

Article XXII.—A REVISION OF THE CLASSIFICATION OF THE KINGFISHERS.

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PLATES XXV AND XXVI.

INTRODUCTION.

The purpose of the present paper is mainly two-fold, first: To establish the proper subfamily divisions of the Alcedinidæ; second, to bring out the characters and relationships of the three genera currently united under *Ceryle*.

The conclusions are based on all available material both in the form of skins and skeletons, and lists of the species examined are appended. The first list includes members of every currently recognized genus of the family.

Dr. P. Chalmers Mitchell's paper 'On the Anatomy of the Kingfishers'¹ has been drawn upon for the myological characters.

The greater part of the material used is in the collection of the American Museum of Natural History. For the loan of additional specimens I am much indebted to the United States National Museum, through Dr. Charles W. Richmond, to the Brooklyn Institute of Arts and Sciences, through Mr. Robert C. Murphy, and to Mr. James H. Fleming of Toronto.

PART I. THE SUBFAMILIES OF ALCEDINIDÆ.

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¹ Ibis, 1901, p. 97.

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LIST OF SPECIES EXAMINED.

I. *Skins.*

Ramphalcyon melanorhyncha	Halcyon coromandus
amauroptera	smyrnensis
capensis (races)	gularis
Megaceryle (all species, not <i>M. maxima</i>	pileatus
<i>sharppei</i>)	semicæruleus
Ceryle (all forms)	albiventris
Chloroceryle (all species)	senegalensis
Alcedo ispida	malimbicus
bengalensis	cyanoleucus
ispidoides	saurophagus
semitorquata	lazuli
meninting	diops
beryllina	macleayi
Corythornis vintsioides	pyrrhopygius
cristata	cinnamominus
Alcyon azurea	sacer
cyanopectus	chloris
Ceyx euerythra	tristrami
innominata	sanctus
melanura	funebis
Ceycopsis fallax	concretus
Ispidina picta	lindsayi
natalensis	Todiramphus recurvirostris
Myioceyx lecontei	Cittura cyanotis
Syma torotoro	Monachalcyon monachus
Lacedo pulchella	Tanyiptera nympha
Melidora macrorhina	sylvia
Clytoceyx rex	doris
Dacelo gigas	margaritæ
leachi	galatea
Choucalcyon gaudichaudi	dea
tyro	

II. *Skeletons.*

Ramphalcyon capensis (palatines im-	Alcedo ispida (skulls)
perfect)	Dacelo gigas
Megaceryle torquata	Halcyon chloris (palatines imperfect)
alcyon	" concretus (sternum and shoul-
Chloroceryle americana	der girdle)
amazona (skull, palatines imperfect)	

SUMMARY OF CONCLUSIONS.

The family Alcedinidæ is divisible into three subfamilies, Cerylinæ (3 genera), Alcedininæ (7 genera), Daceloninæ (12 currently recognized genera; probably one or two more definable).

Ramphalcyon is the only genus in regard to the position of which there can be any uncertainty. It is here placed in the Daceloninæ, which I believe to be its proper place; the only alternative is to create an additional subfamily for it.

The Cerylinæ constitute a well-defined group separated from the two other subfamilies by a number of excellent characters. These are carried to an extreme in *Megaceryle* which is also characterized by several remarkable peculiarities in which it differs not only from *Ceryle* and *Chloroceryle* but from every other genus in the family. These characters are both external and internal, but the latter are not known in *Ceryle* which may prove to be somewhat intermediate between the two related genera in its osteology and myology as it is in several external features.

The Alcedininæ combine some of the characters of the Cerylinæ with others of the Daceloninæ, and possess several marked peculiarities of their own. They are less closely related to the Cerylinæ and more closely to the Daceloninæ than usually considered.

The current names *Sauromarptis* and *Carcineutes* must be replaced by *Choucalcyon*¹ and *Lacedo*² respectively. Both the older names were rejected on grounds of purism. *Dacelo* and *Lacedo* are both anagrams of *Alcedo* and if the former is accepted the latter must be also.

CLASSIFICATION ADOPTED.

The classification here adopted is set forth below. It should be understood that no attempt has been made to revise the genera of the second and third subfamilies; also that the order of genera in the Daceloninæ — the same as that of Sharpe's Hand-List (with the addition of *Ramphalcyon*) — while unsatisfactory is probably as good as any that can be devised with our present knowledge and perhaps as natural as any linear arrangement can be.

¹ Lesson, *Traité D'Orn.*, 1831, 248. Type by subsequent designation (Gray, 1855), *Alcedo gaudichaud* Quoy et Gaim. This genus originally contained two species: (1) *C. gaudichaudii*, (2) *C. australe*. The second species is the same as *Dacelo gigantea* (Latham), which is equivalent to *D. gigas* (Bodd.), the type (by monotypy) of *Dacelo* Leach, 1815.

² Reichenbach, *Handbuch, Alced.*, 1851, 41. Type by subsequent designation (Gray, 1855), *Dacelo pulchella* Horsfield.

ALCEDINIDÆ.

Cerylinæ.

Megaceryle

Chloroceryle

Ceryle

Alcedininæ.

Alcedo

Ceycopsis

Corythornis

Ispidina

Alcyone

Myioceyx

Ceyx

Dalceloninæ.

Syma

Ramphalcyon

Lacedo

Halcyon

Melidora

Todirhamphus

Clytoceyx

Cittura

Dacelo

Monachalcyon

Choucalcyon

Tanyptera

CLASSIFICATIONS OF SHARPE AND SUNDEVALL.

The classification of the Alcedinidæ currently recognized is that of Sharpe's 'Hand-List of Birds,' and this is based on his 'Monograph of the Kingfishers' published in 1871.

This author recognized two subfamilies, Alcedininæ and Daceloninæ. The former comprises *Ramphalcyon*, *Ceryle* (including *Chloroceryle* and *Megaceryle*), and the three genera of small, short-tailed species with compressed bills, *Alcedo*, *Corythornis* and *Alcyone*. The four genera of small, short-tailed forms with broader bills are placed with the remaining genera in the Daceloninæ.

Ramphalcyon is an isolated genus, and its exact position is still somewhat uncertain, but from consideration of both its internal and its external structure I believe it much more naturally located in the Daceloninæ than next to *Ceryle* (or *Alcedo*) to which its resemblances, I believe, are largely due to convergence.

The separation of the genera of the *Alcedo-Myioceyx* group in two subfamilies is, in my opinion, altogether artificial and unnatural. The close interrelationship of all these genera is indicated by their strong mutual resemblances in size, color, and form (particularly the dorsal feathering, the very short tail, and the proportionate length of the toes), and it is quite evident that the breadth of the bill alone is insufficient for more than generic definition. Furthermore, the two groups are nearly, if not quite, connected by certain species of *Ceyx* and *Alcyone*, while *Ispidina leucogaster* is said by Sharpe to approach *Corythornis*.

These seven genera taken together appear to be sufficiently well characterized to form a subfamily of their own, combining to some extent certain characters of the two other subfamilies but possessing several peculiar to this group.

The arrangement of subfamilies here proposed resembles that of Sundevall much more than it does that of Sharpe, differing from the classification of the former author only in the separation of the Cerylinæ from the Alcedininae. Sundevall, as did Cabanis and Heine, placed *Ramphalcyon* with the Daceloninae. The primary division in Sundevall's classification is based on the size of the scapulars. In the Halcyoninae (= Daceloninae) these are said to be "large, forming a mantle, which hides the whole of the back," while in the Alcedininae the scapulars are said to be "small, not hiding the back."

As shown beyond, the conspicuousness of the dorsal plumage in *Alcedo* and related genera is due largely to the fact that the dorsal tract is continuous and equally developed, all the feathers much elongated. In the Daceloninae the dorsal feathers are much shorter. At the same time, however, in some at least of the genera of the latter group, the scapulars are unusually well developed.

DIAGNOSES OF THE SUBFAMILIES.

The three subfamilies proposed may be diagnosed as follows. As the osteological characters are known in but few genera, and some of them will probably prove inconstant, they are not enumerated in the diagnoses but are given in detail beyond.

Cerylinæ.—Alcedinidæ of both hemispheres, unrepresented in the Australian Region or in the Indo-Malayan subregion, the bill long or rather long, compressed, the tenth primary always longer than the fourth except in some specimens of one subspecies (*C. ænea*), the tail of moderate length or rather long (much more than half the length of the wing), the lower end of the tibia completely bare for a distance equal to or greater than the short chord¹ of the hallux claw (sometimes for slightly less in individuals of one or two species — *C. ænea* and *M. lugubris*), the tarsus short or extremely short, shorter than or equal to the inner toe without claw (sometimes in one species, *C. ænea*, slightly longer) the toes short or very short, the second toe relatively longer than the others, being (with its claw) never shorter than the third toe without claw by as much as the short chord of the claw of toe No. 2, and usually equal to or longer than the fourth toe without claw (sometimes a trifle shorter); the dorsal tract somewhat interrupted anteriorly; the bill is never wholly or largely red or yellow, the plumage wholly without changeable blue, the entire upper surface including wings and tail of one ground color or pattern (in each species), the remiges or rectrices always marked with white, the sex never indicated by the coloration of the upperparts but always by that of the underparts, the chest of the male always

¹ I. e., from tip to base of lower side of claw.

rufous when, as usual, it differs in color from that of the female (which is never rufous).

Alcedininæ.—Small or very small Old World Alcedinidæ, with the tenth primary never shorter than the fifth, the tail very short (less than half the length of the wing), the bare space at lower end of tibia shorter than the short chord of the hallux claw on at least the outer side of the tibia, the tarsus rather short but always decidedly longer than the inner toe without claw, the third and fourth toes long, the second short, greatly reduced or absent, always (with its claw) much shorter than the third and fourth toes, without claws (by more than the short chord of the claw of toe No. 2); the dorsal tract perfectly continuous, the feathers being long and conspicuous, the plumage always with more or less blue or violaceous, the crown spotted or barred with blue (in at least some of the species of each genus), the upperparts, remiges or rectrices without spots, bars, or conspicuous areas of white, the sexes alike in the color of the upperparts, but occasionally unlike beneath.

The Alcedininæ may be distinguished from both of the other subfamilies at once by the following brief diagnosis: Small, very short-tailed Kingfishers, with all the feathers of the dorsal tract elongated, the second toe very short or absent, the orbital process of the quadrate practically wanting. (The last character possibly inconstant.)

Daceloninæ.—Rather small to very large Alcedinidæ restricted to the Old World and, with the exception of one genus, to the Australian and Indian Regions, with the tenth primary usually much shorter than the fifth (longer only in certain species of *Halcyon*), the tail long or rather long (rather short in one species of *Halcyon* but always more than half as long as the wing), the tibia feathered to its extreme lower end (partly bare in *Ramphalcyon*, but the bare space on outer side much shorter than the short chord of the hallux claw), the tarsus relatively rather long or long (decidedly longer than inner toe without claw), or (in *Ramphalcyon*) rather short (equalling or a trifle exceeding the inner toe without claw), the toes long, the second toe with claw shorter than the third without claw (but never by more than the short chord of claw of toe No. 2), and shorter than or barely equal to the fourth toe without claw (these toe proportions not holding in *Lacedo*); the dorsal tract interrupted near its anterior end; the plumage always with blue or greenish blue, the primaries never spotted or barred with white and the secondaries and scapulars thus marked only in *Lacedo*, the sexes usually differing more or less in the color of the upperparts or tail, rarely (in a few species of *Halcyon* and in *Lacedo*) in the color of the underparts.

TABLE OF SUBFAMILY CHARACTERS.

In the accompanying table (page 245) the characters peculiar to any one subfamily are given in italics.

RELATIVE DEVELOPMENT OF CHARACTERS IN THE GENERA AND SUBFAMILIES.

In the following table the genera and subfamilies are arranged according to the development of the various characters in each. It is evident that the Cerylinae, particularly *Megaceryle*, represent one extreme in the majority of cases, while in several respects the Alcedininæ are the most divergent.

Characters of the Three Subfamilies of Kingfishers.

	CERYLINÆ	ALCEDININÆ	DACELONINÆ
Bill	Long; compressed, often deep	Long, not deep	Extremely variable
Crest	Narrow, of narrow feathers	Flat	Wide, flat, usually of broad feathers
10th primary	> 3 (> 5 except 2 sps. of <i>Chloroceryle</i>)	= or > 5	< 5 except in some <i>Halcyons</i> (usually = or < 3)
Length of tail	Moderate	Very short	Moderate or long (rather short in <i>Halcyon cretus</i>)
Dorsal tract	Interrupted; feathers long	Continuous; feathers long	Interrupted; feathers moderate to short
End of tibia	Completely bare	Intermediate	Feathered (<i>Ramphalcyon</i> intermediate)
Length of tarsus	Short to very short	Rather short	Moderate to rather long (short in <i>Ramphalcyon</i>)
Third and fourth toes	Short to very short	Long to moderate	Long to moderate
Second toe	Long (moderate in 3 sps. of <i>Chloroceryle</i>)	Short, vestigial or absent	Moderate to rather short (long in <i>Lacedo</i>)
Tuft of oil-gland	Large	Large	Large in <i>Halcyon</i> , etc.; smallish to absent in 6 genera
General coloration	No blue; one pattern above	Blue present	Blue present; often 2 or more patterns above
Crown	Not marked as in Alcedininae	Barred or spotted with blue	Not marked as in Alcedininae
Wings and tail	Spotted or barred	Never spotted or barred	Not spotted or barred (except in two genera)
Sexual coloration	Alike above, always different below	Alike above, rarely different below	Usually different above, rarely different below
Nostril (in bone)	Short	Long	Long (<i>Ramphalcyon</i> intermediate)
Maxillary	Conspicuously expanded	Not expanded	Not expanded
Palatal spine	Vestigial or short	Long (<i>Alcedo</i>)	Long (<i>Dacelo</i>)
Orbital proc. of quadrate	Weak, pointed	Virtually absent	Strong, thick, blunt
Pars plana and d.p. of lacrymal	Meet near upper corner	Meet near middle	Meet below middle (<i>Ramphalcyon</i> peculiar)
Procoracoid	Smaller	United with <i>acrocoracoid</i>	Smaller
Clavicle process	Absent or rather small and gradual	Large and abrupt (blunt)	Large and abrupt (pointed)
Iliac process	Well developed	?	Vestigial
Geog. distribution	Both Hemispheres, not in Australian or Indo-Malayan.	E. Hemisphere, one slight genus restricted to Australian Region	E. Hemisphere, restricted to Australian Region except 2 genera

Iliac process	{ Megacercyle, large. Chlorocercyle, smaller. Daceloninae, vestigial.
Maxillary	{ Megacercyle } conspicuously expanded. Chlorocercyle } Ramphalcyon, <i>slightly</i> approaching Cerylinae. Daceloninae (part), Alcedininae, not expanded.
Post-palatal spine	{ Megacercyle, vestigial. Chlorocercyle, short. Dacelo, long. Alcedo, very long.
Clavicle process	{ Megacercyle, absent. Chlorocercyle, moderate. Alcedo, Daceloninae, large.
Orbital process of quadrate	{ Alcedo, absent. Chlorocercyle, slender, sharp. Megacercyle, sharp. Daceloninae, stout, blunt.
Junction of pars plana and d. p. of lacrymal	{ Megacercyle, upper corner. Chlorocercyle, near upper corner. Alcedo, above middle. Halcyon, Dacelo, below middle.
Tibial feathering	{ Cerylinae, conspicuously bare all around. Alcedininae, average (some like Ramphalcyon, some like Daceloninae). Ramphalcyon, bare in front, feathered on inside. Daceloninae, feathered to or beyond joint.
Length of tarsus	{ Megacercyle, extremely short. Chlorocercyle, Ceryle, Ramphalcyon, short. Alcedininae, slightly longer. Daceloninae, relatively rather long and long.
Length of 2nd toe	{ Megacercyle, Ceryle, Chlorocercyle amazona, Lacedo, long. Chlorocercyle (3 species), Daceloninae (exc. Lacedo), medium or rather short. Alcedininae, short, vestigial or absent.
10th Primary	{ Halcyon, part, = 9. Cerylinae (exc. 2 Chlorocercyle), Alcedininae, Halcyon, part, = or > 5. Chlorocercyle, 2 species, Dacelo, Todirhamphus, Halcyon, part, > 3 to = 5. Daceloninae, 9 genera + Halcyon, part, = or < 3, often < 1.
Length of tail	{ Alcedininae, very short. Halcyon concretus, short. Cerylinae, Daceloninae, part, moderate. Daceloninae, part, long.

Dorsal tract	{ Alcedininæ, continuous, all feathers long. Cerylinæ, feathers moderate, short in interscapular spot. Daceloninæ, part, feathers shorter, short in interscapular spot. Daceloninæ, part, practically bare in interscapular spot. Ramphalcyon, dorsal feathers all very short.
Oil-gland tuft	{ Cerylinæ, Alcedininæ, Daceloninæ, part, large or moderate. Monachalcyon, Clytoceyx, rather small } Daceloninæ, part. Lacedo, Melidora, vestigial Cittura, Tanysiptera, absent
Sexual coloration	{ Cerylinæ, Alcedininæ, few, Halcyon, few (different below). Lacedo, (different below and above). Alcedininæ, most, Halcyon, most, Todirhamphus, Ramphalcyon, Tanysiptera, most, (scarcely or not different). Daceloninæ, most, including Halcyon, few, (different above).

CHARACTERS OF SUBFAMILIES IN DETAIL.

The characters of the subfamilies in greater detail are given below.

Cerylinæ (3 genera).—The only subfamily represented in the Western Hemisphere, to which one of the genera is restricted. It is wholly absent from the Australian Region, New Zealand, the Philippines, East Indies and Europe.

Size exceedingly variable, one of the species almost as small and two nearly as large as the extremes in the family. Bill long or rather long, compressed; the proximal half of the culmen may be flattened but is not expanded basally as in *Ramphalcyon*; the gonyes not keeled as in the latter genus.

A crest always present; short, blended, occipital; longer, less blended, occipital, or (in one genus) large, conspicuous, compressed, occipital and vertical, with linear or narrowly linear lanceolate feathers. It is always narrow, unlike the wide flat crest of *Daceloninæ* and *Corythornis*.

The tenth primary is never shorter than the third, and is always longer than the fourth except in some individuals of one species; longer than the seventh in only one species (in which it is often less).

Tail rather long (always much more than half as long as the wing), graduated for one fifth of its length or less, sometimes nearly even.

The lower end of the tibio-tarsus is not feathered to the joint on any side and in front is conspicuously bare. This unfeathered space at its most restricted point always at least equals the short chord of the claw of the hallux, except in some examples of one or two species.

The tarsus and hallux are short, extremely short in *Megaceryle* which stands alone in the family in this respect.

In the other genera the tarsus is shorter than that of any of the Daceloninæ except *Ramphalcyon* and slightly shorter than most if not all of the Alcedininæ.

All the toes are short (particularly in *Megaceryle* and *Ceryle*) differing from both other subfamilies. The second toe is moderate or long compared with the other anterior toes.

The second toe with claw is usually equal to or longer than the fourth toe without claw, sometimes a *trifle* shorter; and equal to or longer than the third or slightly shorter, never falling short of the third by as much as the short chord of the claw of toe No. 2.

The bill is always black, the lower mandible partially paler (probably orange in life) basally in two species of *Chloroceryle*. These are also the only species with red or orange feet. The dorsal feather tract is intermediate in character between that of the two other subfamilies. It is interrupted in the interscapular region as in the Daceloninæ but somewhat less conspicuously so. The feathers of the lower back and rump are longer and more fully developed than in the latter group, but shorter than in the Alcedininæ.

The Cerylinæ are wholly without the blue or greenish blue present in every genus of the two other subfamilies and very characteristic of them. The upper parts are glossy, metallic green in *Chloroceryle*, lustreless black and white or gray and white or wholly bluish gray in the two other genera.

In each species the entire upper parts including the crown, wings and tail are always of one color or style of coloration — *i. e.*, the ground color is similar throughout and any variegation takes the form of markings on the individual feathers, no large areas of a different color being present.

The inner webs of the primaries are usually spotted or indented with white. This is more or less marked in all species except *Ceryle rudis* in which the large white patches give no indication of being broken up into spots, and in *C. ænea* in which the inner webs are plain, or at most with a fulvous margin. The outer webs of the primaries are also usually marked with white. The secondaries and scapulars are always more or less spotted or indented and the rectrices barred or otherwise marked with white.

The sex in all three genera is invariably indicated by the color of the underparts (and never by that of the upperparts or tail), particularly by the chest or breast band. In both sexes the chest is crossed by a band

which is of the same color as the upperparts (females of *all* species, and males of two), or rufous (males of all species except two), though in the rufous bellied species the rufous of the chest is continuous with that of the breast and belly. Thus the *color of the chest-band* usually distinguishes the sexes (always in *Chloroceryle*, never in *Ceryle*). In one species of *Chloroceryle* the sexes also differ in the color of the throat and breast. In all the species of *Megaceryle* the males may be distinguished from the females by the color of the axillars and (except in one species) by that of the under wing-coverts, while in two species there is also a difference in the color of the belly. While the female never has rufous on the chest and in *Megaceryle* and *Chloroceryle* the male (with one exception) is always rufous there, when there is a difference in the color of the axillars, under wing-coverts, throat, breast or belly as above noted the coloration is reversed, and where the male is white the female is rufous or buff. *Ceryle*, unique in the absence of rufous in both sexes, is also peculiar in having two black bands across the breast of the male.

Outside of the Cerylinæ a sexual difference in the color of the underparts occurs in only two or three species of Alcedininae (*Alcedo* and *Alcyone*) and in *Lacedo* and one section of *Halcyon* of the Daceloninae. In none of these, however (except in *Lacedo*) are the differences of the same nature as in *Megaceryle* and *Chloroceryle* (or *Ceryle*) and they have therefore undoubtedly been independently acquired and do not indicate any particular affinity to the Cerylinæ, nor weaken the value of this character in the latter group.

The oil-gland always has a well developed tuft in this subfamily. The secondaries are eutaxic in *Chloroceryle*, diastataxic in the two other genera.

Several other miscellaneous "negative" characters may be mentioned, each of which serves to distinguish this group from one or more genera of the other subfamilies. The bill is never wholly red, and the culmen is not hooked. The feathering of the lores is normal or not very remarkable, never bare or bristly; the number of rectrices is always twelve and the central pair is never elongated beyond the others. The second toe is always present and well developed.

The following osteological characters are, as previously mentioned, based on only a few species (belonging to six genera¹) and doubtless will not all prove to be constant distinctions between the Cerylinæ and the other subfamilies.

The culmen is not depressed back of the nostrils, and the latter are comparatively short not reaching very far backwards. The mesethmoid is produced anteriorly in a more or less triangular or pointed plate. The pars plana of the mesethmoid meets the descending process of the lacrymal

¹ *Megaceryle*, *Chloroceryle*, *Alcedo* (skull), *Ramphalcyon*, *Halcyon*, *Dacelo*.

decidedly above the middle of the latter, sometimes at the upper corner. The lacrymal is rather narrowly oblong and has no backwardly produced process. The maxillary is conspicuously expanded into a thin, flat plate. The posterior palatal spine is vestigial or short. The orbital process of the quadrate is long or rather long, slender and pointed. The sternum is relatively long and narrow, the coracoids and furcula short, the last much wider toward the upper end. The pointed process arising from the upper end of the clavicle is either moderately developed or wholly absent. The sternal keel is high and prominent. The scapula is not broadened at the bend near its distal end, and without a prominent angle on the inner side at that point. The pelvis is wide and ample without abrupt angles; the ilia narrowed anteriorly, their inner edges not sharply defined and not separated by a deep groove from the sacrum, and the latter is flattened on top. The ilia bears a small pointed process on its margin. (Plates XXV and XXVI.)

Alcedininae (7 genera).—Restricted to the Eastern Hemisphere; one weakly characterized genus confined to the Celebes, three to Africa, the others chiefly Austro-Malayan and Asiatic.

Size rather uniform, small to very small. Bill long or rather long, varying from compressed to much depressed or flattened. Culmen not flattened and expanded basally as in *Ramphalcyon*. The vertical crest when present (as in *Corythornis*) differs in form and in the shape of the individual feathers from that of *Megaceryle*, the crest being wide and depressed, the feathers linear-oblongate or somewhat clavate. In the species examined (representing all the genera) the tenth primary is never shorter than the fifth, and is sometimes equal to the seventh. The tail is very short (always less than half the length of the wing) and of remarkably uniform length throughout the group. In this respect the subfamily is unique.

The lower end of the tibia is more extensively feathered than in the *Cerylinæ*, the feathers extending to the joint in at least three genera. *Alcedo* and *Alcyon* are intermediate, there being a decided bare space in front, above the joint, in at least some species; but on the outer side or rear of the tibia, if not in front, the feathers always extend further down than in the *Cerylinæ*, the bare space at its most restricted point being shorter than the short chord of the hallux claw.

The tarsus is always short or rather short, always decidedly longer than that of *Megaceryle* but never as long as in the longer-legged genera of *Daceloninae*. It is slightly longer than in *Chloroceryle* and about equal to the shorter-legged forms of *Daceloninae* (excluding *Ramphalcyon*). The tarsus is always decidedly longer than the inner toe without claw.

The anterior toes (except the second) are longer than in the *Cerylinæ*

agreeing better with the Daceloninae. The second toe with claw is always much shorter than the third toe without claw (by at least a trifle more than the chord of the claw of toe No. 2); it is sometimes markedly reduced and in two genera wholly absent or represented by a mere vestige. It is thus decidedly shorter than in the Cerylinae and, with the possible exception of a few species of *Halcyon*, always shorter than in the Daceloninae.

The bill in at least some species of every genus is more or less red, at least five of the seven genera containing species with wholly red bills. The feet also are usually red or orange, this coloration represented in every genus.

The dorsal feather tract differs decidedly from that of the two other subfamilies in being perfectly continuous, not interrupted in the interscapular region. The feathers of the lower back and rump also are very long, more so even than in the Cerylinae, and conspicuous, not hidden by the scapulars as in the Daceloninae.

In all the species the characteristic blue of the Kingfishers (except the Cerylinae) is present, varying, as in the Daceloninae, from deep blue to a light silky opalescent or greenish blue.

The upperparts are almost limited to these shades though sometimes invaded by rufous which in a few species overspreads the entire upper surface. In the latter the blue is represented by a strong lilaceous luster.

Nearly as universal as blue is rufous, which is found on the underparts in at least some species of each genus. The scapulars, remiges or rectrices are never spotted, barred or otherwise marked with white.

The crown is often barred or spotted with black on a blue ground, or with light blue on a dark blue or blackish ground. This runs through the various genera and is very characteristic of the group.

There is, ordinarily, little if any sexual difference in the color of the plumage. The sex is never indicated by the color of the upperparts or tail, as in some Daceloninae, except that the female may be duller and greener above as in *Ramphalcyon*, and rarely by the banding of the chest or general color of the underparts as in the Cerylinae. In at least two species, however, the male has a blue chest-band which is absent in the female. This is the case in *Alcyon cyanopterus* in which the blue of the sides and flanks is also more extensive in the male, and in *Alcedo euryzona* in which the ground color of the underparts is white in the male and (except the throat) ochraceous-rufous in the female. Thus in these species the color of the chest-band is exactly the reverse of the normal Cerylinae style.

In *Alcedo euryzona*, however, the general color of the posterior underparts in each sex (white in male, rufous in female) is the same as in *Megasceryle maxima* and to a less extent in *M. alcyon*. This, however, can scarcely be considered as other than a chance resemblance or more properly a case

of parallel development or convergence. Only one other species of Alcedininae appears to have a banded chest. This is *Alcedo beryllina* in which the underparts are white with a blue chest-band in both sexes.

In all the species of *Alcedo* there is a curious difference in the color of the bill according to the sex. This is wholly black in the males while in the females more or less of the proximal half of the lower mandible is red.

The tuft of the oil-gland is always well developed. The status of the fifth secondary has been recorded only in *Alcedo* (2 species) and *Ceyx*. These are both eutaxic, and in all probability the other genera are the same.

Of miscellaneous characters may be mentioned the color of the bill, which is often entirely red; the tomia are always smooth, and the tip of the maxilla is never hooked. The loral feathering is normal and the rectrices always number twelve.

The osteological characters are presumably rather uniform throughout the group, but unfortunately I have had for examination only the skull of *Alcedo ispida*, and the following notes are based on this species.

The culmen is not depressed back of the nostrils and the latter are longer and extend further back than in the Cerylinæ, agreeing better with the Daceloninae. The mesethmoid projects somewhat anteriorly, most resembling the Cerylinæ in this feature. The pars plana of the mesethmoid meets the descending process of the lacrymal a trifle above the middle, being thus intermediate between the Cerylinæ on one hand and *Dacelo* and *Halcyon* on the other. The lacrymal is shorter than that of the Cerylinæ but agrees in its truncate posterior margin, and is not at all produced backwards as in *Dacelo* and *Ramphalcyon*.

The maxillary is not conspicuously expanded, agreeing with the Daceloninae and differing from the Cerylinæ. The posterior palatal spine is long and slender, much like that of *Dacelo* but even longer and very different from that of *Chloroceryle* and *Megaceryle*. (In the skulls of *Ramphalcyon* and *Halcyon* examined the palatines are imperfect and this character cannot be determined.) (Plate XXV, Fig. 1.)

The orbital process of the quadrate is remarkably short and blunt. This condition is very different from that found in most genera, but is doubtless most closely related to that seen in *Chloroceryle* (in *C. americana* more than in *C. amazona*) in which the orbital process is a very slender spine. The disappearance of this spine would result in a quadrate much like that of *Alcedo*.

As no part of the body skeleton has been available for examination, I am unable to describe the sternum, shoulder girdle or pelvis in detail. Fürbringer's figures, however, show that there is a process near the proximal end of the clavicle as in *Halcyon*, *Dacelo*, etc., but even larger and more

abrupt, differing in being broad and rounded terminally instead of triangular and pointed. Fürbringer states that in this genus the procoracoid is united with the acrocoracoid by a bony bridge. This peculiarity is probably confined to the present subfamily.

The figures of the sternum show that the keel is high and prominent but less so than in *Megaceryle* (more as in *Chloroceryle*), the upper or anterior end decidedly concave as in all the genera examined except *Megaceryle*.

Daceloninæ (at least 12 genera).—Restricted to the Old World and, with the exception of the large and widely distributed genus *Halcyon*, to the Australian and Indian Regions. Only two other genera (*Ramphalcyon* and *Lacedo*) are found at all outside of the Australian Region and these are mostly confined to the Indo-Malayan subregion. *Lacedo* is the only one of the group not represented in the Australian Region.

Size rather small to very large, the smallest species about equalling the largest species of the Alcedininæ.

Bill extremely variable in length and general shape, varying from long to very short, and from very deep to much depressed, but compressed only in *Ramphalcyon*. In all the others except *Halcyon* the form of the bill is decidedly different from that found in the other subfamilies and in some, as *Cittura* and *Clytoceyx*, it is remarkably modified.

The occipital feathers are always more or less lengthened, though slightly so in *Ramphalcyon* and many *Halcyons*. Often, as in *Dacelo*, *Melidora*, *Clytoceyx* and *Monachalcyon*, the feathers of both the occiput and vertex are considerably elongated and form a wide flat crest, quite different from the narrow crest of the *Cerylinæ*. There is nothing approaching the high, compressed vertical crest of *Megaceryle*, nor the peculiar form found in *Corythornis*. The feathers are usually broad and rounded at the tip.

The wing is usually decidedly rounded. In some species of *Halcyon* the tenth primary is as long as the ninth, these two quills being the longest, but in all other genera the outermost quill is shorter than the fifth, usually conspicuously so, and shorter than the fourth in all but *Todirhamphus* and *Dacelo*.

With the exception, therefore, of *Halcyon* the *Daceloninæ* differ in this respect from all the Alcedininæ and from the *Cerylinæ* except certain species of *Chloroceryle*.

The variation in the primary formula in *Halcyon* is most remarkable. The tenth primary is in some species much shorter than the first, while in others the tenth and ninth are equal and longest. There are doubtless few if any other genera of birds in which this range of variation is equalled. There is little doubt, however, that this large genus of over eighty forms, by far the largest in the family, is divisible into at least two genera, as it

includes both eutaxic and diastataxic groups, and there are also differences in form and coloration.

The tail is always rather long or long (rather short in *Halcyon concretus*, but always more than half the length of the wing) and attains the greatest length in the family in *Cittura*, *Monachalcyon*, and *Tanysiptera*, in which it is nearly as long as the wing. The last genus is unique in the presence of only ten rectrices, the middle pair greatly elongated, linear, widening at the tip. In four genera — *Tanysiptera*, *Cittura*, *Lacedo* and *Syma* — the tail is graduated for one third or more of its length (leaving out of account the central rectrices of *Tanysiptera*).

The lower end of the tibia is always completely feathered to the joint except in *Ramphalcyon*, which is intermediate between the other genera and the Cerylinæ in this respect, the lower end of the tibia being bare in front for more than in any other non-Cerylinæ genus (for a distance about equal to or longer than the short chord of the hallux claw), but on the outside it is bare for much less than this distance, thus differing from the Cerylinæ.

In the following genera the feathers extend beyond the joint, small feathers growing on the upper end of the tarsus: *Clytoceyx*, *Lacedo*, *Syma*, *Cittura*, *Dacelo*, *Choucalcyon*, and some species of *Halcyon*. In *Melidora* the feathers fall over and beyond the joint. In all the other genera except *Ramphalcyon* the feathering extends right down to the joint, densely in all the species of *Halcyon* examined, but sparsely in *Monachalcyon*.

The tarsus is comparatively long in all except *Ramphalcyon*, in which it is of about the same length as in *Chloroceryle*, equalling or a trifle exceeding the inner toe without the claw. In all the other genera the tarsus is decidedly longer than the inner toe without claw, sometimes (*Clytoceyx*, *Monachalcyon*, *Tanysiptera* and *Syma*) equalling or exceeding the toe and claw combined.

The following measurements, in millimeters, all taken from the bones, show well the relative length of the tarsus in several genera:

	<i>Tarsus</i>	<i>Femur</i>
<i>Megaceryle torquata</i>	12.6	33.4
<i>Chloroceryle americana</i>	9.3	17.5
<i>Ramphalcyon capensis</i>	15.	29.
<i>Halcyon chloris</i>	14.	21.9
<i>Dacelo gigas</i>	24.	37.4

It will be observed that in *Megaceryle* the tarsus is much less than half the length of the femur; in *Chloroceryle* and *Ramphalcyon* a trifle more than half; in *Halcyon* and *Dacelo* much more than half.

The second toe with claw is always (excepting in *Lacedo*) shorter than

the third toe without claw, though sometimes only a trifle shorter. The sole exception to this very uniform proportion is *Lacedo*, in which the second toe slightly exceeds the third (thus agreeing with *Megaceryle*). The second toe (with claw) is, however, never much shorter than the third (without claw), as is the case in all the Alcedininæ, never falling short of the third by more than the short chord of the claw of toe No. 2, except probably in *Halcyon coromandus* and possibly a few other species. The second (with claw) is always (again excepting *Lacedo*) distinctly shorter than the fourth (without claw) or barely equal to it. In *Lacedo* the second is a trifle longer than the fourth.

Thus in this subfamily the second toe is relatively longer than in the Alcedininæ and shorter than in most Cerylinæ; but *Lacedo* agrees with the latter, while the two or three small species of *Chloroceryle* agree with the Daceloninæ.

The dorsal feather tract resembles that of the Cerylinæ in being interrupted by a spot on the interscapulum in which the feathers are very short. This is carried to the extreme in the present group, as, in most genera, this area is conspicuously bare, with only a few small downy feathers growing in it. In several genera as in *Ramphalcyon*, *Halcyon* and *Dace'o* the tract is continuous, a single line of small, weak feathers connecting the anterior and posterior parts of the tract. In *Ramphalcyon* and to a greater or less extent in *Halcyon* and *Dacelo* this interscapular spot is densely covered with down.

The feathers of the lower back and rump are shorter than in the Cerylinæ, but there is some variation in their length in the different genera. In *Ramphalcyon* all the dorsal feathers are notably short.

The bill is very rarely entirely black and in the majority of genera is wholly red or yellowish in at least some species. (This is also the case in the Alcedininæ but never in the Cerylinæ.)

In every genus of this group, and indeed in every species (at least of those examined) the characteristic blue or greenish blue is present, though occasionally hardly more than a trace is evident.

The rectrices are barred only in *Dacelo* and *Lacedo*, and the remiges and scapulars only in the latter, the entire upperparts of which are barred. The crown never exhibits the blue banding or spotting so characteristic of the Alcedininæ.

In all but two genera (*Ramphalcyon* and *Todirhamphus*) in some species at least, the sexes differ more or less from each other in the color of some part or parts of the upper surface (including crown, cheeks, wing-coverts, and particularly the tail) which are usually blue in the male, this wholly or partly replaced by rufous or, less frequently, black in the female. *Syma*

is peculiar in having the head cinnamon in the male, and with a large black patch in the center of the crown in the female.

Differences in coloration of this nature are wholly absent in the Cerylinæ and Alcedininæ. Moreover in the Daceloninæ (excepting in a few species of *Halcyon* and in *Lacedo*) the sexes never differ in the color of the underparts as do those of the Cerylinæ, no chest-band being present.

Lacedo, in addition to presenting greater sexual differences in the color of the upper parts than in any other genus also differs in the color of the underparts almost exactly as do the species of *Megaceryle* and *Chloroceryle*. In the male the breast and sides are fulvous or ochraceous-buff, while in the female these parts are almost white, narrowly barred with black.

In *Tanyssiptera* the sexes are described as similar except in *T. sylvia* in which the female has a buff instead of white dorsal patch and the proximal portion of the outer web of the central rectrices blue (wholly white in the male).

In *Halcyon* the sexes are usually alike, the female sometimes somewhat duller in color but there are well marked differences in two groups of the genus. In *H. concretus* and *H. lindsayi* the distinction is much as in the majority of genera of the subfamily, blue on the upperparts of the male being replaced by greenish in the female.

In the group containing *H. lazuli* and several other species the sexes differ in the distribution of blue and white on the underparts or the presence or absence of a white collar, or in both respects. The male may be entirely white or entirely blue below, the female white with a blue chest-band, or the abdomen may be blue in the male and white in the female.

In *H. albiventris*, which belongs to another group, the female is said to be much duller than the male (black above replaced by brown), the blue parts greener, the white or buff of the hind neck and portions of the under surface deeper buff or more rufescent.

In *Todirhamphus* there appears to be no sexual difference. This genus is closely related to *Halcyon*, particularly to a section in which the sexes are alike.

In *Ramphalcyon* also the sexes differ in coloration only in the duller, more brownish or greenish (less blue) upperparts of the females, as in some species of *Halcyon*.¹ In this genus moreover the color pattern is as different as possible from that of the Cerylinæ, and both color and pattern agree much more closely with those of the Daceloninæ and Alcedininæ.

Skeletons of the following genera of Daceloninæ have been examined: *Dacelo*, *Halcyon* (*chloris*, and sternum and shoulder girdle of *concretus*), and

¹ Cf. Oberholser, Proc. U. S. Nat. Mus., XXXV, 1909, 658.

Ramphalcyon. Unfortunately the palatines are imperfect in all the specimens except that of *Dacelo*. These have been compared with skeletons of *Megaceryle* (*alcyon* and *torquata*) and *Chloroceryle* (*americana*, and skull of *C. amazona*) representing the Cerylinæ, and skulls of *Alcedo ispida* (also figures of sternum and shoulder girdle) representing the Alcedininæ. It must be understood that the following statements refer only to the genera enumerated, and, as already remarked, some of the minor characters described will probably be found inconstant when all the genera are examined.

There is no reason to believe, however, that the essential characters of the Cerylinæ as here set forth will have to be changed when the osteology of *Ceryle rudis* has been investigated.

In the Daceloninæ the culmen is bent down or depressed at its base; this is not the case in the other groups.

The nostrils are long, extending far backwards, but *Ramphalcyon* is intermediate between *Dacelo* and *Halcyon* on one hand and the Cerylinæ on the other. *Alcedo* is little different from the Daceloninæ.

The mesethmoid is not produced forwards in a pointed plate as in *Megaceryle* and to a less extent in *Chloroceryle* and *Alcedo*. *C. amazona* apparently agrees with the Daceloninæ in this respect but I am not certain that this part of the skull is perfect in the specimens examined.

The pars plana of the mesethmoid meets the descending process of the lacrymal a little below the middle of the latter, not slightly above the middle as in *Alcedo* nor much above as in the Cerylinæ. In *Ramphalcyon* the descending process of the lacrymal is so peculiar that its relation to the pars plana cannot be easily compared with that in the other genera.

In *Dacelo* and *Ramphalcyon* the lacrymal has a conspicuous backward (superorbital) process, longer than the anterior part of the bone in the former, much shorter in the latter. This process is altogether absent in *Halcyon* (*chloris*), *Alcedo*, and the Cerylinæ.

The maxillary, as in *Alcedo*, is normal, not expanded into a plate as in the Cerylinæ. *Halcyon* is farthest from the latter, while *Ramphalcyon* shows a slight approach to the Cerylinæ type.

As above stated the palatines are imperfect in all the specimens of Daceloninæ examined except in *Dacelo*. In this genus, as in *Alcedo*, the posterior palatal spine is highly developed, being more than one-third the length of the pterygoids (nearer one-half in *Alcedo*). This process is vestigial in *Megaceryle* and short (about one-eighth the length of the pterygoids) in *Chloroceryle americana*.

In the fusion of the posterior portion of the palatines along their prominent internal laminæ *Ramphalcyon* resembles the Cerylinæ¹ (the union being

¹ Shufeldt states that in *Megaceryle alcyon* "the interval between the anterior ends" of the palatines ("of about two millimeters") "is continued backwards to a point well within

even more extensive) and is quite different from *Dacelo* in which the internal laminae are completely separated. *Halcyon* is somewhat intermediate, the extreme posterior ends being fused. In *Ramphalcyon*, however, the angle formed by the laminae as they approach each other is wider and more rounded than it is in the *Cerylinæ*.

In *Alcedo* the fusion of the post-palatines is nearly as in the *Cerylinæ*, but the internal laminae are scarcely raised above the main expanse of the palatines, differing in this respect from the other groups examined. The palatines, however, agree with those of *Dacelo* and differ from the *Cerylinæ* in being nearly in one plane, while in the latter they slant strongly downwards from the median line towards the outer edge. (Plate XXV, fig. 1.)

The orbital process of the quadrate is very similar in the three genera of *Daceloninae* examined, being stout throughout, blunt and thick at the distal end. In *Alcedo* it is extremely short and obtuse, in fact it might almost be said to be absent. In the *Cerylinæ* it is slender, tapering to a point anteriorly, being particularly slender and weak in *Chloroceryle*, evidently approaching the condition found in *Alcedo*.

The sternum averages shorter and wider than that of the *Cerylinæ*, the coracoids and furcula longer. This is conspicuously so in *Halcyon concretus*, while *Megaceryle* is the other extreme.

The process arising from the clavicle, near its upper end, is abrupt and large as in *Alcedo* (but pointed rather than broadly rounded terminally as in the latter). This process is smaller and less abrupt in *Chloroceryle*, absent in *Megaceryle*. (Plate XXVI, fig. 1.)

The sternal keel as in all the genera examined except *Megaceryle* is concave on its anterior (or upper) end (most so in *Halcyon*), and comparatively low. (Plate XXVI, fig. 2.) In none of the genera examined is the precoracoid united with the acrocoracoid by a bony bridge as in *Alcedo*. The foot of the coracoid is normal, without the curious upstanding process on the inner edge found in *Megaceryle*. The scapula, unlike that of the *Cerylinæ*, is widened at the bend and with a prominent angle on the inner side at that point. (Plate XXVI, fig. 1.)

The anterior end of the pelvis differs from that of the *Cerylinæ* as described under that subfamily, but in *Ramphalcyon* there is some resemblance in the ilia to the *Cerylinæ*. There is only a slight indication of the

the articulation of the heads that articulate with the pterygoids." This condition is shown in the figure accompanying Shufeldt's article, the internal laminae of the palatines being separated to their extreme posterior ends. (Journal of Anatomy, Vol. XVIII, 1884, pp. 279-294; Amer. Naturalist, Vol. XXXVII, 1903, 707 and 708.)

In my opinion this description and figure must be erroneous for in the two skulls of *M. alcyon* and one of *M. torquata* examined by me, the posterior ends of the internal laminae are solidly fused together for a distance of three mm. in the former species and five and one-half in the latter.

small process on the margin of the ilium which is better developed in *Chloroceryle* and conspicuous in *Megaceryle*.

THE POSITION OF RAMPHALCYON.

Fürbringer states that *Ramphalcyon* appears to occupy a special position and to connect the Alcedininæ (= Alcedininæ + Cerylinæ doubtless) with the Halcyoninæ (= Daceloninæ). He remarks that in external characters and the majority of osteological characters this genus agrees better with the Alcedininæ than with the Halcyoninæ, but that in some particular points of the osteology and particularly of the musculature it agrees better with the Halcyoninæ. Fürbringer states that if it were not for *Ramphalcyon* he would agree to the separation of the Alcedinidæ into two families, but that, as the matter stands, further investigations are required to settle the question.

I cannot agree with the statement that in external characters this genus agrees better with the Alcedininæ (of Fürbringer) than with the Halcyoninæ. As regards the skeletal resemblances the material available is too incomplete for positive conclusions yet I believe that *Ramphalcyon* is more distinct from the Cerylinæ than from the Daceloninæ (in the restricted sense).

The following tabulation of the characters of *Ramphalcyon* shows the grounds for placing this genus in the Daceloninæ. It agrees best with this subfamily in sixteen of the characters enumerated (also in several important muscular peculiarities), with the Alcedininæ in eight characters and with the Cerylinæ in five.

In almost all of the features in which *Megaceryle* and *Chloroceryle* differ from each other, *Ramphalcyon* more nearly agrees with the latter than with the former. This is the case not only in the characters here enumerated, but also in the sternal keel, the foot of the coracoid, and the crest, in all of which *Megaceryle* is highly specialized.

It is my belief that the resemblance in certain respects of *Ramphalcyon* to the Cerylinæ is due largely if not wholly to convergence caused by similarity of habits. These likenesses while more or less striking are imperfect, and the details in which they are imperfect are suggestive of analogy and not of common descent.

Thus the bill while compressed, though to a less extent than that of *Megaceryle*, differs in the form of the culmen, gonys and mandibular rami. The culmen is flattened and widened basally (unique), the gonys decidedly keeled (broader and flatter in the Cerylinæ). The mandibular rami are decidedly thinner and not conspicuously bent inwards as in the Cerylinæ,

and form a rounded symphysis, not a narrow V-shaped angle as in the latter. The interramal space is broader, and the feathers (like those of the underparts in general) are less firm, dense and scale-like than in the Ceryline group. In all these respects the resemblance to certain Daceloninæ, for example *Halcyon pileatus*, is striking. The bill is of the same red color in that species as in two of the three species of *Ramphalcyon* (a feature unknown in the Cerylinæ), and except for the form of the culmen the bill of *Ramphalcyon* differs from that of *Halcyon* only in being more strikingly compressed. (Plate XXV, fig. 2.)

The loral feathering and the tibial feathering have both evidently been modified by the aquatic habits, yet in both respects there is a decided difference from the Cerylinæ. The feathers of the lores are extremely small and very closely appressed.

Neither the form of the wing nor the coloration are Ceryline, but much more Dacelonine. A significant point of resemblance between *Ramphalcyon* and the Daceloninæ is the nidification. Little has been published regarding the breeding of any of the species of this genus but it is certain, at least, that the nest is often placed in trees. McGregor describes a nest of *R. gouldi* "in a deserted termite's nest which was built approximately thirty feet from the ground, in a small dead stub. It was probably excavated by the birds, as there is no other way in which the hole could have been made." As far as is known all the members of the Cerylinæ invariably nest in holes excavated in sand or clay banks.

While some of the resemblances of *Ramphalcyon* to the Cerylinæ may be due to convergence, others are probably explainable by descent from a common ancestor, for the genus is unquestionably an old and isolated one. The short tarsus and fused palatines are two of the most important resemblances to the other piscivorous Kingfishers.

Of the differences from the Alcedininæ the most important are: length of second toe; proportion of primaries; character of dorsal feathering; form of lacrymal and of orbital process of quadrate; size; length of tail; and probably the form and arrangement of certain muscles.

Nearest Daceloninæ

Length of second toe (also agrees with aberrant Cerylinæ)
Proportion of primaries
Dorsal feathering (much nearer Cerylinæ than to Alcedininæ)
Gonys and mandibular rami (equally near Alcedininæ?)
Lacrymal (like *Dacelo*; unlike *Halcyon* which is like *Alcedo* and Cerylinæ)
Quadrate, orbital process
Base of culmen depressed (in skull)
Pelvis (that of *Alcedo* not seen)
Certain muscles (important)

Nearest Daceloninæ and Alcedininæ

General coloration (blue present, remiges and rectrices unmarked)
 Sexual coloration (no difference below; no chest-band)
 Length of third and fourth toes (little different from *Chloroceryle*)
 Maxillary not expanded (*slightly* approaches Cerylinæ)
 Proximal end of furcula (nearest Daceloninæ, not far from *Chloroceryle*)
 Nidification

Nearest Daceloninæ and Cerylinæ

Length of tail
 Size

Nearest Cerylinæ

Length of tarsus (like *Chloroceryle*)
 Compressed bill (also deep)

Nearest Alcedininæ

Feathering of tibia (intermediate between Cerylinæ and Daceloninæ)

Nearest Alcedininæ and Cerylinæ

Fusion of palatines (even more extensive)

REMARKS ON OTHER GENERA.

While the question of generic distinction in the Alcedininæ and Daceloninæ is beyond the scope of the present paper, some random remarks on the subject suggest themselves and a few characters often overlooked in systematic works may be mentioned.

The very large and dominant genus *Halcyon* is remarkable not only for the great number of species (three or four times that of *Tanysiptera*, the next largest genus of Daceloninæ) and wide geographical distribution (the only genus of the subfamily found in Africa, where it is well represented), but also for the striking variations in the relative length of the primaries and the presence or absence of the fifth secondary.

Halcyon is evidently a generalized form and approaches the other subfamilies more closely than any other genus of its group. In the absence of a backward process to the lacrymal it differs from *Dacelo* and *Ramphalcyon* (and doubtless other genera) agreeing with Alcedininæ (*Alcedo* at least) and the Cerylinæ.

Lacedo (*Carcineutes*) is distinguished by several peculiarities, the strikingly barred upperparts and remarkable difference between the sexes being the most conspicuous. In the proportionate length of the toes *Lacedo* differs from all others of the group and agrees with the typical Ceryline

proportions. The second toe (with claw) is a trifle longer than the third and fourth toes (without claw); in other genera the second is shorter than the third and barely or not as long as the fourth.

It is curious that in the barring of the upperparts, the sexual difference in the coloration of the underparts and the relative length of the toes this genus should so strongly recall the Cerylinæ, but the resemblance cannot be considered as anything but a coincidence. The resemblance of the female to *Bucco radiatus*, a bird of another suborder, is quite striking, and in its conspicuous fulvous collar the *Bucco* is even more Kingfisher-like than *Lacedo* itself.

The tuft of the oil-gland is well developed in about half of the genera of Daceloninæ. In *Clytoceyx* and *Monachalcyon* it is rather small and sparse, in *Lacedo* and *Melidora* reduced to a mere vestige and in *Tanyisiptera* and *Cittura* it is altogether wanting. The absence of the tuft in *Tanyisiptera* has been previously recorded by Beddard and in *Cittura* by Mitchell, and my observations confirm their statements.

The character of the tarsal podotheca is a useful generic character but too variable to use in delimiting the subfamilies. It is constant in the Alcedininæ in all of which the tarsus is covered with skin only, without a suggestion of scales. In the Cerylinæ we find that *Chloroceryle* differs from the two other genera in its unscaled podotheca. In the Daceloninæ it is naked only in *Cittura*, covered with a single row of broad plates as in *Halcyon*, a double row as in *Monachalcyon*, or with three or more rows as in *Dacelo*.

The extent of coherence between the anterior toes is very constant throughout the family, and the form of the external nostrils is of no more than generic value. The nostril is a narrow slit in the Cerylinæ and Alcedininæ, wider and more open in most of the Daceloninæ.

The natural grouping of the genera in the Daceloninæ is a matter of considerable difficulty and no arrangement can be considered final until the internal anatomy has been examined.

It is obvious that *Halcyon* and *Todirhamphus* are very closely related, while *Dacelo*, *Choucalcyon*, and probably *Clytoceyx* form a natural group, but the exact positions of the remaining genera is a question for future determination.

Tanyisiptera is highly remarkable in the form of its tail but in no other respect, though the almost perfect agreement of the sexes in coloration is worthy of note. In his 'Map of the Family Alcedinidæ' Sharpe places *Monachalcyon* between *Halcyon* and *Tanyisiptera*, a position almost certainly wrong in my opinion. *Monachalcyon fulgidus* recognized by Sharpe in his Monograph as a distinct genus, *Caridonax*, I have not seen. It is apparently

much like *Monachalcyon* in form but strikingly different in coloration and closer examination may discover characters of generic value.

The Alcedininæ is a very compact group, the genera all being closely related. They are based on the form of the bill, compressed in some, more or less depressed in others, and in the development of the second toe, which is always short and often vestigial or absent. *Ceycopsis* is a weakly characterized genus being perfectly intermediate between *Ispidina* and *Ceyx*, differing from the former only in the slightly shorter second toe.

PART II. THE GENERA OF CERYLINÆ.

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GENERIC NAMES.

It is rather remarkable that with all the minute generic subdivision of recent years the old genus *Ceryle* has thus far remained intact.

The obvious differences between the Neotropical green Kingfishers, the large, crested blue-gray species found in both hemispheres, and the black and white Afro-Indian *Ceryle rudis* (the type of the genus), were first recognized in nomenclature by Kaup in 1848, when he distinguished the first two mentioned groups as *Chloroceryle* and *Megaceryle* respectively. In the same paper Kaup proposed names for three other groups of Kingfishers; *Ispidina*, *Corythornis* and *Cittura*. All of these names were used subgenerically by Kaup, but while the last three have been universally accepted as genera, most authorities have continued to treat *Megaceryle* and *Chloroceryle* merely as subgenera. These two groups, however, are actually more distinct than either *Ispidina* or *Corythornis* and are distinguished by characters of ample importance to entitle them to the rank of genera. Several of the more important differences are not obvious or do not exist in the museum skin and this fact has retarded the recognition of the distinctness of these groups. Kaup's choice of names for his sections of *Ceryle* was felicitous as both are most appropriate; the dark glossy green of *Chloroceryle* is unique in the family, while the large size of the species of *Megaceryle* distinguishes them from the others of the Ceryline group.

GENERIC SYNONYMY.

In addition to the three valid generic names, four others have been proposed in this group which cannot be used, one of them being preoccupied while the three others are either absolute or virtual synonyms. The complete list of these names follows:

Ceryle BOIE, Isis, XXI, 1828, 316. Type by subsequent designation, the first species, *Alcedo rudis* Linn. (Gray, 1840). This species is also the type by elimination (Kaup, 1848). *Ceryle* originally contained five species: *rudis*, *amazona*, *americana*, *alcyon*, and *bicolor* (= *inda*). By the recognition of *Chloroceryle* and *Megaceryle* this genus is restricted to a single species (divisible into three subspecies), characteristic of the Afro-Indian Region.

Chloroceryle KAUP, Verh. naturhist. Vereins Hessen, II, 1848, 68. Type, by subsequent designation, *Alcedo amazona* Latham (Gray, 1855). The first species is *Alcedo superciliosa* Linn. (= *Alcedo aenea* Pallas). By elimination either *amazona* or *americana* could become the type. The original species of this genus were the same four as at present recognized, with the addition of "*bicolor*," a synonym of *inda*. Four very distinct species, with four or five subspecies, all confined to the Neotropical Region. A very natural genus, of which the following is a synonym.

Amazonis Reichenbach, Handb. Alced., 1851, 28. Type, by subsequent designation, the first species, *Alcedo superciliosa* Linn. = *Alcedo aenea* Pallas (Sharpe, Jan. 1871 and 1892). Not *Amazona* Lesson, 1831. This was proposed as a subgeneric term to include *Chloroceryle aenea* and *C. inda* and was used generically for the same two species by Bonaparte. These scarcely differ from *C. americana* except in coloration and in my opinion are not even subgenerically separable from the latter.

These three species collectively, however, differ in several respects from *C.*

amazona (the type of *Chloroceryle*) and the name *Amazonis* might be used subgenerically to express this difference. The utility of subgenera, however, with the small present-day genera is very doubtful. Moreover, *Amazonis* is perhaps invalidated by *Amazona* Lesson, 1831.

Megaceryle KAUP, Verh. naturhist. Vereins Hessen, II, 1848, 68. Type, by subsequent designation, *Alcedo maxima* Pallas (Gray, 1855). The first species is "*guttata*," presumably *guttata* Vigors, 1830 (not of Boddaert, 1783 = *Alcedo maxima* Pallas), *Ceryle guttulata* Stejn. Elimination would fix the type on *guttata* (*guttulata*) for though this was the first species to be removed from the genus (by Reichenbach in 1851), it was not placed in a new genus, but merely transferred back to the old genus *Ceryle*. The original genus contained the same species now referred to it. with the exception of the slightly distinct *lugubris*.

Five species, four of them very strongly marked, and three subspecies, one or two of which may be specifically distinct. The only genus of Kingfishers found in both Hemispheres; generally speaking each of the four great continents is inhabited by a characteristic species. Three other generic names have been used for the various species of this very natural and compact genus, as follows:

Ispida Swainson, Classif. Birds, II, 1837, 336. Type, by subsequent designation, the first species, *Alcedo alcyon* Linn. (Sharpe, Jan. 1871 and 1892), not *Ispida* Brisson, 1760. Contained *alcyon*, *bitorquata* (= *rudis*) *gigantea* (= *maxima*) and *torquata*. This is the earliest name for the genus *Megaceryle* but is invalidated by Brisson's name for those who accept the genera of that author.

Streptoceryle Bonaparte, Consp. Volucr. Anisod., 1854, 10. Type, by subsequent designation, the first species, *Alcedo torquata* Linn. (Gray, 1855; Sharpe, Jan. 1871, and 1892).

This genus was quite unnecessarily established by Bonaparte (as a full genus) for *torquata* and *alcyon*, the New World species of *Megaceryle*. They are both, at least *M. torquata*, strictly congeneric with *M. maxima*.

Ichthyomus Cabanis and Heine, Mus. Hein., Th. ii, 1860, 150. Type, by monotypy, *Alcedo maxima* Pallas.

This is a pure synonym of *Megaceryle*, having the same species as its type. Five years before *Ichthyomus* was published Gray had, in 1855, designated *maxima* as the type of *Megaceryle*, although this is the last mentioned of the four species given by Kaup under that genus. In specifying the *last* species as the type Gray was probably influenced by Reichenbach's ill-advised action (in 1851) in transferring *guttata* (= *guttulata*) from *Megaceryle* back to true *Ceryle*, and by Bonaparte's removal (in 1854) of *torquata* and *alcyon* to his genus *Streptoceryle*, leaving only the single species *maxima* in *Megaceryle*. Possibly also the fact of there being two *guttatas*, that of Boddaert (= *maxima* Pallas) and that of Vigors (= *guttulata* Stejn.) made it seem undesirable to Gray to fix *guttata* as the type.

On the other hand Cabanis and Heine in founding the genus *Ichthyomus* for *M. maxima* took Kaup's *guttata* as the *guttata* of Vigors (*guttulata* Stejn.) in which they were unquestionably correct, and considered it as the type of *Megaceryle* (doubtless because of its being the first species), ignoring Gray's citation of *maxima* as the type of the latter genus.

Unfortunately the nomenclature in this group is still unsettled, for it is uncertain whether it will not be necessary to replace *Alcedo* by *Ispida* and to use the former name in place of *Megaceryle*.

The type of the Linnæan genus *Alcedo* (1758), by subsequent designation, is the first species, *A. ispida* (Lesson 1828, Gray 1840). The type of Brisson's *Ispida* (1760) is, by absolute tautonymy, its first species, *I. ispida*.

If the fact that the types of these two genera are the same renders *Ispida* a synonym of *Alcedo* then *Ispida* is thereby canceled and removed from further consideration, and the changes above mentioned are averted. However, at the time *Ispida* was established *Alcedo* had no type, as this was not fixed until 1828. For this reason some maintain that *Ispida* cannot be canceled but must be used for *Alcedo ispida*. *Alcedo* would then be tenable for one of the other species of the original genus, and should probably be used either for *A. smyrnensis*, which is a species of *Halcyon* (Swainson, 1820), but is not the type of this or of any other genus, or for *A. alcyon*, a species of *Megaceryle* (Kaup, 1848), and the type of *Ispida* (Swainson, 1837, *nec* Brisson, 1760), by special designation (Sharpe, 1871).

By pure elimination the type of *Alcedo* Linn. is *A. alcyon*.

As there is a decided difference of opinion among the systematists whom I have consulted as to the interpretation of the rules bearing on this case it seems best to leave these names as currently understood, particularly as there is a strong probability that no change will be necessary. The question may well be left for decision by the International Zoölogical Commission.

DIFFERENTIAL CHARACTERS.

In the accompanying tables the differences between the three genera are briefly stated.

Unfortunately the osteology and myology of true *Ceryle* (and, excepting the skull, of *Ch. amazona*) do not seem to have been investigated. When these are known the exact relation of *Ceryle* to *Megaceryle* and *Chloroceryle* will be much clearer than at present.

In external characters, at least, it will be observed that both *Megaceryle* and *Chloroceryle* possess a number of unique characters, while *Ceryle* has fewer strongly marked peculiarities, being mainly characterized by a combination of the characters of the two other genera. In the texture and coloration of its plumage, however, it stands quite alone.

Megaceryle is unquestionably the most strongly characterized genus, as several of its characters (form of crest, extreme shortness of tarsus and hallux, and coloration) are found in no other genus of the family. It is highly probable that several of its skeletal or myological peculiarities are also unique, but some of these may prove to be shared by *Ceryle*.

Of the nine exclusive characters of *Chloroceryle* only four are constant, the five others failing in *C. amazona*, the aberrant member. This species

Table showing the external differences between the three genera.

	MEGACERYLE	CERYLE	CHLOROCERYLE
Form of bill	Stout (moderate in <i>alcyon</i>)	Slender	Moderate to rather slender
Tomia	<i>Serrate</i>	Entire	Entire
Internatal feathering	Normal	Overlapping rami	Normal
Crest	Occipital and vertical, highly developed	(Occipital)	(Occipital; short and blended in three species)
Texture of plumage	Comparatively harsh; lusterless	Soft, hairy, satiny	Soft, glossy metallic above
10th primary	> 5 to > 6 (> 7 in <i>alcyon</i>)	> 6	$= 3$ to nearly $= 6$
5th secondary	Diastataxic	Diastataxic	Eulazic
Tail, graduated	(For more than $\frac{1}{15}$ but less than $\frac{1}{3}$ of its length)	For less than $\frac{1}{15}$ of its length	(For more than $\frac{1}{3}$ of its length in three species; more than $\frac{1}{15}$ in one species)
Rectrices, tip	Not widened (sometimes narrowed) somewhat pointed	Broadened and obtusely rounded	Rounded but not widened
Length of tarsus	Extremely short	Very short	Short
Length of hallux	Extremely short	Rather short	Rather short or moderate
Anterior toes	Short; $2 > 4$, = or > 3 (or a trifle < 3 , but rarely so except in <i>M. maxima</i>)	Short; $2 > 4$, = or > 3	Longer; ($2 < \text{or} = 4$, < 3 , in three species)
Acrotarsium	Scaled	Scaled	Without scales
Upperparts, ground color	Gray, wholly or partly blue-gray	Black and white	Glossy green
Markings above, wings and tail	Feathers of upperparts uniform, spotted or barred; no large white areas on scapulars, secondaries, or rectrices, no solid white on outer webs of primaries	Feathers of upperparts black, tipped with white and with more or less basal white. Large white areas in scapulars, secondaries, primaries, and all rectrices	Feathers of upperparts not tipped with white. Inner secondaries with considerable black on inner web near tip; central rectrices without basal white
Underparts	With rufous on chest or belly in at least one sex. Axillars white in male, rufous in female	With no rufous. Female with one, male with two black bands on breast	With rufous on chest in male and sometimes on belly in both sexes. Sexes not differing in color of axillars
Size	(Large, <i>M. alcyon</i> medium)	Medium	(Very small to small in three species; medium in one)
Geographical distribution	Both hemispheres	Afro-Indian	Neotropical

Table showing the osteological difference between *Megaceryle* and *Chloroceryle*.¹

	MEGACERYLE	CHLOROCERYLE
Post-palatal spine	Vestigial	Slightly longer
Maxillary	Greatly expanded	Less conspicuously expanded
Descending process of lacrymal and pars plana	Meeting at upper edge of former and bounded above by a large vacuity	Meeting below upper edge of former and with a smaller vacuity above
Mesethmoid	Produced anteriorly in a thin triangular plate	Plate smaller
Sternal keel	Very high, anterior edge straight, obliquely ascending	Lower; anterior edge concave
Costal process	Wider and blunter	Narrower and more pointed
Clavicle	With no process near proximal end (latter broad and blunt); flattened at symphysis	With a conspicuous process near proximal end (latter narrower and more pointed); not flattened at symphysis
Coracoidal foot	With a conspicuous upstanding process on inner side; outer corner obliquely cut off	With no process on inner side; outer corner not obliquely cut off
Iliac process	Conspicuously developed	Slightly less strongly developed
Tarso-metarsus	Extremely short	Moderately short

¹ These characters are based on *M. alcyon*, *M. torquata*, *Ch. americana*, and (skull only) *Ch. amazona*.

nearly agrees with *Ceryle* in all five of these points and with *Megaceryle* in three or four of them. In the appended table the characters peculiar to each genus are given in italics; those enclosed in parentheses are diagnostic except for *Chloroceryle amazona*.

In all of the above skeletal characters (except outer corner of foot of coracoid and form of costal process) *Megaceryle* is unique in the family as

*Table showing the myological differences between Megaceryle and Chloroceryle.*¹

	MEGACERYLE	CHLOROCERYLE
Latissimus dorsi anterior et posterior	Subequal	Anterior very thin, posterior enormous
Expansor secundariorum	Present, but feeble	Absent
Ilio-tibialis externus	Belly narrow (<i>maxima</i>) or rather narrow (<i>alcyon</i>)	Broad
Ilio-tibialis	Preacetabular part well developed	Represented by a band of fasciæ with only a few muscular fibres near proximal end.
Caud-ilio femoralis, pars caudalis	Comparatively narrow	Somewhat wider
Peroneus superficialis	Moderately reduced	Greatly reduced, merely a long tendon.
Deep plantar tendons	Vinculum forked, etc.	Vinculum simple, etc.
Deltoides propatagialis	(<i>Ch. americana</i> resembles <i>Megaceryle</i>)	(<i>Ch. inda</i> differs from <i>Ch. americana</i> as well as from <i>Megaceryle</i>)
Alar tendons	<i>Brevis</i> generalized	<i>Brevis</i> specialized

far as known, while *Chloroceryle* is intermediate between *Megaceryle* and the other (non-Ceryline) genera, being nearer *Megaceryle* in most respects, but in the form of the clavicle, sternal keel and coracoid agreeing more closely with the Daceloninæ.

The three smaller species of *Chloroceryle* (particularly *C. inda* and *C. ænea*) approach the other subfamilies in several characters found in no other Cerylinæ. Thus in the relatively short second toe they agree with the Daceloninæ and approach the Alcedininæ; in the more rounded wing they are nearer the Daceloninæ, and in the orange of feet and lower mandible they resemble many members of both those groups.

On the other hand in two skeletal peculiarities (mesethmoid and palatines) *C. americana* agrees with *Megaceryle* while *C. amazona* is distinctly different.

¹ These characters are taken from Mitchell, and are based wholly upon *M. alcyon*, *M. maxima*, *Ch. americana*, and *Ch. inda*.

The following list shows how *Chloroceryle* combines many of the characters of *Megaceryle* (though often to a less degree) with others agreeing better with those of the Alcedininae or the Daceloninae or both.

Agreements with Megaceryle.

Markings of remiges and rectrices.

Tibial feathering.

Nostrils (in skull).

Form of pelvis (*Alcedo* not known).

Form of scapula (*Alcedo* not known).

Nearest Megaceryle but showing approach to others.

Primary formula.

Length of third and fourth toes.

Relative length of second toe (*C. amazona* agrees with *Megaceryle*, others with Daceloninae).

Bill, depth and tomlia (depth between *Megaceryle* and Alcedininae).

General color, no blue (the glossy green perhaps nearer blue of other subfamilies than to gray of *Megaceryle*).

Sexual coloration (agreement with *Megaceryle* in chest color, but no sexual difference elsewhere).

Maxillary (very near *Megaceryle*).

Palatal foramen (*C. americana* like *Megaceryle*, but *C. amazona* apparently like other groups).

Post-palatal spine (*Halcyon* and *Ramphalcyon* not known).

Pars plana and desc. process of lacrymal (between *Megaceryle* and *Alcedo*; Daceloninae still more different).

Mesethmoid (*C. americana* nearest *Megaceryle*; *C. amazona* apparently like Daceloninae).

Quadrate (approaching Alcedininae).

Iliac process (very different from Daceloninae).

Nearest Alcedininae or Daceloninae or both.

Absence of vertical crest.

Length of tarsus (between *Megaceryle* and Daceloninae, like *Ramphalcyon*, nearly like Alcedininae).

Tarsal podotheca (like Alcedininae).

Foot of coracoid (normal, differing from *Megaceryle*).

Sternal keel (normal, differing from *Megaceryle*).

Process of clavicle (less highly developed, approaching *Megaceryle*).

Symphysis of furcula.

Bill.—The bill in all three genera is straight and compressed. The variations in size and form are as marked within the limits of each of the two larger genera as between any two of them.

As a basis of comparison the distance from the bend of the wing to the tips of the lower primary coverts has been adopted. The following figures show the length of the bill relative to this distance.

Ratio of length of bill to distance from bend of wing to tips of lower primary coverts.

<i>Megaceryle</i>	<i>alcyon</i>	1.50
	<i>lugubris</i> }	
	<i>gutturata</i> }	1.44
	<i>torquata</i>	1.15
	<i>maxima</i>	1.14
<i>Ceryle</i>	<i>rudis</i> (excluding <i>C. r. insignis</i>)	1.15
<i>Chloroceryle</i>	<i>inda</i>	1.05
	<i>amazona</i>	.98
	<i>ænea</i>	.98
	<i>americana</i>	.91

The bill is relatively stoutest (deepest compared to its length) in *Megaceryle*, but *M. alcyon* agrees in this respect with *Ch. inda* which has decidedly the stoutest bill of its group. *Ceryle* has a strikingly slender bill, slenderer than that of any other species though closely approached by *Ch. americana*, there being in fact only an average difference between these two species.

The relative depth of the bill is shown by the following statements. The figures indicate the number of millimeters by which four times the depth of the bill at gonydeal angle falls short of or exceeds the length of the bill from the anterior end of the nostril.

In *Ceryle* length of bill from nostril is *more* than four times depth of bill at gonydeal angle (constantly and decidedly, 2-8 mm. more, averaging 4.2 mm.).

In *Megaceryle* length of bill from nostril is *less* than four times the depth at gonydeal angle (1-6 mm. in *alcyon*, av. 2.6; 5-12 mm., av. 7, 9, 11, in three other species).

In *Chloroceryle* the bill averages more slender than in *Megaceryle* and stouter than in *Ceryle*.

Relative thickness of bill.

	Extremes	Average
<i>Ceryle</i>	- 2. to - 8	- 4.2
<i>Chloroceryle</i>		
<i>americana</i>	- 4. to + .5	- 2
<i>amazona</i>	- (5.5) 2.3 to + 2	- .6
<i>ænea</i>	- 3 to + 2.5	+ .8
<i>inda</i>	+ 1 to 4	+ 2.8
<i>Megaceryle</i>		
<i>alcyon</i>	(- 4) + 1 to 6	+ 2.6
<i>maxima</i>	+ 5 to 10	+ 7.
<i>torquata</i>	+ 4 to 10	+ 9.
<i>gutturata</i>	+ 10 to 12	+ 11.

The variation in the outlines of the bill and in its exact proportions furnish specific rather than generic characters, hardly any two species closely agreeing in the precise form of the bill.

In its serrated tomtia *Megaceryle* differs from both the other genera. These serrations are usually distinct in all the species of *Megaceryle*, but in some individuals of *M. alcyon*, *M. lugubris*, and *M. guttulata* they are obsolete.

In *Chloroceryle* the tomtia are never distinctly serrate, only an occasional individual showing a very slight approach to this condition.

In *Ceryle* the edges of the mandibles are perfectly smooth.

Crest.—*Megaceryle* differs from both other genera in its highly developed occipital and vertical crest. *Ceryle* and *Chloroceryle amazona* have a moderate occipital crest, but the three other species of the latter genus are practically crestless.

A striking feature of all the species of *Megaceryle* is the long compressed crest. No other genus of Kingfishers has a crest of similar form. It covers the entire pileum from the forehead to the nape, extending forward to the extreme base of the bill. The feathers as far forward as the anterior end of the eyes are conspicuously elongated. Those of the vertex are as long as those of the occiput or even longer in some species. Those between the eyes are longer than half the length of the bill. It is the high development of the feathers of the anterior part of the crown that mainly distinguishes the crest of *Megaceryle* from that of the allied genera which altogether lack a vertical crest. The individual feathers are long, narrowly linear or linear lanceolate, the web not as conspicuously frayed out as in *Ceryle*.

In *Chloroceryle* there is no vertical crest, but in all the species the feathers of the crown are of ample length and breadth. Those of the occiput are decidedly lengthened, rather broad, very soft and blended, and of somewhat hairy texture, forming a short bushy crest. In *Chloroceryle amazona* the crest is more conspicuous, the feathers longer and narrower, yet scarcely linear, more distinct from each other (less blended) and firmer (less hairy). They are broader than in *Megaceryle*; and compared with *Ceryle* are much firmer, less soft, and slightly shorter and broader. In this genus and in *Ceryle* the feathers of the vertex are much less than one-half the length of the bill.

Ceryle has a crest most like that of *Chloroceryle amazona* but the occipital feathers are slightly longer and narrower. They are also very soft and hairy, being conspicuously frayed out along the margins into long delicate fringes.

Interramal feathering.—In *Ceryle* the feathering of the interramal space is peculiar. The long, soft feathers bordering each fork of the mandible curl outwards and upwards, overlapping the ramus and completely hiding

its lower sides. In the other genera the feathering is normal, the overlapping being exhibited to only a slight degree at most.

Primary formula.— In the proportionate length of the primaries, aside from the usual individual variations, there are specific differences between certain members of each genus and average differences between the three genera. This amounts to a sharp distinction only between *Ceryle* and *Chloroceryle*.

In *Ceryle* the tenth primary is normally *longer* than the sixth while in *Chloroceryle* it is invariably *shorter* than the sixth.

In *Megaceryle alcyon* the tenth primary is even longer, relatively, than that of *Ceryle*, always decidedly exceeding the sixth; it is always nearer the seventh quill than the sixth and often exceeds the seventh. In the remaining species of *Megaceryle* the tenth primary is always nearer the sixth than the seventh and is always longer than the fifth.

Stated in condensed form the proportionate length of the tenth primary in the various species is as follows:

<i>M. alcyon</i>	always nearer seventh than sixth, often longer than seventh.
<i>Ceryle rudis</i>	longer than sixth, not nearer seventh than sixth.
<i>M. torquata</i>	} between fifth and sixth (rarely longer than sixth in <i>M. torquata</i> , rarely shorter than fifth in <i>C. americana</i> and <i>C. ænea</i>).
<i>M. maxima</i>	
<i>M. lugubris</i>	
<i>M. guttulata</i>	
<i>C. amazona</i>	
<i>C. americana</i>	} never longer than fifth.
<i>C. ænea</i> (Mexico)	
<i>C. inda</i>	
<i>C. ænea</i> (Honduras southward)	

Fifth secondary.— The presence of the fifth secondary distinguishes *Chloroceryle* from both *Ceryle* and *Megaceryle* in both of which this quill is missing, in other words, the first-named genus is eutaxic or quintocubital while the others are diastataxic or aquintocubital. This character has been determined in all the well marked species of each genus.

Pycraft (1899) gave *M. maxima*, *M. alcyon*, *M. torquata* and *C. rudis* as diastataxic and stated that "the remaining species of the genus [*Ceryle*, as currently recognized] are eutaxic." I have carefully examined every species (except *M. lugubris*, which unquestionably agrees in this respect with *M. guttulata*) and my determinations confirm those of Pycraft except as regards *M. guttulata* of which I have examined two specimens and find that it agrees with the other members of *Megaceryle*. Mitchell (1901) records the status of the fifth secondary in *M. maxima*, *M. alcyon*, *C. americana*, and *C. inda* and his observations agree with the above.

The exact value of this curious character in the Kingfishers is uncertain because of its variation in *Halcyon*, but in the *Ceryle* group, at least, it coincides with other characters of full generic value.

The majority of large groups of birds (orders or suborders) are consistently either eutaxic or diastataxic, without any exceptions as far as they have been examined. In only three families are both styles of wing known to occur. These are the Columbidae (Peristeridae of Sharpe), the Alcedinidae and the Micropodidae.

In the Pigeons and Swifts the character always coincides with the limits of currently recognized genera but varies within the subfamilies.

With the recognition of *Megaceryle* and *Chloroceryle* as genera there remains in the Kingfishers only a single genus containing both forms of wing. This is the large and polymorphic *Halcyon* the species of which fall into several minor groups, differing remarkably in the wing formula as well as in the form of the bill and in coloration, and the character of the fifth secondary holds good in each of these sections as far as it has been investigated. As Pycraft remarks: "There is no known exception to the rule that, though a genus may include both forms of wings, it will be found that the species constituting that genus will group themselves, invariably, into two sections, — those with eutaxic and those with diastataxic wings; for, as yet, individual variation in this particular is unknown."

Mitchell, in his paper 'On the Anatomy of the Kingfishers, with Special Reference to the Conditions in the Wing known as Eutaxy and Diastataxy,' uses generically the name *Sauropatis* for the four diastataxic species examined by him.

As *Halcyon* is at present the only genus among birds known to contain both styles of wing there is little doubt that when this character is determined in all the species it will be practicable and desirable to recognize generically one or more of the many names, including *Sauropatis*, currently synonymized under *Halcyon*.

According to Pycraft the Swifts are mostly eutaxic. Of the forms having this type of wing he mentions specifically only one — *Acanthyllis* (= *Chætura* or *Hirundapus*) *caudacuta*. At least two genera, he states, possess both forms, *Dendrochelidon* (= *Hemiprocne*) *mystacea* and *Acanthyllis collaris* (= *Chætura* or *Streptoprocne* *zonaris*) being diastataxic.

As regards *Chætura*, the large Neotropical fork-tailed Swifts (*Streptoprocne*) are generically separable from the species formerly associated with them.¹

Whether any of the Tree Swifts (*Hemiprocne*) are eutaxic as stated by

¹ Cf. Oberholser, Proc. Biol. Soc. Washington, XIX, 67.

Pycraft, is doubtful. Of the four more distinct species of the genus I have examined three — *H. longipennis*, *H. comata* and *H. mystacea* — and find them diastataxic.

I can find no published statements in regard to the condition of the fifth secondary in any particular species of *Hemiprocne*. Wray remarks that "the Swifts are quinto-cubital," while Sclater states more definitely that "In true *Cypselus*, as stated by Wray, the fifth *c. r.* is present, as it is also in the Tree Swift (*Dendrochelidon*). But I find it absent in a specimen of *Collocalia*, which is certainly a member of this family."

It may be inferred that Sclater based his remarks on his own examination of some species of the genera and if this was *H. coronota* his statement may prove to be correct as regards this one species. As the matter stands, however, there is need of a careful examination of the latter, and it is probable that it will turn out to be diastataxic like its congeners.

Length of tail.—No generic characters are furnished by the length of the tail. *Megaceryle alcyon* has the shortest tail of the group and *Chloroceryle americana* the longest, but the other species are variously intermediate and perfectly connect them. The difference between the extremes is not great, amounting to only one-third of the distance from the bend of the wing to the tips of the lower primary coverts. In each of the two larger genera the range of variation is almost as great as in all three genera combined. The tail averages longer in *Chloroceryle* than in *Megaceryle* but as shown by the figures the two genera widely overlap.

Ceryle agrees exactly in this character with *Ch. amazona*, the shortest tailed species of its genus, and these fall between the two longer and the two shorter tailed species of *Megaceryle*.

The following table shows the relative length of the tail in the various species. The figures were obtained by dividing the actual length of the tail by the distance from bend of wing to tip of longest lower primary covert.

Distance from bend of wing to tip of longest of several outer lower primary coverts relative to length of tail.

	Ratio		Ratio
<i>Ceryle rudis</i>	1.40	<i>Chloroceryle</i>	
<i>Megaceryle</i>		<i>amazona</i>	1.40
<i>alcyon</i>	1.33	<i>ænea</i>	1.44
<i>maxima</i>	1.37	<i>inda</i>	1.59
<i>guttulata</i> }	1.47	<i>americana</i>	1.66
<i>lugubris</i> }			
<i>torquata</i>	1.54		

There is a noticeable variation in the relative length of the central pair of rectrices and those on each side of it. In *Chloroceryle* the median pair

is nearly always distinctly (often decidedly) shorter than the longest feathers; in *Megaceryle* this is less frequently the case.

In the Kingfishers, at least in this particular group, there seems to be less uniformity in the relative length of the rectrices than in most birds; often one or two quills will be longer or shorter than they should be. Furthermore, the proportion of specimens with one or more growing rectrices is unusually large.

Form of rectrices.—In the form of the rectrices there are slight but noticeable differences.

In *Ceryle* they are wider terminally and more broadly rounded at the tip than in the other genera.

In *Megaceryle* they are not obviously widened terminally nor broadly rounded at the tip but rather (especially in *M. alcyon* and *M. torquata*) are somewhat pointed, particularly the middle pair. In the latter two species the rectrices are probably slightly narrower than in the three other species of *Megaceryle*.

In *Chloroceryle* the ends of the rectrices are rounded, but are relatively narrower than in *Ceryle*, particularly the short outermost feathers.

Graduation of tail.—The differences in the graduation of the rectrices are more pronounced than those in the length of the tail, but the variations in each respect are, to a large extent, correlated.

As shown in the accompanying table the outer rectrices in *Megaceryle* and particularly in *Ceryle* are only slightly shorter than the longest ones, while in *Chloroceryle*, with the exception of *C. amazona*, the shortening of the lateral quills is much more pronounced.

In *Ceryle* the average amount of graduation amounts to less than one-fifteenth of the length of the tail. In *Megaceryle* and in *Chloroceryle amazona* it is more than one-fifteenth but less than one-eighth, while in *Chloroceryle* (excepting *C. amazona*) the graduation exceeds one-eighth.

The following figures express the proportions borne by the total length of the tail to the distance between the tips of the outermost pair of rectrices and the longest pair.

<i>C. americana</i>	5.0	<i>M. lugubris</i>	} 12.3
<i>C. inda</i>	5.1	<i>M. gutturalata</i>	
<i>C. ænea</i>	6.0	<i>M. alcyon</i>	12.8
<i>C. amazona</i>	13.4	<i>M. maxima</i>	14.3
<i>M. torquata</i>	9.6	<i>C. rudis</i>	16.2

Feet (general).—The characters of the feet are considered in detail under the following separate heading: Feathering of Tibia, Podotheca, Length of Tarsus, Length of Hallux, Relative Length of Fore Toes.

Some general comparisons may first be made. The group as a whole is distinguished for the bare tibia and short tarsus.

Megaceryle is unique in the family in its small feet, with extremely short tarsus and hallux in particular. In the Cerylinæ the inner anterior toe averages relatively longer compared with the third and fourth toes, and in *Megaceryle* this becomes a constant difference, distinguishing this genus from all other non-Ceryline Kingfishers with the exception of *Lacedo* (*Carcineutes*). The characters of the feet are remarkably similar in the four species of the genus.

Chloroceryle and *Ceryle* differ from each other in the nature of the podotheca; and in the proportions of the toes *Ceryle*, *Megaceryle*, and *Chloroceryle amazona* agree with each other and differ from the three smaller species of *Chloroceryle*.

Feathering of the tibia.—The Cerylinæ differ from all other Kingfishers (though closely approached by two or three of the other piscivorous genera) in the completely bare lower end of the tibia-tarsus. Between the three genera of Cerylinæ there is no constant nor even distinct average difference in this respect. The tibia is not feathered to the joint on any side and is always conspicuously bare in front. The unfeathered space at its most restricted point is always equal to or greater than the lower (short) chord of the claw of the hallux except in some specimens of *Chloroceryle ænea* where the tiny feathers slightly encroach on this space.

Tarsus and toe-covering.—The lower part of the tarsus and upper side of the toes are covered with scales in *Ceryle* and *Megaceryle*, with skin only in *Chloroceryle*.

In *Ceryle* the scales are perhaps not so strongly marked as in *Megaceryle*, at least in occasional specimens of *C. rudis* there are no distinct scales visible. However, in such individuals, the lower end of the tarsus is always covered with the thicker, hardened outer skin of which the scales are formed. This is wholly absent in *Chloroceryle* in which the entire tarsus is longitudinally wrinkled, as is the upper end in *Ceryle*. Mr. L. A. Fuertes tells me that the feet of *Chloroceryle amazona*, in the bird in flesh, are peculiar and striking, covered with smooth, unwrinkled, intensely black skin as though a black kid glove were drawn tightly over the foot.

Length of tarsus.—In its exceedingly short tarsus *Megaceryle* differs not only from the related genera but from all other members of the family.

The relative length of the tarsus was determined by comparison with the length of the claw of the hind toe.

In all four species of *Megaceryle* the tarsus is almost exactly $1\frac{1}{2}$ times the length of the long chord of the hind claw, always decidedly less than $1\frac{3}{4}$ this distance.

In *Chloroceryle* and *Ceryle* the tarsus is $1\frac{3}{4}$ to very nearly twice the length of the claw. In *Ceryle*, however, the tarsus is relatively slightly shorter than in *Chloroceryle*, as it is decidedly shorter, absolutely, than in *C. amazona* (which does not greatly exceed *Ceryle* in size) and of nearly the same length as in *C. inda* (a considerably smaller bird).

Measured in the skeleton, the tarsus (tarso-metatarsus) of a specimen of *Megaceryle torquata* is 12.6 mm. long, while the femur is 33.4, or much more than twice the length of the tarsus. In an example of *Chloroceryle americana* the tarsus is 9.3, the femur 17.5, or slightly less than twice the length of the tarsus.

In several species of the three genera the metatarsal bone measures as follows:

	mm.
<i>Megaceryle torquata</i>	12.6
“ <i>alcyon</i>	10.
<i>Ceryle r. leucomelanura</i>	9.7
<i>Chloroceryle amazona</i>	12.
“ <i>americana</i>	9.3

Megaceryle alcyon and *Chloroceryle amazona* are birds of equal size, *Ceryle r. leucomelanura* being distinctly smaller than either.

These figures confirm the results obtained from skin measurements, *Chloroceryle* having a considerably longer metatarsus than *Megaceryle* while that of *Ceryle* is intermediate.

Comparison of the length of the tarsus with that of the inner toe (without claw) is not altogether satisfactory because of the variation in the relative length of the latter.

In all the species of *Megaceryle* the tarsus is distinctly shorter than the inner toe, fully one millimeter shorter in *alcyon* and *torquata*.

In *Ceryle* the tarsus about equals the inner toe.

In *Chloroceryle* there is more variation than in *Megaceryle*, ranging from *C. amazona*, in which the tarsus is always distinctly shorter than the inner toe, to *C. ænea* in which it is equal to or sometimes slightly longer than the inner toe.

Length of hallux.—The length of the hallux is correlated with that of the tarsus, consequently it is relatively shorter in *Megaceryle* than in the two other genera.

Ceryle rudis, though a decidedly smaller bird than *Megaceryle alcyon*, has an actually slightly longer hallux, while in *Chloroceryle amazona*, which is practically identical in size with *alcyon*, the hind toe is decidedly longer than in the latter.

In *Megaceryle* the hallux with its claw is not so long as the inner toe

exclusive of the claw. In *Chloroceryle* these measurements are equal or the hallux is a trifle longer than the inner toe.

Comparing the upper or long chord of the claw of the hind toe with the length of the toe itself (the latter measured either along its upper side or along the outer side from the seam crossing its base to the end, above) we get the following results: In *Megaceryle* the hallux is distinctly to decidedly shorter than its claw; in *Ceryle* and *Chloroceryle* the hallux is decidedly to barely longer than the claw. This is most pronounced in *C. inda*, and perhaps in *C. ænea*.

On comparison of *Ceryle rudis*, *Chloroceryle amazona* and *Megaceryle alcyon* the following points of interest in the proportions of the tarsus and toes may be remarked.

Relatively speaking, *alcyon* has the shortest tarsus and hallux. *M. alcyon* and *Ceryle* have very short fore toes, *amazona* distinctly longer.

Ceryle has the anterior toes, and, to a less extent, the tarsus (and hallux) relatively shorter than in *amazona*.

These general proportions hold good for all species of the three genera. The characters of each genus may be summarized as follows:

Megaceryle. Feet stout; tarsus and hallux extremely short, anterior toes short.

Ceryle. Feet slender; tarsus very short, toes short.

Chloroceryle. Feet slender; tarsus short, toes (third and fourth at least) moderate or fairly long.

Anterior toes.—The proportionate length of the anterior toes (the second compared with the third and fourth) distinguishes *Megaceryle* and *Ceryle* from all the non-Ceryline Kingfishers excepting the genus *Lacedo* (*Carcineutes*). *Chloroceryle* is intermediate between *Megaceryle* and the remaining genera of the family, but *C. amazona* practically agrees with *Megaceryle*.

In *Megaceryle* the claw of the second toe invariably reaches beyond the base of the claw of the fourth toe (in eighteen specimens of *alcyon* and eight of *lugubris* and *guttulata* there is no exception to this statement; in fifteen of *torquata* there is a single exception, and one foot of one of the five specimens of *maxima* examined also violates the rule).

In *Ceryle* the proportions of the second and fourth toes are the same as in *Megaceryle*, only two of fifteen specimens varying from this standard, and in each of these in one foot only. The same relative length is found in *Chloroceryle amazona*, only one bird in the ten examined being aberrant. In the three other species of *Chloroceryle* the second toe is relatively shorter. In *C. americana* (fourteen skins) as a rule, the claw of the second toe just reaches the base of that of the fourth toe, sometimes slightly exceeding this

and sometimes falling a trifle short. *C. inda* (six skins) and *C. ænea* (nine skins) agree practically with *C. americana*, but the second toe averages perceptibly shorter, its claw rarely passing beyond the base of that of the fourth toe, but equalling or falling a trifle short of it.

The genus *Lacedo* agrees with *Megaceryle* in this respect but in no other Old World genus of Kingfishers does the claw of the second toe pass beyond the base of the claw of the fourth toe.

Comparing the second and third toes we find much the same proportions exhibited. In *Megaceryle* (except *M. maxima*) and in *Ceryle* the second toe with claw almost always equals or slightly exceeds the third toe without claw. In *M. maxima* it is more often a trifle less than the third, than a trifle more, and *C. amazona* agrees with *M. maxima* in this respect.

In the three other species of *Chloroceryle* the claw of the second toe falls short of the base of the third toe-claw, though sometimes only very slightly so in *C. americana*. In all non-Ceryline genera except *Lacedo* the claw of the second toe falls short of the base of the claw of the third toe. In *Lacedo* it slightly passes this point.

Thus, broadly speaking, *Megaceryle*, *Ceryle*, and *Chloroceryle amazona*, on the one hand, agree in the proportionate length of the anterior toes, while on the other hand, the three smaller species of *Chloroceryle* essentially agree with each other. These two groups, however, are practically connected by the more or less intermediate species, *M. maxima*, *C. amazona*, and *C. americana*.

Coloration.—While a particular style of coloration characterizes each of the genera of Cerylinæ, color characters of greater importance distinguish the entire group from the Alcedininæ and Halcyoninæ.

The Cerylinæ entirely lack the changeable blue or greenish blue so characteristic of the other subfamilies, being found in every genus, if not, indeed, in every species of those groups.

The entire upperparts, including the head, wings and tail are of one color or pattern throughout (except for a white or ochraceous collar) frequently variegated on the body plumage and always on the remiges and rectrices with white or buff (and sometimes with black), in small pattern, or often, on the wings and tail, in large areas. The sexes never differ in the color of the head or tail as is so frequently the case in the Daceloninæ. The sexual difference in the color of the underparts, particularly in the banding of the chest, is found throughout the Cerylinæ and is very characteristic of the group. A chest-band is always present, though in the three species in which the male (at least) is rufous-bellied, the rufous of the chest-band is continuous with the rufous of the abdomen. The female always has a conspicuous chest-band of the same color as the upperparts, *i. e.*, of a non-

reddish shade (green, blue-gray, slate color, or black,— very different from the white or rufous ground color). In *Ceryle* and in one species of *Megaceryle* (*M. alcyon*) the male has a band of the same color as that of the female. All the other species of *Megaceryle* and all those of *Chloroceryle* are rufous or a similar shade on the chest, usually in the form of a conspicuous band on a white ground, but in three species the entire underparts, except the throat, are rufous. As these characters will be discussed in greater detail beyond, the distinctions between the three genera of *Cerylinæ* may now be considered.

The species of *Megaceryle* are of some shade of gray above, varying from slate-gray to grayish blue, usually more or less varied with spots or bars of white and sometimes with black. The rectrices are barred and the remiges and scapulars are more or less spotted or barred with white or (on the inner webs of the primaries in two species) with large white spaces, but neither on the tail nor on the secondaries or scapulars, nor across both webs of the primaries are there any large continuous areas of white. The underparts always have more or less rufous or cinnamon in at least one sex, the amount and distribution of this color being a sexual character. The female has a grayish chest-band (solid or composed of spots), replaced by rufous in the male, except in *M. alcyon* in which it is gray in both sexes. The axillars are always white in the male and rufous in the female, but in the color of the under wing-coverts and belly the sexual differences are less constant.

Ceryle is wholly black and white, the upperparts marked in larger pattern than in *Megaceryle*. The basal two-fifths or more of the tail is white (sometimes spotted with black), and a narrow white band crosses the tip; the primaries and secondaries and scapulars are also marked by large, conspicuous areas of white, which cross both webs and occupy the greater part of the feathers. The lower parts are without a trace of rufous, the sex being indicated by the presence of one black band in the female and two in the male.

Chloroceryle is remarkable for the uniform dark glossy green of the upperparts. The pattern of the rectrices and remiges varies according to the species but the central two pairs of rectrices are never white basally; the inner webs of the secondaries always have a conspicuous amount of black terminally, and the outer webs of the primaries are plain or at most spotted with white, while the inner web never has a large solid white area reaching the shaft. At least some of the scapular feathers have conspicuous white basal areas. Chestnut or rufous is present below in at least the male of all species. The female has a green chest-band which is replaced by rufous in the male, but there is no sexual difference in the color of the axillars, lower

wing coverts or abdomen, as there is in *Megaceryle*. In *C. americana*, however, the sexes differ slightly in the color of the throat.

Aside from the differences in coloration there are differences in the texture of the plumage.

In *Ceryle* the plumage is notably soft and silky, and the white of the underparts has a satiny lustre particularly noticeable on the throat; the feathers of the upperparts are long and (except those of the crest) broad, with broadly rounded or almost truncate tips, and more frayed out and hairy than those of the allied genera, the barbs very soft and fine.

The glossy, metallic green of the upperparts in *Chloroceryle* has already been described. In *Megaceryle* the plumage is more opaque and lustreless, and seems particularly harsh in *torquata* and *alcyon*.

Muscles and tendons.—The anatomy of the tendons and muscles of the Kingfishers has been particularly investigated by Dr. Chalmers Mitchell.

Of the particular group under consideration two species of *Chloroceryle* (*americana* and *inda*) were examined and compared. The following notes are condensed from Mitchell's account.¹

It should be premised that Mitchell's studies were made for the purpose of determining which of the two conditions of the wing, the eutaxic or the diastataxic, is the original and which the secondary condition. The conclusion is reached that the eutaxic forms are the most modified in their anatomy and hence that the eutaxic condition has been derived from the diastataxic.²

Latissimus dorsi, anterior et posterior.—In its original condition the anterior and posterior parts of this muscle are fully and equally developed. In the more modified Kingfishers the *anterior* division tends to be reduced.

"Thus in the eutaxic *Ceryle americana* and *C. inda*, as compared with the diastataxic *C. maxima* and *C. alcyon*, the anterior division is very thin and weak; the posterior is enormous, broad and strong, and with a considerable forward extension of its origin" (*l. c.*, p. 106).

Expansor secundariorum.—This alar tendon is present, though feeble in *M. alcyon* and *M. maxima*, but altogether absent in *C. americana* and *C. inda*. Its absence is an obviously secondary condition (*l. c.*, p. 112).

Ilio-tibialis externus seu sartorius.—The belly of this muscle is narrow in *M. maxima*, somewhat broader in *M. alcyon*. In *C. americana* and *C. inda* "the increase in breadth is enormous" (p. 112).

Ilio-tibialis seu gluteus maximus.—In *M. alcyon* and *M. maxima* the

¹ Ibis, 1901, p. 97.

² Pycraft believes that while the eutaxic is the original condition in birds the diastataxic made its appearance very early in the phylogeny of the Class, and that the *Neognathæ* is a diastataxic group in which various orders, suborders, families, genera, and even subgenera, have become eutaxic through closing up of the gap and loss of the coverts (Transactions of the Norfolk and Norwich Naturalists' Society, VII, 325).

preacetabular portion of this muscle is well developed. In *C. americana* and *C. inda* "the muscle is represented by a band of fasciæ with only a few muscular fibres near the proximal end" (*l. c.*, p. 113).

Caud-ilio-femoralis.—The *pars caudalis* is comparatively narrow in *Megaceryle alcyon* and *M. maxima*, somewhat wider in *C. americana* and *C. inda*.

Peroneus superficialis.—This muscle is in a degenerate state in birds. "In *Dacelo* it arises from the external corner of the tibial crest as a narrow tendon, instead of the more normal broad origin by muscle or fasciæ. It is joined by a few fibres from the tibia along the region of the fibula, and is inserted to the knee-capsule without the usual slip to the flexor of the middle digit. The same condition exists in all the diastataxic forms and in some of the eutaxic forms. But in other eutaxic forms, notably *Ceryle americana* and *C. inda*, in the *Halcyones*, and *Ceyx* it is still more reduced, being simply a long round tendon with the merest vestige of muscular fibres in it" (*l. c.*, p. 116).

Deep plantar tendons.—A well marked difference in these tendons between *Megaceryle* and *Chloroceryle* is clearly shown in the figures given by Mitchell of the four species examined by him.

"The typical Kingfisher condition, that most strikingly different from those more common in other birds, is for the so-called *hallucis* to supply digits three and four, and for the so-called *communis* to supply the hallux and digit two. This is extremely well seen in the eutaxic forms; only a narrow vinculum connects the two tendons. In *Dacelo* and *Sauropatis* and especially in the diastataxic as contrasted with the eutaxic *Ceryles*, the *communis* retains a more strong hold on the third and fourth digits by means of a branching vinculum, so that in these Kingfishers the peculiarity is not so acutely marked" (*l. c.*, p. 119).

In other words, in *Chloroceryle* a simple vinculum is sent off from well above the bifurcation of the *communis* and joins the *hallucis* just above the point at which the latter branches; while in *Megaceryle* the vinculum springs from about the point at which the *communis* forks and divides into two branches each of which runs to one branch of the *hallucis* joining it far below the point of forking.

Judging by the figures, *Chloroceryle* agrees in the simple vinculum with *Cittura*, *Halcyon* (*pileata* and *rufa*), *Ceyx* (*rufidorsa*), and *Alcedo*. In these genera, however, the vinculum springs from about the point at which the *communis* forks (as in *Megaceryle*) or from below the fork, while in *Chloroceryle* it leaves the *communis* decidedly above the fork.

Deltoides propatagialis.—In this muscle the differences do not coincide with the limits of the genera, for *C. americana* agrees in general with the

two species of *Megaceryle* while *C. inda* is quite distinct, and more closely resembles *Cittura* and *Alcedo*.

Alar tendons.—*M. maxima* and *M. alcyon* agree in the general form of the brevis tendon while *C. americana* and *C. inda* are markedly different from them and at the same time essentially similar to each other.

In the former there is "a broad diffuse band of fasciæ stretching from the deltoïdes to the extensor muscles, and receiving the pectoralis tendon," the tendons being blended proximally in this band.

In *C. americana* and *C. inda* there is a single rounded tendon proximally, without fasciæ, and one of the tendinal branches well developed in the species of *Megaceryle* is absent in *C. inda* and very small in *C. americana*. These differences are also well shown in Mitchell's plates.

Osteology.—As no skeleton of *Ceryle rudis* could be obtained it is only possible to contrast the osteology of *Megaceryle* with that of *Chloroceryle*. The material available for this comparison consists of one skeleton of *M. torquata*, one, and part of another, of *M. alcyon*, one of *Ch. americana* and an imperfect skull of *Ch. amazona*.

Owing to the somewhat intermediate nature of *Ch. amazona*, judging by its external characters, it is much to be regretted that the sternum and shoulder girdle of this species were not available. Furthermore, the exact relation to the two allied genera of the somewhat ambiguous genus *Ceryle* cannot be determined until its osteology has been examined.

In the following notes the more important skeletal differences between *Megaceryle* and *Chloroceryle* are pointed out. These differences are probably found in all the species of the two genera with the exception, perhaps, of *C. amazona* in which it is possible that the important characters of the sternum and shoulder girdle may show an approach to *Megaceryle*. Most of the distinctions have already been pointed out by Shufeldt in his papers on the 'Osteology of *Ceryle alcyon*,'¹ and 'On the Osteology and Systematic Position of the Kingfishers (Halcyones)'², in which he compares *M. alcyon* with *C. americana cabanisi* and *Alcedo ispida*.

Skull.—The palatal foramina are larger in *C. americana* than in *Megaceryle*, but absent in *C. amazona*, the latter thus agreeing with *Alcedo*, *Dacelo*, and most other Kingfishers.

The posterior palatal spine, so conspicuous in *Alcedo* and *Dacelo*, is vestigial in *Megaceryle* but somewhat better marked in *C. americana*. The outline of the outer edge of the palatines of *C. americana* closely agrees with that of *Alcedo ispida*.

Megaceryle and *Chloroceryle* differ from most if not all other Kingfishers

¹ Journal of Anatomy, Vol. XVIII, 1884, p. 279.

² American Naturalist, Vol. XXXVII, 1903, 697.

(with the probable exception of *Ceryle*) in the abrupt and conspicuous widening of the maxillary or anterior portion of the jugal bar. Thus in *M. alcyon* this is expanded horizontally in a flat, thin plate of bone, 4.5 mm. wide at its broadest part.

In *Megaceryle* the widening begins rather abruptly at a point opposite the anterior end of the pterygoids, involving fully the anterior half of the jugal bar. In *Chloroceryle* the widened portion of the maxillary does not run back so far as in *Megaceryle*, and in *C. amazona*, with a skull equaling that of *M. alcyon* in size, the actual width of the expanded part is slightly less than in that species. (Plate XXV, fig. 1.)

The posterior end of the ramus of the mandible seen from the rear is much thicker and clumsier in *M. torquata* than in *C. amazona* and *C. americana*; *M. alcyon* is intermediate.

There is a distinct difference in the form of the temporal fossæ between the two genera. In *Megaceryle* the anterior line of the fossa runs slightly forward as it approaches the median line, while in *Chloroceryle* this is not the case. In *Megaceryle* the descending process of the lacrymal is not so high as in *Chloroceryle*, leaving a large transversely oval or elliptical vacuity above it, and is joined by the pars plana of the mesethmoid at its upper inner corner. In *Chloroceryle*, particularly in *C. americana*, the vacuity is decidedly smaller and the pars plana meets it below the upper edge. (In *Alcedo*, *Halcyon*, and *Dacelo* the superior vacuity is very small; in the former the pars plana reaches the lacrymal almost in its middle and in the latter two genera considerably below the middle, showing the widest divergence from *Megaceryle*.)

In *Megaceryle* the mesethmoid is produced forwards in a pointed plate, vestigial in *Chloroceryle americana*, and wanting in at least *Alcedo*, *Dacelo* and *Halcyon*. At the base of the maxilla there is on each side a conspicuous impression or hollow both in *Megaceryle* and in *Ch. amazona* but this is almost wanting in *Ch. americana*.

Sternum and shoulder girdle.—In *Megaceryle* the anterior end of the sternal keel is very high and prominent (somewhat as in a Gannet or Merganser), the anterior edge, between the spina sterni and the point of the keel, being an approximately straight ascending line.

In *Chloroceryle americana* the anterior point of the keel is lower and less pronounced, and the edge is concave. This is the case also in *Halcyon*, *Dacelo*, and *Ramphalcyon* (sternum of *Alcedo* not seen).

The costal processes are relatively shorter, wider and blunter in *Megaceryle* and the exotic genera examined, longer, narrower and more pointed in *Chloroceryle americana*. In the former they are somewhat Passerine, in the latter more as in the Pici. The two genera agree (to a large extent

at least) in having shorter and broader furcula, more curved on a side view. There is, however, an important difference between these genera in the form of the furcula. In *Megaceryle* the proximal end is broad and blunt, in *Chloroceryle americana* it is narrower and more pointed. Furthermore, in the latter genus, the clavicle bears near its upper or proximal end a conspicuous upward process that articulates with the front upper end of the coracoid. In *Megaceryle* there is a slight angle at this point but no process. This process is even more highly developed in *Halcyon*, *Ramphalcyon*, *Dacelo*, and *Alcedo* than in *Chloroceryle*, being longer and rising more abruptly. The absence of this process is probably therefore peculiar to *Megaceryle*, unless *Ceryle* also prove to be without it.

The widening of the clavicles toward the upper end is much more pronounced in *Megaceryle* and *Chloroceryle* than in other genera. They are also broadened and flattened at their symphysis in *Megaceryle* but not in *Chloroceryle americana* nor in other genera. In *Megaceryle* the coracoid bears a remarkable and conspicuous upward process, springing from the inner edge of its foot. This is wholly absent in *Chloroceryle americana* as well as in all other genera examined, and its presence in *Megaceryle* was overlooked by Shufeldt. In *M. torquata* the projection is 3.5 mm. long, and about equally well developed in *M. alcyon*. (Plate XXVI, fig. 1.)

The opposite or outer end of the coracoidal foot also presents a decided difference. In *Megaceryle* the corner is obliquely cut off, which is not at all the case in *Chloroceryle americana* nor in *Halcyon concretus*, but *H. chloris* and *Ramphalcyon* resemble *Megaceryle*.

No important characters are presented by the scapula but it is observable that in *Megaceryle* the basal or proximal portion is somewhat wider relatively than in *Chloroceryle*, the distal end less conspicuously bent outward and the angle at the bend sharper.

Pelvis.—The process on the outer margin of the ilium characteristic of the Ceryline Kingfishers is somewhat smaller in *Chloroceryle* than in *Megaceryle*, thus reaching its highest development in the latter genus.

Feet.—The remarkable shortness of the "tarsus" in *Megaceryle* is very obvious in the skeleton. Thus in *M. alcyon* the metatarsus (measured along front of inner side) is 10 mm., much less than one-half the femur which is 25.9; while in *C. americana* the metatarsus is 9.2, or distinctly more than one-half the length of the femur, which measures 17.4. Though so little longer than that of *C. americana* the metatarsal bone of *M. alcyon* is much stouter, particularly at its lower end, across which it measures 4.5 mm., against 2.8 in *C. americana*.

I can find no character in the wing-bones worthy of note.

Basing our comparisons only on the genera examined, it is obvious that

Megaceryle stands quite alone in certain skeletal characters, and in certain others is connected by *Chloroceryle* with the other genera. The most remarkable characters of *Megaceryle* are the vestigial palatal spine, the expanded maxillary, the relation of pars plana and lacrymal, the sternal keel, form of furcula (two differences), form of coracoids, and shortness of metatarsus. In all of these there is a wide difference between *Megaceryle* on the one hand, and *Dacelo*, *Alcedo* (skull), *Halcyon* (palatines ?), *Ramphalcyon* (palatines ?), on the other. In all these characters except the form of the coracoid, symphysis of furcula, and perhaps the sternal keel, and to a large extent of the form of proximal ends of the furcula, *Chloroceryle* strongly approaches *Megaceryle* and differs from the other genera mentioned. The iliac process is peculiar to *Megaceryle* and *Chloroceryle* but is slightly better developed in the former.

It is a curious fact that the geographical ranges of the species of *Chloroceryle* are almost identical, all four of them being found together throughout the greater part of Central and South America. This fact doubtless explains the striking differences in size, the species having become adapted for prey of different sizes. The species of *Megaceryle* are much more uniform in size and their ranges are strictly complementary. It is noteworthy that the genus *Chloroceryle* is absent from the Antillean subregion.

In the succeeding pages the various divisions of the Cerylinæ are treated in detail. Under each genus and species a short diagnosis, including only the characters peculiar to the group in question, is first presented. Following this is a longer and more detailed description.

The genera and species of this subfamily fall naturally in the following sequence.

Megaceryle lugubris	Ceryle rudis
“ guttulata	Chloroceryle amazona
“ maxima	“ americana
“ torquata	“ inda
“ alcyon	“ ænea

The only uncertainty in this arrangement is in regard to the relative position of the last two species, as in some respects *C. ænea* approaches *C. americana* more closely than does *C. inda*.

Genus **Megaceryle.**

Large and rather large Ceryline Kingfishers (the wing over 145 mm. long), with finely serrate bill, conspicuous vertical and occipital crest, and extremely short

tarsus and hallux; the upperparts wholly or partly bluish gray (without green), the axillars white in the male, rufous in the female.

Large or (one species) rather large Ceryline Kingfishers of both Hemispheres, with wing more than 145 mm. in length, stout, deep bill (moderate in one species) with serrate maxillary tomtia (sometimes obsolete in one species), conspicuous vertical and occipital crest, the tenth primary always longer than the fifth, diastataxic secondaries, nearly even tail (the outermost pair of rectrices falling short of the longest by between one-eighth and one-fifteenth of the length of the tail (the central pair not shortened), the rectrices more or less pointed at the tip, the front of the tarsus with distinct scales, extremely short but stout tarsus and hallux, the second toe with claw usually equal to or longer than the third toe without claw (often shorter in one species) and always normally longer than the fourth toe without claw; the plumage lustreless, above solid bluish gray, or slate-gray edged with bluish gray (either plain or varied with spots or bars of white), the scapulars not extensively white basally, and no large white areas on the tail nor across both webs of the primaries, more or less rufous on the underparts in at least one sex, the axillars always white in the male, rufous in the female.

Bill.— According to the size and form of the bill the species fall into three groups. *Maxima* and *torquata* agree in having a large stout bill, much longer than the head; the up-curve of the gonys more prominent than the down-curve of the culmen which is nearly straight; that of *alcyon* is much smaller, being shorter and relatively more slender, the curves of culmen and gonys about equal.

In *lugubris* and *guttulata* the bill is short as in *alcyon* (about equalling the head) but much stouter, even more so, for its length, than that of *maxima* and *torquata*; the maxilla is more decurved, while the gonys is straighter, and the tip of the maxilla is thicker and less attenuated than in the other species. Furthermore, the tomial serrations which are always evident in the long-billed species are often less decided in *lugubris* and *guttulata* and frequently indistinct or obsolete in *alcyon*.

In the following table the figures in the first column indicate the relative length of the bill compared with the distance from the bend of the wing to the tips of the lower primary coverts. Those in the second and third columns give the extremes and the average respectively of the relative depth of the bill, the figures expressing the number of millimeters by which four times the depth of the bill at the gonydeal angle exceeds the length of the bill from the anterior end of the nostril.

	Relative length	Relative Depth	
<i>alcyon</i>	1.50	1-6	2.6
<i>lugubris</i> }	1.44	10-12	11.
<i>guttulata</i> }			
<i>torquata</i>	1.15	4-10	9.
<i>maxima</i>	1.14	5-10	7.

In a single specimen of *alcyon*, which has a long and oddly slender bill, four times its depth is 4 mm. *less* than the length instead of from 1-6 mm. *more* as in all the other specimens examined. The measurements given for *torquata* are of the typical form; *M. t. stellata* has a shorter and relatively deeper bill, but lack of good adult specimens prevents me from giving the bill proportions of this race.

Crest.—The essential character of the crest in *Megaceryle*, as compared with other genera, is the high development of the anterior part or vertical crest, and this is well shown in all the species.

In *M. lugubris* and *M. guttulata* the frontal crest feathers attain their greatest development both absolutely and compared with those of the occiput (especially as contrasted with *M. torquata*). They are more elongated anteriorly than in *M. maxima*, particularly in *lugubris*. The crest is composed of narrow, linear, *broad-tipped* feathers (their ends truncate or very broadly rounded), the webs of which are moderately firm, not conspicuously frayed as in *Ceryle*.

In *M. maxima* the crest is similar to that of *M. lugubris* in development and form of the feathers but is not quite so long (at least relatively), particularly the vertical feathers. The latter are *strikingly elongated* forward to the anterior end of the eye.

In *M. torquata* the crest is not so highly developed as in the other species, the feathers shorter, less linear, distinctly narrowed towards the tip, and more or less pointed.

M. alcyon has a very well developed crest; the feathers relatively longer than those of *M. torquata*, but narrowed terminally and pointed as in the latter, and somewhat more hair-like than in any of the other species, owing to the extensive separation of the barbs. The crest is distinctly double, there being a point about midway between the front and the rear where the feathers are shorter than elsewhere. The crest of this species does not at all approach that of either *Ceryle* or *Chloroceryle*.

The feathering of the lores is correlated with the development of the crest. The loreal feathers are largest and densest, least reduced and appressed, in *M. maxima*, and particularly in *M. lugubris*, and are well developed in *M. alcyon*; in *M. torquata* they are smaller and more appressed than in any other species of the genus.

Wing.—*M. alcyon* is aberrant in its long-pointed wing, the tenth primary always nearer the seventh than the sixth and often exceeding the seventh. In none of the other species is the tenth primary longer than the sixth (except in occasional specimens of *torquata*), and it is normally shorter than the sixth, always exceeding the fifth, however. The proportionate length of the primaries is shown by the following:

alcyon (25 specimens), P. 10 always nearer 7 than 6, often > 7 .

torquata (14 specimens), P. 10 decidedly > 6 to decidedly < 6 (usually = or < 6 ; always nearer 6 than 7, sometimes nearer 5 than 6).

lugubris and *guttulata* (7 specimens), P. 10 decidedly < 6 (from nearer 5 to much nearer 6, always > 5).

maxima (4 specimens), P. 10 < 6 (nearer 6 than 5 in three specimens; always > 5).

Tail.—*M. alcyon* has the shortest tail of the genus and *M. torquata* the longest, but even between these extremes the difference is slight and unimportant. The proportion that the tail bears to the distance from the bend of the wing to the tips of the several outer lower primary coverts is as follows:

<i>alcyon</i>	1.33
<i>maxima</i>	1.37
<i>lugubris</i> }	1.47
<i>guttulata</i> }	
<i>torquata</i>	1.54

The difference in length between the outer pair of rectrices and the longest ones ranges between one-fifteenth and one-eighth of the length of the tail. The graduation is greatest in *torquata* and least in *maxima*.

	No. of specimens	Average length of tail	Average amount of graduation	Graduation in length of tail
<i>torquata</i>	(10)	119.8	12.5	9.6 times
<i>lugubris</i> }	(3)	110.7	9.	12.3 "
<i>guttulata</i> }				
<i>alcyon</i>	(12)	88.2	6.9	12.8 "
<i>maxima</i>	(2)	115.5	8.1	14.3 "

Feathering of tibia.—The lower end of the tibia is completely bare in all species, the unfeathered space being least extensive in *M. lugubris* in which it is only equal to the short chord of the claw of the hallux. In *alcyon* the bare space always exceeds this distance and usually equals or exceeds the long (upper) chord of the claw. In *torquata* and *maxima* the bare area is distinctly greater than the long chord.

Tarsus.—In the length of the extremely short tarsus there is remarkable uniformity. The tarsus in all five species is almost exactly equal in length to one and one-half ($1\frac{1}{2}$) times the long chord of the hallux claw. Compared with the inner toe (without claw) the tarsus is always distinctly shorter, fully one millimeter in *alcyon* and *torquata*.

Toes.—The hallux is distinctly to decidedly shorter than its claw (the toe being measured either along its upper surface or along its outer side from the seam crossing its base to the end, above); and the hallux and claw combined are shorter than the inner toe without claw.

The proportionate length of the anterior toes is very constant. The second toe with its claw is *always* longer than the fourth toe without its claw. At least this rule is so nearly invariable that in the forty-six specimens examined there is only one complete and one partial exception.

Comparing the second toe with the third we find that the second (with claw) is normally, except in *M. maxima*, equal to or a trifle longer than the third (without claw). This proportion holds in four-fifths of the specimens of *torquata* and *alcyon* examined, and in all eight individuals of *lugubris* and *guttulata*.

In *maxima* the second toe averages a little shorter than in the other species, being as often shorter than the third as longer. In all the species, however, except in the single aberrant individual of *torquata* and (one foot only) in one specimen of *maxima*, the second toe (with claw) never falls short of the third (without claw) by more than a mere trifle.

By means of the appended table the variations in this character may be easily seen.

Second toe with claw compared with third and fourth toes without claws.

<i>alcyon</i> , 18 spec.	{ = or rather slightly > 3 always distinctly > 4 (exc. two birds and one foot of two more).
<i>torquata</i> , 15 spec.	{ = or very slightly > 3 (except in three birds). almost always > 4 (< 4 in one bird).
<i>lugubris</i> , 1 spec.	{ = or slightly > 3
<i>guttulata</i> , 7 spec.,	{ always > 4
<i>maxima</i> , 5 spec.,	{ = or slightly > 3 or slightly < 3 always > 4 (except in one foot of one bird).

Color.—The essential color characters of the genus have already been briefly mentioned. They are, first: the general lusterless gray coloration of the upper parts, the female with a chest-band of the same color (a subfamily character).

The white variegation of the scapulars, remiges, and rectrices and of the upperparts (when not uniform) is always in the form of small spots and bars, never in large areas, excepting only on the inner webs of the primaries in two species.

In the male the axillars and lower wing coverts are always pure white (the latter barred with gray in *M. maxima sharpei*), in the female (excepting only the coverts in *M. alcyon*) rufous.

With the exception of *M. alcyon* the chest-band of the male is rufous or rusty, but *torquata*, *lugubris* and *guttulata* are actually intermediate between *alcyon* and *maxima* in this respect.

The uniform unspotted grayish blue of *M. alcyon* and typical *M. torquata* seems at first sight very different from the gray and white barring of *M. lugubris* and *M. guttulata*, but the latter do not differ *essentially* from true *M. maxima*, and this is connected with *M. t. torquata* by *M. t. stellata* and *M. maxima sharpei*.

In *alcyon* and *t. torquata* the upperparts are uniform grayish blue, a few small white spots tipping the wing coverts, and the upper tail coverts more or less spotted; but in *torquata* the former are usually obsolete and the latter concealed.

In *M. t. stellata* the feathers of the upperparts are slatey-black basally and along the shaft, and more or less marked with small spots of white.

This is a close approach to *M. m. maxima*, in which the entire basal portion and center of the feathers are blackish, the gray remaining as a wide border. The entire upperparts are conspicuously dotted with small spots of white. In *M. m. sharpei* the white spotting is greatly reduced, absent from the interscapulars and barely indicated on the crest.

In *M. guttulata* the white markings, except those of the wing coverts, take the form of broad bars, rather than small spots, usually reaching or crossing the shaft; and in *M. lugubris* this barring is even more pronounced. It is obvious, however, that the bars of these species correspond to the spots of *maxima* and may have been developed from that type of marking. In the Asiatic species the ground color of the upperparts is a slatey gray; the bluish shade so characteristic of the other members of the genus is less evident and exists only in light bluish-gray margins.

In the pattern of the primaries there is essential agreement between the three Old World species. Each web of all the quills is symmetrically marked with a series of white spots, which, on the outer web at least, extend well towards the tip.

The New World species are decidedly different and do not agree so closely with each other. The primaries are more extensively black terminally (without spots), while proximally there is a large white area on the inner web of each feather, particularly extensive in *alcyon*, in which the outer half dozen quills are practically wholly white on the basal half of the inner vane. In *torquata* the shaft is bordered by black, which runs out irregularly into the white area, and in extreme cases breaks it up into four or five smaller patches which, however, are always coalescent along the inner edge of the feathers.

In *alcyon* the outer web of all the primaries is more or less irregularly spotted, barred or even longitudinally marked with white, while in *torquata* at least the first three primaries and usually several others are wholly unmarked or at most with a mere indication of some of the spots on the mar-

gin. Both species vary greatly in the extent and character of these markings.

The differences in the coloration of the underparts presented by the four more distinct species of the genus are curious and interesting.

The only invariable characters in either sex are the rufous axillars and gray chest-band of the females, and the white axillars of the males. This difference in the axillars is thus the only sexual color distinction that holds in all the species. The coloration of each sex may be summarized as follows:

Male.—Under wing coverts and axillars always white (*i. e.*, without rufous; in *M. m. sharpei* the coverts, at least, are barred with dark gray and white). Chest-band rufous (paler, with slatey spotting, chiefly below the surface, in *lugubris* and *guttulata*; encroached upon by the blue gray of the sides in *torquata*), except in *alcyon* in which it is blue-gray as in the female. Belly white, except in *torquata*, in which it is rufous, continuous with the rufous chest-band. Sides of the body with a longitudinal slatey patch in *alcyon*, barred with slatey in the other white-bellied species; in *guttulata* and *lugubris* this extends as a zone of sparsely barred feathers across the abdomen, and in *M. m. sharpei* the entire underparts posterior to the chest-band are closely barred.

Female.—Chest-band always gray (solid in the New World, spotty in the Old World species); axillars always rufous; under wing-coverts also rufous in all but *alcyon*. The belly solid rufous in *maxima* and *torquata*, wholly white in *lugubris* and *guttulata* and intermediate in *alcyon*, being white with a narrow band of rufous across its anterior border and broadly rufous on the sides.

According to the coloration of the underparts the species may be diagnosed as follows:

♂ with gray chest-band (and white belly); ♀ with belly partly rufous; ♀ with white under wing-coverts	<i>alcyon</i>
♂ with rufous belly (♀ with belly wholly rufous)	<i>torquata</i>
(♂ with white belly) ♀ with belly wholly white	{ <i>lugubris</i> <i>guttulata</i>
(♂ with white belly) (♀ with belly wholly rufous)	
	<i>maxima</i>

The characters enclosed in parentheses are those not confined to any one species. It is seen that *alcyon* may be diagnosed by the color of the underparts in each sex, *torquata* by that of the male, *lugubris* and *guttulata* (taken together) by that of the female. In *maxima*, only the combination is characteristic, that of neither sex alone being distinctive.

Megaceryle alcyon.

Small *Megaceryle* (wing under 170 mm.), with slender bill, long wing tip (tenth primary always nearer seventh than sixth), the male with blue-gray chest-band and no rufous, the female with white under wing-coverts and white belly bordered anteriorly and on the sides with rufous.

Small Nearctic *Megaceryle* (wing under 170 mm.), with short and slender bill, the tomial serrations sometimes obsolete, the crest distinctly double, the vertical portion well developed, composed of narrow, pointed feathers, the barbs of which are extensively disconnected, the wing decidedly pointed (the tenth primary always nearer the seventh than the sixth in length, often longer than the seventh), the tail rather short, the rectrices somewhat pointed, the outermost pair falling short of the longest by about one-thirteenth of the length of the tail, the second toe with claw almost always equal to or longer than the third toe without claw, and always distinctly longer than the fourth without claw; the entire upperparts uniform bluish gray without white markings except on the wing- and tail-coverts, the basal half of the inner web of the outer five primaries almost entirely white, a solid blue-gray chest-band in both sexes, the adult male without rufous, the female with rufous sides and narrow band across lower breast, large white abdominal area and white under wing-coverts.

M. alcyon is the most distinct species of the genus, possessing several characters separating it at once from all its congeners. Its small size, slender bill, pointed wing, the pattern of the primaries, the absence of rufous in the male, and its peculiar distribution in the female (particularly its absence from the lower wing-coverts), are all diagnostic of this species.

It is a typical *Megaceryle*, however, in the essential generic characters, showing no approach in these respects either to *Ceryle* or to *Chloroceryle amazona*. While it agrees with these in size and with the former in its pointed wing, it is probable that both these resemblances are due to parallelism or convergence and do not indicate any particularly close relationship between those species and *M. alcyon*.

It is undoubtedly most nearly allied to *M. torquata* with which it agrees in the clear ashy-blue coloration. This relation is also shown in the pattern of the remiges and rectrices, by the presence of rufous on the under side of the body in the ♀ and by the form of the crest feathers. It is distinguished from *M. torquata* chiefly by the same characters in which it differs from the other species (particularly from *M. maxima*), i. e., the characters peculiar to *M. alcyon*.

While the presence in the male of a chest-band of the same color as the upperparts and wholly without rufous, separates this species not only from all its congeners but from all the species of *Chloroceryle* as well, *M. torquata* and the Asiatic species show an approach to this style of coloration. In *M. torquata* the sides of the chest are blue-gray; in *M. lugubris* and *M.*

guttulata the sides of the chest are slate-gray and the feathers of the chest are extensively slate-color below the surface (visible to a slight extent), while the rufous is reduced to a pale superficial wash.

Probably the most remarkable variation in *M. alcyon* is found in the markings of the outer webs of the primaries, which present very diverse patterns.

Despite its wide range the geographic variations in this species are so slight that it is unnecessary to enter into them here. One geographic race has been described.

Megaceryle torquata.

Megaceryle with entire lower breast and belly solid rufous in both sexes.

Large, Neotropical *Megaceryle* with long or moderately long, stout bill, the culmen only slightly decurved for its distal one-third, relatively rather short crest the feathers of which are narrowed terminally, the tenth primary varying from decidedly shorter than the sixth to decidedly longer than the sixth, but always nearer the sixth than the seventh, the tail rather long, the rectrices somewhat pointed, the outermost pair falling short of the longest by between one-ninth and one-tenth of the length of the tail, the second toe with claw usually equal to or very slightly longer than the third toe without claw and almost always longer than the fourth without claw; the ground-color of the upperparts bluish gray, the crest never spotted with white, the primaries not symmetrically spotted with white on both webs, the outer three with, at most, vestigial spots on the outer web, the white on inner webs in large areas, not in isolated spots, the entire lower breast and abdomen uniform rufous in both sexes, the female with rufous under wing-coverts and a solid blue-gray chest-band, the male with the sides of the chest blue-gray.

M. torquata is distinguished from all its congeners by the uniform solid rufous of the breast and belly in both sexes. It has few if any other peculiar characters.

The crest is relatively smaller than in the other species, its feathers terminally narrowed and pointed as in *M. alcyon*.

The tail averages relatively longer than that of any other species, and with the shortest outermost rectrices. The difference in length is most pronounced, though not important, between *torquata* and *alcyon*, which, however, agree most closely in the form of the rectrices, these being more pointed and apparently narrower than in the other species.

In *M. torquata* the tenth primary averages slightly longer than in the Old World species, thus approaching *M. alcyon*, and the coloration shows several decided points of resemblance to the latter. This is evident in the color of the upperparts, the pattern of the remiges and rectrices, and the presence of rufous on the belly of the female.

On the other hand, in the rufous chest of the male, in general size, and in the size and form of the bill, *torquata* agrees with *maxima* and, in the

first two respects, to a less extent, with *lugubris* and *guttulata*. *M. torquata* therefore connects *M. alcyon* with the other species of the genus.

At least three races of *M. torquata* are recognizable, but the geographical variations in this species have never been thoroughly worked out. As this is beyond the scope of the present paper no attempt has been made to revise the subspecies.

True *M. torquata* inhabits Middle America; the form of northern and eastern South America is probably the same. *M. t. stellata* is accredited to western and southern South America (Chili, Bolivia, and Peru), but its range and characters have never been thoroughly determined. Its characters are supposed to be a shorter bill than true *torquata*, the upperparts spotted with white, the slaty centers of the feathers broader. These alleged color characters, however, may be due, to a certain extent at least, to age, immature birds exhibiting the coloration above described. On the other hand, it is possible that two races of *torquata* with short bills are recognizable, one colored like true *torquata*, the other marked as above. Of most interest in the present connection is the short bill, relatively stouter than in *M. t. torquata* (but of which I have given no measurements owing to lack of perfect adult specimens) and the coloration suggestive of *M. maxima*.

M. t. stictipennis Lawrence, of Guadeloupe, Lesser Antilles, of which I have examined two adult males, including the type, is, judging by these specimens, an easily distinguished form, chiefly characterized by the large amount of white in the plumage. The white bars on the rectrices are much better developed than in true *torquata*, there is a greater amount of white on the primaries and primary coverts (usually little or none on the latter in true *torquata*), and more white specks and narrow bars on the upper parts (largely concealed). The rufous of the underparts probably averages decidedly deeper and of a slightly different shade. The slaty stripes of the crest feathers are reduced to a minimum.

This form, while included in the British Museum Catalogue, is omitted from the Hand-List of Birds.

Megaceryle maxima.

Megaceryle with the belly white (with or without gray bars) in the male, solid rufous in the female.

Large African *Megaceryle* with large, stout bill, the culmen gently decurved for its terminal third, long vertical and occipital crest with broad tipped feathers, the tenth primary ranging between the fifth and sixth in length, the tail rather short, the outermost pair of rectrices falling short of the longest by about one-fourteenth of the length of the tail, the second toe with claw about equalling the third toe without claw, usually longer than the fourth toe without claw; the feathers of the upperparts with conspicuous slate-colored or blackish centers, those of the crest and rump

(at least) more or less spotted with white, the primaries symmetrically spotted with white on both webs, the male with a rich rufous chest-band but no rufous elsewhere, the female with the chest heavily marked with slate-gray, the entire abdomen and the under wing-coverts rufous.

M. maxima is well characterized by the coloration of the lower parts, no other species combining a rufous chest-band and white belly in the male, with a rufous belly in the female. (In the male of *M. maxima sharpei* the belly is heavily marked with slate color but it is never rufous.) The male is essentially similar in pattern to the males of *M. lugubris* and *M. guttulata*, the females of which have no rufous on under surface of body; while the female resembles that of *M. torquata*, the male of which has a rufous belly. *M. maxima* is therefore the only species in which the male has the entire belly white (*i. e.*, without rufous) while the female has it entirely rufous.

Aside from the coloration of the underparts *M. maxima* has no strongly marked peculiar characters. In the coloration of the upperparts it is to a certain extent intermediate between the two New World species on one hand, and the two Asiatic forms on the other hand. In the pattern of the remiges and rectrices, and in the size of the crest and its feathers it agrees with *M. guttulata*, while in the size and form of the bill it is similar to *M. torquata*. In the proportions of the primaries, the length and form of the tail, and the form of the rectrices there is close agreement with *M. lugubris* and *M. guttulata*, but *torquata* does not differ importantly in any of these respects.

The anterior toes show the Megaceryline proportions less strongly than in other species, the second toe with claw being frequently shorter than the third toe without claw, which is only rarely or abnormally the case in the other species.

In addition to the typical subspecies, *M. m. maxima*, one well marked race is recognized, *M. m. sharpei* of West and Equatorial Africa. This form, of which I have seen no specimens, differs from true *maxima* in its darker coloration, the white spots of the upperparts much restricted and wholly absent from the interscapulum; the abdomen, crissum, under wing-coverts (and axillars doubtless) of the male, heavily barred with slate-gray.

Whether or not there are any differences in form or proportions between the two races I am unable to state, but it is probable that there are none of any importance.

Megaceryle guttulata.

Megaceryle with short, stout bill, the maxilla decidedly decurved for more than its distal third and with laterally thick tip, the entire upperparts conspicuously barred with gray and white, the crest with two patches of almost wholly white feathers, the male with pale rufous chest-band which is spotted with slate-gray below the

surface, and a pale rufous spot on posterior malar region, the female with no rufous below, except on axillars and under wing-coverts.

Ten or eleven white spots on outer web of outer rectrix (including base and tip), the spots on proximal half of quill not wider than the dark interspaces, mostly much narrower; the distance between the distal white spot on inner web of outer three primaries and the tips of the quills greater than the depth of the bill; the white bars of the upperparts (including the scapulars) narrower than the dark bars, those of the rump little if any wider.

Rather large Asiatic *Megaceryle* with short but stout bill, the maxilla decidedly decurved for more than its distal third, and with laterally thick tip, very large crest, the vertical part highly developed, the feathers with broad truncate tips, the tenth primary ranging in length between the fifth and sixth, the tail of moderate length, the outermost pair of rectrices falling short of the longest by about one-twelfth of the length of the tail, the second toe with claw usually equal to or slightly longer than the third toe without claw and always (?) longer than the fourth toe without claw, the upperparts conspicuously barred with dark gray and white, some of the crest feathers pure white with, at most, one or two small black spots at the tip, the primaries symmetrically barred with white on both webs, the male with pale rufous chest-band (spotted with slate-gray below the surface) and pale rufous spot on posterior malar region, the female with white underparts, only the axillars and under wing-coverts pale rufous, a band of gray spots or bars crossing the chest. (To this may be added the minor color characters, distinguishing *guttulata* from *lugubris*, given in the second paragraph of the diagnosis.)

Megaceryle lugubris.

Megaceryle similar to *M. guttulata*, but differing in greater amount of white in the plumage. About thirteen white spots on the outer web of the outer rectrix (including base and tip), the spots on proximal half of quill much wider than the dark interspaces; the distance between the distal white spot on inner web of outer three primaries and tips of quills less than the depth of the bill; the white bars of the upperparts (including the scapulars) mostly as wide as or wider than the dark bars, much wider on the rump.

M. lugubris and *M. guttulata* are very closely related, differing from each other only in the relative amount of slate color and white in the plumage, while agreeing exactly in several important characters not found in any other species.

The short but thick bill, with decurved maxilla and thickened tip, is the only marked structural peculiarity. In coloration the unique features are the broad, white barring of the upperparts, the pallor of the rufous shade and its restriction in the female to the under wing-coverts and axillars, and, in the male, the presence of a rusty malar spot and a concealed slatey chest-band, superficially rusty. The last feature is an approach to the unique blue gray chest-band of *M. alcyon*, and the shortness of the bill is another resemblance to the latter.

It is probable, however, that these resemblances are due to convergence, for the nearest ally of the Asiatic species is unquestionably *M. maxima*.

This relationship is shown in the crest, the proportions of the primaries, the length and form of the tail and rectrices, and to a considerable extent in coloration, particularly in the pattern of the remiges and rectrices. The barring of the upperparts is only an exaggeration of the spotting of *M. maxima*.

The gray and white coloration of the Oriental species bears a superficial resemblance to the black and white of *Ceryle*, and the similarity is increased by the pallor and restriction of rufous on the underparts. It was for this reason, doubtless, that Reichenbach separated them from their congeners and placed them in *Ceryle*. Even in coloration, however, *M. lugubris* and *M. guttulata* are essentially Megaceryline and differ in important respects from *Ceryle*, particularly in the pattern of the individual feathers.

While *M. lugubris* and *M. guttulata* are very nearly related I have followed Dr. Stejneger¹ in considering them as specifically distinct. *M. lugubris* appears to be an island form confined to Japan, and as far as known the differences separating it from the continental *M. guttulata* are constant. The two species are distinguished by the relative amount of gray and white in the plumage. I have a single fine specimen of *lugubris* and six (three from India and four from North China) of *guttulata* for comparison. These exhibit the following differences.

	<i>M. lugubris.</i>	<i>M. guttulata.</i>
Primaries	A white spot on inner web opposite the subterminal spot on outer web of outer three or four primaries	No white spot on inner web opposite the subterminal spot on outer web of outer three or four primaries.
10th primary	Nine or ten white spots on inner web (including base). Nine past tip of spurium primary.	Eight white spots on inner web (including base). Seven or eight past tip of spurium primary.
	Distance of last spot on inner web from tip is less than greatest depth of bill.	Distance of last spot on inner web from tip is more than greatest depth of bill.
Innermost large secondary	White bars not conspicuously narrower than dark bars,—fully three-fourths as wide.	White bars much narrower than dark bars, only about one half as wide.
Scapulars	Many of the white bars are broader than the dark ones.	The white bars are always narrower than the dark ones (except near the base of some feathers).
Central rectrices	White base reaching shaft.	White bars not reaching shaft.

¹ Proc. U. S. Nat. Mus., XV, 1892, 294.

	<i>M. lugubris.</i>	<i>M. guttulata.</i>
Outer web of outer rectrix	Thirteen well-defined spots including base and tip. On basal half the white spots are much wider than the dark spaces, often twice as wide.	Ten or eleven well-defined spots, including base and tip. On basal half the white spots are not wider than the dark spaces, mostly much narrower.
Rump	Many of the white bars are nearly or quite twice as wide as the dark ones.	White bars little if any wider than the dark ones.
Upper tail-coverts	White bars mostly equal or exceed dark ones in width.	White bars are narrower than the dark ones.

Genus *Ceryle*.

Medium sized Ceryline Kingfishers with slender bill, the sides of the mandibular rami overlapped by the interramal feathers; coloration wholly black and white, the feathers of the upperparts black with at least the tips white, the wing with a large white area covering both webs of several adjacent primaries, the plumage of the throat with a satiny lustre, the male with two black bands crossing the breast.

Medium sized Ceryline Kingfishers of Africa and Asia (the wing less than 145 mm. long) with rather long, slender, non-serrate bill, the interramal feathers overlapping the sides of the mandibular rami, well developed occipital but no vertical crest, rather long, pointed wing (the tenth primary longer than the sixth), diastataxic secondaries, nearly even tail (the outer pair of rectrices falling short of the longest by less than one-fifteenth of the length of the tail), the rectrices with broad, obtusely rounded tips, the tarsus short hallux moderately short, the front of the tarsus covered with scales except at its upper end, the second toe with claw longer than the fourth without claw, and not shorter than the third; the plumage very soft, the feathers of the upperparts and crest with the barbs disconnected terminally and very fine, the throat and to a less extent the rest of the underparts with a satiny luster; the plumage wholly black and white, the feathers of the upperparts neither uniform nor marked with small spots or bars, but black with a white terminal margin and often more or less extensively white proximally, some of the primaries and secondaries and all of the rectrices with large continuous areas of white across both webs, one black band on the breast in the female and two in the male.

The exact relationship of *Ceryle* to *Megaceryle* and *Chloroceryle* cannot be satisfactorily determined until its muscular and skeletal anatomy have been examined.

Coloration is the most distinctive feature of *Ceryle*. This differs so markedly in several respects from the characteristic styles of the allied genera that it may be considered an excellent distinction. Aside from coloration there are no very strongly marked characters separating *Ceryle* at once from both of the other genera, but the slender bill with its rami overlapped by feathers, and the soft, satiny texture of the plumage are also diagnostic. The scaled podotheca and diastataxic wing are the most

important characteristics allying it to *Megaceryle* and distinguishing it from *Chloroceryle*, while in the absence of a vertical crest it agrees with the last-named genus and differs from the first. Its differences from *Chloroceryle* would be much more pronounced were it not for the intermediate nature of *C. amazona*.

To the following list of characters may be added "Geographical distribution" as a distinction between *Ceryle* and *Chloroceryle*.

Ceryle agrees with

Chloroceryle:

Smooth tomia (but approached by *M. alcyon*).

Length of tarsus and hallux (but former closely approaching *Megaceryle*).

Slender feet.

Crest (with *C. amazona* only and is a little further from the three other species than is *C. amazona*).

Size.

Megaceryle:

Diastataxic.

Primary formula.

Scaled podotheca (but approaching *Chloroceryle*).

Length of bill (but differing less from *Chloroceryle* than from the two short-billed species of *Megaceryle*).

Fore-toes; second relative to third and fourth (but agrees with *C. amazona* also).

Length of anterior toes.

Neither (unique).

Slender bill (but only averaging slenderer than the slenderest billed species of *Chloroceryle*).

Graduation of tail (but little different from *Megaceryle* and *C. amazona*).

Form of rectrices.

Interramal feathering.

Texture of plumage, very soft, hairy and with a satiny lustre.

Color and pattern of upperparts, wings and tail.

Color and pattern of underparts (sexual coloration and absence of rufous).

The bill is very straight and is much more slender than that of *Megaceryle* (particularly the larger species) and *Chloroceryle inda*; from the three other species of *Chloroceryle* there is only an average difference but, except in *C. americana*, this amounts almost to a constant distinction.

In the graduation of the tail *Ceryle* differs but slightly from *Chloroceryle amazona* and the species of *Megaceryle*, *M. maxima* approaching it most closely. The rectrices are noticeably broader and more obtuse at the ends than in the allied genera. The difference from *M. alcyon* and *M. torquata* is most pronounced, and, particularly in the outer pair of rectrices, from the three smaller species of *Chloroceryle*.

The overlapping of the sides of the mandible by the interramal feathers is usually conspicuous in *Ceryle*, and slightly if at all developed in the other genera.

The plumage of the upperparts is soft and smooth in *Chloroceryle* but even more so in *Ceryle*. The more or less disconnected barbs are extremely fine and soft, giving the crest, in particular, a hairy aspect. The plumage of the throat is satiny white with a strong lustre, and this is shown to a less extent by the rest of the underparts.

Most of these characters, peculiar to *Ceryle*, are not very important, yet collectively they emphasize the distinctness of the genus. As already stated, however, it is by coloration and by a different combination of the characters found in the related genera that *Ceryle* is best distinguished.

The single species constituting the genus *Ceryle* stands quite alone in coloration. It is wholly black and white, with no rufous or fulvous in either sex or at any age, differing in both respects from all the species of *Megaceryle* and *Chloroceryle*. It is unique in the conspicuous white terminal margins to all the feathers of the upperparts and the large white areas in the primaries, secondaries, and rectrices (and the wing- and tail-coverts also). An approach to this condition (in the secondaries and tail only) is seen in *Chloroceryle ænea* and particularly in *C. americana*, but the resemblance is by no means close.

While the sexes are distinguished by the banding of the underparts as in other Cerylinæ, there is an important difference in this respect between *Ceryle* and the two related genera. Both sexes have a broad black chest-band narrowing towards the median line and there interrupted in the female, while the male has, in addition, a second, narrower but complete band crossing the lower breast.

Thus the female agrees with the female of all the species of both *Chloroceryle* and *Megaceryle* in having a chest-band of the same color as the upperparts (the resemblance to the female of *C. amazona* is particularly close, in the white underparts, interrupted chest-band and dark-marked sides).

In these genera, however (with the exception of *M. alcyon*), the dark chest-band of the female is replaced by a rusty band in the male. In *M. alcyon* the band remains as in the female, while in *Ceryle* this band becomes complete and there is a second band back of it. This is a feature unknown in the other genera.

There was formerly some uncertainty as to whether or not there is a sexual difference in coloration in *Ceryle*, and as late as 1905¹ doubts were expressed as to there being any difference in this respect between the male and female. In my opinion there can no longer be any question but that the sexes differ as above described. The uncertainty was caused by the fact that the immature male has but a single band as in the female.

¹ Oberholser, Proc. U. S. Nat. Mus., XXVIII, 1905, 851.

Sharpe, in his 'Monograph,' quoted the opinion of Dresser, based on "a very large series," that the sexual differences are as above described. He also quoted Dr. Tristram as follows: "I preserved twenty-one specimens and many were collected by others of the party. In all the sex was carefully noted and the rule held good of the male having a second band, which was wanting in the female and young bird."

Sharpe adhered to these distinctions in the 'Catalogue of the Birds in the British Museum' (1892), and as he there listed 183 specimens of *Ceryle rudis* and *varia*, the material on which to base his conclusions was surely ample.

The small series available in the present connection includes only ten specimens in which the sex was determined by the collector, and, I believe, includes those on which Mr. Oberholser based his remarks. Of these, five are double-banded and these are all marked ♂; five have but a single band, and four of them are marked ♀, while one, an immature bird is sexed as a ♂.

Ceryle rudis rudis and *C. r. leucomelanura* (*varia* of authors, in part, not of Strickland which is based on the South African bird; cf. Hartert, Nov. Zool., XVII, 1910, 216) are strongly marked subspecies. The series examined included birds from Cape Colony (1), Natal (1), British East Africa (4), Egypt (2), India (6), and China (2). The latter belong to *C. r. insignis* Hartert, distinguished by its longer bill.

The Asiatic specimens may be invariably distinguished from the African by the characters given below, but as I have seen no specimens from the region lying between Egypt and India (Palestine, Persia, and Baluchistan), in which the ranges of the two forms meet, it seems better to treat them as subspecies. That intergradation is not improbable is indicated by the specimens from Egypt which show a decided approach to *C. r. leucomelanura* in both size and coloration. Indeed there is probably no material difference in size between birds from Egypt and India.

There is little doubt that *Ceryle rudis rudis* is a composite form and separable into at least two races, but as the single skin from Cape Colony equals the Egyptian birds in size it seems inadvisable to describe any new forms from the meagre series available.

C. r. rudis may be distinguished from the two Asiatic races by the following characters:

C. r. rudis.—White areas less extensive throughout than in the other forms. Basal two-fifths of the tail more or less marked with black, the shaft (in this space) always partly or wholly blackish or dusky. White of the primaries and secondaries less extensive; the first primary that is broadly pure white, completely across both webs is the sixth or fifth. The black spots on the sides are narrower and confined mostly to one web. Throat never spotted with black.

C. r. leucomelanura et insignis.—White areas everywhere more extensive than in *C. r. rudis*. Basal two-fifths of the tail always pure, immaculate white, the shaft (in this space) with no blackish or dusky. White in primaries and secondaries more extensive; the first primary that is broadly pure white completely across both webs is the eighth (more rarely the ninth or seventh). The black spots on the sides are rounder or broadly cordate and spread nearly equally on both webs. Lower part of throat usually spotted with black.

Genus **Chloroceryle**.

Eutaxic Ceryline Kingfishers with glossy green upperparts and scaleless podotheca.

Very small to medium-sized Ceryline Kingfishers of the Neotropical Region (the wing less than 145 mm. long), with rather slender to rather stout bill, the tomtia perfectly smooth, without vertical crest, a short blended occipital crest present (longer and less blended in *C. amazona*), the tenth primary shorter than the sixth, the secondaries eutaxic, the tail graduated for one-fifth or one-sixth of its length (or, in *C. amazona* for only one-thirteenth), the tarsi covered only with skin and wholly without scales, the tarsus and hallux moderately short, the second toe with claw shorter than the third without claw and rarely longer than the fourth without claw (excepting in *C. amazona*); the plumage uniform, glossy, metallic green above, the chest always rufous in the male; no sexual difference in the color of the axillars.

Excluding *C. amazona* the short diagnosis can be enlarged as follows:

Very small to rather small eutaxic Ceryline Kingfishers (the wing less than 105 mm. long), with short, blended occipital crest, the tail graduated for more than one-seventh of its length, the podotheca scaleless, the second toe with claw shorter than the third without claw and rarely longer than the fourth without claw, the upperparts glossy green.

Bill.—The bill is not exactly alike in form or proportions in any two species of *Chloroceryle*. *C. amazona* and *C. ænea* closely agree in the length of the bill (proportionate to the bird itself), and in its relative depth. They hold a central position in these respects, as in *C. inda* the bill is decidedly shorter and thicker, while in *americana* it varies equally in the opposite direction being the longest and most slender.

In the following table the figures in the first column give the relative length of the bill compared with the distance from the bend of the wing to the tips of the lower primary coverts. The second and third columns give the extremes and average of the relative depth of the bill, the figures expressing the number of millimeters by which four times the depth of the bill at the gonydeal angle is less than or exceeds the length of the bill from the anterior end of the nostril.

	Length	Depth	
<i>inda</i>	1.05	+ 1 to 4	+ 2.8
<i>amazona</i>	.98	— 2.3 to + 2	— .6
<i>ænea</i>	.98	— 3 to + 2.5	+ .8
<i>americana</i>	.91	— 4 to + .5	— .2

In a single aberrant specimen of *C. amazona* the bill is distinctly slenderer than in those included in the above table, four times its depth being less than the length by 5.5 mm.

Crest.—In the three smaller species the feathers of the occiput are decidedly lengthened and form a short blended crest. In *C. amazona* they are considerably longer, narrower and less blended and the crest is more conspicuous.

Wing.—The outermost (tenth) primary normally ranges between the sixth and fourth, rarely reaching the third in one species.

In *C. amazona* the outer primary is always longer than the fifth and in *C. americana* usually longer; in *C. inda* and more southern specimens of *C. ænea* it does not exceed the fifth, while more northern specimens of the latter agree with *C. americana*. The proportions in more detail are as follows:

- C. amazona* (13 specimens) P. 10 slightly > 5 to nearly $= 6$ (averaging nearer 5).
C. americana (22 specimens) P. 10 a trifle < 5 to a trifle < 6 (usually between 5 and 6. Birds from Texas and Mexico do not differ from South American specimens).
C. inda (6 specimens) P. 10 distinctly > 4 to $= 5$ (averaging about half way between 4 and 5).
C. ænea 1. (4 specimens from Vera Cruz, Mex.) P. 10 a trifle < 5 to < 6 (equidistant between 5 and 6).
 2. (12 specimens from Honduras southward) P. 10 $= 3$ to $= 5$ (usually distinctly > 3).

Tail.—*C. americana* is the longest tailed species and *C. amazona* and *C. ænea* are the shortest; *C. inda* is intermediate but is decidedly nearer *americana*.

The following figures express the relative length of the tail in each species, comparison being made with the distance from the bend of the wing to the tips of the longer lower primary coverts. Thus in *C. amazona* the tail is equal to one and four-tenths of this distance, in *americana* to one and two-thirds. The entire range of variation, therefore, amounts to only one-fourth of the above measurement.

<i>amazona</i>	1.40
<i>ænea</i>	1.44
<i>inda</i>	1.59
<i>americana</i>	1.66

In the three smaller species the outer pair of rectrices is conspicuously shortened, the graduation of the tail amounting to one-fifth of its length in *americana* and *inda*, and to one-sixth in *ænea*. In *amazona* the abbreviation of the outer quills is much less — not quite one-thirteenth of the length of the tail.

	No. of Specimens.	Av. length of tail.	Av. amount of Graduation	Graduation in Length of Tail
<i>amazona</i>	(10)	79.	5.9	13.4 times
<i>ænea</i>	(7)	35.4	5.8	6.0 "
<i>inda</i>	(6)	64.8	12.6	5.1 "
<i>americana</i>	(10)	56.7	11.2	5.0 "

Thus in the smaller species the graduation of the tail is correlated with its length, *americana* having the longest tail and the shortest outer rectrices, while *ænea* has the shortest tail and the longest outer rectrices.

Feathering of the tibia.—The lower end of the tibio-tarsus is perfectly bare in all species. The unfeathered space is, at its most restricted point, always equal to or greater than the lower (short) chord of the claw of the hallux, except in some specimens of *C. ænea*, in which the tiny feathers slightly encroach on this space.

In *C. ænea*, usually, and in some examples of *C. americana*, the bare space is equal to the short chord of the claw, in *C. inda* and most specimens of *C. americana* the unfeathered area exceeds the short chord of the claw; in *C. amazona* this area always equals or exceeds the upper (long) chord of the claw.

The length of the tarsus is about one and three-fourths to very nearly twice the long chord of the hallux claw.

Tarsus.—The tarsus compares with the inner toe (without claw) as follows:

<i>amazona</i>	Tarsus	distinctly shorter than inner toe.
<i>inda</i>	"	usually shorter than, sometimes =, inner toe.
<i>americana</i>	"	=, sometimes slightly shorter than, inner toe.
<i>ænea</i>	"	=, sometimes slightly longer than, inner toe.

C. ænea has a slightly longer tarsus than the other species.

Toes.—In the proportionate length of the anterior toes the three smaller species virtually agree. The second toe with claw is always shorter than the third toe without claw, and equal to or shorter than the fourth toe without claw.

In *C. amazona* the second toe with claw averages equal to the third without claw, and is almost always longer than the fourth without claw. *C. americana* shows a distinct approach to *amazona*. The exact proportions in each species are shown in the following table.

Second toe with claw compared with third and fourth toes without claw.

<i>amazona</i> , 10 specimens,	{	= 3, (a trifle < 3 in 4 birds,
		perceptibly > 3 in 2 birds).
		> 4, (slightly to very distinctly; in 1 bird = 4 in one foot, a trifle < 4 in other foot).

<i>americana</i> , 14 specimens,	$\left\{ \begin{array}{l} < 3, \text{ (slightly to very distinctly;} \\ & = 3 \text{ in one foot of one bird).} \\ & = 4, \text{ (10 birds = 4,} \\ & \quad 2 \text{ " slightly } < 4, \\ & \quad 2 \text{ " slightly } > 4.) \end{array} \right.$
<i>inda</i> , 6 specimens,	$\left\{ \begin{array}{l} < 3 \text{ always.} \\ \text{slightly } < 4 \text{ to } = 4 \text{ (in one foot of 1 bird a trifle } < 4). \end{array} \right.$
<i>ænea</i> , 9 specimens,	$\left\{ \begin{array}{l} < 3 \text{ always} \\ \text{slightly } < 4 \text{ to } = 4 \text{ (in 5 birds = 4, in 4 birds a trifle } < 4). \end{array} \right.$

Color.—The uniform, dark, lustrous, metallic green of the entire upper-parts, so unlike that of any other genus, is remarkably similar in all four species. It is lightest and most brassy in *amazona* and averages deepest or most saturated in *inda* and *ænea*, but there are no well marked constant differences.

The plumage is soft and blended and the color changes, according to the position in which the bird is held, from yellowish-green or brassy to deep bluish-green.

The wings, tail, and scapulars are spotted, barred or otherwise marked with white, chiefly on the inner webs or beneath the surface. The pattern varies with the species. The spotting sometimes invades other parts of the upper plumage as concealed markings below the surface of the dorsal feathers, or as spotting on the wing-coverts, rump, and upper tail-coverts.

The central pair of rectrices is unmarked in *amazona* and *ænea* and, at most, with a few small spots in *inda* and *americana*.

The other rectrices are more or less barred or spotted in all species but scarcely or not at all on the outer web except on the outer one or two quills in *amazona*, basally in *ænea*, and extensively in *americana* in which the outer three pairs are mostly white.

There is no sexual difference in the color of the axillars, lower wing coverts, belly, nor, except in *C. americana*, of the throat, the sex being ordinarily indicated only by the color of the chest.

The coloration of the underparts furnishes well marked specific characters. Thus, *C. amazona* stands alone in the pure white ground color of the underparts, the sides and flanks broadly striped with green and the green chest-band of the female interrupted in the middle. In *C. americana* the male has pure white underparts but in the female the throat and breast are more or less strongly tinged with buff. The sides are spotted with green and the upper belly is crossed by a band of green spots.

C. inda and *C. ænea* agree in the general rufous color of the underparts, including the axillars and under wing-coverts (the throat paler, ochraceous), but in *ænea* the entire center of the abdomen is white.

The bill and feet are wholly black in *amazona* and *americana* except for a

touch of lighter color at the junction of the mandibular rami. In *inda* and *ænea* the feet and part of the lower mandible, including the proximal half of the gonys and a stripe along the lower edge of each ramus are light colored in skins and in life are probably red or orange.

Chloroceryle amazona.

Large *Chloroceryle* with well-developed occipital crest, the tail graduated for about one-thirteenth of its length, the second toe with claw not shorter than the fourth without claw, the primaries combining absence of white on their outer webs with large, continuous white areas on the inner webs, the green chest-band of the female incomplete, the sides broadly striped with green.

Large *Chloroceryle* with bill of moderate length and thickness, well-developed occipital crest, the feathers narrowed and not blended, the tenth primary longer than the fifth, the tail rather short and graduated for about one-thirteenth of its length, the second toe with claw not decidedly shorter than the third without claw, and not shorter than the fourth without claw, the dorsal plumage with no concealed white, the outer webs of the remiges without white, the inner webs with large, continuous white areas, rectrices without decided white basal area, with no rufous below except the chest-band of the male, the green chest-band of the female incomplete, the sides with broad stripes of dark green, the bill and feet wholly black.

C. amazona is the type of *Chloroceryle* and therefore of necessity "typical," but in the sense that it differs in certain characters from those shared by all the other species, it is a decidedly aberrant member of the genus.

In its well-developed occipital crest, nearly even tail, proportion of the anterior toes, and in general size it virtually agrees with *Ceryle*, though in the first mentioned character *Ceryle* is somewhat nearer *Megaceryle* than is *Ch. amazona*.

In its more pointed wing also it recalls *Ceryle*. In all these characters it also approaches or agrees with *Megaceryle* though the resemblance in the crest extends only to the occipital part.

In the most essential generic characters, as the eutaxic secondaries, glossy green upperparts, and rufous chest-band of the male, and in other more variable characters as the bill, this species is a typical *Chloroceryle*, showing no approach to *Ceryle*.

In the details of coloration there are well-developed specific features. The outer webs of the remiges are unicolorous green with no white spotting whatever. On the inner webs are extensive and continuous areas of pure white, never taking the form of spots. The tail is spotted with white on all but the central pair of rectrices, but there are no large white areas on any of the feathers, only the outer pair being completely crossed by white at the extreme base.

The metallic green chest-band of the female is wholly interrupted medi-

ally, taking the form of a blotch on each side of the chest. Both this feature and the green stripes on the sides are peculiar to the species. In the distribution of the rufous on the underparts, *C. amazona* agrees with *C. americana* in having only a rufous chest-band in the male and no rufous whatever in the female, but *C. amazona* altogether lacks the buff shade present on the underparts of *C. americana*.

The range of *C. amazona* extends from Mexico through Central America and over the greater part of South America to the Argentine Republic. No subspecies, however, are recognized and the geographical variation, if any, must be slight.

Chloroceryle americana.

Rather small *Chloroceryle*, with rather long, slender bill, at least the inner primaries conspicuously spotted with white on both webs, the outer three or four pairs of rectrices chiefly white, the underparts combining a complete green chest-band in the female with a rufous chest-band (and no rufous elsewhere) in the male, the flanks and a band across the upper belly spotted with green, the throat and breast of the female tinged with buff.

Rather small *Chloroceryle* with rather long, slender bill, slightly developed occipital crest, the tenth primary never more than a trifle shorter than the fifth, the tail relatively long and graduated for one-fifth of its length, the second toe with claw shorter than the third without claw and averaging equal to the fourth without claw, the dorsal plumage with concealed white, at least the inner primaries conspicuously spotted with white on both webs, the inner secondaries with entire basal portion conspicuously white, the outer three or four pairs of rectrices chiefly white, the rufous confined to a chest-band in the male and absent in the female, the sides and flanks spotted with green and a band of green spots across the upper belly, the throat and breast of the female tinged with buff, the bill and feet wholly black.

C. americana is a very well marked species related much more closely to *C. inda* and *C. aenea* than to *C. amazona*, but differing from them conspicuously in the restriction of rufous on the underparts (as in *C. amazona*), the white spotting of both webs of the remiges, and the large white areas on the inner secondaries and on the rectrices.

The coloration of the underparts is very distinctive. In the buff throat and breast of the female there is an approach to the deeper coloration of *C. inda* and *C. aenea*, but *americana* is unique in the genus in exhibiting any sexual difference in color other than that of the chest-band.

The bill is more slender than in any other species and, while the relative length of the toes practically agrees with that of *inda* and *aenea*, there is a slight approach to the proportions found in *C. amazona*.

C. americana is distributed over the greater part of South America and north to Texas. Four subspecies are at present recognized, differing somewhat in color and size, and to a slight extent in the thickness of the bill.

The proportionate length of the primaries is very constant, specimens from Texas and Mexico agreeing in this respect with those from South America (Colombia; Trinidad; Matto Grosso, Brazil).

Chloroceryle inda.

Medium sized *Chloroceryle* with short, thick bill, and with no white on the underparts, the entire belly rufous.

Medium sized *Chloroceryle* with short, thick (both horizontally and vertically) bill, slightly developed occipital crest, the tenth primary not exceeding the fifth, the rather long tail graduated for one-fifth of its length, the second toe with claw always shorter than the third without claw, and not exceeding the fourth without claw, the outer webs of the primaries and rectrices unmarked or with a few minute white specks, the inner webs of the primaries with fulvous spots, no basal light areas on the outer webs of the secondaries, the feathers of the chest-band of the female white, crossed by two dark bars, the throat fulvous, the belly entirely rufous, the feet and lower edge of the mandibular rami orange in life.

C. inda is obviously related to *C. ænea* but is easily distinguished by its much greater size, spotted inner web of primaries, absence of light areas on basal portion of inner secondaries and rectrices, and of white on center of abdomen, and shorter, thicker bill. In none of these characters except the spots on the inner webs of the primaries does it show any approach to *C. americana*.

C. inda is distributed over much of South America and north to Nicaragua. No subspecies are at present recognized. With the possible exception of *C. ænea* this is the rarest of the four species of *Chloroceryle*.

Chloroceryle ænea.

Very small *Chloroceryle* without distinct light spots on the primaries, the abdomen rufous on the sides, white in the middle.

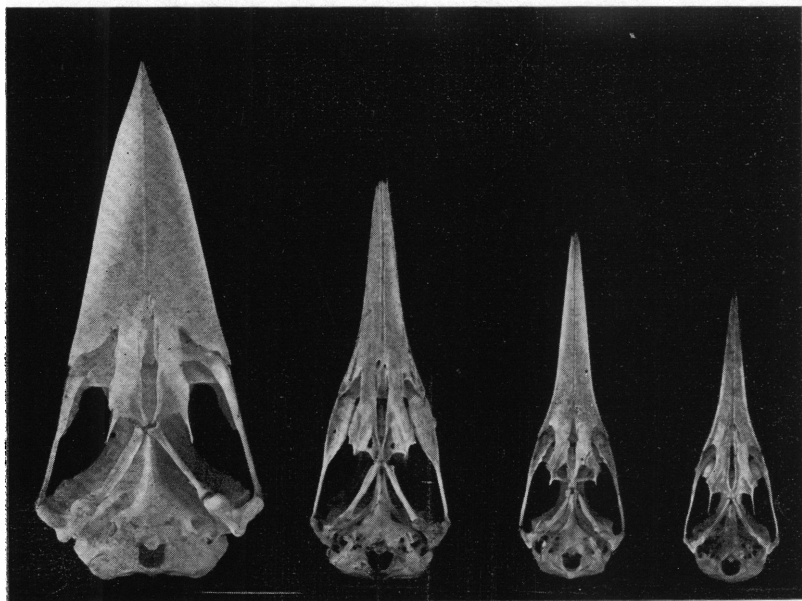
Very small *Chloroceryle*, with bill of moderate length and thickness, slightly developed occipital crest, the tail rather short and graduated for one-sixth of its length, the second toe with claw shorter than the third without claw, and not longer than the fourth without claw, no distinct light spots on the primaries, a light basal area across the inner secondaries and on the outer three or four pairs of rectrices, the feathers of the chest-band of the female barred, the throat fulvous, the abdomen rufous on the sides, white in the middle, the lower edge of the mandibular rami orange in life.

C. ænea is abundantly distinct in its extremely small size and unspotted primaries. Additional differences from *C. inda* are the presence of light basal areas on the inner secondaries and several outer rectrices, and the presence of a large white area on the center of abdomen.

It agrees closely with *americana* and *inda* in most details of form but has a distinctly shorter tail than *americana*, *inda* being intermediate. In

this respect it is nearest *C. amazona*, and also slightly approaches that species in the graduation of the tail. Its bill is intermediate in length and form between the long, slender bill of *americana* and the short, thick bill of *inda*.

Three races are currently recognized, *C. ænea ænea* with an extensive South American range, *C. æ. æquatorialis* of Ecuador, and *C. æ. stictoptera* ranging from Panama to Mexico. It is probable, however, that the last-named race does not extend as far south as Panama. The only important difference in form between northern and southern specimens is in the wing formula. In the Mexican birds examined (four from Vera Cruz) the outermost (10th) primary varies from a *trifle* shorter than the fifth to decidedly shorter than the sixth (equidistant between the two). In twelve birds from Honduras and further south the tenth quill ranges from equal to the third to equal to the fifth, usually distinctly longer than the third.

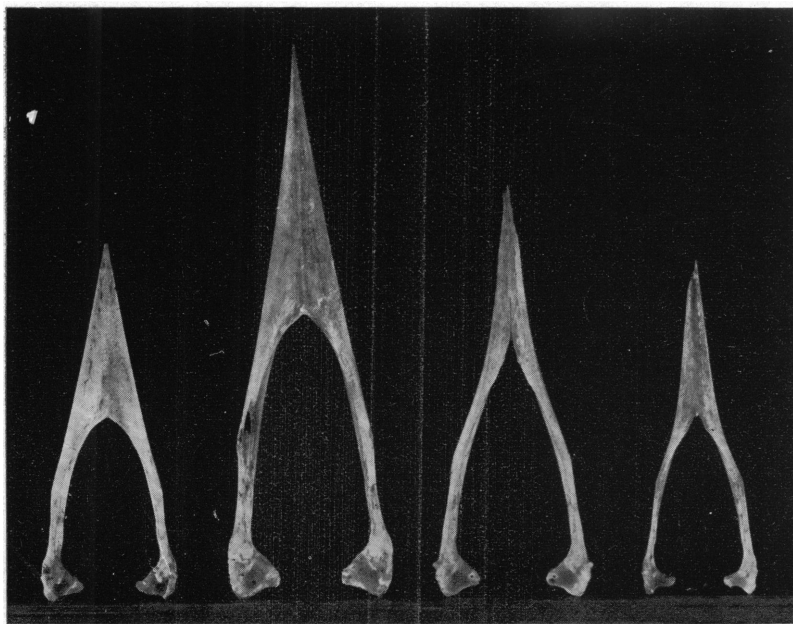


a

b

c

d



a

b

c

d

Fig. 1. Skulls of Kingfishers, palatal aspect ($\frac{2}{3}$ nat. size).

- a. *Dacelo gigas*.
- b. *Megaceryle alcyon*.
- c. *Chloroceryle americana*.
- d. *Alcedo ispida*.

Fig. 2. Mandibles of Kingfishers, from below (nearly $\frac{4}{5}$ nat. size).

- a. *Halcyon chloris*.
- b. *Ramphalcyon capensis*.
- c. *Megaceryle alcyon*.
- d. *Chloroceryle americana*.



a

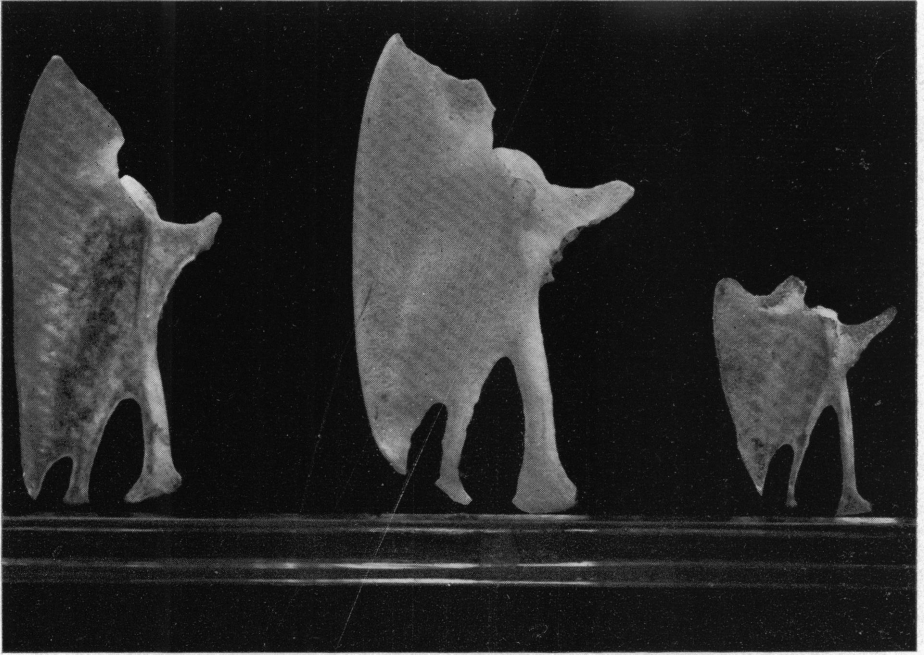
b

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d

e

f



a

b

c

Fig. 1. Coracoids, scapulas, and clavicles of Kingfishers (slightly enlarged).

Fig. 2. Sterna of Kingfishers (enlarged $\frac{1}{3}$).

- a. Coracoid of Megaceryle alcyon.
- b. " " Dacelo gigas.
- c. Scapula of Megaceryle alcyon.
- d. " " Dacelo gigas.
- e. Clavicle of Megaceryle alcyon.
- f. " " Dacelo gigas.

- a. Megaceryle alcyon.
- b. Dacelo gigas.
- c. Halcyon concretus.

