcely any, or none. A more or less decidedly terrestrial or arboreal mode of life may reasonably be presumed, if not logically inferred, to have something to do with this change. The case is better illustrated in comparing allied genera. Thus *Mimus* is an eminently bush- and tree-living genus; the species of its nearest ally, *Harporhynchus*, spend much of their time on the ground, walking and scratching among leaves, &c. The feet of the latter are correspondingly larger and stronger than those of the former. The same is the case regarding *Pipilo*, as compared with other allied genera less eminently, or scarcely, terrestrial in habit. If such modification can be traced in this grade of forms, I see no reason why it should not be exhibited, in however much less degree, between congeneric species that differ in a more or less decidedly arboreal mode of life. Admitting, then, possible modifications of the feet, in specific as well as generic grades,—modifications correspondent to the nature of the foot-hold that the birds habitually take,—there seems no reason why the argument by analogy should not be carried a step further, and made to include possible results from a difference in the kind of trees or bushes, or the kind of ground that arboreal or terrestrial species respectively frequent. Terrestrial sparrows of muddy situations will probably be found to have some modifications of the feet not shared by those of sandy deserts, or of rocky gorges. Rush-sparrows, as *Ammodromi*, that climb up perpendicular swaying stems, have not the same feet as their nearest allies among bush-sparrows that habitually rest upon horizontal and less yielding twigs. These are merely illustrations in point of what I wish to propose,—namely, that the small feet of *A. exilipes* may be due to a difference in the size, texture, &c., of the trees or bushes that they habitually frequent, or are really confined to, as compared with the greatly varying range of footholds that *linarius*, in its extensive movements, necessarily takes. It does not seem irrational to suppose that the stunted resinous conifers that form so marked a feature of the northern flora may have produced, in the course of time, the modification that is now witnessed. However well or ill grounded the suggestion may be, it is at least a fair inference; and, at any rate, I know of no other assignable cause for the observed fact.

As intimated when *canescens* was spoken of, it is interesting to note that the

same condition of feet is found in that species. The feet, indeed, are larger than those of *exilipes*, and the tarsi, particularly, are long; but the toes are still notably short, in a relative sense, not having increased *pari passu* with enlargement in other respects. I would attempt to explain this fact in the same way.

So far as I know, the claws of *Ægiothus* have not been modified coincidentally with those changes that have made the several races what they are. The claws of *exilipes* and *canescens*, indeed, are longer, compared with the toes, than those of other forms; but this a relative, not absolute difference. The claws of all the species are liable to vary within rather wide limits.—this discrepancy belonging clearly, however, to the class of individual peculiarities.

The conclusions to be drawn from the foregoing facts are obvious. We have seen that *canescens*, the form most strongly differentiated at present, is also the one most easily accounted for by the operation of certain known laws that produce variation in species. If this were not a separate and independent creation, it must have been evolved at some time out of *linarius*. The question of its specific distinction, then, is merely a question of time; we can only say that it has divaricated further than any other known forms from the original standard, and that, though it has reached a point where most ornithologists would draw a dividing line quâ species, yet it is really only a variety of *linarius*. *A fortiori*, in the case of all the other above described modifications of *linarius*, we have varieties, not species. Simply, they have not progressed so far in the process of differentiation; they either began to be modified later, or the modifying influences have not been so effectual towards that end. But if *canescens* is a "species," so also is each of the others. There are only involved differences in degree, not in kind.

The Law of Development in the Flowers of AMBROSIA ARTEMISIÆFOLIA.

BY THOMAS MEEHAN.

In the fruit of *Ambrosia artemisiæfolia* the perigynium is crowned with a series of horns. I propose to show that these are all that remains of other flower buds, which have been absorbed by their elder sister during infancy.

It is not generally known that this species is occasionally dicœcious, though Dr. Darlington in his *Flora cestrica* makes note of the fact; nor is it known to the mass of botanists that a peculiar form of neutral flower exists, though many years ago Torrey & Gray (*Flora of North America*) briefly alluded to it. These dicœcious forms and neutral flowers afford the key to the whole structure.

In the regular form of this species the sequence of the flowers is according to the laws recently developed in my papers on sex. The female flowers receive the plants' first and greatest care, and always appear in the lines of strongest vitality, of which a vigorous axial development is one striking type. The male flowers only appear in the weaker lines, after the cohesive force so essential in building up the woody axis has been considerably spent. In the purely pistillate forms we almost always observe an unusual axial activity. The female flowers in the regular forms are sessile in the axils of the leaves; but in the mostly pistillate forms they are generally elevated on short peduncles, giving the plants a peculiar twiggy appearance. On the other hand, the nearly male plants, which by the way are rarely seen, present characteristics the reverse of these. The heads, usually female, when appearing as male flowers, exist as large burrs tightly set in the axils, without the slightest tendency to pedunculation. Though varying in intensity, and occasionally intermingling, no one can fail to see that these forces prevail in these forms—the feminine, in connection with cohesive and vital activity in the axillary parts —the masculine, with weakened axillary activity, and individualization.

The flowers themselves, however, afford a better illustration of this than the