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Humeri of Central European Smaller Passeriformes

By

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Abstract: Keys to identify on the specific level of the humeri of smaller Passeriformes of eastern Central Europe are given. Some taxonomical conclusions are drawn from the morphological analysis.

One of the greatest problems in avian osteology is the morphological distinction of the bones of the smaller oscine Passeriformes. The small dimensions, the great number of systematical units and the few number of features on any one bone is the basis of all the difficulties. Thus, not only the distinction of species but even that of phenotypically very distinct families is often problematic. We have before us the complicated network of real evolutionary lines and the result of parallel rows in a very simplified form: in the morphological features of a single bone. Besides all the above difficulties, one has to face the fact that although during the last decades a number of orders of birds have been analysed osteologically (Anseriformes, Galliformes, Columbiformes; a part of Falconiformes and Strigiformes: BACHER 1967, WÖLFLE 1967, EBERSDOBLER 1968, KRAFT 1972, FICK 1974, LANGER 1980, OTTO 1981); the literature on the bones of Passeriformes had hiterto been very meagre chiefly because the contributions did not go into specific level (e.g. LAMBRECHT 1914, ASHLEY 1941, WETMORE 1957, BOCK 1962, BALLMANN 1973 etc.)

This situation is all the more regrettable as the demand for identification of recent, fossil and subfossil bones of members of this order is extremely great.

For that reason I first embarked upon this work after an experience of several years. Because of a puzzling network of convergencies in the World material (see also BOCK 1962 and WETMORE 1957) after a short look at the skeleton collection of the British Museum (Natural History), London-Tring, I decided to elaborate only the chiefly south-eastern Central European material. Considering the fact that it is the humerus which shows the best morphological features among the bone of Passeriformes, I want to analise it in this paper and I try to give in the following pages some identification-keys and some descriptions. I have to thank in this place the help of all the colleagues who sent me comparative material for this work or helped me in other way especially G. S. COWLES, Tring; B. STEPHAN, Berlin; H. SCHIFTER, Vienna and Z. BOCHENSKI, Kraków.

IDENTIFICATION OF THE HUMERUS

I deal in this paper only with the corresponding bones of smaller Passeriformes (excl. Corvidae).

In the keys I attribute greatest importance to a maximal exactness of the figures, made by myself precise professionally rather than artistically. As I have mentioned above, the stereoscopic situation of some anatomical features was very hard to figure. Therefore the use of comparative bone material is indispensable, in some cases along with extensive experience. I was going to give here a simple key for identification and descriptions with allusions to the possibilities of confusions perhaps of systematically very distinct groups. Just as the identification of all groups of living things undergoing the "eruption of evolution", so it is impossible to give a key with absolute solutions in all cases.

The investigations were based on the osteological collection of the Natural History Museum of Budapest, containing more 90% of the Central European species of this group.

Very important is the use of a good stereo- microscope and a convenient tangential light.

One of the greatest problems is the convenient anatomical designation of adequate morphological features. The avian anatomy in details is up to today not precise enough. I kept myself to the names of BAUMEL (1979) although in several cases I had to designate some other features too. Thus, some designations are, from BOCK (1962).

KEY OF DIFFERENT MORPHOTYPES
(see Plate I)

Bones layed down on a flat surface, looked from above (or proximal epiphysis looked sometimes in distal foreshortened view).

1(14) Bones with smaller dimensions (smaller than 20 mm)
2(3) Robust forms, with stout and short bone: Hirundinidae
3(2) Lightly built, slimmer forms
4(9) With two deep fossae proximally: the fossa tricipitalis and fossa pneumoanconaea
5(8) The two fossae distinctly separated by a medial bar (=crus dorsale fossae)
6(7) Fossa tricipitalis strikingly pneumatic, sievelike - crus ventrale fossae ventrally seemingly elongated: Paridae
7(6) Fossa tricipitalis deep, but not pneumatic, the medial bar separating the two fossae well developed: Muscicapa, Phoenicurus, Saxicola, Oenanthe
8(5) The two fossae (f. tricipitalis and pneumoanconaea) not separated by the medial bar, deep, fully joined: Fringillidae (except Pinicola, see in the group of larger dimensions), Motacillidae, Prunellidae, Remizidae, Aegithalidae
9(4) with less than two deep fossae
10(9) only the fossa pneumoanconaea well developed, fossa tricipitalis very shallow, flattened, nearly lacking: Sylviidae, Erithacus, Luscinia, Panurus
11(10) fossa pneumoanconaea more or less reduced
12(13) crista pectoralis short, both fossae absolutely reduced, the whole bone elongated: Troglodytes
13(12) Crista pectoralis long, one of the two fossae somewhat deeper, elongated proximal epiphysis: Sitta, Tichodroma, Certhia
14(1) Bones with larger dimensions (larger than 20 mm)
15(22) Fossa tricipitalis very shallow, flattened fossa pneumoanconaea deep
16(19) Fossa pneumoanconaea more or less pneumatic, sieve-like
17(18) The inner part of fossa pneumoanconaea strongly pneumatized, sieve-like, the bone not inflated: Alaudidae
18(17) Pneumatic part of the inner side of fossa pneumoanconaea very reduced, the bone seemingly "inflated": Lanius, Oriolus, Bombycilla

19(16) Fossa pneumoanconaea not pneumatic
20(21) Below of the middle part of caput humeri a special impression: Cinclus
21(20) Below of the middle part of caput humeri not an impression
22(15) Both fossae (f. tricipitalis and f. pneumoanconaea) well developed, deep.
23(24) The medial bar absolutely separating the two deep fossae:
Sturnidae, Monticola, Pinicola
24(23) The two fossae confluent, medial bar reduced: large Turdidae (Turdus s.l.)

SYSTEMATICAL-MORPHOLOGICAL DESCRIPTIONS

I give in the following section short descriptions of the humeri of the various species of Central European smaller Oscine Passeriformes in order of systematical frequence of familie, in problematic cases following rather the solution of taxonomical groups osteor logically better defined than other features. I refer always to the aforesaid key for identification.

Alaudidae
(Plate I, Fig. 10; Plate II)

The main common feature of the family, as mentioned above [key: 16(19) and 17(18)], is the flattened fossa tricipitalis and the pneumatic fossa pneumoanconaea in the proximal epiphysis may be seen better from distal side, as well as the reduced processus supracondyloideus (dorsalis). The smaller species have lightly built bones, the larger ones are more robust. With moderate experience a confusion with Lanius, Bombycilla or Oriolus is not excluded!

The two more or less Mediterranean forms occuring also at the margin of temperate Europe are distinct in size:

1/ Smallest is the bone in Calandrella brachydactyla: length cca. 20 mm, proximal width cca. 6 mm, width of diaphysis 1.8 mm, distal width cca. 4 mm. The measurements refer to the special lightly built epiphysis, the proximal part of fossa tricipitalis somewhat deeper than in other lark species.

2/ Largest is the bone in Melanocorypha calandra and relatively the most robust too: length cca. 30 mm, proximal width cca. 9 mm, width of diaphysis cca. 3 mm. Tuberculum ventrale relatively stronger, crista lateralis shorter than in other larks, fossa pneumoanconaea with the pneumatic holes relatively deep.

Among the middle-sized species occurring in Central Europe, Lullula arborea is the smallest: length 22-23 prox. 6.3-6.8 dist. 4.6-4.9 diaph. 2.1-2.2 mm. Crista pectoralis short, cut off, crus dorsale fossae reduced, crus ventrale fossae ventrally elongated, forming nearly a right angle in outline (foreshortened view).

The remaining three forms are nearly of the same size (length in Galerida: 25.5-28.0, in Alauda: 23.8-26.4, in Otocoris 25.1 (n=1)). In Otocoris (=Eremophila) alpestris the proximal part of the corpus humeri caudally bent, the outline of the crus ventrale fossae (in caudal view) rounded, field of pneumatical holes relatively widespread, crista pectoralis short in dorsal view cut off in a straight line.

In Galerida cristata prox. ep. broad, corpus humeri straight, not bent, outline of crus ventrale fossae (in caudal view) angled, pneumatic holes reduced, crista pectoralis longer (in dorsal view) cut off.

In Alauda arvensis prox. ep. narrower, corpus humeri straight, outline of the crus ventrale fossae (in caudal view) angled, pneumatic holes showing a medium field, crista pectoralis (in dorsal view) showing a curver line.

Hirundinidae
(Plate I, Fig. 1; Plate III)

The humerus of this group is very characteristic and confusion with other ones is not possible [see key 2 (3)]. Fossa pneumoanconaea pneumatic, fossa tricipitalis weakly developed, processus supracondyloideus strong proximally, processus flexoris distally elongated.

The differences among the three species (genera) of temperate Europe are as follows: in Hirundo rustica rather rather stout and average length figures 15.0 mm, av. width of the diaphysis 1.9 mm. Tuberculum dorsale mediocre broadened, the impression distally from this tuberculum not very deep, processus flexoris distally elongated. In Riparia riparia bone of same size but rather slender (av. length figures 15.0 mm, av. width 1.7 mm), tuberculum dorsale very strongly developed, the impression distally from it very scarcely developed, incisura capitis from ventral view broader than in other species. In Delichon urbica somewhat smaller dimensions (av. length figures 14.0 mm, av. width 1.7 mm), tuberculum dorsale rounded, the above-mentioned impression well developed, incisura capitis from ventral view narrow, tuberculum ventrale from the same view narrower too.

Motacillidae
(Plate IV)

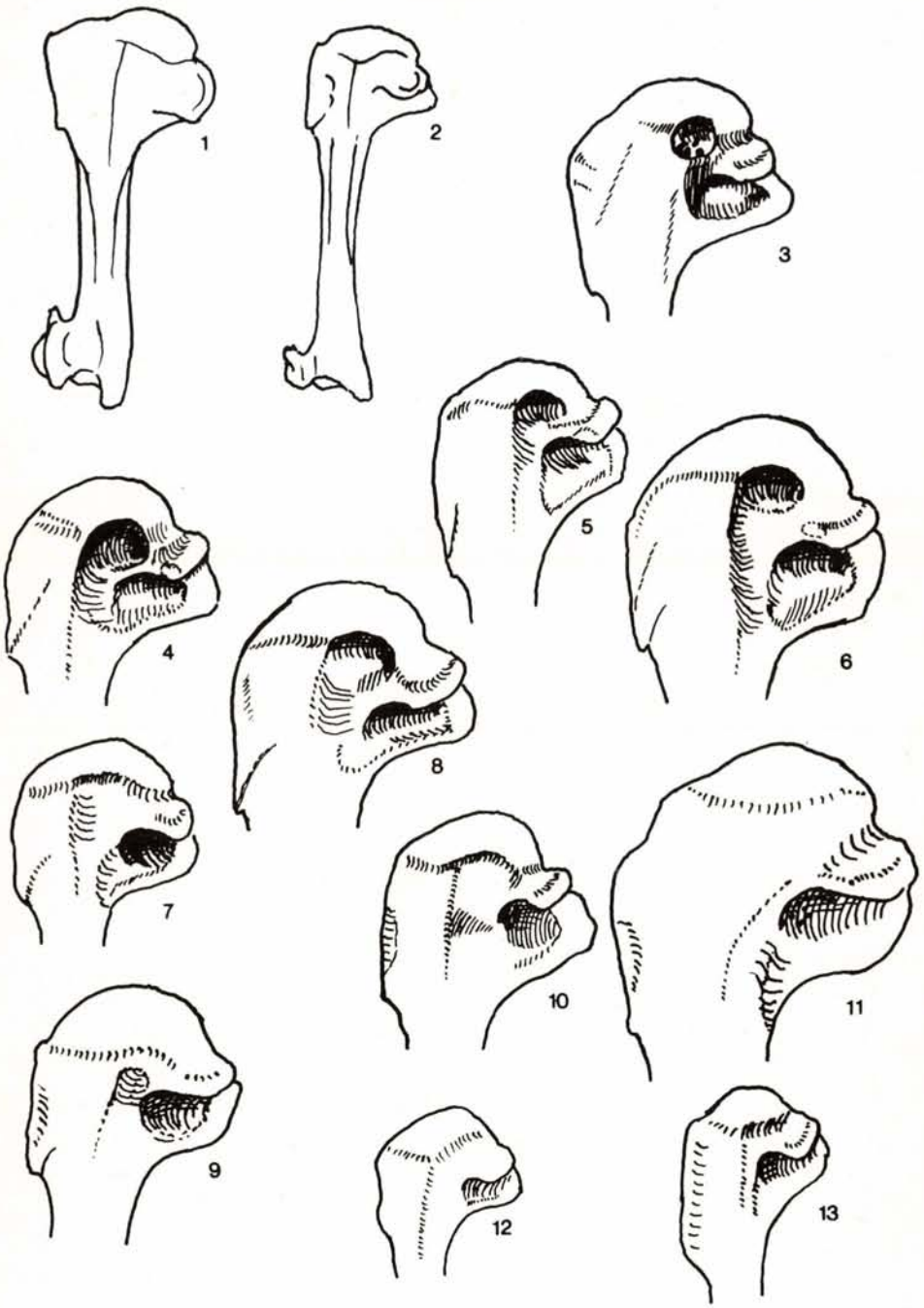
In the taxonomical key five families are summarized by the morphological types, in which both fossae of the humerus are deep, confluent, nearly not separated by the crus dorsale fossae: Fringillidae, Motacillidae, Prunellidae, Remizidae and Aegithalidae [Key No. 8 (5)]. Among these systematical units Remizidae and Aegithalide can be excluded by their morphology (for description see at the families) and smaller dimensions (length 11-12 mm, proximal width 4.3 mm, against 17-21 mm and 5.3-7.0 mm in Motacillidae). The Prunellidae are morphologically also different (for description of features see at that family).

The differences from Fringillidae are very slight and hard to define. BALLMANN (1973) gave some features, most of them should be proved by a new revision. According to these definitions the habitus of the humerus of Motacillidae is rather narrow, with weeker epiphyses, crista pectoralis ending distally in a sharp edge, processus supracondyloideus being rather obtuse. In addition to these, I would mention the more reduced wall of crus dorsale fossae (as against Fringillidae), as well as the less sharp inner contour of crus ventrale fossae too (this last feature shows exceptions!). The differences between Motacilla and Anthus are even much more subtle. The crista pectoralis seems to be in Motacilla rather short, in Anthus rather long. The most valuable feature is apparently the shape of the epicondylus ventralis from ventral view, being in Motacilla more prominent, in Anthus rather reduced.

Let us now go on to the characterisation of the humeri of the wagtails and pitpits nesting in, or migrating through temperate Europe.

PLATE I. Fig. 1. Delichon urbica - Fig. 2. Phylloscopus trochilus - Fig. 3. Parus major - Fig. 4. Chloris chloris - Fig. 5. Oenanthe oenanthe - Fig. 6. Sturnus vulgaris - Fig. 7. Luscinia megarhynchos - Fig. 8. Turdus philomelos - Fig. 9. Cinclus cinclus - Fig. 10. Calandrella brachydactyla - Fig. 11. Oriolus oriolus - Fig. 12. Troglodytes troglodytes - Fig. 13. Certhia brachydactyla (Fig. 1-2. medial view; Fig. 3-13. foreshortened view of medial side of the proximal epiphysis)

PLATE I



Among all, Anthus campestris is the most distinct by the pneumatisation (or at least the tendency for it) in both the fossa tricipitalis and pneumo-anconea of the humerus. Due to this feature the inner contour of the crus ventrale appears often as sharp as in Fingillidae! I found this character in all the four specimens available, originating from different populations of Hungary. Length of the bone 19.7-21.8 mm, prox. width 5.7-7.0 mm, dist. width. 4.4-4.6 mm.

The distinction among the other species of the region in question seems to be not quite unambiguous.

Anthus cervinus and A. pratensis are rather smaller (length of humerus 18.8-19.6 mm (n=5)). In foreshortened view from distal side the crus dorsale and ventrale fossae seems to be in A. cervinus nearly parallel, in A. pratensis they enclose a narrow angle. In both species the fossa tricipitalis is deep, narrow, the sheet of crus dorsale fossae quite reduced.

Anthus spinoletta and A. trivialis are somewhat larger (length 19.8-21.0 mm, n=5), fossa tricipitalis is broader, the sheet of crus dorsale fossae less reduced. In A. trivialis the proximal epiphysis seems to be larger, the crista pectoralis shorter than in the other species. Passing over to the genus Motacilla it is worthy of mention that in my comparative material Motacilla alba has the absolutely largest humerus (length 18.6-20.5 mm, n=5).

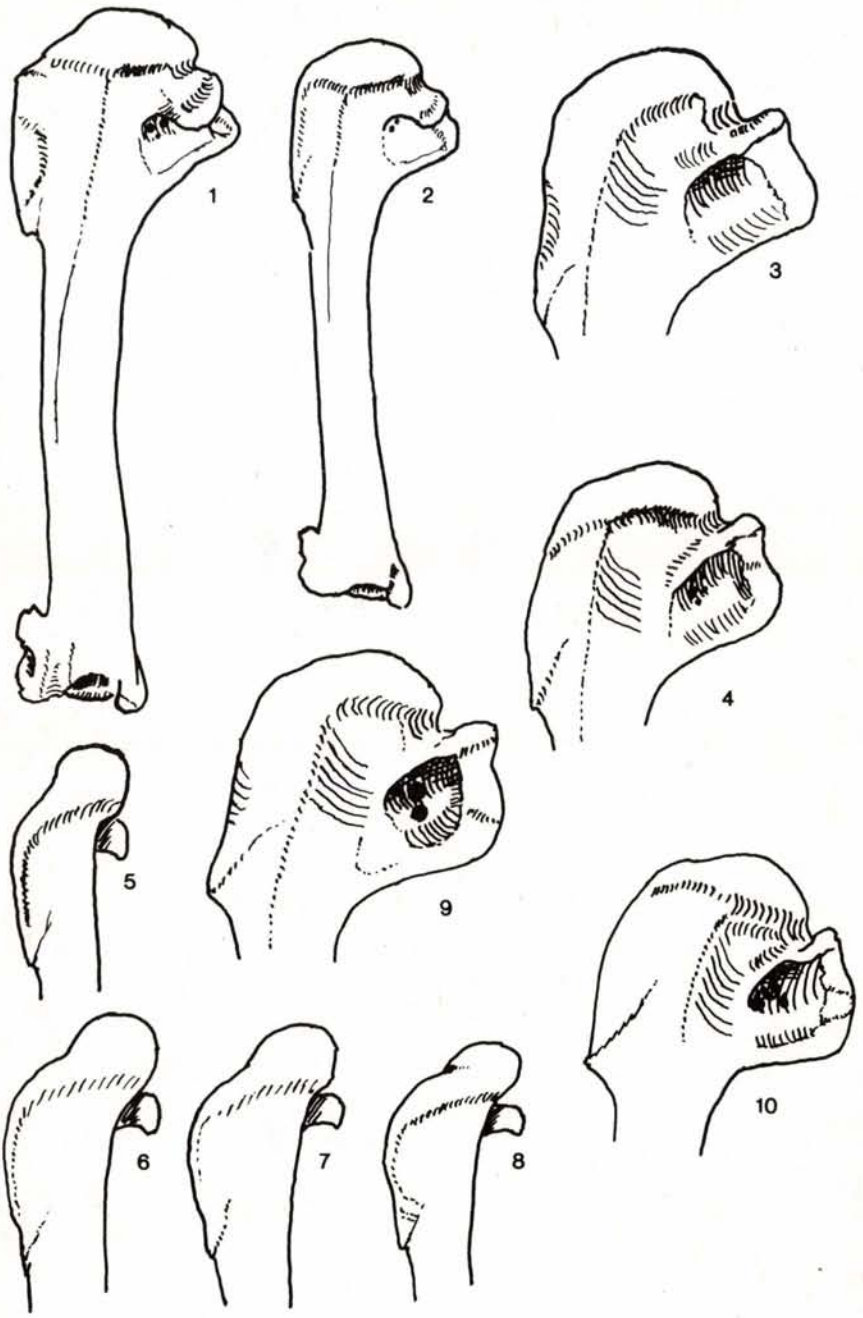
In this species the fossa pneumo-anconea is broader, the fossa tricipitalis relatively narrower. The tendency for composition of foramina pneumatica is observable (!) The corresponding bones of Motacilla cinerea and M. flava are rather smaller (17.0-18.2 mm, n=2+4). In M. cinerea the fossa pneumo-anconea is the narrowest, with a small, deep depression, fossa tricipitalis relatively broader. In M. flava the relations are somewhat different: the fossa pneumo-anconea is broader, f. tricipitalis narrower.

Bombycillidae
(Plate V, Fig. 2 and 8)

The single species of the family is Bombycilla garrulus in this region. The humerus of this form is robust, seemingly "inflated", in the whole pneumatic. The robustness is expressed by measurements of the bone, length 23.7, prox. width. 7.9, distal width 6.5 and width of the diaphysis 2.4 mm. In caudal view, proximally from the caput humeri (in the field of the reduced fossa tricipitalis) there is a strong longitudinal fold, well developed, pneumaticity of the fossa pneumo-anconea may be seen only from (distal) foreshortened view. In middle part of proximal third of bone (caudal surface) a weekly developed ridge (as against Cinclus, in which this ridge strong), distally processus supracondyloideus (dorsalis) strong, dorsally widened (as against Alaudidae), crista pectoralis short. The bone differs from those of the morphologically close forms of Central Europe among others in the following: Cinclus with a special depresson in the fossa tricipitalis, Lanius and Oriolus with a longer crista pectoralis, Alaudidae with (besides the mentioned reduced proc. supracondyloideus) a shallower, but similarly pneumatized fossa pneumoanconea.

PLATE II. Fig. 1. Melanocorypha calandra - Fig. 2. Calandrella brachydactyla - Fig. 3. Alauda arvensis - Fig. 4. Lullula arborea - Fig. 5. Eremophila alpestris - Fig. 6. Galerida cristata - Fig. 7. Alauda arvensis - Fig. 8. Lullula arborea - Fig. 9. Galerida cristata - Fig. 10. Eremophila alpestris - (Fig. 1-2. in medial view; Fig. 3, 4, 9 and 10: foreshortened view of medial side of the proximal epiphysis; Fig. 5-8: dorsal view of the proximal epiphysis)

PLATE II



Laniidae
(Plate V, Fig. 4 and 6)

The humerus of the members of this group is rather more inflated (pneumatized) than in other forms of similar morphology. Fossa tricipitalis shallow, longitudinal fold in this field (defined in Bombycilla) indistinct, crista pectoralis relatively long, in margo caudalis proximally a distinct impression, tuberculum ventrale from caudal view relatively short, tendency for pneumatisation in fossa tricipitalis.

I had the possibility to examine the corresponding bones of all the four European species and in my (partly very modest) comparative osteological material these forms differ absolutely in their measurements:

	length	width of diaphysis
Lanius excubitor (n=1)	26.4	2.5
Lanius minor (n=8)	24.6-26.0	2.0-2.4
Lanius collurio (n=7)	19.6-21.0	1.6-2.0
Lanius senator (n=4)	21.0-22.2	1.8-2.0

Prunellidae
(Plate V, Fig. 1 and 7)

Members of this family belong to the morphological group characterized by the morphotype in which "fossa tricipitalis and pneumo-anconaea is confluent, not separated", in the taxonomical key No. 8. (5). Some distinctions within this group are given in the description of Motacillidae. Let us give here a characterisation in detail: the whole proximal epiphysis narrower than in other members of this group and hereby the outer margin of crus ventrale fossae more reduced, the angle between the diaphysis and proximal epiphysis (ventrally) composing a wider angle. Fossa tricipitalis shallower (sometimes a tendency to pneumatisation), proximal part of margo caudalis not forming a distinct fold as in Fringillidae, Motacillidae, Emberizidae, Remizidae or Aegithaliidae. Crista pectoralis relatively short, dorsally not outstreched, distally blunt, distal epiphysis broad, processus supracondyloideus well developed.

The two Central European species of the genus are in their measurement absolutely different:

	length	proximal width	distal width	width of the diaphysis
Prunella modularis	16.5	5.0	4.3	1.6
Prunella collaris	22.5	7.6	6.2	2.1

Sylviidae
(Plate I, Fig. 2; Plate VI, Fig. 1-7, 9-12 and 14-16)

Warblers in the wider sense belong to the so-called "rather ill-defined families of small insectivorous Passeriformes" in the ornithological literature. In this place I deal

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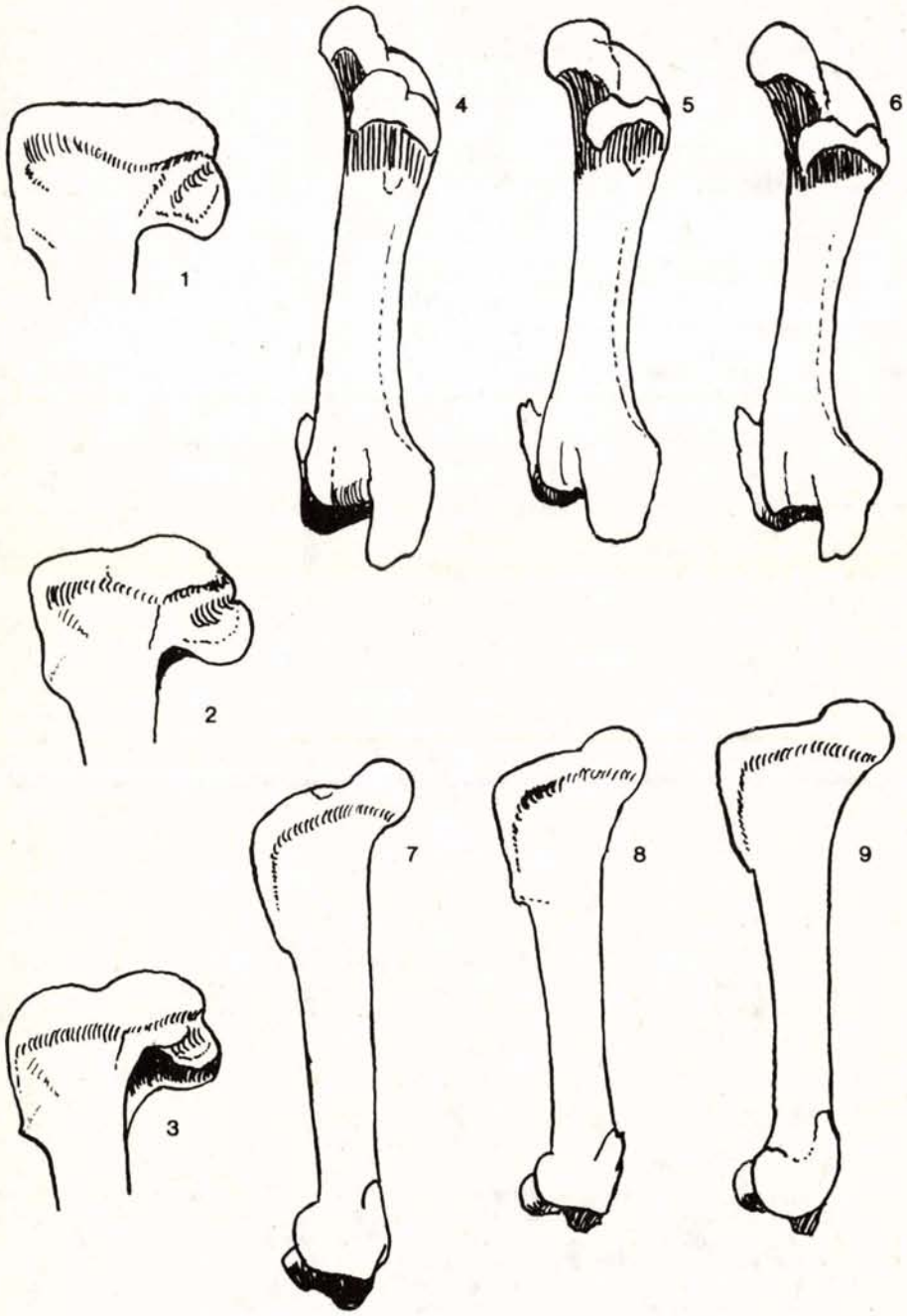
PLATE III. Fig. 1. Riparia riparia - Fig. 2. Delichon urbica - Fig. 3, 4. Hirundo rustica - Fig. 5. Delichon urbica - Fig. 6. Riparia riparia - Fig. 7. Hirundo rustica - Fig. 8. Delichon urbica - Fig. 9. Riparia riparia (Fig. 1-3. medial (caudal) view of the proximal epiphysis; Fig. 4-6. ventral view; Fig. 7-9. dorsal view)

PLATE III



with the genera Sylvia, Locustella, Lusciniola, Acrocephalus, Hyppolais, Phylloscopus and Cettia. The humerus of this group belongs to the morphotype defined in the taxonomical key as "only the fossa pneumoanconaea well developed, fossa tricipitalis very shallow" [Nr. 10. (9)]. The smaller Turdidae (Luscinia, Erithacus) also belonging to the same morphotype may be separated from warblers by their longer crista pectoralis with a rectilinear margine. Hereby the proximal part of the humerus from dorsal side looks more flattened (further characterisation see at the Turdidae). In Panurus this bone is seemingly more lightly built than in all the warblers, chiefly the proximal epiphysis (prox. width only 4.0 mm!).

We may characterize members of this family dealt with in this paper as follows:

In Sylvia the proximal epiphysis from dorsal view is obliquely widened, crista pectoralis relatively longer, on caudal surface of proximal epiphysis, proximally from caput humeri, in field of reduced fossa tricipitalis a longitudinal fold (see also Bombycilla!), tuberculum ventrale from dorsal view prominent, distally elongated. Central European species differ in their corresponding bones in the size and proportions (see measurements): Sylvia nisoria being absolutely the largest, S. curruca the smallest, S. atricapilla medium-sized and proximally narrower, S. borin proximally broader and with the same length, S. communis somewhat shorter proximally and its diaphysis slimmer. The morphological relation in Phylloscopus is similar to Sylvia although in smaller dimensions. In Phylloscopus fossa tricipitalis somewhat deeper, does not possess a longitudinal ridge, the "wall" of crus dorsale fossae originates somewhat deeper, the margin of the wall not thickened (as in Acrocephalus), tuberculum ventrale more reduced, as in Sylvia.

Among the three species treated in this paper Phylloscopus sibilatrix is the largest and thickest, Ph. collibyta being somewhat smaller and thinner, Ph. trochilus being the most lightly built.

In the group of reed-warblers (s.l.) in Locustella the proximal epiphysis from dorsal view is antero-posteriorly more widened than in Acrocephalus and the same situation is in caudal view, too. Fossa tricipitalis in both is shallow, the margin of the wall of crus dorsale fossae in Locustella is slightly thickened, in Acrocephalus forming a definite "rim". The crista pectoralis in both is short, tuberculum dorsale forming in Locustella a most prominent edge among all warbles (s.l.).

The three species of Locustella dealt with in this paper differ absolutely in their measurements in my very modest comparative material: L. fluviatilis being the largest, L. luscinioides being of mediocre size, L. naevia the smallest (see measurements).

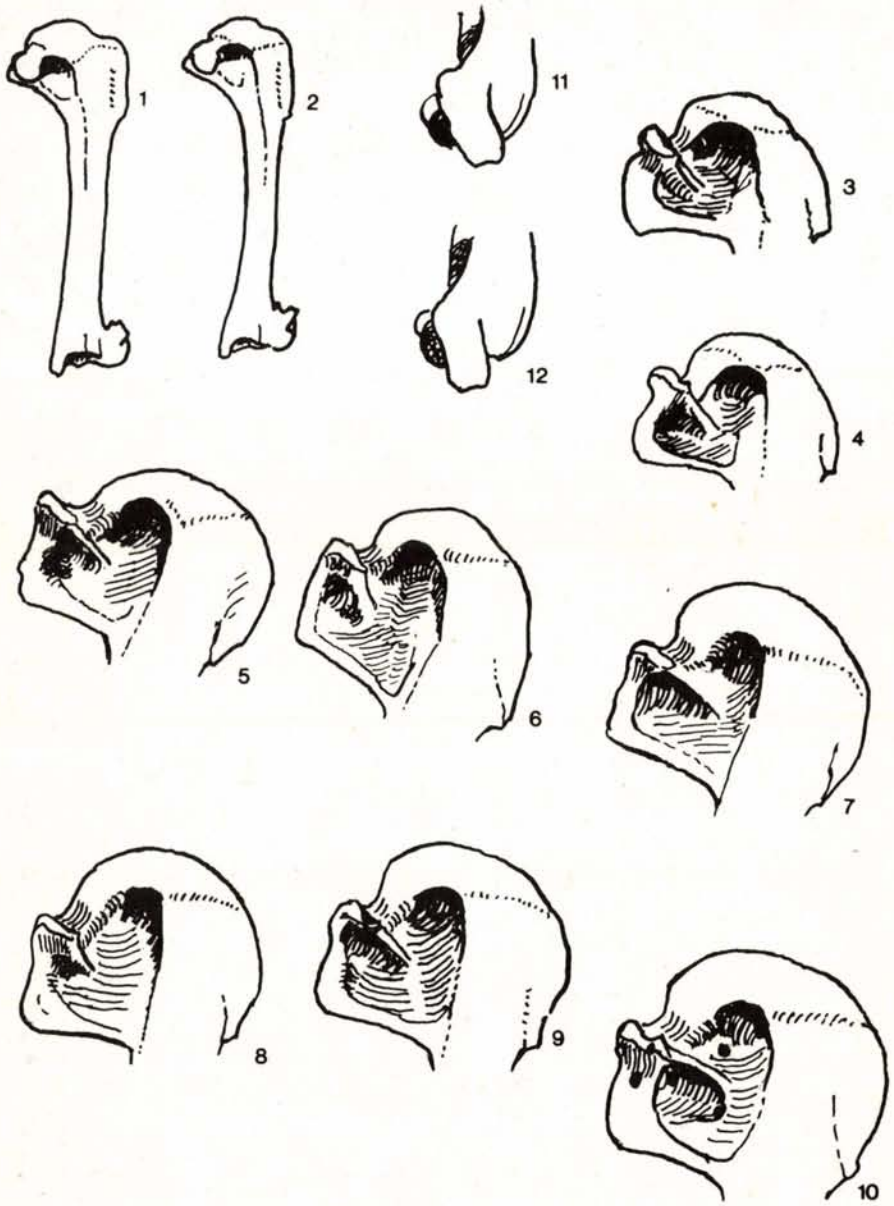
Among the small species of Acrocephalus (and Lusciniola which I could not separate exactly from the others) - according to the measurements - Acrocephalus palustris seems to be in average the largest, A. schoenobaenus mediocre, A. scirpaceus in average smaller. Lusciniola melanopogon seems to be between the first two of the abovementioned species. Acrocephalus arundinaceus is the only species which is absolutely separable by its large measurements (see measurements).

Cettia cetti shows in its whole shape and more gracile proportions, a quite different form (see measurements).

Regulus differs among the members of this family beside the smallest dimensions, in its longer crista pectoralis and the strong torsion of the whole bone. The differences between the twinning species Regulus regulus and Regulus ignicapillus are not clear, there are perhaps in the average of measurements. I found in R. regulus (n=6) the length of 9.4-10.0 mm, the width of diaphysis of 0.9-1.0 mm, in R. ignicapillus (n=2) the same of 9.9-10.1 and 1.0-1.1 mm.

PLATE IV. Fig. 1. Chloris chloris - Fig. 2. Motacilla alba - Fig. 3. Motacilla cinerea - Fig. 4. Motacilla flava - Fig. 5. Motacilla alba - Fig. 6. Anthus spinoletta - Fig. 7. Anthus pratensis - Fig. 8. Anthus cervinus - Fig. 9. Anthus trivialis - Fig. 10. Anthus campestris - Fig. 11. Motacilla alba - Fig. 12. Anthus campestris (Fig. 1-2: medial (caudal) view; Fig. 3-10: foreshortened view of medial (caudal) side of the proximal epiphysis; Fig. 11-12: ventral view of distal epiphysis)

PLATE IV



At last we have to deal with Hyppolais. In this genus the fossa tricipitalis is proximally the deepest, with a distict margin in the middle of the bone (caudal view), tuberculum ventrale stronger than in other genera of the family, with a characteristic insertion-surface, the whole bone (chiefly H. icterina) extremely robust (caudal view). The discussed two species H. icterina and H. pallida absolutely differ in their measurements (see measurements).

Measurements of the humeri of Sylviidae:

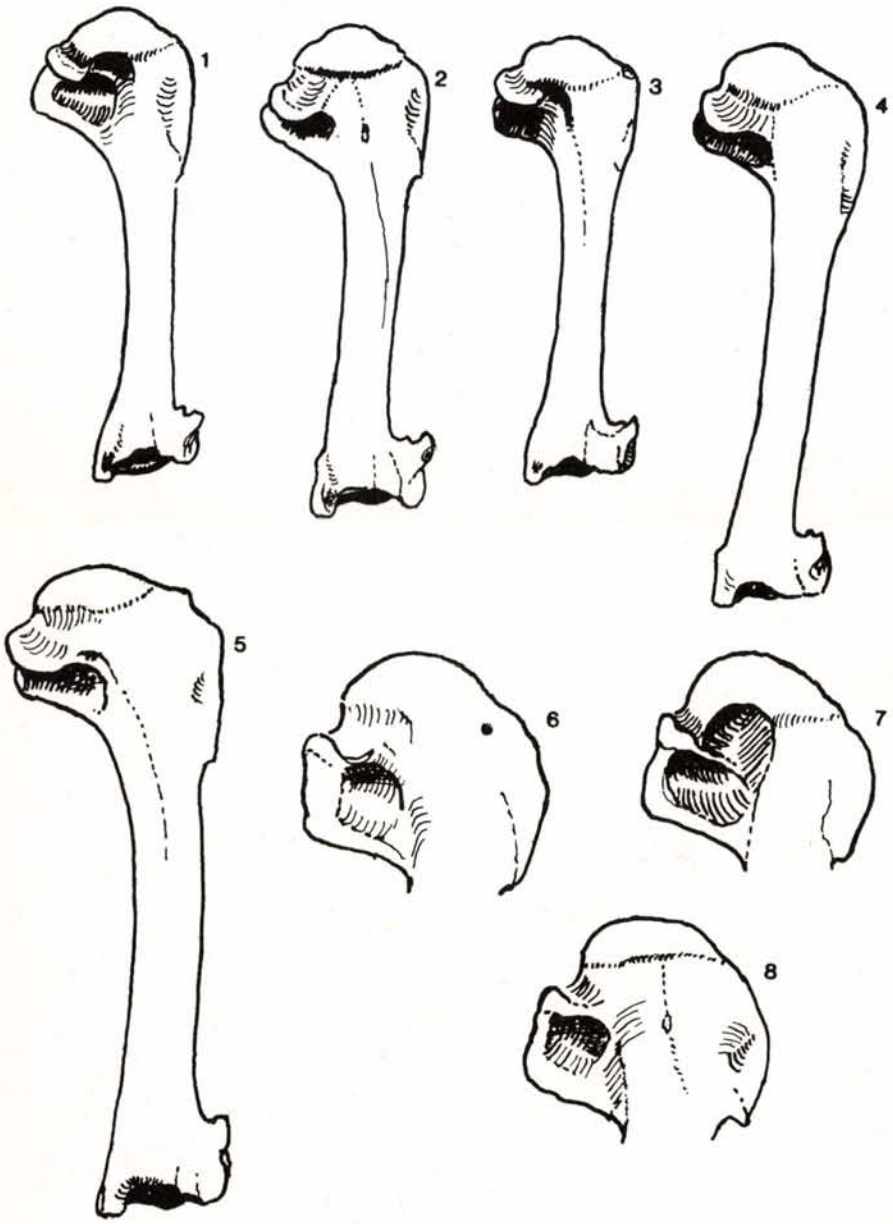
	length	proximal width	distal width	width of the diaphysis
Acrocephalus arundinaceus (n=3 mean)	19.5	5.8	4.5	1.5
A. scirpaceus (n=5)	12.4-13.2	3.9-4.2	3.0-3.4	1.1-1.2
A. schoenobaenus (n=4)	13.0-13.3	4.2-4.3	3.2-3.6	1.2
A. palustris (n=2)	13.4-13.8	4.0-4.3	3.2	1.2
Lusciniola melanopogon (n=2)	13.0-13.6	4.0-4.2	3.3	1.2
Cettia cetti (n=1)	15.1	4.2	3.6	1.2
Locustella naevia	13.3	4.3	3.5	1.2
L. lusciniodes	14.3	4.2	3.1	1.2
L. fluviatilis	16.6	4.7	3.6	1.4
Hyppolais icterina	15.0	5.0	4.0	1.6
H. pallida	13.4	4.2	3.6	1.2
Sylvia nisoria	18.6	5.7	4.6	1.7
S. borin	17.7	5.5	4.4	1.6
S. atricapilla	16.6	4.8	3.7	1.5
S. communis	15.8	5.2	4.9	1.4
S. curruca	14.0	4.3	3.5	1.2
Phylloscopus trochilus	11.7	-	-	1.0
Ph. collybita	12.2	-	-	1.1
Ph. sibilatrix	13.0	-	-	1.2
Regulus regulus (n=6)	9.4-10.0	3.3-3.5	2.7-2.9	0.9-1.0
R. ignicapillus (n=2)	9.9-10.1	3.3-3.4	2.7-3.0	1.0-1.1

Muscicapidae (s.s.)
(Plate VII, Fig. 1 and 11)

In this family I deal only with the flycatchers of the region in question (genus Muscicapa viz. Ficedula). The humerus of members of this genus belongs to the morphotype in which the fossa tricipitalis is deep, but not pneumatic (as in Paridae), the 'crus dorsale fossae ("bone bridge") well developed, separating the two fossae [taxonomical key No. 7. (6)]. We can characterize the corresponding bone of the flycatchers as follows: beside the features, mentioned above, contrary to smaller Turdidae (Phoenicurus, Oenanthe) of the same size and morphotype, in caudal view whole proximal epiphysis more shortened, laterally widened, crista lateralis shorter, with rectilinear margine, tuberculum ventrale, in ventral view shorter, fossa tricipitalis shallower than f. pneumo-anconaea. The morphological differences shown by some African sub-Saharan viz. southern Asiatic flycatchers [e.g. Batis, Tchitrea (=Terpsiphone)] speak for a polyphyletism (convergencies) of this group.

PLATE V. Fig. 1. Prunella collaris - Fig. 2. Bombycilla garrulus - Fig. 3. Cinclus cinclus - Fig. 4. Lanius excubitor - Fig. 5. Oriolus oriolus - Fig. 6. Lanius excubitor - Fig. 7. Prunella collaris - Fig. 8. Bombycilla garrulus (Fig. 1-5: medial (caudal) view; Fig. 6-8: foreshortened view of the medial (caudal) side of the proximal epiphysis)

PLATE V



The Central European "sibling-species" Muscicapa albicollis and hypoleuca do not differ either morphologically or metrically (length 14.7-15.0 width of diaphysis 1.5 mm), M. striata being larger (the same measurements: 16.6/1.5 mm), M. parva considerably smaller (13.4/1.2 mm).

Turdidae (s. s.)

(Plate I, Fig. 5 and 1-8; Plate VI, Fig. 8 and 13; Plate VII, Fig. 2-4 and 9-10; Plate VIII, Fig. 2 and 4-7, 9 and 11)

The family Turdidae in strict sense comprises osteologically very heterogeneous forms and therefore I deal with them in three different groups:

1) The first group of smaller members belong to the morphotype No. 7 (6) of the taxonomical key (see also in Muscicapidae), both fossae being deep, absolutely separated, as against Muscicapa the proximal epiphysis in its whole shape narrower, crista pectoralis longer with a margin (in foreshortened view) not rectilinear, but rounded, tuberculum ventrale from ventral view elongated.

Phoenicurus and Saxicola belong to this group, in the first one crista pectoralis longer, in dorsal view more rounded in foreshortened view, margin of bony sheet between two fossae composing a narrower angle than in Oenanthe. Crista lateralis in the last one in dorsal view less rounded.

Some measurements given below show the metrical-proportional differences between the species concerned here: Oenanthe oenanthe and hispanica being in average the largest, among the middle-sized Phoenicurus the species phoenicurus more gracile than Ph. ochruros and Saxicola torquata somewhat more lightly built than S. rubetra.

Measurements of the humeri of some smaller Turdidae (group 1.)

	length	width of diaphysis
Phoenicurus phoenicurus	17.2	1.6
Ph. ochruros	17.2	1.5
Saxicola torquata	15.9	1.5
S. rubetra	16.4	1.6
Oenanthe oenanthe (n=10)	17.8-20.2	1.8-2.0
Oe. hispanica (n=4)	17.0-19.0	1.6-1.9

2) The second group may consist of the considerably larger members of the family including the genera Turdus and Monticola. I refer in this place to Nos. 23 (24) and 24 (23) of the taxonomical key. In Monticola, in contrast with Turdus, the whole bone more robust, chiefly distal epiphysis especially flattened, proximal epiphysis more shortened, caput humeri low, in inner part of fossa tricipitalis a sharp rim. (For differences against e. g. Strunidae or Pinicola of the same size category, see at the systematical category in question). While during the present revision I found some differences among the larger members of the genus Turdus both metrically and morphologically, which had formerly been neglected in the literature. Beside the fact that in my comparative material some small series seem to prove an absolute difference in size (see table of measurements), i in Turdus torquatus the bone sheet between the two foramina is thin and composes with the longitudinal axes of the bone an approximate square (smallest form), in T. pilaris it composes a wide angle (middle sized form) and in T. viscivorus this sheet is thickened, - by nearly the same angle (largest form), Turdus merula differs in its proportions (slender epiphysies by the same length), although T. iliacus and ericethorum of the smallest size category are hardly separable (some uncertain differences in the shape of the crista pec-

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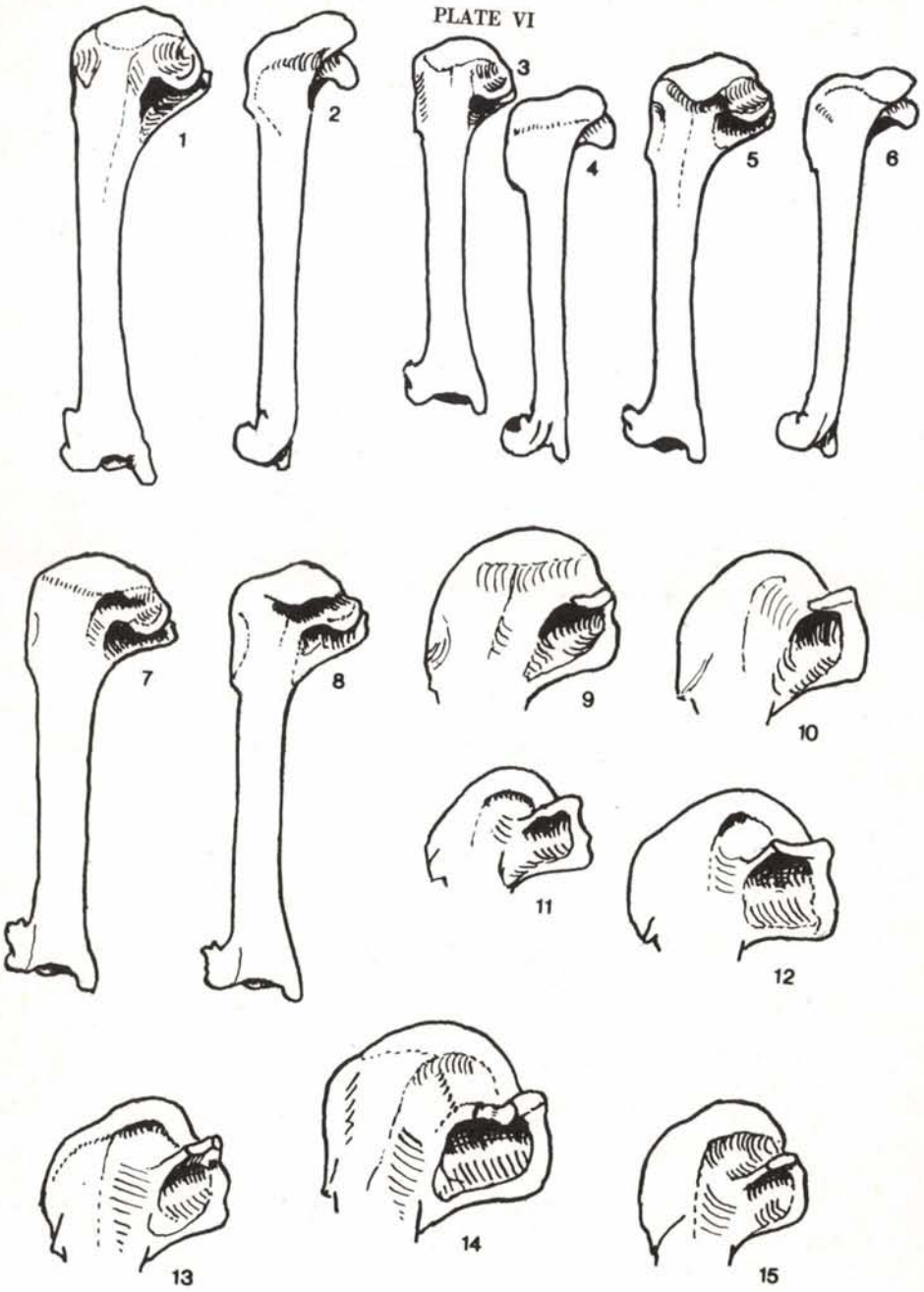
PLATE VI. Fig. 1-2. Locustella fluviatilis - Fig. 3-4. Acrocephalus palustris - Fig. 5-6. Sylvia curruca - Fig. 7. Hippolais icterina - Fig. 8. Erithacus rubecula - Fig. 9. Locustella fluviatilis - Fig. 10. Acrocephalus palustris - Fig. 11. Phylloscopus trochilus - Fig. 12. Hippolais icterina - Fig. 13. Erithacus rubecula - Fig. 14. Sylvia nisoria - Fig. 15. Cettia cetti (Fig. 1, 3, 5, 7 and 8: medial (caudal) view; Fig. 2, 4 and 6: dorsal view; Fig. 9-15: foreshortened view of medial (caudal) surface of the proximal epiphysis)

PLATE VI



toralis, as well as the torsion of the whole bone show some slight differences, the taxonomical value of these features remains questionable).

Measurements of the humeri of some larger Turdidae (group 2.)

	length	proximal width	distal width	width of the diaphysis
Turdus pilaris (n=9)	29.4-31.8	9.4-10.3	7.5-8.5	2.7-3.2
T. viscivorus (n=5)	32.0-33.8	10.3-10.6	8.2-9.0	3.0-3.3
T. torquatus (n=2)	30.3-30.8	10.4-10.6	8.5-8.8	2.8-3.0
T. merula (n=5)	27.8-29.9	8.3-9.3	7.2-7.8	2.6-2.9
T. iliacus (n=3)	26.0-26.7	8.2-8.5	6.7-7.0	2.4-2.6
T. ericetorum (n=2)	26.7-27.0	8.2-8.3	7.0-7.3	2.5-2.7
Monticola saxatilis (n=1)	25.9	8.6	7.3	2.4

3) To the third group of the Central European members of this family belong the species of Luscinia and Erithacus with a quite different structure of the bone (taxonomical key No. 10 (9), for differences for Sylviidae see the characterisation of that family). The whole habitus of the humerus of these forms resembles that of other small Turdidae, although fossa tricipitalis is very shallow, the dorsal margin of the crista pectoralis rectilinear, in ventral view therefore the whole shape of the proximal epiphysis gracile, compressed. Especially in Luscinia, from caudal view the outstreched form of proximal epiphysis, the ridge proximally, from the fossa tricipitalis continue quite to the ventral side of the bone, tuberculum ventrale covers up (only in caudal view) nearly entirely the ventrally otherwise expanded crus ventrale fossae, tub. ventrale in ventral view short and broad. On the contrary in Erithacus the prox. epiphysis narrower, the tuberculum ventrale not covering (in caudal view) the crus ventrale, the ridge proximally from fossa tricipitalis does not continuing ventrally, tub. ventrale in ventral view narrow, as in other smaller Turdidae. The three species of the genus Luscinia of our region differ in their proportions due to the measurements. Erithacus is on average smaller than the above genus.

Measurements of the smaller Turdidae (group 3.)

	length	width of diaphysis
Luscinia suecica	17.0	1.5
L. luscinia (n=2)	17.2-18.6	1.7-1.8
L. megarhynchos	17.9	1.6
Erithacus rubecula	16.1	1.4

Remizidae
(Plate VII, Fig. 7-8)

The only representative of this family in our region is Remiz pendulinus, belonging to the group No. 8 (5) in the taxonomical key. Beside the small dimensions (length 12.3, proximal width 4.3, distal width 3.6, diaphysis width 1.2 mm) being in foreshortened view the proximal epiphysis is more outstretched than in other Passeriformes of the same size category (see also the characterisation of some forms of Fringillidae, e.g. Loxia at the description of that family), the bony bridge of the crus ventrale fossae absolutely reduced, (even more than in Motacillidae too) and hereby the fossa tricipitalis and pneumoanconaea unite as a uniform deepening. The habitus of the whole bone is more robust, distal epiphysis also broad.

Paradoxornithidae
(Plate X, Fig. 4 and 10)

The only member of this family in Central Europe is Panurus biarmicus, belonging to the group No. 10 (9) in the taxonomical key.

Compared with the other members of this morphotype, the slender form is characteristic (as mentioned at the description of Sylviidae), tuberculum ventrale relatively strong, broad, fossa pneumoanconaea very deep, fossa tricipitalis quite flattened, nearly lacking. Length of the bone 13.4 proximal width 4.1, distal width 3.4, diaph. width 1.2 mm.

Aegithalidae
(Plate VII, Fig. 5-6)

The only representative of this family dealt with in this paper is Aegithalus caudatus, belonging to the morphotype No. 8 (5) in the taxonomical key. There are some resemblances to Remiz, although the diaphysis is slender, the epiphysis relatively more outstreched, the two fossae in the proximal epiphysis not quite confluent, the bone bridge between them rather developed, fossa tricipitalis shallower, f. pneumoanconaea very deep. Length 11.1, prox. width 4.3, distal width 3.5, width of the diaphysis 1.1.

Paridae (s.s. Parus)
(Palte I, Fig. 3; Plate IX)

This family is very well characterised and defined by the humerus having a pneumatized fossa tricipitalis [see taxonomical key 6 (7)]. It is to be mentioned that sometimes (in less than 1%!) the pneumatic holes are reduced to such a degree that they can be seen only by strong optical enlargement, but the tendency of having pneumatic structure is always ascertainable. Among all, Parus major is identifiable unambiguously by its large size and robust form. Length of humerus measures 17-18 mm, width of diaphysis 1.5-1.7 mm (n=8).

Among the smaller species the humerus of Parus montanus seems to be in average the most robust: length 13.2-14.5, width of diaphysis 1.3-1.5 (thickness 1.2-1.4 mm), proximally and distally widened, processus supracondylaris lateralis low.

In Parus palustris the proximal epiphysis in caudal view is more outstreched and the distal epiphysis (by the torsion of bone) more slender than in other species. In ventral view the tuberculum ventrale looks slender and elongated, the whole diaphysis slender and in the distal epiphysis the processus flexorius broader than in other species. Length: 14-15, width of diaphysis 1.2-1.4 mm (n=3).

In Parus cristatus the distal epiphysis in caudal view seems to be more widened, in ventral view the tuberculum ventrale shorter and more curved, in dorsal view the crista pectoralis stronger. Length 14.2, width of diaphysis 1.4, thickness of the same 1.2 mm (n=1).

In Parus coeruleus in caudal view the diaphysis slender and hereby the proximal and distal epiphysis relatively more widened. Tuberculum ventrale similar to P. cristatus, crista pectoralis in dorsal view more curved in its ontline. Length 13.6-14.3, width of diaphysis 1.2-1.3 mm, thickness of diaph. 1.1-1.2 mm (n=5).

Parus ater seems to be the most gracile, with shorter crista pectoralis, very low processus supracondylaris (dorsalis). Length 12.7-13.9, width of diaph. 1.2-1.3, thickness of diaph. 1.0-1.1 mm (n=2).

Sittidae
(Plate X, Fig. 2 and 8)

The nuthatches, tree creepers and the wall creeper show very distinct octeological features among the Passeriformes, not only in the humerus but in the morphology of other bones (e. g. the tarsometatarsus). However, they represent different osteological types among themselves. Thus a distinction in separate families seems to be justified.

The only member of the family Sittidae in Central Europe is Sitta europaea, belonging to the group No. 13 (12) of the taxonomical key. This species shows a humerus in which in caudal view the proximal epiphysis looks elongated, narrow, concavity of the fossa pneumo-anconaea somewhat deeper than that of the fossa tricipitalis. The medial bar between the two fossae with more or less parallel margins, crista pectoralis from dorsal view shorter, with rounded border. Distal epiphysis broadened, processus supracondyloideus dorsalis well developed, fossa brachialis shallow.

Length of the humerus 18.2, proximal width 5.8, distal width 4.9, width of the diaphysis 1.7 (thickness 1.5) mm.

Tichodromadidae
(Plate X, Fig. 1 and 7)

The world-wide only representative of the family, the wall creeper, Tichodroma muraria stands in the morphology of its humerus (and tarsometatarsus) in such measure separated that - as mentioned above - the ranging as an independent family seems to be justified. The bone belongs to the group No. 13 (12) of the taxonomical key.

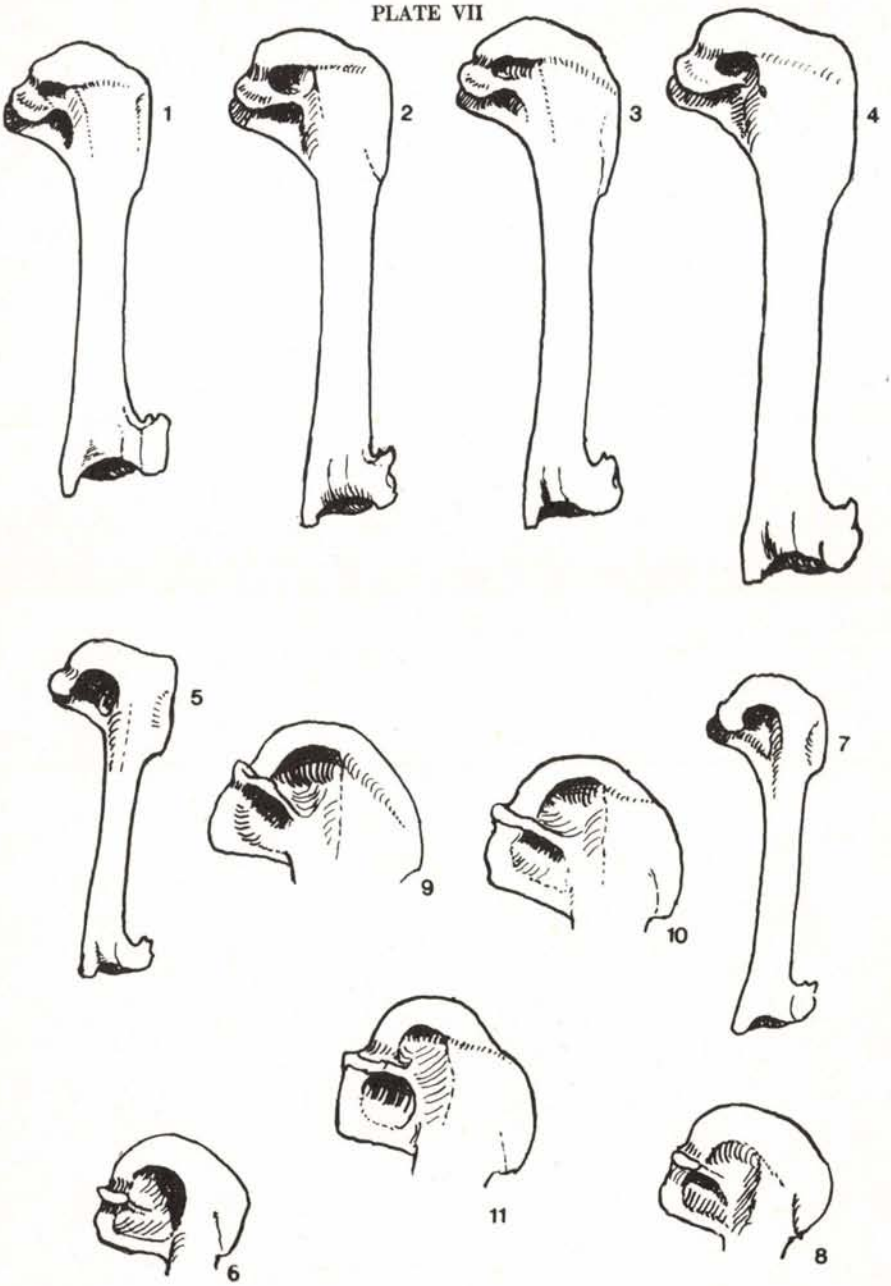
The humerus shows in caudal view an elongated shape, the concavity of the fossa pneumo-anconaea and f. tricipitalis from foreshortened view equally deep, the base of the medial bare between the two fossae with thickened base, otherwise thin. Crista pectoralis elongated, from dorsal view with rectilinear border. The diaphysis of the bone more flattened than in other morphologically close species (see measurements). Processus supracondyloideus (dorsalis) reduced, with a blunt, single insertion-surface, fossa brachialis very deep, strongly demarkated. Measurements: length 19.5, proximal width 6.0, distal width 4.5, width of diaphysis 1.6, thickness of the same 1.4 mm.

Certhiidae
(Plate I, Fig. 13; Plate X, Fig. 3)

The sibling species Certhia brachydactyla and C. familiaris are characterized, as all members of the family, by their small size. Their humerus belongs to group No. 13 (12) of the taxonomical key. Morphologically they represent a mixture of the features of Tichodroma and Sitta, showing a deeper fossa pneumoanconaea and shallower fossa tricipitalis, an elongated crista pectoralis, with rectilinear border, but distally a well developed processus supracondyloideus. Length of the bone 13.0, proximal width 4.2, distal width 3.5, width of the diaphysis 1.2 mm.

PLATE VII. Fig. 1. Muscicapa hypoleuca - Fig. 2. Saxicola rubetra - Fig. 3. Phoenicurus phoenicurus - Fig. 4. Oenanthe oenanthe - Fig. 5-6. Aegithalos caudatus - Fig. 7-8. Remiz pendulinus - Fig. 9. Phoenicurus phoenicurus - Fig. 10. Saxicola rubetra - Fig. 11. Muscicapa hypoleuca (Fig. 1-5 and 7: medial (caudal) view; Fig. 6 and 8-11: foreshortened view of the proximal epiphysis)

PLATE VII



Troglodytidae
(Plate I, Fig. 12; Plate X, Fig. 5)

The only Old-World representative of this otherwise quite New-World family, the Common wren, Troglodytes troglodytes shows very distinct morphological features among the European Passeriformes.

We can reaffirm in this place the characterisation of the humerus given in the taxonomical key [No. 12 (11)]: both fossae absolutely reduced, the whole bone elongated, crista pectoralis short, processus supracondyloideus week.

The measurements express the lightly built habit: length 12.2 proximal width 3.8, distal width 3.2, width of diaphysis 1.1 mm.

Cinclidae
(Plate I, Fig. 9; Plate V, Fig. 3)

In the ornithological literature the often substantiated opinion about the close relationship between the dippers and wrens (Cinclidae and Troglodytidae) is not supported by the morphology of the humerus. The special position of this systematical unit shows its distinct place in the taxonomical key [No. 20 (21)]. The humerus of this species is robust, as in Bombycilla garrulus, differing from the latter one (in foreshortened view) in the special form of the fossa tricipitalis, the reduced tuberculum ventrale, the flatter fossa pneumoanconaea and the shallower fossa musculi brachialis distally.

Fringillidae s.l.[x]
(Plate I, Fig. 4; Plate VI, Fig. 1; Plate XI)

As discussed in the course of the description of the humerus of Motacillidae, the corresponding bone of this family differs from other very distinct osteological characters (e.g. the shortness of tarsometatarsus) only in subtle morphological details from the former one. Both are therefore ranged with No. 8 (5) of the taxonomical key. I refer in this place to the note of BALLMANN (1973), as well as the description of the family Motacillidae in this paper. Among all features the most outstanding is its shorter habitus, with proximally and distally broadened epiphyses.

Considering that the family contains a considerable number of genera and species morphologically very close one to another, I give in this place a key for distinction of the genera:

1 (10) Crista lateralis longer, medial bar well developed.
2 (7) Medial bar forming a prominent wall, with a thickened margin.

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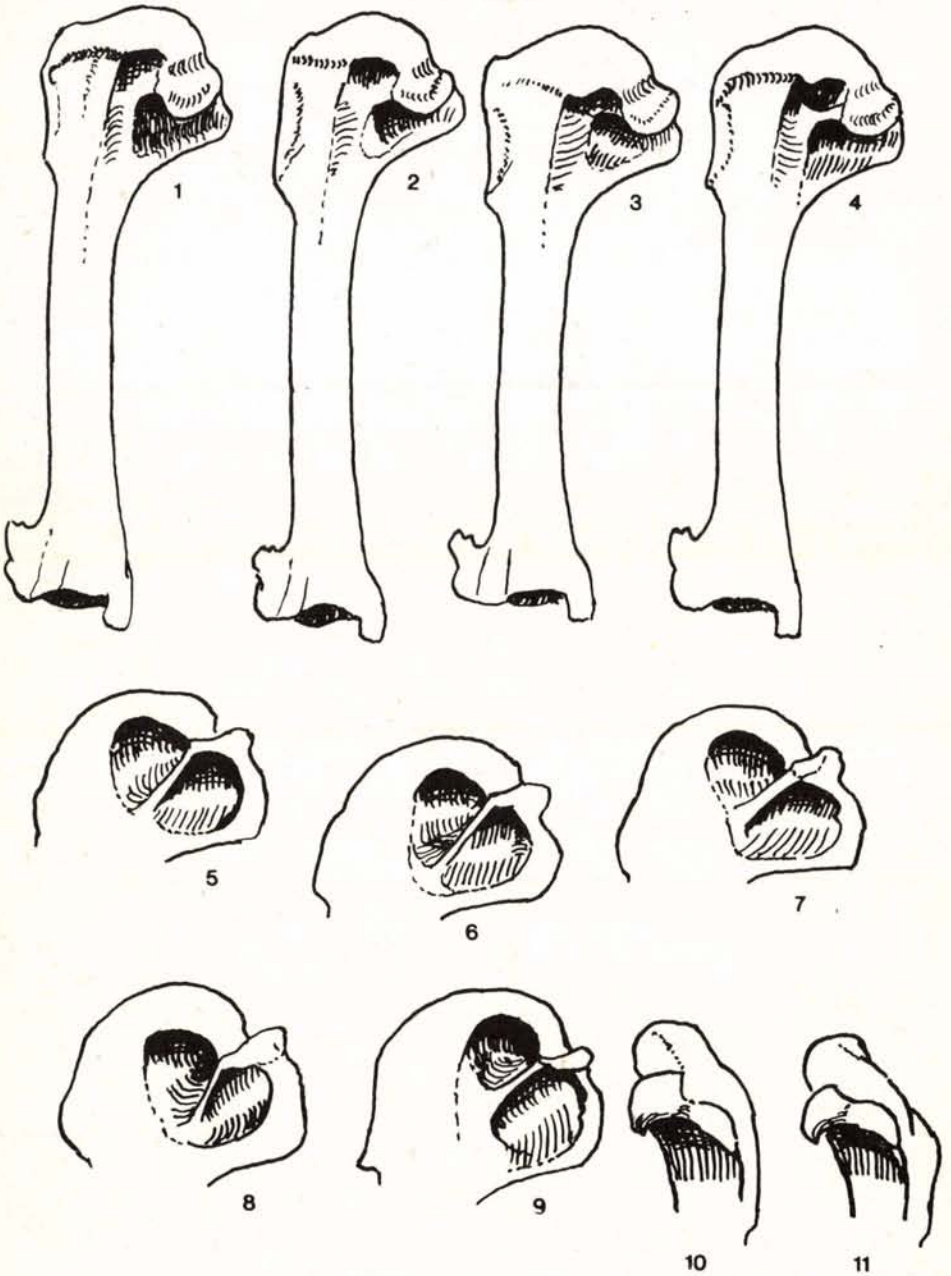
[x]Considering the fact that the humeri of Fringillidae in the classical sense (incl. Emberizidae/Emberizinae and Passeridae/Ploceidae) are to high degree morphologically homogenous, - I discuss them therefore on this place together.

PLATE VIII. Fig. 1. Sturnus vulgaris - Fig. 2. Turdus iliacus - Fig. 3. Pinicola enucleator - Fig. 4. Monticola saxatilis - Fig. 5. Turdus pilaris - Fig. 6. Turdus torquatus - Fig. 7. Turdus viscivorus - Fig. 8. Pinicola enucleator - Fig. 9. Monticola saxatilis - Fig. 10. Pinicola enucleator - Fig. 11. Turdus iliacus (Fig. 1-4: medial (caudal) view; Fig. 5-9: foreshortened view of medial (caudal) side of the proximal epiphysis; Fig. 10-11: ventral view of the proximal epiphysis)

PLATE VIII



3 (6) The crus ventrale fossae narrow, without a small depression in it.
4 (5) Fossa pneumo-anconaea shallower than the fossa tricipitalis, the humerus, the whole bone proximally and distally broad, dimensions large (average length 24.0, av. width of diaphysis 2.4 mm): Coccothraustes.
5 (4) Fossa tricipitalis and pneumo-anconaea equally deep, the former one narrow, as the whole bone too, (chiefly distally), dimensions smaller (av. length 18.0, av. width of diaph. 1.6 mm): Passer.
6 (3) Crus ventrale fossae broadened, with a small depression in it may be seen (only in tangential light), tuberculum ventrale weaker, medial bar translucently thin: Fringilla.
7 (2) Medial bar forming a less prominent wall (with a thickened margin), crus ventrale fossae stronger.
8 (9) Medial bar extending more into the direction of dorsal side, measurements larger: Pyrrhula
9 (8) Medial bar forming a wall only on ventral side of the fully joined two fossae: Carduelis
10(1) Crista lateralis shorter, medial bar reduced.
11(14) Lightly built, elongated forms.
12(13) Crus ventrale fossae and tuberculum ventrale narrow, fossa tricipitalis shallower, with a knob within it ("auricle-like: surface), with small dimensions: Serinus
13(12) Crus ventrale fossae and tuberculum ventrale broader, both fossae confluent, larger forms: Emberiza
14(11) Stouter built, proximally and distally broadened forms.
15(16) Two fossae not quite confluent, fossa tricipitalis somewhat shallower than f. pneumoanconaea: Chloris
16(15) Two fossae quite confluent, the bone proximally and distally remarkably broadened: Loxia

Distinction of the species within the genera is rather problematic. For genera which are represented by only one species in our region the descriptions of the key are valid.

Among them the identifications are stenghened by some measurements; this is the case in Coccothraustes, Chloris, Serinus, Loxia and Pyrrhula.

Measurements of the humeri of some smaller Fringillidae (group 1.)

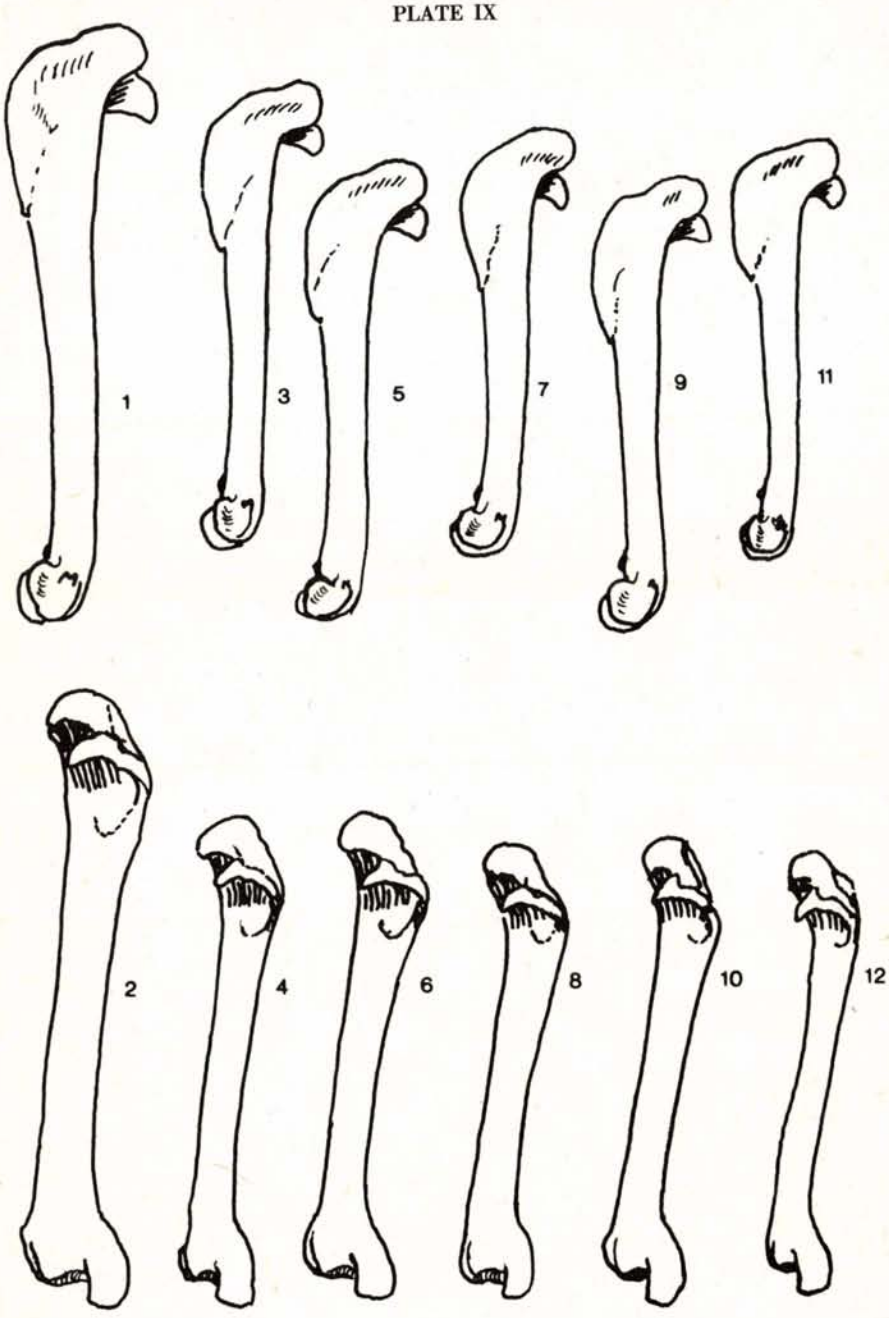
	length	width of diaphysis	proximal width	distal
Coccothraustes coccothraustes	23.7-24.8	2.3-2.4	8.1-8.2	6.4-6.9
Chloris chloris	18.6-20.0	1.7-1.8	-	-
Serinus serinus	14.6	1.4	-	-
Serinus canaria (domesticated canary)	18.2	1.7	-	-
Loxia curvirostra	19.4	2.0	7.5	-
Pyrrhula pyrrhula	20.4	2.1	7.0	5.2

Within the genus Emberiza (often cited in the literature as a family Emberizidae or a subfamily Emberizinae) among the Central European forms E. calandra is the largest, E. citrinella and hortulana are medium-sized (the last one proximally broader, distally and in its diaphysis narrower), E. cia, cirlus and schoeniclus are the smallest (E. cia distally broader, cirlus narrower, schoeniclus the narrowest; measurements see below).

Similar allometrical differences are found within the genus Carduelis (s.l.). The corresponding bone of C. cannabina is on average proprtionally larger than in C. carduelis.

PLATE IX. Different species of the genus Parus: Fig. 1-2. P. major - Fig. 3-4. P. palustris - Fig. 5-6. P. cristatus - Fig. 7-8. P. montanus - Fig. 9-10. P. coeruleus - Fig. 11-12. P. ater (Fig. 1, 2, 3, 5, 7, 9 and 11: dorsal view; Fig. 2, 4, 6, 8, 10 and 12: ventral view)

PLATE IX



The differences appear chiefly in the proportions length/width of diaphysis. C. spinus is medium-sized, C. flammea being the smallest one. The proportions of C. flavirostris equal the ones of C. carduelis (see measurements).

The differences between Fringilla coelebs and montifringilla are manifested similarly in their proportions: Fr. coelebs being proximally narrower and distally broader, Fr. montifringilla on the contrary (see measurements).

The same is the case in the two species of Passer, montanus being proximally broader, domesticus narrower (see measurements).

By far the largest among the Fringillidae discussed in this paper is Pinicola enucleator. For differences in the corresponding bone of this species in contrast with the ones of the similar-sized and morphologically close Turdus, Sturnus and Monticola, see the characterisation of the corresponding genera.

Measurements of the humeri of some Fringillidae (group 2.)

	length	width of diaphysis	proximal width	distal width
Carduelis carduelis (n=7)	15.9-16.6	1.5-1.7	5.6-6.1	4.4-4.8
C. cannabina (n=4)	16.4-17.2	1.6-1.8	5.6-6.0	4.4-4.8
C. flavirostris	16.2	1.6	-	-
C. spinus (n=2)	14.0	1.4-1.5	5.0	3.8-4.2
C. flammea	13.6	1.4	5.0	4.2
Emberiza calandra	24.6	2.3	7.6	5.5
E. citrinella	21.0	2.0	6.6	4.6
E. hortulana	20.0	1.9	6.7	4.6
E. cia	19.2	1.8	6.2	5.1
E. cirlus	19.2	1.8	6.2	4.8
E. schoeniclus (n=4)	18.0-19.6	1.5-1.7	5.3-6.0	4.3-4.6
Fringilla montifringilla	18.2	1.8	6.8	5.0
Fr, coelebs	18.7	1.7	6.3	5.3
Passer montanus	17.5	1.6	6.5	4.5
Passer domesticus (n=10)	18.2-19.7	1.6-2.0	6.0-6.4	4.2-5.0
Pinicola enucleator	25.0	2.4	8.6	7.4

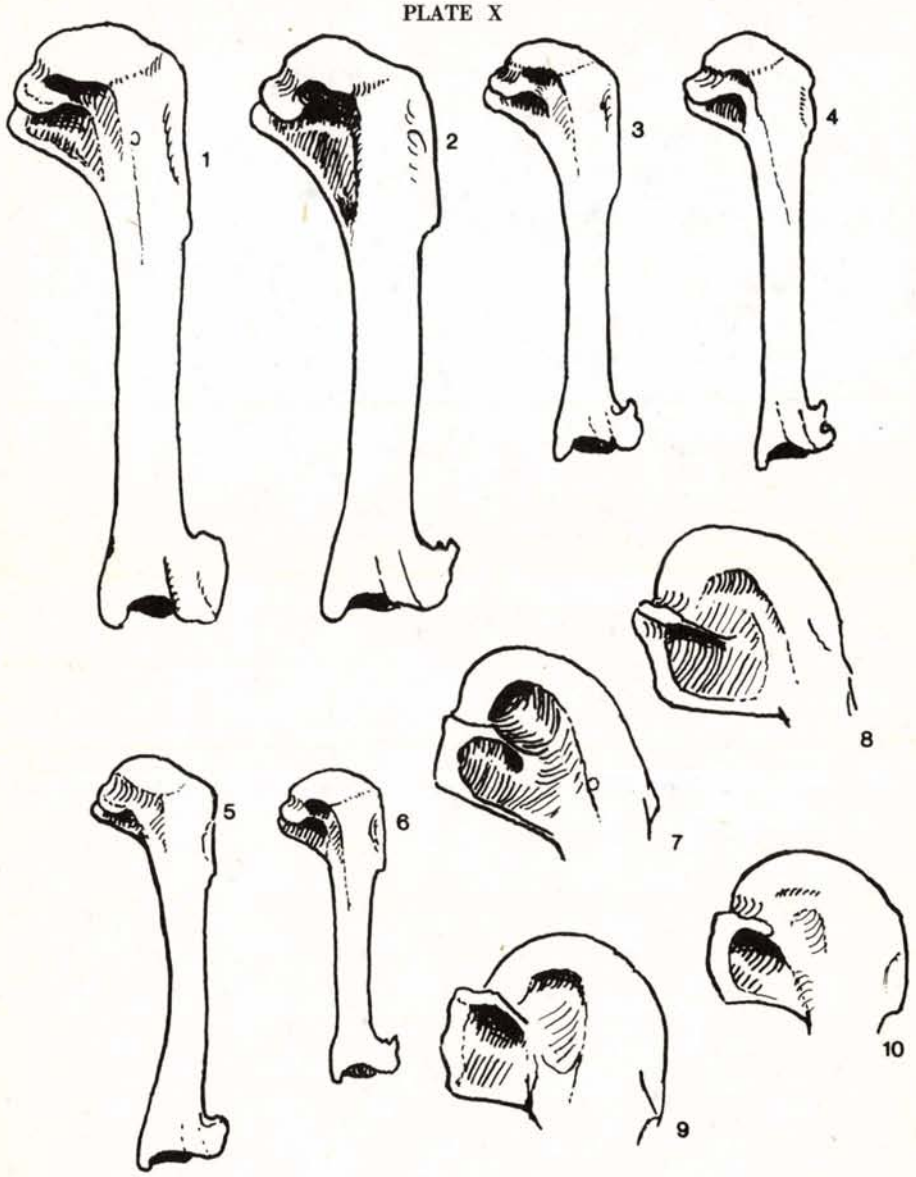
Sturnidae
(Plate I, Fig. 6; Plate VIII, Fig. 1)

In the humerus of the two Central European species (sometimes reckoned with as two different genera): in Sturnus vulgaris and Sturnus roseus, are characteristic the two deep, absolutely separated fossae in their proximal epiphysis [systematical key No. 23 (24)]. The whole bone is proximally and distally narrower than the one of the morphologically-metrically close Monticola, Pinicola or various Turdus species. Caput humeri relatively high, medial bar stronger than in related species (viz. genera), crista pectoralis short, processus supracondyloideus dorsalis relatively high.

The difference between the two forms of Central Europe is, - as usual - to be found in the proportions of the bone: in St. roseus being proximally narrower, in St. vulgaris broader.

PLATE X. Fig. 1. Tichodroma muraria - Fig. 2. Sitta europaea - Fig. 3. Certhia brachydactyla - Fig. 4. Panurus biarmicus - Fig. 5. Troglodytes troglodytes - Fig. 6. Regulus regulus - Fig. 7. Tichodroma muraria - Fig. 8. Sitta europaea - Fig. 9. Regulus regulus - Fig. 10. Panurus biarmicus (Fig. 1-6: medial (caudal) view; Fig. 7-8: foreshortened view from the vetralo-distal side of the medial (caudal) surface of the proximal epiphysis: Fig. 9-10: foreshortened view of the medial (caudal) surface of the proximal epiphysis)

PLATE X



Measurements of the humeri of Sturnidae

	length	width of diaphysis	proximal width	distal width
Sturnus roseus	27.2	2.6	8.2	6.7
Sturnus vulgaris	26.4-28.2	2.5-2.8	8.5-9.2	6.7-7.3

Oriolidae
(Plate I, Fig. 11; Plate V, Fig. 5)

The single European member of this family, Oriolus oriolus may be characterized by the fact that the fossa tricipitalis in the humerus is reduced, flattened, fossa pneumoanconaea deep, somewhat pneumatized, the whole bone "inflated" and relatively large [see systematical key No. 18 (17)]. Because of its size it cannot be confused with the morphologically otherwise close corresponding bones of Bombycilla or Lanius, at most with the one of the largest members of Alaudidae (Melanocorypha-species). As opposed to the last ones the mentioned "inflated" habitus, the more curved form of the whole bone and the more developed tuberculum ventrale are characteristic, from dorsal view overlapping the ventral edge of the crus ventrale fossae. The measurements (average) of the humerus of Oriolus oriolus: length 30.0 mm, proximal width 10.0 mm, distal width 8.5 mm, width of diaphysis 3.2 mm.

CONCLUSIONS

I do not have doubts about the fact that the analysis of the humerus of smaller Oscine Passeriformes given in this paper is based upon a single bone of the birds of a geographically very confined region (Eastern Central Europe only), and therefore it can be registered only as a first step forward in this field of knowledge. Thus, to draw far-reaching evolutionary viz. systematical conclusions would be out of place here. This is the situation all the more, because, as it is known, there is in literature a great deal of discussion concerning the taxonomical value of morphological features of the humerus of Passeriformes, especially of the one of the double or single pneumatic fossa (ASHLEY 1941, DELACOUR & VAURIE 1957, MAYR 1958, WETMORE 1960, BOCK 1962, BALLMANN 1973 etc.).

Therefore I have only to hint in this place some morphological features, - mentioned partly during the discussion of the analysis of the corresponding bone of various taxonomical units.

The great morphological homogenity in the features of the humerus within the families Hirundinidae, Fringillidae (in the widest sense, including Emberizidae and Passeridae), Alaudidae, Motacillidae or Paridae (in stricter sense, only species of the genus Parus), - draws one's eye. In contrast the more or less extreme heterogeneity of such large families as Sylviidae, Muscicapidae (in recent literature often in the widest sense incl. Turdidae, with by itself very different types) seems to be remarkable.

Some families are in their humeri, - and osteologically in general, - very distinct: these are at first Hirundinidae, Cinclidae, Troglodytidae and Tichodromatidae viz., the single species of the family: Tichodroma muraria. The last one is not only in its humerus,

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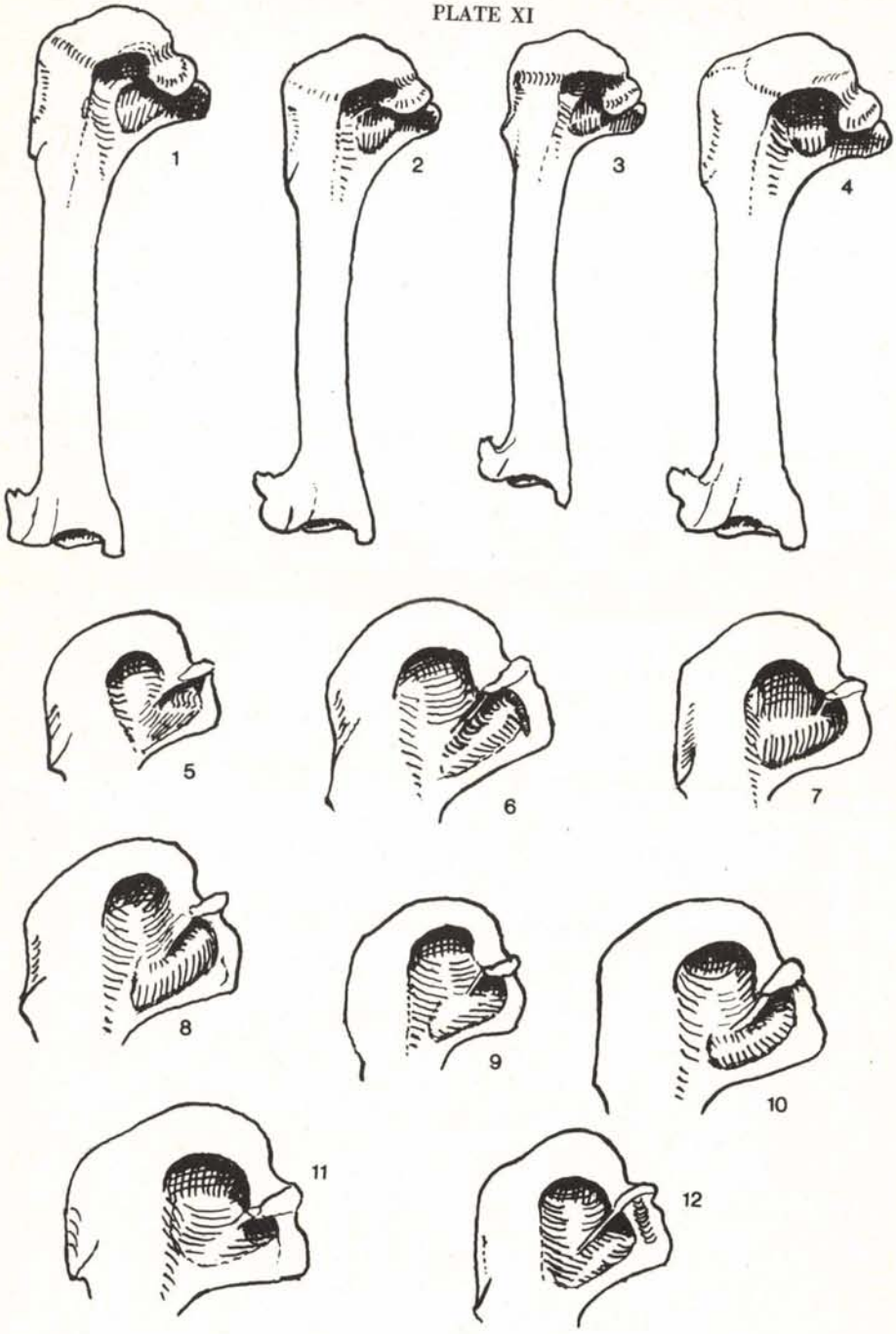
PLATE XI. Fig. 1. Emberiza citrinella - Fig. 2. Fringilla coelebs - Fig. 3. Passer montanus - Fig. 4. Loxia curvirostra - Fig. 5. Serinus serinus - Fig. 6. Coccothraustes coccothraustes - Fig. 7. Carduelis carduelis - Fig. 8. Emberiza citrinella - Fig. 9. Passer montanus - Fig. 10. Pyrrhula pyrrhula - Fig. 11. Loxia curvirostra - Fig. 12. Fringilla coelebs (Fig. 1-4: medial (caudal) view; Fig. 5-12: foreshortened view of medial (caudal) side of the proximal epiphysis)

PLATE XI



but also in the tarsometatarsus very specialized, having a broader and flatter middle trochlea than in most of the other species of the order. The specially elongated humerus of Sitta and Certhia, combined with the deeply incised middle trochlea of the tarsometatarsus may be mentioned here too. All these osteological features speak for a geologically old origin and for a relict nature of these taxonomical units.

These short allusions of the mentioned features may perhaps help in the future in the classification of this group of birds, - the largest order within the class. In any case, the descriptions given in this paper call our attention to the fact that we have to analyse the different bones morphologically in the most subtle details and drawing conclusions only from a few features (e. g. the double or single pneumatic fossa etc.) seems to be an oversimplification of the problem.

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