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LIMICOLINE VOICES.

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THE Limicolæ or Shore Birds appeal to the imagination as do few other groups. Their wide migrations, flocking habits, and the uncertainty which attends their movements at all times contribute to the charm of their pursuit. Their calls, usually short, are often ringing and musical, and express well the temper of their haunts, marsh and shore, and so forth. These notes are generally diagnostic and stick well in the memory.

With these few introductory words I will say that the voices of these birds have been studied from several different view-points. The first has been to learn the difference between those of different species, as an aid primarily in identifying the species by ear; entailing a more or less careful study of the range of calls of each kind. The investigation with the greatest philosophic possibilities has perhaps been to determine, so far as possible, the significance of each note of a given species, the circumstances under which used, what it meant to the individual using it, and more especially to other individuals; in short, to get some idea of the "language" of the species. These two lines of study have led imperceptibly to a comparison of the notes of one species with those of another, and speculation on homologies (identification of the note of one species with the note of like derivation in a related species) and

analogies (determining what note of one species has the same *significance* with what note of another which may or may not be its homolog). One of the first things apparent is that the notes of species with similar habits are analogous, those of allied species more or less homologous, but often with very little analogy.

In view of the philosophic interest of the subject it is surprising how few records the literature of ornithology contains of careful observations made to interpret the language of birds and to determine its extent and precision. In Chapman's *Handbook of Birds of Eastern North America* (1912 ed., p. 60, etc.) we find summarized in a few paragraphs the principal facts about this language obvious to the field naturalist. Ordinarily no attempt is made to go beyond these, indeed to do so involves difficulties calling rather for experimentation than for casual observation. Most of the writer's observations on Shore Birds have been made under what are almost experimental conditions. More or less perfectly concealed in a blind, he has observed the birds, many of them in active migration, passing decoys (called "stool" in his locality). There are under such circumstances a limited number of simple acts open for them to perform, each rather easily interpreted, and each repeated over and over in the course of time by birds of the same and related species. It is conclusions from correlation of the birds' cries with their actions under these conditions that he hopes will make a slight step in advance into a difficult subject and be of value to later observers.

The Black-breast, Golden, Kildeer, Ringneck Plover, have each a characteristic diagnostic flight-note, respectively "pe-oo-ee," "que-e-e-a," "ke-he," "tyoo-eep." Though different all these notes have the same rolling character; in fact, are so much alike that they certainly have a common origin, as the birds have,—that is, are homologous. Also, they are used by each in the same way, have the same significance,—that is, are analogous.

Migratory Shore Birds in general have each a diagnostic flight-note analogous with the flight-notes of these Plovers. The flight-note of the Willet ("kiyuk") is sufficiently plover-like to be considered homologous, were the Willet a Plover. I hesitate to use the term "homology" in this case, however, and will therefore call it a note of the same group, and the Plover and Willet notes

flight-notes of group A (rolling notes). The Willet also has a note of less importance homologous with the "whew whew whew" of the Greater Yellow-legs, but lower pitched, which is not its flight-note. The "whew whew whew" of the Greater Yellow-legs is the flight-note of that species, a flight-note of group B (polysyllabic notes). The Greater Yellow-legs also has a more or less plover-like rolling note of group A, "toowhee toowhee toowhee." The commonest flight-note of the Lesser Yellow-legs, though frequently monosyllabic, is clearly homologous with that of the Greater. This intermediate condition in the Lesser Yellow-legs favors consideration of the monosyllabic flight-notes of the Krieker, etc., as group B rather than group A.

The Lesser Yellow-legs, Krieker and Semipalmated Sandpiper have short, snappy, flocking notes which may be considered of group C. There seems to have been an evolutionary tendency for notes of less importance to rise into prominence and replace notes of a preceding group as the diagnostic flight-note of the various species. Before judging of this hypothesis, it will be well to review the calls of the different species studied, which are taken up in the order of the A. O. U. 'Check-List.'

Northern Phalarope (*Lobipes lobatus*). On taking wing, this species utters a chipping note suggesting somewhat that of the Sanderling, either monosyllabic, "tchip" or "tchep," or in two or more syllables.

Woodcock (*Philohela minor*). This solitary, wood inhabiting more or less nocturnal species, is perhaps the most silent. A "twittering" as the bird takes wing is produced by the modified wing feathers. It is almost invariable as the bird takes wing and sometimes heard in full flight, but not as a rule. Species well concealed on the ground which trust to their concealment, and flush only at close range, throwing concealment to the wind as they do so, usually have an analogous striking note at that time, doubtless of value as a signal to others that may be near-by. It corresponds to the whirr of the Ruffed Grouse or the grunting of a startled Bittern, and thus may be mechanical, though usually vocal. Such sounds are very serviceable to the observer as identification marks.

The Woodcock has a well-known crepuscular song, which accompanies the nuptial performance, periodic Night-hawk-like "peents" on the ground, followed by rhythmical wing-twitching as the bird mounts in spirals into the air, followed by series of short, sweet descending whistles as it makes its earthward plunges. The Woodcock and Spotted Sandpiper are the only species that I know as breeders, and although probably most have something analogous with song, I must leave it to other more fortunate observers to describe them.*

Wilson's Snipe (*Gallinago delicata*). The Snipe, like the Woodcock, usually flushes at close range. It calls a harsh "scape," as it goes off, and this note is frequently given or repeated by it when in full flight. Two birds moving east to west over the meadows back of the beach at Mastic, Long Island, on the morning of August 23, 1919, were calling in this manner as they stopped to circle and then went on. As the bird goes out almost from under foot, the "scape" is at times replaced by a series of short hurried notes of similar character. Taken together these two notes are analogous with the wing "twitter" of the Woodcock. They are homologous, on the other hand, with the Woodcock's nasal "peent."

It is interesting to find in the Wilson's Snipe this imperfect differentiation of a note uttered at the moment of taking wing from one uttered when in or approaching full flight,—as it is a condition slightly different from the calls of other more social Shore Birds which trust comparatively little to concealment, take wing while danger is still at a distance with hurried minor notes, so soft as to readily escape notice, and have each a loud diagnostic flight-call of much service in their identification.

The harsh "scape" of the Wilson's Snipe at one end of our series, in keeping with the voices of unrelated marsh birds, frogs, etc., and the discords of close-by marsh sounds continually in its ears contrasts with the peculiarly clear mellow whistle of the Black-breast at the other end, with carrying power over the open distances of that plover's haunts. The connecting series, through

*See numerous references to the songs of northern breeding species in the volumes of 'The Auk.'

reedy calls of marsh loving species and ringing notes of those which spend more time in the open, leaves little doubt that there is some correlation between habitat and quality of voice. We will merely point out that carrying power of voice is an asset to the wide-ranging species of the open, and call the reader's attention to the interesting, if fanciful, remarks of Rhoads on the mimetic character of bird language in 'The American Naturalist' for 1889.

Dowitchers (*Macrorhamphus griseus griseus* and *M. g. scolopaceus*). The flight-note of the Dowitcher resembles that of the Lesser Yellow-legs but is recognizably different,—less loud and more hurried, usually suggesting the bird's name: "dowitch," or "dowitcher," sometimes of a single syllable. This call is subject to considerable variation. When used as a regular flight or recognition note I believe it is most frequently two-syllabled, clear and full. This at least was true of one or more birds observed on the north gulf-coast of Florida, September 6, 1919. One was certainly the Long-billed race, but I detected nothing unfamiliar in its voice and infer that that of the two races is the same. When the call becomes more abrupt and emphatic and the last syllable is multiplied it seems to indicate that the bird is excited rather than to have especial significance, "dowicheche."

A flock manoeuvred about the stool with single unloud low-pitched "chup"s (Mastic, Long Island, August 25, 1919). A low rattle from this species dropping down to alight (Mastic, May 18), and a startled "chee" from an extra tame Long-billed Dowitcher in Florida flushed by being almost struck with something thrown at it, completed, until recently, the writer's knowledge of the Dowitcher's calls, except that variations of the flight-note have not been fully described.

On September 28, 1919, however, I met with the Long-billed Dowitcher for the first time on Long Island. Two birds of this race stopping on a meadow where there was favorable feeding ground, when coming or going on the wing, when pausing from feeding to call to Yellow-legs which decoyed to them readily, or when standing alert and suspicious of me before flying, kept calling a short sharp "pip!" suggestive of one of the calls of the Solitary Sandpiper, though less loud and metallic. This note was

modified somewhat, perhaps occasionally to "pup" coming in to decoys, or to "peep" at other times. In flushing they sometimes had an unloud chuckling call, short or prolonged.

Except for recent experience with that race in Florida, inclination would be to consider these notes characteristic of the Long-billed Dowitcher, but the chances are there is no significant difference in the calls of the two races. The "pip" note of the Dowitcher corresponds, I take it, to the flocking "kip" note of the Lesser Yellow-legs. When flocks of Lesser Yellow-legs have been present and gone, a few birds still remaining tend to use the flocking note more than their numbers would warrant, for several days. The two Long-billed Dowitchers under consideration had likely been associated with members of their own kind immediately before the migration which brought them to Long Island. Previous unfamiliarity with the flocking note in the eastern bird is accounted for by its small numbers in recent years; we know it to have been highly gregarious when abundant.

Stilt Sandpiper (*Micropalama himantopus*). The common flight-note of the Stilt Sandpiper is very like the single "whew" of the Lesser Yellow-leg, but recognizably lower-pitched and hoarser. An unloud, reedy "sher" has been heard from a pair of birds when flushing (Long Island, July 26, 1919).

The resemblance of flight-notes of Dowitcher and Stilt Sandpiper to notes of the Lesser Yellow-legs is too striking to be passed without comment. They are species whose habits of flight differ least from it, and which are most generally associated with it in the same flocks, though their feeding habits are different. The resemblance of notes may be explained in several ways. One explanation would be of racial homology, that these are specialized descendants of the Lesser Yellow-legs not related to *Gallinago* which they resemble in form and near which they are conventionally placed. It is more reasonable to suppose the notes have been to some extent borrowed back and forth between the three. We are dealing here with *flight notes*, which in the two Yellow-legs certainly have shown a tendency to deviate rather than to come together, but then the flight-habits of those two are more contrasted. As the matter stands, the notes of the three (Dowitcher,

Stilt Sandpiper, Lesser Yellow-legs) are sufficiently different for identification and perhaps the very lack of close relationship in the birds has facilitated convergence of their calls.

The findings of W. E. D. Scott relative to acquisition by imitation versus inheritance of passerine bird notes has no real bearing on the subject matter of the present paper save possibly at this point. They make it not unreasonable to suppose an influence of the calls of customarily associated species upon one another.

Knot or Robin Snipe (*Tringa canutus*). The flight-note of the Robin Snipe is a low-pitched whistle, frequently in two parts, with a peculiar lisp or buzz in it: "tlu tlu."

Krieker or Pectoral Sandpiper (*Pisobia maculata*). The habits of the Krieker are, in a sense, intermediate between those of the Wilson's Snipe and of other species to which it is more closely allied and resembles more nearly in habits. On the wing, it associates in flocks which migrate by day, often mixed with other species. On the ground it frequently scatters singly among the grass, and, trusting to concealment, does not take wing till approached very closely. Its notes are neither as hoarse and heron-like as the Snipe nor as clear and ringing as those of most other species, having a reedy character.

The flight or identification note analogous with the three ringing "whew's" of the Big Yellow-legs analogous and probably also homologous with the "cherk" of the Semipalmated Sandpiper, is a loud reedy "kerr," resembling the latter more than any other Shore Bird call.

In being flushed, the Krieker often has hoarse hurried cheeping notes, analogous with similar harsher notes of the Snipe.

Rarely in flight the "kerr" is varied into or replaced by a diagnostic near-whistled "krriu."

A chorus of short snappy "tchep's" or "chip's" has been heard from a flock of birds, alert and on the move. This call is probably analogous with the short flocking notes of the Lesser Yellow-legs. To my ear the Krieker's flushing note is more or less a combination of its flight-note and flocking note, and it is likely a combined expression of the mental states most commonly associated with these two. The flocking note communicates alertness to near-by

members of a flock, the flight-note is used most emphatically by singles that have become separated from their companions or are in active flight and disposed for companionship. On being flushed, the bird is signalling to possible companions, but as it has been feeding singly, concealed from such others as there may be, by the grass, their distance is uncertain.

White-rumped Sandpiper (*Pisobia fuscicollis*). The flight-note is a squeaky mouse-like "jeet," quite unlike any other Shore Bird note. This seems to be its only call in southward migration.

Least Sandpiper (*Pisobia minutilla*). The identification flight-note of this species is a loud diagnostic "kleep." It is occasionally varied to resemble somewhat the "weet" of the Spotted Sandpiper, or the flight-note of the Ring-neck, though it is neither whistled nor melodious. It is seldom used on the ground, but on August 9, 1919, at Mastic, I made an observation on its use by an alighted bird to call in another individual from the air. About four Kriekers, a couple of Solitary Sandpipers, and about five Least Sandpipers were alighted on a bit of dead meadow. One of the latter called repeatedly, a very fine high clear "kleep," apparently corresponding with a faint husky "kleep" from another somewhere in the distance, presumably a bird which presently appeared hovering and dropping down to alight with the others.

In flushing, a Least Sandpiper sometimes utters a string of short unloud notes with or without the ee sound, "quee-quee-quee-que," or "queque," to be followed almost immediately by a variation of the flight call, as it gets more fully underway.

The flight-note varies down to "che" and "cher," not readily, if at all, distinguishable from similar calls of the Semipalmated Sandpiper.

When a flock are up and wheeling about a feeding spot to alight there again almost at once, they have sometimes a confiding little note "chu chu chu chu," etc., with variations, which has also been heard from the first bird of a flock to alight, when already on the ground. This is suggestive of the "yu yu" note of the Lesser Yellow-legs, analogous with notes No. (6) or (7) of that species.

The Least Sandpiper has a whinny, a little less clearly enunciated than that of the Semipalmated, but almost identical with the same.

American Dunlin or Red-backed Sandpiper (*Pelidna alpina sakhalina*). The flight-note is an emphatic near-whistled "chu!" or "chru!" resembling some of the calls of Krieker and Semipalmated Sandpiper. The species very likely has other calls with which I am not familiar, as I have had little field experience with it.

Flushing note, of a single, a fine "chit-l-it" (Florida, 1919).

Semipalmated Sandpiper (*Ereunetes pusillus*). The Semipalmated and Least Sandpipers, our smallest species, are very generally found associated and some of their varied lesser calls are almost identical, the more definite ones, however, are absolutely distinct. It is noteworthy that the calls of the Least Sandpiper are less similar to the Krieker's than are those of the Semipalmated. Such dissimilarity between flight-notes of closely allied species seems to be the rule rather than the exception. We may note the difference between the calls of the two Yellow-legs, and that the note of the White-rumped Sandpiper is entirely different from that of allied Krieker and Least Sandpiper.

The flight-note of the Semipalmated Sandpiper is a rather loud "cherk," softer and less reedy than the analogous Krieker "kerr." It is commonly modified to a softer "cher" or "che," which, with much variation, becomes the conversational twittering of members of a feeding flock.

Soft, short, snappy "chip"'s are characteristic of flocks manoeuvring about decoys, and less frequently heard from singles or two or three birds together,—analogous and homologous with the short flock note of the Krieker.

Hurried cheeping notes ("ki-i-ip") on being flushed, are suggestive of the same note of the Krieker. This seems to be a variation of the short, flocking note; at other times the Semipalmated Sandpiper flushes with what appears a variation of the flight-note, as "serup cherp cherp," (Mastic, August 23, 1919). I have heard the former from a bird on a meadow, loosely associated with Kriekers. This suggests the probability that borrowing of notes

between species which associate has had some part in the evolution of their calls, or that there is a tendency for certain analogous notes of such species to approach one another. That the analogous loud flight or identification note of each is so distinct indicates that the opposite tendency is at work, which in turn, supports the hypothesis that such calls have identification value for the birds themselves, as they will soon come to have for any field student who takes up the group. It seems scarcely probable that the short flocking note of Krieker and Semipalmated Sandpiper have any true homology with the analogous note of un-allied Lesser Yellow-legs, but from seeing Lesser Yellow-legs and Kriekers flocking together on meadows, equally favorable feeding grounds for each, I suspect some such borrowing may have taken place between these two.

A clear ringing whinny, from a bird in a flock or otherwise, on the ground or in the air, usually heard in the spring, is probably in some manner associated with the breeding season.

Western Sandpiper (*Ereunetes mauri*). Though some of its calls seem indistinguishable, in general the notes of this species (as studied on the north Gulf Coast of Florida, September 1919) are unlike those of *pusillus*. Its most common loud call is variable and may be written "cheé-rp, cheep!" or "chir-eep." This note has the "ee" sound found in the "kleep" of the Least Sandpiper, but has a plaintive quality suggestive of the note of the Sanderling, and it also suggests the squawk of a young Robin. Its closest resemblance to that of other small species is to the unloud "serup" heard from *pusillus* when flushing, and which varies into the regular flight "cherk" of that bird. It seems to be the corresponding flight-note of the Western Sandpiper, and is also used by a bird on the ground calling to others in air which alight with it, just as the flight "whew" of the Lesser Yellow-legs is so used.

Birds in flushing had a second dissimilar note "sirp" or at another time, "chir-ir-ip," which heard also in a medley of variations from a flock already on the wing, may be more or less analogous with the short flocking note of the Semipalmated Sandpiper, and suggested the notes of the Horned Lark.

Surf Snipe or Sanderling (*Calidris leucophaea*). The note of the Surf Snipe is a soft "ket, ket, ket," uttered singly or in series. I have heard it from birds taking wing but am not sure just how generally it is used or what its analogies are. This species is rather silent at all times.

The notes of the Shore Birds allied to the Tattlers have no apparent homology with those of the species so far treated. The Greater and Lesser Yellow-legs are the Tattlers whose voices have been most closely studied. A rather careful compilation has been made of the notes of these birds as heard in 1918, the same compared with earlier data, and conclusions checked up by observation the present year (1919).

Greater Yellowlegs (*Totanus melanoleucus*). The varied notes of the Yellow-legs are perhaps the most familiar of any, and frequent reference is made to them in discussion of other species. For convenience they are numbered serially.

(1) The yodle (a rolling "tóowhee tóowhee" etc.) is commonest in a flock, from birds remaining in one locality, not travelling. I think I have heard it from a single bird in the fog. It is characteristically given in the air, generally with set wings, by birds which seem to contemplate alighting. It advertises birds tarrying in one general locality, and has probably the function of *location* notice. It is doubtless homologous with the gather call of the Spotted Sandpiper with which it has little analogy.

(2) Loud ringing 3, "wheu wheu wheu." The characteristic cry of the species, spring and fall. It is commonly given by passing or leaving birds. It advertises the species,—and a change of policy in the individual according to its loudness. Analogous with notes of other species spoken of as *flight-notes* or identification notes; occasionally heard from an alighted bird. This call is subject to considerable variation, when heard from a bird about to drop down and join others feeding it is comparatively low-pitched and even, leaving or about to leave a feeding ground, highly modulated.

(3) Four "whew"'s, heard as follows, seem to have a rather definite significance: Low hurried descending, heard from a bird leaving companion. Short clear four, by a following bird. Loud

four, bird without intention of alighting, trying to flush decoys. This may be called a *recruiting* call.

(4) Twos, ("whew whew") seem to be characteristic of a *recruit*. A "gentle" bird which comes nicely to decoys is apt to call in twos when approaching and coming in.

(5) Rarely, in taking wing in the presence of an intruder, a single bird utters a string of unmodulated "whew's" which breaks up into threes or fours as it goes off. This is likely a note of *protest*, which would be more common in the breeding season.

(6) Conversational murmuring, from a flock dropping in, expresses *companionship* and confidence.

(7) Conversational "chup" notes from birds about to alight, also heard from birds alighted, moving about at ease. The *alighting* note.

(8) Unloud "chup's" identical with the preceding but more hurried, given by a small flock of birds as they take wing. The *flushing* note.

(9) "Kyow,"—common in spring, only rarely heard in southward migration; probably associated with the breeding season; seems to express *suspicion*.

Lesser Yellow-legs (*Totanus flavipes*). When on the ground in flocks, the Lesser Yellow-legs is usually silent. The same is true frequently of single birds coming in. In the air it is more or less noisy and has two common distinct notes:—"whew" and "kip" or "keup," which seem to be used rather indiscriminately on various occasions and which vary into one another. Wandering singles and small companies seem to use the "whew" more, often double. The combination "whew hip" is frequent. From large companies, especially in uncertainty, one may hear a chorus of "kip's."

(1) The yodle probably corresponds in significance with that of the Greater Yellow-legs—*location*. It is certainly its homolog and scarcely, if at all, distinguishable from it.

(2) The "whew" is a regular *flight-note*, likely advertisement. Generally silent birds alighted, sometimes call an occasional single "whew" (at such times particularly soft and mellow) before others drop in to join them, as if in *welcome*.

When double, this note of the lesser Yellow-leg is at times clear and full, difficult to differentiate from that of the larger species, and apparently likewise characteristic of a "gentle" bird, which will join decoys, or others alighted.

(5) Whereas the "whew" note of the Lesser Yellow-leg is most frequently single and very seldom more than double, I have heard a variation of it in series from one of an alighted flock (Mastic, July 13, 1919) "hyu-hyu-hyu-hyu-hyu" etc. Presumably this was in protest at my presence, corresponding to the similar note of the larger species.

(6) Soft, unloud murmuring of a flock in chorus, "yu yu yu" etc., characteristically heard, as on August 10, 1919, from a flock moving leisurely over the meadows, after having been flushed, to shortly alight again, expressive of *companionship* and confidence.

(7) When dropping down to alight, often hovering over decoys, a flock of Lesser Yellow-legs has soft short "cup, cup, cup," etc. notes.

(8) At the instant of flushing almost the identical notes as above given hurriedly with more emphasis. This for the Lesser Yellow-legs is a rough analog of the cheeping note of the Krieker, but in view of the different habits of the two species, can not be said to be strictly analogous with same.

(10) An unloud chuckle or series of short notes suggesting a very distant Jack Curlew, heard sometimes, not very frequently, when one or more birds take wing. Should probably be considered a flushing note or signal to take wing. Seems like the attempt of one individual to reproduce the preceding, which is often from several birds of a flock.

(11) The "kip" is likely one bird calling to another close-by. It is typically a *flocking* note, otherwise used almost exactly as is note No. (2). A variation,—"keup," with broader sound, approaching the "whew," expressing *attention*, is frequent. It has been heard from a flock of birds which had been resting and bathing, just before taking wing (Mastic, September 15, 1918).

(12) An infrequent note of quite different character from the Lesser Yellow-legs' ordinary calls is very high and clear, "queep." It is subject to much variation, as "peép-quip," "eep!" but is characterized by the high "ee" sound. It has been heard from

birds alighted, more particularly when their companions, alarmed or for some other reason, move on, and is thought of as the *tarrying individual's* note. On August 17, 1919, I had picked up decoys preparatory to leaving a pool in the meadows when a single Lesser Yellow-legs came down to the pool calling a similar "kee-a" on the wing, though I was in full view. It went on without alighting with "whew" notes characteristic of the species. Probably this was an individual which wanted to stay, from a small company which had left the meadow.

(13) Wounded birds, on being pursued and captured, have a harsh scream of fear, "cheerp." I have noticed this from birds of the year in southward migration only, not from adults under the same circumstances.

Thus six of the ten notes assigned to the Lesser Yellow-leg are interpreted as analogous with six of the nine of the Greater, namely, *location, flight, protest, companionship, alighting* and *flushing* notes. With the exception of the flight-note these seem also strictly homologous, and little differentiated intraspecifically. The flight or identification note if homologous is divergent, as utility requires that it should be. It is homologous with the Greater's flight-note series—Nos. (2), (3), (4), and (5). Setting aside note No (9) of the Greater, likely associated with the breeding season, the two for which nothing to correspond has been found in the Lesser are *recruiting* and *recruit* calls, Nos. (3) and (4), differentiations of the flight-note. As a matter of fact a variation of the Lesser's flight-note is very close to the recruit note, and the condition may be summed up by saying that the flight-note of the Greater has to a greater extent than that of the Lesser been broken up into different notes of specialized application.

Setting aside No. (13), which the Greater probably also possesses, though I have not heard it, there are three notes of the Lesser for which nothing to correspond has been found in the Greater. Of these the flocking note, No. (11), correlates with its more gregarious habits. From knowledge of the voices of the two to date it seems that the more individualistic, intelligent and wary Greater has calls with more precise significance than the more social Lesser, something more closely approaching a true language, whereas the voice of the Lesser has undergone a longer evolution,

and it has acquired greater dissimilarity of calls. The specialized notes of the Greater are largely variations of the flight-note stem, which occurs in its simplest form in the Lesser, not its primitive form, however, if such is as we suppose, polysyllabic. The habits of the Lesser are less adaptively specialized in detail than those of the Greater, yet more specialized taken as a whole, a condition paralleled by the respective notes of the two.

In the majority of cases there is no difficulty in identifying either Yellow-legs with certainty from its ordinary louder notes; except that the analogous as well as homologous "whew whew" common with both and the rare occasions when the Greater uses a single "whew," require a keen ear to detect the difference in quality of voice. Nevertheless, just this last year (1919) there have been two instances in the field on Long Island, where with a little less training my ear would have assigned Lesser Yellow-legs calls to the other species. In both instances, the first in May, the second in late September, a small number of the Lesser Yellow-legs were associated with a larger number of the Greater, reversing the ordinary condition. My suspicions that in default of its own kind the Lesser was endeavoring to copy the calls of the other with which it was associated, aroused by the first observation, which was unsatisfactory, were confirmed by the second, a thoroughly satisfactory one. A flock of birds containing a couple of Lesser and perhaps five Greater Yellow-legs was flushed by a Marsh Hawk from a pool where my decoys were also placed. All went off to the north with the exception of one Lesser which promptly returned and alighted with the decoys. It called "whew" and "eep!" repeatedly, and flushed again with an unloud Jack Curlew-like series, all notes characteristic of the Lesser, and highly appropriate to the circumstances, then followed the direction the other birds had taken. Its notes now should have been a somewhat more abrupt "whew" or "whew-hip," or short "kip"s, had it been recently associating in flocks of its own kind, but to my astonishment they were "whew-whew" and "whew-whew-whew," trisyllabic! not at all abrupt and unusually loud for the Lesser; I think it was not my imagination which made them sound strained. The situation was not without its humorous side as a Greater Yellow-legs under similar circumstances would have been

apt to use four syllables, and if three, these highly modulated and ringing, the Lesser's three approaching most nearly that of a Greater about to alight.

I think I am correct in homologizing the ringing whistled voices of the Yellow-legs with comparatively sharp piping voices of Solitary and Spotted Sandpipers. The difference is related to the more wide-ranging and flocking habits of the former.

Solitary Sandpiper (*Helodromas solitarius solitarius*). The flight-note of the Solitary, "peep weep weep," is often difficult to differentiate from notes of the Spotted Sandpiper, but probably always differentiable. It is a cleaner-cut sound, less variable, more suggestive in accent than are those of the Spotted Sandpiper or the whistle of the Greater Yellow-legs. In August, 1919, several Solitaries were living on the meadows at Mastic, Long Island. They were frequently found feeding, flushed or observed making longer or shorter flights at no great heights. In these cases the note was double "peep weep," rarely single. When a bird is changing its grounds the same note is more often three, sometimes two-syllabled, and so given when definitely leaving a locality or by wandering birds which ordinarily fly high.

A quite dissimilar call, less frequently heard, is a fine "pit," "pit pit," or "chi-tit." This may have no significance other than being a reduction of the preceding, when the bird is less definitely on the wing, but seems to depend on there being another individual fairly close by. There is likely homology between it and the short flocking call of the Lesser Yellow-leg, and if correctly determined, a certain analogy thereto is also established, perhaps as much as possible with this non-social species. Of similar quality was a peculiar "kikikiki" from one of two birds in company which came to decoys nicely (Mastic, August 10, 1919), as they went out past me without alighting.

A third note, isolated "pip"'s, suggesting the call of the Waterthrush, is expressive of excitement when a bird is on the ground, as when just alighted.

Willet (*Catoptrophorus semipalmatus* races). The identification flight-note of the migratory Willet is a far-reaching, gull-like "kiyuk," repeated at intervals. On the breeding grounds in

spring there are several variations of this note, one "ki-yi-yuk," much like the loudest, most ringing call of the Greater Yellow-legs.

A less frequent note resembles the "whew whew whew" of the Greater Yellow-legs but is much lower pitched, not loud. It is homologous but not analogous with this Yellow-legs note. It has been heard from a bird hanging about a pool in the meadows.

"Ply-wly-wip, ply-wly-wip," corresponds to song; it is the common loud note on the southern breeding grounds in spring; its author most frequently poised on quivering wings above the meadow.

"Kuk-kuk-kuk-kuk-kuk" etc., in tern-like series from two mating birds is probably homologous with the *alighting* and *flushing* notes of the Yellow-legs, Nos. (7) and (8).

Loud high "kree-uk" infrequent in spring on the breeding grounds, suggests No. (12) of the Lesser Yellow-legs with which it may be homologous.

Spotted Sandpiper (*Actitis macularia*). The Spotted Sandpiper is the only species of which the calls, while nesting, are thoroughly familiar to the writer, and it should be borne in mind in comparing them with those of the others treated that the comparison is not a fair one; these others doubtless have breeding calls with which he is unfamiliar.

"Hoy, hoy, weet, weet, weet, weet weet weet weet" is a prolonged call frequently heard in the early part of the nesting season, in toto or in part, suggesting in that respect the songs of the cuckoos. It doubtless has value as *advertisement* or *location* notice and something the significance of a very generalized song. A series of loud "weet's," heard also at other times of year, the most far-reaching call of the species, doubtless serves as location notice. Towards sunset on July 16, 1919, Oyster Bay, N. Y., the weather still and foggy, one at the shore was so calling repeatedly, I felt sure in an effort to locate another of its kind.

"Pip! pip! pip!" is a note heard between adult birds in the breeding season which seems to be of polite address, or possibly impolite, as it is almost identical in form with a note of protest by old birds when nest or young are threatened. This last is perhaps shorter and dryer. Something very like the former has been heard from an old bird when with her young.

A rolling note, "kerrwee, kerrwee, kerrwee," now loud, now very low and distant, has been heard from an adult with the evident purpose of assembling her young. Though with different, specialized application, it is pretty surely homologous with the location notice, No. (1) of the Yellow-legs.

Young birds that have taken refuge in the grass, presently if danger seems passed, begin to call "pip wip," perhaps the note most like that of the Solitary Sandpiper, to advertise to one another and their parents what and where they are. The "pit-wit-wit" frequently heard from adults as a note of departure may best be considered a variation of this one as also the "peet weet weet" or "weet weet" most frequent a little later in the season as little companies of birds start out over the water for longer or shorter distances. The third variation is the most characteristic note of the species, frequently heard from passing birds, and a very good analog of the flight-identification notes referred to under the transient species. From it is constructed the latter part of the song. The initial notes of same likely have some homology with the rolling note compared to No. (1) of the Yellow-legs.

An old bird, surprised near her brood and fluttering off playing wounded called "cheerp cheerp," a sort of scream as of pain and fear, doubtless the impression it was intended to convey, and a young bird, captured, cried "seep," indicative of its dire extremity.

Hudsonian or Jack Curlew (*Numenius hudsonicus*). The flight-note of the Jack Curlew resembles that of the Greater Yellow-legs from which it is rather easily distinguished, being less modulated and usually lower pitched. It commonly consists of four short whistles, but is frequently prolonged even into a trill. The more prolonged calls are usually the dryer, and seem characteristic of the noisiest birds, flying highest or with most uncertainty.

Black-bellied or Black-breast Plover (*Squatarola squatarola*). The flight-note of the Black-breast is a clear, ringing "pe-oo-ee" although shortened and otherwise varied at different times, this note is the only one ordinarily heard from single individuals or small flocks of this species. In general it may be said that the

diagnostic flight or identification note of Plovers is used more generally than in Yellow-legs and other species, for instance, and that they seem to have less variety of calls.

A second, flocking note, is a soft mellow "quu-hu" (from about 15 birds together, Florida, September 6, 1919) heard both in air and on the ground, and in chorus when a flock was flushed, circling and hovering in uncertain manner.

A dissimilar untold "cuk cuk cuk, cuk, cuk, cuk cuk cuk cuk" heard from a single bird alighted with decoys and running about (also Florida, September).

Golden Plover (*Charadrius dominicus dominicus*). The flight-note of the Golden Plover is a ringing "que-e-e-a" less clear and whistled than that of the Black-breast, with a suggestion of the Kildeer in it.

Kildeer Plover (*Oxyechus vociferus vociferus*). The common note of the Kildeer used in flight and at other times is a sharp "ke-he!". When the bird is flushed it is characteristically varied to "ki-i-he." About its breeding grounds, where it is very noisy, the note is commonly "ke!" or "kehe!".

Semipalmated or Ring-necked Plover (*Aegialitis semipalmata*). The flight-note of the Ring-neck is a short, whistled "tyoo-eep." The birds have a variety of lesser notes which are not so often heard, and most frequently in the spring. A little company of probably wintering birds (Florida, late March) called "kup, kup," as they were flushed and flew a few yards to alight again. The flight-note is sometimes replaced by rougher cacking notes in small flocks on the wing.

Piping Plover (*Aegialitis meloda*). The plaintive piping notes of this species are so characteristic of its breeding grounds, they are evidently associated with the nesting season, and perhaps correspond to song. At other times the birds are rather silent.

Wilson's Plover (*Ochthodromus wilsonius wilsonius*). The commonest note on the ground and on the wing (Florida, late March, apparently on breeding grounds) is a tern-like "quip," sometimes double "qui-pip." Less frequently, on the ground, a surprisingly human whistled "whip."

Ruddy Turnstone (*Arenaria interpres morinella*). The common flight-note of the Turnstone is a low cackle. This note is not very broadly used as flight-notes go, being most common from birds that are leaving the vicinity. A much rarer loud plover-like "kik-kyu" I have heard from a bird when coming to decoys or flying along the edge of favorable meadows.

The above is a pretty comprehensive resumé of the calls of the different species as definitely noted to date. Attempts to render each call by letters are at best unsatisfactory and probably no two people would do so in a like manner, but a field student of the birds will in most cases have no difficulty in following this classification of notes, and it is my only way to give any idea of their variety and character. It should be understood that it is only in the majority of cases that the calls correspond to circumstances to which they are assigned. No more could be expected in view of the doubtless rapidly changing psychic processes of the birds, of which we know nothing. The amount to which each note varies, and they vary into one another, should not be lost sight of. In the writer's opinion comparatively little of the birds' "vocabulary" is lost, however, by incomplete knowledge of these variations, whereas a great deal is lost by imperfect differentiation of inflection and tone. His hypothesis is that the form of the call, limited by the species to which the bird belongs, is correlated with numbers, environment and behaviour, especially present but also past or future; that its quality depends largely on emotion or state of mind, as alarm or confidence, restlessness, sociability, etc., etc. Less indication than presupposed, has been found of distinct and dissimilar calls corresponding to emotional states. A "note of alarm" has proved particularly elusive. Alarm, easily introduced experimentally, shows as determinant of the bird's actions, but the accompanying notes (if any) are such as accompany similar actions when it is obviously not alarmed.

One other thing is very striking; birds in the air are extremely sensitive to the calls of others on the ground, and only in a less degree to imitations of them. Birds on the ground are equally sensitive to the calls of others in the air, but pay astonishingly little attention to any imitated notes.

Whether one calls them language or not, the calls of other individuals of each kind of Shore Bird and associated kinds, are unquestionably an important part of the life of every member of the more social species, and one of the chief factors which direct its behaviour.

In the consideration of obscure details there is danger of omitting the obvious thing which would be of most interest to some readers. It is certain that an individual recognizes the flight-note of its own kind as such, as who can doubt who has had a Black-bellied Plover, too wary to come to decoys, yet circling round and round answering each imitation of its cry? As certainly in some cases birds recognize the flight-notes of other species for what they are, the Turnstone will decoy particularly well to the whistle of the Black-breast, a species of similar habits to its own, with which it likes to associate.

From the point of view of general contour and of habits (and taking the characters which separate the Limicolæ from other groups as criteria) the Plovers are our most generalized end, and that of *Gallinago* the most specialized end of the series here considered. Without assuming that this superficial viewpoint corresponds with the true philogeny of these birds in any way, it is to be expected that the notes, which are intimately related to habit, will be most readily classified in a parallel manner. The analogies between dissimilar notes and lack of analogy between certain evidently homologous notes of related species, implies that these calls are not stereotyped for each, but in process of change in a manner allied to that of human language. Studied mostly in migration, all species seem to have primarily a flight, identification or advertisement note, calls less loud and striking, and sometimes still louder and more ringing notes, allied to, but with less definite application than the identification note. It is my hypothesis that there is a more or less definite evolutionary tendency for lesser calls to replace the flight-note, which becomes still louder and far-reaching as it loses particular value and becomes less frequent.

By this hypothesis, the differing but evidently homologous flight-notes of the Plovers (Black-bellied, Ring-necked, Kildeer, Golden) correspond to the "kik-kyu" of the Turnstone, which

they resemble, and which is being replaced in the Turnstone as a flight-note by the characteristic rattle of that species. Similarly the Yellow-legs' yodle has been derived from a plover-like flight-note, and the Greater Yellow-legs and Jack Curlew flight-notes correspond to the Turnstone rattle.

The flight-note of the Willet seems to correspond rather to those of the Plovers than to those of the Yellow-legs. On the other hand the single "whew" of the Lesser Yellow-legs is evidently homologous with the "whew whew whew" of the Greater, and the flight-notes of the Krieker, etc., may as well correspond to it, or to that of Willet and Plovers.

ADDITIONAL DATA 1920

The notes of two Oyster-catchers (*Haematopus palliatus*), forced to take wing: "crik, crik, crik," etc., once a longer "cle-ar" interpolated, which suggested flight-calls of Willet and Black-breast Plover (North Carolina, April).

A Marbled Godwit (*Limosa fedoa*), flying towards decoys, gave a single unwhistled note, "hank," likely the flight-note of the species in migration. Alighted, it had a short unloud note, a goose-like "honk," especially when other Shore Birds swung by it (Long Island, August).

A single Dowitcher on the ground, when a flock of Lesser Yellowlegs were flushed a little way off, called a mellow plover-like "cluee?," and when these departed took wing with more ordinary Dowitcher calls and followed after. The peculiar cry suggested the *tarrying individual's* note of the Lesser Yellowlegs, with which it is likely analogous (Long Island, July).

When a flock of a half dozen Lesser Yellowlegs came to decoys, one bird alighted first, had a low-pitched unfamiliar "too-dle-hoo-hoo, too-dle-hoo-hoo, too-dle-hoo-hoo," before the others, still on the wing, came back and alighted with it. Though probably of similar derivation, this note was quite different from the yodle of the species, and is probably more of a gather call (Long Island, August).

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